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BIRD MONITORING AT ZACKENBERG, NORTHEAST GREENLAND, 2006[1]

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Abstract. Bird populations were monitored during the breeding season of 2006 in the 19.3 km^2 designated bird census area at Zackenberg Research Station in central Northeast Greenland. Results presented herein are compared with those from previous seasons, 1995 to 2005. Changes in the phenology and numbers observed of most bird species in the BioBasis monitoring programme apparently reflect the extensive snow cover and late snowmelt in 2006. Wader (Charadrii) nest initiation in 2006 was generally very late; medians of the first egg dates were later than 25 June in four of the five species monitored. Nest success, however, was fairly high for Dunlin *Calidris alpina* and very good for Common Ringed Plover *Charadrius hiaticula*, whereas for Sanderling *Calidris alba* and Ruddy Turnstone *Arenaria interpres* nest success was very low. The all-wader predation rate was *c.* 63%, which is above average. Numbers of Arctic Fox *Alopex lagopus* encounters in the bird census area were high, and foxes were the likely predators of most nests, since no nests were found with clear signs of avian predation. For waders, mean clutch size was 3.4, which is lower than average. Juvenile wader numbers in two coastal deltas at low tide were extremely low compared to previous seasons.

Long-tailed Skua *Stercorarius longicaudus* breeding initiation was late, and only two nests were found within the bird census area. The number of pairs was similar to previous years and, hence, most pairs were non-breeding. The number of Barnacle Goose *Branta leucopsis* broods was among the lowest recorded so far, and the mean brood size was only 1.1 goslings per brood.

Sanderling territories were found in record high numbers; Dunlins and Ruddy Turnstones appeared in numbers above average. Common Ringed Plover and Red Knot *Calidris canutus* were recorded in numbers around the average of previous years. After high numbers of Snow Bunting *Plectrophenax nivalis* territories during the last two seasons', numbers in 2006 were lower, although still well above average. Five Rock Ptarmigan *Lagopus mutus* territories are more than have been recorded for years.

Key words: Arctic, avian monitoring, climate, geese, Greenland, Long-tailed Skua, waders.

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MONITOREO DE AVES EN ZACKENBERG, NORESTE DE GROENLANDIA, 2006

Resumen. Se monitorizaron las poblaciones de aves durante la temporada reproductiva de 2006 en los 19.3 km² del área de censos de aves de la Estación Científica de Zackenberg, en el noreste de Groenlandia. Los resultados presentados aquí son comparados con los de temporadas anteriores, de 1995 a 2005. Los cambios en la fenología y números observados en la mayoría de especies en el programa BioBasis parecen reflejar la abundante cobertura de nieve y el deshielo tardio de 2006. Las zancudas (Charadriidae) iniciaron la puesta generalmente tarde en 2006; las medianas de las fechas de puesta del primer huevo fueron posteriores al 25 de junio en cuatro de las cinco especies monitorizadas. El éxito de anidación, sin embargo, fue bastante alto para *Calidris alpina* y muy bueno para *Charadrius hiaticula,* aunque muy bajo para *Calidris alba* y *Arenaria interpres*. La tasa de depredación sobre zancudas fue cercana al 63%, lo cual supera la media. El número de encuentros con zorros árticos *Alopex lagopus* fue alto, y los zorros fueron los depredadores más probables, pues no se encontraron nidos con evidencia de depredación por aves. La puesta media para las zancudas fue de 3.4 huevos, por debajo de la media. El número de juveniles en dos deltas costeros con marea baja fue extremadamente bajo en comparación con otras temporadas.

El inicio de la reproducción de *Stercorarius longicaudus* fue tardia, y sólo dos nidos fueron encontrados en el área de censo. El número de pares fue similar al de otros años y por tanto muchas parejas no se reprodujeron. El número de pollos de *Branta leucopsis* fue entre los más bajos registratos hasta la fecha, y la puesta media fue de 1.1 huevos por puesta.

Hubo un número récord de territorios de Calidris alba; *Calidris alpina* y *Arenaria interpres* estuvieron presentes en números superiores a la media. *Charadrius hiaticula* y *Calidris canutus* mostraron números similares a años anteriores. Tras dos temporadas de un número elevado de territorios de *Plectrophenax nivalis*, el número en 2006 fue inferior, aunque todavía muy por encima de la media. Cinco territorios de *Lagopus mutus* son más de lo que se ha registrado en varios años.

Palabras clave: Artico, monitoreo de aves, clima, Groenlandia, zancudas.

INTRODUCTION

The monitoring programme, Zackenberg Basic, based at the Zackenberg Research Station in central Northeast Greenland (Fig. 1), was initiated in 1995 in order to establish long-term data series on abiotic and biotic parameters in this high-arctic ecosystem in relation to climatic fluctuations and change. BioBasis is the biological part of Zackenberg Basic and monitors both floral communities, invertebrate occurrence, and mammalian and avian breeding performance and population trends (Meltofte et al. 2007a). This paper synthesises the bird monitoring part of BioBasis, and we present data from 2006, the 12th consecutive season of effort. The results presented here are partly available in the 12th ZERO Annual Report (Klitgaard et al. 2007). Similar reports are available for all previous field seasons (see www.zackenberg.dk/publications.htm#ZAR).

STUDY AREA AND METHODS

The study area is situated in the national park of North and Northeast Greenland, at the northern shore of Young Sund. Zackenberg Research Station (74°30'N, 21°00'W) is situated in the broad valley Zackenbergdalen. Details on the full BioBasis methodology are available at the home page of NERI (http://biobasis. dmu.dk). The current sampling protocol is found in Meltofte et al. (2007a), available through the authors.

The bird census area is a 19.3 km² designated area, stretching from sea level to 600 m a.s.l. on the south-western slopes of Aucellabjerg (Fig. 1). The extensive valley floor from 0 to 50 m a.s.l. is largely covered with dwarf scrub heath (mainly Mountain Avens Dryas spp., White Arctic Bell-heather Cassiope tetragona, and Arctic Willow Salix arctica) and wet fens. In some areas, more or less, barren gravel and fell field predominate.

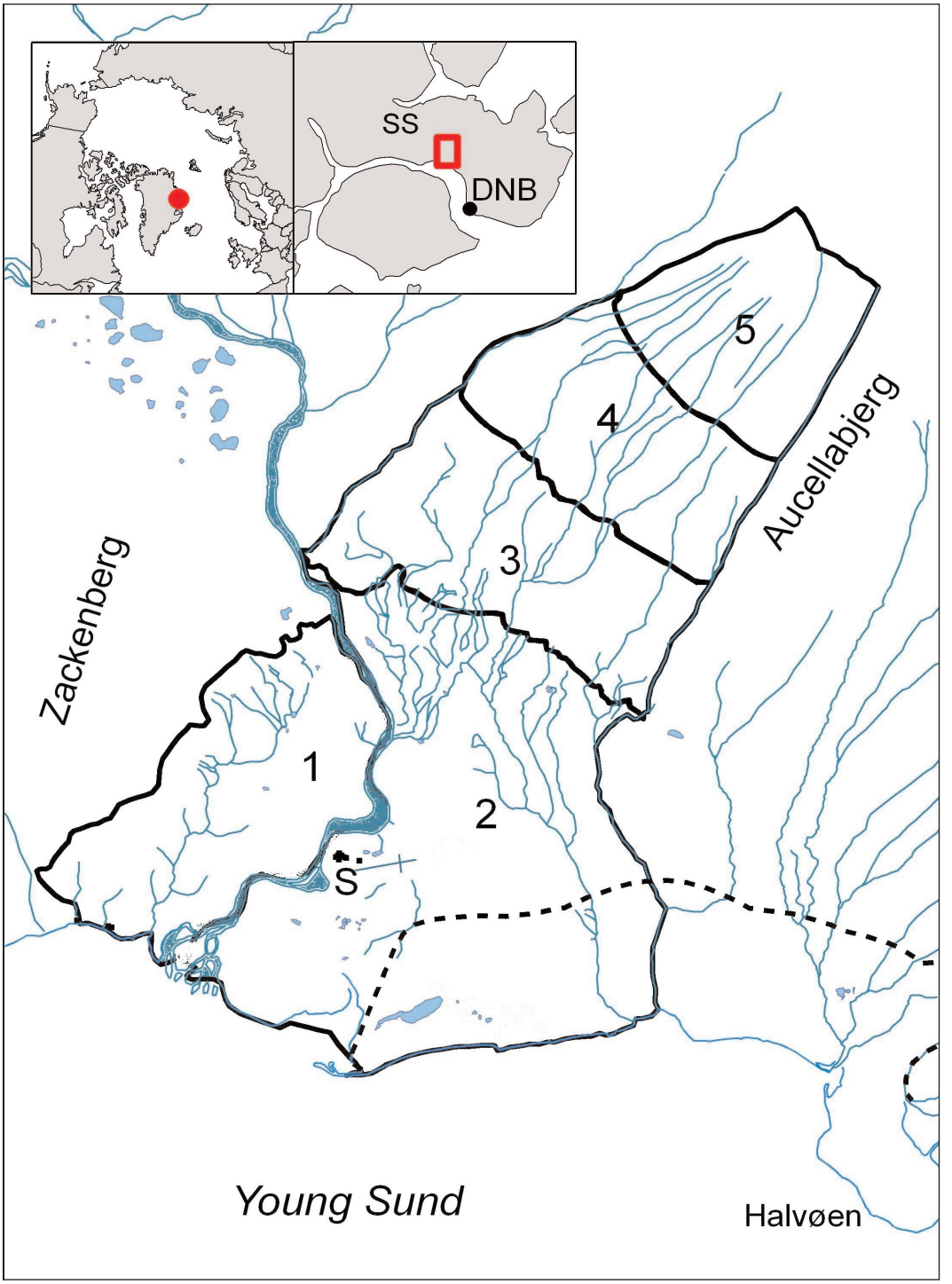

FIGURE 1. The study area in Zackenbergdalen, central Northeast Greenland, showing sections 1-5 of the bird census area. Also shown are place names mentioned in the text and the border of the closed goose molting area (broken line).

The area below 50 m a.s.l. is divided by the river Zackenbergelven into sections 1 and 2 (Fig. 1).

Between 50 and 150 m a.s.l. (section 3, Fig. 1) the terrain is hilly and more barren, but still with extensive grassland and fen areas. Between 150 and 300 m a.s.l. (section 4, Fig. 1) the slopes are dominated by Mountain Avens heath and have low inclinations (app. 7°-13°). From 300 to 600 m a.s.l. (section 5, Fig. 1) there are more areas with zones of grassland and some Mountain Avens heath. The plant communities are described in detail by Bay (1998).

The annual bird census takes place during mid to late June, and all birds present are mapped. During this period most birds are displaying and concentrated on snow-free areas where territories are established. This early timing aims to record the entire potential breeding population before incubators become hard to find, and before failed breeders begin to leave their territories (for further details, see Meltofte 2001, Meltofte et al. 2007a). However, it takes a week to cover the entire area, which means that some areas are surveyed later than what would be optimal (cf. Meltofte 2006a). Snow cover in June is usually high (Table 4), but it decreases rapidly during the census period.

Bird locations are plotted on maps in the field together with information on song, alarm calling, territoriality and pairs. Ultimately, these maps are used for a total territory map at the end of the census period. Information on nests and broods collected during the remaining breeding season is used to supplement and fine-tune the territory map (see Meltofte et al. 2007a).

From late June, goslings are counted in the valley and along the coast, in the closed goose molting area (Fig. 1).

BREEDING POPULATIONS

In 2006, the complete initial census of breeding birds within the census area (sections 1-5, Fig. 1) was performed between 17 and 26 June, which is a period later than usual due to the extensive snow cover. At that time, most parts of the 19.3 km^2 census area were snow free although to a lesser extent than the historical average. The entire census was performed in good weather conditions.

In addition, large parts of the area were censused regularly during June, July and most of August, exceptions being the Aucellabjerg slopes above 350 m a.s.l. and the closed goose molting area along the coast (Fig. 1). The slopes were censused on only three occasions due to fog (see below).

The results of the initial census, supplemented with records during the rest of the season (see above and Meltofte et al. 2007a), are presented in Table 1, and in Table 2 they are compared to the results of previous seasons.

Red-throated Divers *Gavia stellata* breed regularly at Zackenberg, but no nests were found in 2006. Four to five pairs were found during the census.

Long-tailed Ducks *Clangula hyemalis* are regular breeders at Zackenberg, and two nests were found in 2006. Pairs were seen in the census area from 7 June to 2 August, and ducklings from 30 July to 11 August; three broods in total were found.

After a string of years with low numbers, the Rock Ptarmigan *Lagopus mutus* population was high. At the opening of the station, many Rock Ptarmigan remains were found at active Arctic Fox *Alopex lagopus* dens and in other parts of the valley. From these remains we concluded that foxes in the bird census area took a minimum of 19 Rock Ptarmigans during winter and spring. At dens in adjacent areas, remains of an additional minimum of four Rock Ptarmigans were found.

During the census, 4-7 pairs of Rock Ptarmigans were registered. The nest of one of these pairs was found, containing eight eggs that all subsequently hatched. The brood was seen on 17 July for the first time, and survived at least another day. The re-emergence of breeding Rock Ptarmigans in the census area fits well with the expected synchrony for this species in Northeast Greenland (cf. Hansen et al., in prep.).

Among waders, Sanderlings *Calidris alba* were recorded in record high numbers, even a little above the previous peak of 2003. Dunlins *Calidris alpina* and Ruddy Turnstones *Arenaria interpres* also appeared in numbers above average. For Ruddy Turnstone, it seems that the population was at a low in 2002 and 2003, and that it has now risen to levels well above average. Most of these birds did not seem to breed this year, which is likely to be associated with the late snowmelt (see below). Common Ringed Plover *Charadrius hiaticula* and Red Knot

TABLE 1. Estimated numbers of pairs/territories in the five sectors of the 19.3 km² census area in Zackenbergdalen, 2006; altitude is shown a.s.l.

Direction from river	West	East	East	East	East	Total
Species	<50 m 3.47 km²	<50 m 7.77 km²	50-150 m 3.33 km²	150-300m 2.51 km²	300-600 m 2.24 km²	
Red-throated Diver	1	3-4	0	0	0	4-5
King Eider	0	1	0	0	0	1
Long-tailed Duck	0-1	5-6	0	0	0	5-7
Rock Ptarmigan	1-2	2-3	0	0-1	1	4-7
Common Ringed Plover	8-9	20-29	4-5	5	4-5	41-53
Red Knot	0	4-10	15-22	8	0	27-40
Sanderling	8-11	40-47	6-7	12-14	7-8	73-87
Dunlin	23-25	68-83	15-18	0	0	106-126
Ruddy Turnstone	7-9	36-41	18-23	2-5	0	63-78
Red-necked Phalarope	0	2	0	0	0	2
Red Phalarope	0	5-7	0	0	0	5-7
Long-tailed Skua	5-7	7-12	8-10	1	0	21-30
Glaucous Gull	1	0	0	0	0	1
Arctic Redpoll	0	0-1	0-1	0	0	0-2
Snow Bunting	17	22-24	23-24	9	9-10	80-84

TABLE 2. Numbers of territories of regular and irregular breeders in the 19.3 km² census area in 2006 compared to the average number of territories for the period 1996-2005.

Species	No. territories	Average min. and max. no. territories 1996-2005	No nests found[a]	Comments
REGULAR BREEDERS				
Red-throated Diver	4-5	2.5-2.9	3	
Common Eider	0	0.4	0	Flocks seen in June, females with chicks in Aug.
King Eider	1	1.9-2.8	0	Few other observations.
Long-tailed Duck	5-7	5.7-7.5	2	Broods seen from 30 July.
Rock Ptarmigan	4-7	3.8-4.3	1	
Common Ringed Plover	41-53	40.4-44.7	4	
Red Knot	27-40	26.8-31.6	0	
Sanderling	73-87	55.9-64.8	8	
Dunlin	106-126	94-104.4	14	
Ruddy Turnstone	63-78	46.1-51.7	4	Many non-breeders this season.
Red-necked Phalarope	2	0.8-1.7	0	
Long-tailed Skua	21-30	22.3-26	2	Many non-breeders this season.
Glaucous Gull	1	0.2	1	
Common Raven	(2-3)	-	0	Breed outside the census area.
Snow Bunting	80-84	59.4-61.3	1	Nests of passerines found opportunistically.
IRREGULAR BREEDERS				
Pink-footed Goose	0	0.6-0.7	0	Min. 532 immatures seen migrating northwards
Eurasian Golden Plover	0	0.1	0	1 individual, 31 May. 2nd earliest record at ZERO
Red Phalarope	5-7	0.2-0.3	1	First nesting record at Zackenberg
Snowy Owl	0	0.1	0	No observations this season
Northern Wheatear	0	0.2-0.5	0	No observations this season
Arctic Redpoll	0-2	0.5	0	One additional observation in adjacent areas

[a] Within the census area

Calidris canutus were recorded in numbers around the average of previous years (Tables 1 and 2).

Red Phalarope *Phalaropus fulicarius* territories were found in record high numbers in 2006 (Table 2) and a nest was found, the first of this species thus far in this monitoring effort. Possibly, the late snowmelt suited this high-arctic breeder.

The number of Long-tailed Skua *Stercorarius longicaudus* territories was average (Table 2). Early in the season, higher numbers were observed, possibly due to the fact that many birds were not breeding and therefore moved around a lot. Only two pairs nested in the census area (see below).

The last two seasons have shown rising numbers of Snow Bunting territories. This season numbers were lower again, although still the 3rd highest in total (Table 2).

REPRODUCTIVE PHENOLOGY IN WADERS

Likely due to the extensive spring snow cover, nest initiation by waders in the 2006 season was very late (see also Meltofte et al. 2007b). Only 6.25% of all wader clutches were initiated before 10 June, and medians of the first egg dates were after 25 June in four of the five species monitored (Tables 3, 4).

REPRODUCTIVE SUCCESS IN WADERS

Nest success was fairly good for Dunlin and very good for Common Ringed Plover, whereas the nest success for Sanderling and turnstone was very low. The all-wader predation rate was *c.* 63%, which is above average. Thirteen of 28 nests were found predated. The fate of five nests was unknown. All but one turnstone nests was unsuccessful (n = 4), compared to success in all Common Ringed Plover nests (n = 5). Of course, the few nests found, makes this result unclear. Not being a target species for us, Common Ringed Plover nests were found opportunistically. Had we sought nests of this species intensively, we would likely have found nests that would later suffer from predation. Unsuccessful nests not suffering from predation were either abandoned (n = 1) or the brood was predated during, or just after, hatching (n = 1). Also, all but two Sanderling nests were predated

TABLE 3. Median first-egg dates for waders at Zackenberg 2006, as estimated from incomplete clutches, egg floating, hatching dates, as well as weights and observed sizes of pulli.

Species	Median date	Range	N
Common Ringed Plover	28 June	19 June - 29 June	5
Red Knot	-	-	0
Sanderling	30 June	20 June - 10 July	12
Dunlin	27 June	16 June - 4 July	20
Ruddy Turnstone	21 June	13 June - 29 June	4
Red-necked Phalarope	-	-	0
Red Phalarope	1 July	1 July	1

TABLE 4. Snow cover (%) on 10 June together with median first-egg dates (in June) for waders at Zackenberg, 1995-2006. Data based on <10 nests/broods are in brackets, those <5 are omitted. The snow cover is pooled (weighted means) from section 1, 2, 3 and 4 (see Klitgaard et al. 2007), from where the vast majority of the nest initiation dates originate.

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Snow cover (%), 10 June	84	82	76	80	91	53	84	79	83	48	28	*
Sanderling		(16)	18	18	23.5	16	22.5	17	13	8	(15)	30
Dunlin	(18)	11.5	13	16.5	22	11.5	25	8	12	12	12	27
Ruddy Turnstone	(12)	18.5	13	12.5	24	11	23	9	8	8	11	

* Yet to be estimated, but high.

(n = 12). Numbers of Arctic Fox encounters in the bird census area were high (Table 5), and foxes were the likely predator of most nests, as no nests were found with clear signs of avian predation.

With a mean clutch size across species of 3.4, mean clutch size was lower than the average for previous years (Table 6). One Ruddy Turnstone nest and one Dunlin nest held only one egg each, and one Sanderling nest and three Dunlin nests held only two eggs. Only one Red Phalarope nest was found, and it contained four eggs.

In July and early to mid-August, alarm-calling parents, and later juveniles, were found in the census area. Juvenile Ruddy Turnstones were only seen late in the season, most often in connection with low-tide feeding, indicating that most of these hatched outside the census area.

From 16 July, flocks of up to 12 Long-tailed Skuas roamed the lower slopes of Aucellabjerg and the lowlands (sections 1-3, Fig. 1) making survival of wader chicks more difficult.

The number of juvenile waders in the two deltas (Fig. 1) at low tide was extremely low compared with previous seasons; Common Ringed Plover was the only species having a near-average number (Table 7). The reason for this was probably a combination of poor breeding success in the region and deterioration of the habitat of the present delta of Zackenbergelven due to a surge flood in 2005. In total, 78% of all waders observed during low tide were recorded in the former delta, including 71% of all adult and almost 93% of all juvenile waders. The waders might simply have chosen other areas in which to forage. Indeed, minor deltas exist at several rivulet mouths along the coast of Young Sund (Fig. 1).

Note: from 2007 and onwards low tide counts will no longer be part of the permanent monitoring. Results of the counts over the years are summarised and analysed by Meltofte and Berg (2004) and Meltofte et al. (2007).

TABLE 5. Mean hatching success, 1996-2006, according to the modified Mayfield method (Johnson 1979). Poor data (<125 nest days or five predations) are given in brackets. Data from species with <50 nest days have been omitted (-: no nests at all). Nests with at least one pipped egg or one hatched young are considered successful. Also given are total numbers of adult foxes observed by the bird observer in the bird census area during June-July (away from the research station proper).

Species	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	1996-2006
Common Ringed Plover				(60)		(38)				-	(100)	62-100
Red Knot	-	-			-		-			-	-	(18)
Sanderling	(72)	(33-100)	(88)	40	(46)	19	(33)	45	71-85		(7.4)	37-41
Dunlin			28-47	65	68	(75)		63	93	(43)	47	60-65
Ruddy Turnstone	21-68	67-100	16	23-28	29	(60)	52	21-27	83			38-45
All waders	33-63	52-100	32-37	42-44	44	43	43	42-44	87-90	22	37	45-52
No. nests	17	31	44	44	47	32	21	51	55	15	28	385
No. nest days	163	274	334	521	375	328	179	552	700	104	332	3860
No. Lemming nests km^{-2}	77	176	346	158	89	156	152	46	210	144	129	
Fox encounters	14	5	7	13	11	14	21	11	16	18	22	

TABLE 6. Mean clutch sizes in waders at Zackenberg, 1995-2006. Samples of <5 clutches are given in brackets.

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Mean
Common Ringed Plover	(4.00)	(4.00)	(3.50)	(4.00)	(3.50)	(4.00)	(3.50)	(4.00)	(4.00)	(4.00)		(3.75)	3.84
Red Knot				(4.00)	(4.00)		(4.00)		(4.00)	(4.00)			4.00
Sanderling	(4.00)	4.00	3.86	4.00	3.67	4.00	3.43	3.83	4.00	4.00	3.75	3.63	3.85
Dunlin		(4.00)	(3.75)	3.90	3.70	3.93	3.63	(4.00)	4.00	3.92	4.00	3.13	3.81
Ruddy Turnstone		3.71	3.79	3.82	3.58	3.80	3.75	4.00	3.77	3.92	3.86	(3.00)	3.73

TABLE 7. Total numbers of juvenile waders recorded at low tide in the former and the present deltas of Zackenbergelven, on the basis of 15 counts performed every third day during the period 18 July – 28 August, 1995-2006. Data from missing counts have been substituted by medians from previous and following counts. Note that the total number also includes juvenile Red Knots, which are not otherwise featured in this table.

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Common Ringed Plover	96	126	249	42	44	142	320	140	170	253	176	166
Sanderling	304	726	149	333	445	366	540	156	242	346	78	72
Dunlin	325	360	323	232	509	273	326	554	309	308	173	91
Ruddy Turnstone	80	108	82	109	23	73	162	183	75	19	52	28
Waders total	810	1342	803	722	1021	854	1351	1040	803	928	479	357

REPRODUCTIVE PHENOLOGY AND SUCCESS IN LONG-TAILED SKUAS

Only three Collared Lemmings *Dicrostonyx groenlandicus* were seen during field work by the bird observer during June and July, indicating a moderate lemming season. This was also reflected in the low number of lemming winter nests found (see Table 5). In accord, only two Long-tailed Skua nests, each with only one egg, were found within the census area. These would have been initiated as late as 16 and 22 June, respectively. As mentioned above, the number of pairs was similar to other years and, hence, most pairs were non-breeding.

The egg of one skua nest never hatched, although it was incubated well beyond the normal incubation period, while the egg of the other nest hatched (Table 8). The chick is believed to have survived for a maximum of 10 d.

Possibly, Long-tailed Skua reproduction was generally low in eastern Greenland in 2006, as no Long-tailed Skua chick fledged at Karupelv, on Traill Ø, either (B. Sittler, pers. comm.).

No observations of juvenile birds were made at Zackenberg in 2006.

BREEDING AND MOLTING GEESE

On 9 June 2006, an old Barnacle Goose *Branta leucopsis* colony west of the census area was revisited, and the call of one Barnacle Goose was heard from the upper terraces of the southern face of the Zackenberg mountain (Fig. 1). Two smaller flocks were foraging at the foot of the mountain. From this observation and later observations of traffic towards that part of the mountain, it is assumed that a modest level of breeding activity took place here in 2006.

The first family with a gosling was seen on 30 June in the former delta (Fig. 1), foraging with seven other adults. The number of broods along the coast was among the lowest recorded so far (Table 9), and the maximum number of goslings seen within a brood at one time was only five. The mean number of broods seen for the period 1995-2005 was 16. Also, in adjacent areas, very few young were seen. On 16 July, two families with one and two goslings, respectively, were observed with four other adults and 112 immatures at the coast of Halvøen in the south-eastern part of the valley. The other broods were observed within the closed goose molting area (Fig. 1).

TABLE 8. Median clutch initiation dates, breeding effort and success in Long-tailed Skuas at Zackenberg, 1996-2006. The numbers of clutches found include replacement clutches. Mean hatching success according to the modified Mayfield method (Johnson 1979). Poor data (<125 nest days or five predations) are given in brackets. Nests with at least one pipped egg or one hatched young are considered successful. Also given are numbers of lemming winter nests within the ca. 2 km^2 lemming census area.

Species	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Median 1st egg date		7.6	12.6	17.6	18.6	15.6	9.6	15.6	8.6	8.6	19.6
No. clutches found	8	17	23	8	5	21	14	7	21	8	2
No. young hatched	1	25	16	2	2	18	14	5	36	6	1
Nest success % (Mayfield)		(80.6)	24.1	(18.1)	(17.5)	39.5	44.1	(76.2)	(100)	(51.8)	(50)*
Estimated no. young fledged	0	5	6	1	0	5	4	2	22	1	0
Lemming nests km^{-2}	77	176	346	158	89	156	152	46	210	144	129

TABLE 9. Average brood size of Barnacle Geese in Zackenbergdalen during July and early August, 1995-2006, together with the total number of broods led to the valley from nearby colonies. Samples of <10 broods are given in brackets. Average brood size during autumn and winter on the Isle of Islay, Scotland, is given for comparison, including the percentage of juveniles in the population (M. Ogilvie, unpubl. data).

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Early July		(3.0)	3.1	(2.9)	1.9	(3.2)	(1.8)	2.4	(1.8)	2.6	(1.7)	(2.0)
Mid July		(2.3)	2.7	2.3	1.8	(3.1)	(1.7)	2.4	(1.2)	2.3	2.7	(1.5)
Late July	(2.0)	(3.0)	2.6	2.2	1.7	3.1		2.3	(1.1)	2.3	(2.2)	(1.1)
Late August	(2.3)	(2.3)	2.4		1.8		(2.0)	2.2	(1.2)	(1.9)		(1.5)
No. broods	≥7	6-7	19-21	≥18	29	11	4	32	8	26	14	9
Scotland	2.00	2.30	1.95	2.28	1.92	2.20	1.94	2.23	1.59	2.35	1.67	1.15
Juveniles (%).	7.2	10.3	6.1	10.5	8.1	10.8	7.1	12.5	6.4	15.9	6.3	3.2

The mean 2006 brood size, 1.1 young per brood, equals the lowest late July figures recorded so far,. From Isle of Islay, western Scotland, it was reported that the percentage of young in flocks at their wintering quarters also was very low (Table 9; M. Ogilvie, pers. comm.)

Large numbers of immature Icelandic and Greenlandic Pink-footed Geese *Anser brachyrhynchus* as well as Greenlandic Barnacle Geese *Branta leucopsis* molt in Northeast Greenland. At Zackenberg, fair numbers, especially of Barnacle Geese, molt in our study area (cf. Meltofte 2006b). Due to disturbances from our activities, Pink-footed Geese numbers have declined during the monitoring period, whereas immature Barnacle Goose numbers have increased in some areas, with record high numbers in 2006 (Table 10).

OTHER WATERBIRDS

Common Eiders *Somateria molissima* have bred at Zackenberg on a few occasions (Meltofte 2006b), but breed in great numbers at a colony at Daneborg, 23 km southeast of Zackenberg (for details see Meltofte 1978). At Zackenberg, the first female eider was seen on 12 June, and the first two males were seen with a flock of 14 females on 21 June. The last male was seen 7 July, and the first ducklings on 7 August; the

TABLE 10. The number of immature Pink-footed Geese and Barnacle Geese molting in the study area at Zackenberg, 1995-2006. The closed area is zone 1c in Figure 1.

Study Area	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
PINK-FOOTED GOOSE												
Closed molting area & further east	310	246	247	5	127	35	0	30	41	11	17	27
Transect Daneborg - Zackenberg	0	0	0	0	0	0	0	0	0	20	0	-
Coast west of closed area	230	40	60?	0	29	0	0	0	0	10	0	3
Upper Zackenbergdalen	0	0	15	0	0	0	0	0	0	0	0	1
Outer Store Sødal	20	12	21	0	5	0	16	8	11	0	2	8
Inner Store Sødal	20	55	144	123	21	56	69	28	27	-	34	-
Pink-footed Goose total	>580	>353	<487	128	182	91	85	66	79	>41	53	39
BARNACLE GOOSE												
Closed area at Lomsø & Kystkærene	21	0	29	21	60	84	137	86	120	81	87	148
Coast east of closed area	>120	150?	96	55	66	0	109	80	45	0	2	218
Coast west of closed area	0	0	0	0	0	30	0	0	0	0	29	29
Upper Zackenbergdalen	41	85	2	75	<57	27	60	0	14	0	25	30
Outer Store Sødal	114	46	97	114	117	150	150	81	78	81	161	108
Inner Store Sødal	>19	61	63	184	87	78	46	57	71	-	108	389
Barnacle Goose total	>315	<342	287	449	<387	369	502	304	328	<162	412	922

TABLE 11. Visitor and vagrant bird species recorded at Zackenberg, 1995-2006. For 1995-2005, the number of individuals is given; for 2006, both the number of individuals and observations are listed.

	Visitors and Vagrants - Previous Records											Visitors and Vagrants - 2006		
Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	No. individuals	No. observations	Notes
Great Northern Diver	0	0	0	0	0	0	1	0	0	0	0	0	0	
Whooper Swan	0	0	0	0	0	4	0	0	0	0	0	0	0	
Snow Goose	0	0	0	0	0	2	11	0	23	0	0	0	0	
Canada Goose	0	0	0	0	0	0	0	0	0	0	0	4	3	b,c
Merlin	0	0	0	0	0	1	0	0	0	0	0	0	0	d
Gyr Falcon	1	1	1	3	0	4	5	1	3	4	2	0	0	
Pintail Duck	0	0	0	1	0	0	0	0	0	0	0	0	0	g
Common Teal	0	0	0	0	0	0	0	1	0	0	0	0	0	
Eurasian Golden Plover	0	3	1	3	1	0	11	1	0	1	1	1	1	
White-rumped Sandpiper	0	0	0	0	0	0	1	0	0	0	1	0	0	
Pectoral Sandpiper	0	0	0	1	0	0	0	1	0	0	0	1	2	
Purple Sandpiper	0	0	0	0	0	0	0	1	0	0	0	0	0	
Red Phalarope	0	0	0	4-5[a]	0	0	4[a]	0	1	0	2[a]	11[a]	7	
Whimbrel	0	0	0	0	0	1	1	0	0	2	1	0	0	
Pomarine Skua	0	0	0	0	0	0	2	0	0	0	0	0	0	
Arctic Skua	0	0	11	6	0	2	7	4	3	2	0	1	1	
Great Skua	0	0	0	4	0	0	0	1	0	0	0	0	0	
Lesser Black-backed Gull	0	0	0	0	0	0	1	0	1	2	1	4	2	e
Iceland Gull	0	0	0	0	0	0	0	0	0	0	0	2	1	b
Great Black-backed Gull	0	0	0	0	0	1	3	0	0	0	0	0	0	
Black-legged Kittiwake	0	0	0	0	0	0	0	0	14	0	0	0	0	f
Arctic Tern	≈200	2	1	2	0	14	0	0	32	0	0	0	0	
Snowy Owl	0	0	2	1	1	1-2	min. 4[a]	0	0	0	0	0	0	
Meadow Pipit	0	0	0	1	0	0	0	0	0	0	1	2	2	g
White Wagtail	0	1	0	0	0	0	0	0	0	0	0	0	0	
Northern Wheatear	4	8[a]	4	3a	1-2[a]	0[h]	0	0	0	0	2	1	1	
Arctic Redpoll	7	9	16	23	8	5	3	6	31[i]	12	3[a]	2	2	
Lapland Longspur	0	0	0	0	1-2	0	1	0	0	0	1	0	0	

[a] One or more territories, possible territories or breeding found, see table 1
[b] 2006: First records at Zackenberg
[c] Subspecies *interior*
[d] Immature Merlin, 1 and 14 July.
[e] Increasing in East Greenland (Boertmann 2008)
[f] 10 adults, 4 juveniles 28 August 2003.
[g] Northernmost records in East Greenland (*cf.* Boertmann 1994)
[h] One dead individual found
[i] 20 of these, a flock of juveniles in August

latter date is extremely late. These ducklings were most likely from the colony at Daneborg, where personnel from the Sirius dog sledge patrol counted 1,554 active nests. Extensive snow cover hindered full use of the colony area, and an estimated 15-20% of the females did not nest. The average number of nests (2002-2005) was 2,174 (range: 1614-2606). King Eider *Somateria spectabilis* breeds regularly at Zackenberg (Meltofte 2006b), and in 2006 a pair was seen on 24 June.

VISITORS AND VAGRANTS

Two new species were added to the Zackenberg avifauna : Canada Goose *Branta canadensis* and Iceland Gull *Larus glaucoides* (Table 11). The first Canada Goose was observed on 29 May, and on 14 June, two were foraging in fens at the research station. Lastly, three pairs were foraging in the coastal fens on 24 June. Three subspecies have been recorded in Greenland, and the birds at Zackenberg were *Branta canadensis interior*, a subspecies known to be expanding in Greenland (Kristiansen and Jarrett 2001, Fox et al. 2006).

Two Iceland Gulls were seen among 60 Glaucous Gulls *Larus hyperboreus* in the delta of Zackenbergelven on 25 July.

One Eurasian Golden Plover *Pluvialis apricaria* was seen near the research station on 31 May, thus keeping the species as a near-annual visitor. The third record of Pectoral Sandpiper *Calidris melanotos* at Zackenberg was made in the fens south of the research station on 6 July. Most likely, it was the same individual, presumably a female that was found in a fen just north of the research station on 7 July. The Pectoral Sandpiper is a rare visitor to eastern Greenland (Boertmann 1994). On 22 July, an Arctic Skua *Stercorarius parasiticus* was observed near the coast. Arctic Skuas are less common in the fjords areas than at the outer coast, and also have a more southerly distribution than the Long-tailed Skua (Boertmann 2003). Sporadic observations of Lesser Black-backed Gulls *Larus fuscus* were made from 23 June to 28 July. The species is steadily expanding northwards in eastern Greenland (Boertmann 2008). Two records of Meadow Pipits *Anthus pratensis* in 2006 represent the third season that this species was seen at Zackenberg. Only one record, on 18 August, was made of a Northern Wheatear *Oenanthe oenanthe*, once a breeding bird to the area. A male Lapland Longspur *Calcarius lapponicus* was observed in the fens north of the research station on 23 June.

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CHANGES IN A FOREST BIRD COMMUNITY DURING AN OUTBREAK CYCLE OF THE SPRUCE BUDWORM IN NORTHWESTERN ONTARIO[1]

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Abstract. We report here changes in the forest bird community of a 10.4 ha study plot located in boreal mixedwood forest of northern Ontario, Canada, between 1966 and 1998. During this period, the region was subject to a severe outbreak of the spruce budworm (*Choristoneura fumiferana*). Overall, community response to increasing budworm prevalence was positive, although response pattern differed among species. All bird species that increased in population size did so during the increasing phase of the budworm cycle. By the time the budworm outbreak reached its peak in 1989-1990, both in terms of budworm density and defoliation, bird numbers had already been declining for five or more years, suggesting that the advantages conferred by a superabundant food supply were offset by negative effects on habitat.

Key words: community composition, competition, forest birds, habitat, numerical response, spruce budworm outbreak.

CAMBIOS EN UNA COMUNIDAD DE AVES DE BOSQUE DURANTE UN BROTE DEL GUSANO DEL ABETO EN EL NOROESTE DE ONTARIO

Resumen. Documentamos cambios en la comunidad de aves en una parcela de estudio de 10.4 ha en bosque boreal mixto del norte de Ontario, Canadá, entre 1966 y 1998. Durante este periodo, la región sufrió un fuerte brote del gusano del abeto *(Choristoneura fumiferana)*. En general, la respuesta a nivel de comunidad al aumento de prevalencia del gusano fue positiva, aunque la respuesta varió entre especies. Todas las especies de aves que aumentaron en tamaño poblacional lo hicieron durante la fase de aumento del ciclo del gusano. Cuando el brote de gusanos alcanzó su pico en 1989-1990, tanto en densidad de gusanos como en defoliación, el número de aves ya había estado en declive cinco o más años, lo cual sugiere que las ventajas que confiere un recurso alimenticio superabundante fueron contrarrestadas por los efectos negativos sobre el hábitat.

Palabras clave: composición comunitaria, competición, aves de bosque, hábitat, respuesta numérica, brote de gusano del abeto.

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INTRODUCTION

Bird population densities in the boreal forest are affected temporally by changes in the character of the forest as it matures, including changes in foliation and tree mortality brought by insect infestation. In eastern North America, a major driving force in forest development is the spruce budworm (*Choristoneura fumiferana*), a native species that periodically multiplies to such high densities that it causes extensive mortality of its host tree species, primarily balsam fir (*Abies balsamea)* and white spruce (*Picea glauca*) (Morris 1963). Outbreaks have occurred at intervals ranging from 20 to 140 years (Blais 1983), with an underlying cycle of about 35 years (Royama 1984, Candau et al. 1998). The relationship between insectivorous birds and budworm was demonstrated during a major outbreak in the 1940s and 1950s in Maine (Hensley and Cope 1951), New Brunswick (Morris et al. 1958) and Ontario (Kendeigh 1947). Populations of canopy-feeding warblers, notably Tennessee Warbler (*Vermivora peregrina*), Cape May Warbler (*Dendroica tigrina*), Blackburnian Warbler (*D. fusca*) and Bay-breasted Warbler (*D. castanea*), increased dramatically, but evidently did not contribute significantly to population regulation of the spruce budworm at high budworm densities (Morris et al. 1958, Mook 1963). Based on stomach contents analyses, Crawford et al. (1983) concluded that bird predation is unlikely to have much effect on high density, epidemic populations of budworm, but could play a major role in the regulation of low density, endemic populations. Torgerson et al. (1985) reached a similar conclusion with respect to western spruce budworm (*C. occidentalis* Freeman).

Two major spruce budworm outbreaks have occurred in northern Ontario in the last 70 years, with the first peaking in 1945 and the second in 1980 (Candau et al. 1998). During the first outbreak, breeding bird censuses were carried out by Kendeigh (1947) to assess the effects of aerial spraying with DDT. In the 1960s, when spruce budworm populations had declined to low densities, additional censuses were conducted in two plots in the same general area (Sanders 1970). These showed that bird densities had declined from 788 to 304 pairs km^{-2}, a difference that could be attributed to the virtual absence of the four warbler species named above. Since that time, breeding bird censuses have continued in one of the plots (Sander's 1970: Plot 2). The other plot became an isolated patch of forest in a large clear-cut when the surrounding area was logged in 1993. This made the value of further data from that plot questionable and censuses were discontinued. Since the 1960s, major changes have taken place in the forest due to natural ageing of the stand and to heavy defoliation by budworm during the 1980s outbreak.

Most studies examining the relationship between forest birds and spruce budworm were conducted over a period of just one or two years near the peak of a regional outbreak, although often in multiple blocks with different local budworm populations (Kendeigh 1947, Hensley and Cope 1951, Stewart and Aldrich 1951, Zack and Falls 1975, Crawford et al. 1983, Crawford and Jennings 1989). While such studies may provide a snapshot of the bird community at various intervals during an outbreak, they are incapable of describing the dynamic, temporal response of birds to changing budworm populations. This is particularly true if the confounding effects of habitat on prey availability are ignored, since both budworm and bird population sizes may be determined as much by forest composition and other local conditions, as by the stage of the outbreak. The alternative is to follow changes in the bird community at one or more sites over time as the budworm infestation proceeds from pre-outbreak to outbreak to post-outbreak levels. In this case, presumably, the bird community would be responding primarily to budworm numbers and the damage they cause. This is the approach taken in bird studies conducted as part of the Green River Watershed project in northern New Brunswick, Canada, from 1947-1968. Morris et al. (1958) presented data from the first 10 years of this project (outbreak years), and Gage and Miller (1978) extended the analysis to include all 22 years (both outbreak and post-outbreak periods).

In this paper, we present the results of bird censuses conducted over a 33-yr period from 1966-1998 on Sander's (1970) Plot 2, together with relevant information on changes in budworm density and defoliation during that period. Our objective is to show how the forest bird community and individual species'

populations change through the different stages (pre-outbreak, outbreak and post-outbreak) of a complete spruce budworm cycle.

METHODS

STUDY AREA

The study area is situated on the western shore of Black Sturgeon Lake, Ontario (49°18´N, 88°52´W), in the Superior Forest Section (B9) of the Boreal Forest Region of Canada (Rowe 1972). The forest type is boreal mixedwood, composed primarily of white spruce, balsam fir, white birch (*Betula papyrifera*) and trembling aspen (*Populus tremuloides*), with the addition of black spruce (*P. mariana*) and jack pine (*Pinus banksiana*) on some sites. The forest in the 10.4 ha study plot (BSL plot) originated from a salvage cut following a spruce budworm outbreak in the 1940s. At the start of the study in 1966, the young mixedwood stand had a few older trees surviving from the previous budworm outbreak. A detailed description of the study plot as it appeared in 1985 was published by Lethiecq and Régnière (1988), in conjunction with associated studies on spruce budworm population dynamics. Additional plot descriptions and vegetation surveys were carried out in 1967, 1977, 1980, 1985, 1993 and 1995, during which trees were enumerated by species and diameter-at-breast-height (dbh). Only the summary data from these surveys are included in this paper.

SPRUCE BUDWORM SAMPLING

Spruce budworm population densities and resulting defoliation were estimated annually from 1961 through 1997. This involved the collection of 45 cm (18 in) branch tips from the upper canopy of the budworm host trees, balsam fir, and white and black spruce. The number of branches sampled each year varied from as few as 20 per tree species to several hundred. Foliage was examined visually for the presence of spruce budworm larvae and numbers were recorded. Visual estimates were also made of the percentage of needles removed from each current-year shoot and these were averaged to get a percent defoliation value for each branch. Details of these sampling methods are provided in Sanders (1980).

BIRD CENSUSES

We used the same census method as described by Kendeigh (1947) and Sanders (1970). The sample plot measured 16 chains x 16 chains (25.6 acres) or approximately 322 m x 322 m (~10.4 ha). To keep disturbance during censuses to a minimum, trails were cut through the plot at 2 chain (40.2 m) intervals. Stakes were placed along these trails every 2 chains (40.2 m). Censuses were conducted by walking the trails and mapping the locations of all singing male songbirds using the marked stakes as reference points. Other vocalizations and non-vocal sounds, as well as visual observations, were recorded for all species. Early morning censuses (05:30 to 10:30 EDT) were carried out at least three times each year on calm, sunny mornings between 10 and 30 June. One or more evening visits were also made each year. Most of the censuses were conducted by the authors (CS, DF and DW), but other individuals were involved on occasion. Each year, the data for each species were copied onto a single sheet and these were examined to determine the probable number of territories of each species in each plot. In order to standardize the interpretation, this work was done by one person (DF).

STATISTICAL ANALYSES

We used Non-metric Multidimensional Scaling (NMS) to describe variation in the forest bird community of the BSL plot over the course of the budworm outbreak. The ordination was based on a Bray-Curtis similarity matrix constructed from untransformed species abundance data and was performed using PRIMER 5 for Windows software (PRIMER-E Ltd., Plymouth, UK). NMDS arranges samples in multidimensional species (ordination) space in such a way that the rank order similarity of the samples is maintained. Thus, samples that are closer together on the plot are more similar than samples that are farther apart. Species scores were added to the NMS plot using a weighted averaging approach described by McCune and Grace (2002). Species abundances tend to be greater where species points and sample points are closer together on the plot.

To examine local species' population trends (1966-1998) in their regional contexts, we plotted species abundance data from the BSL plot (pairs per 10.4 ha) and Ontario Breeding Bird Survey

data (annual indices) on the same graphs. The data were first standardized by subtracting the sample mean for each species in each dataset from the raw values (scores) and dividing the differences by the sample standard deviation. This transformation allowed us to compare variables originally measured in different units on the same scale.

RESULTS

SPRUCE BUDWORM

Through the 1960s and early 1970s, spruce budworm populations were extremely low in the BSL plot (what we will refer to as the "low" phase of the budworm cycle), with never more than six larvae per 100 branch tips and no larvae at all in some years (Fig. 1a; note the log scale on the y-axis). Beginning in 1974, budworm numbers began to increase (the "increasing" phase of the budworm cycle) and, except for a temporary decline in 1978-1979, continued to increase until 1983 when the density was well over 10 larvae/branch tip. Despite increasing budworm numbers, visible defoliation remained relatively low on the BSL plot and regionally during this period (Fig. 1b). High budworm densities and defoliation were sustained on the BSL plot from 1984 through to the early 1990s (the "high" phase), peaking in 1990 at >60 larvae/branch tip. The population started to decline (the "declining" phase) in 1994. Defoliation also declined during this period, although by this time much of the fir and spruce were already dead (see below).

STAND DEVELOPMENT

In 1966, the basal area on the BSL plot was dominated by small balsam fir (average dbh 9.3 cm) and trembling aspen (average dbh 9.5 cm). Except for a few large white spruce, survivors of the last spruce budworm outbreak in the 1940s, and white birch, the average stand height was only about 10 m. There were numerous openings in the plot dominated by shrubs, primarily beaked hazel (*Corylus cornuta*). By 1977, the total basal area had increased approximately threefold, with balsam fir (average dbh 10.9 cm) and aspen (average dbh 13.8 cm) still the dominant species (Fig. 2). The canopy was closed and the shrub layer was suppressed. By 1985, the total basal area had increased only slightly, but the basal area of aspen had almost doubled (Fig. 2). The aspen were larger on average (14.8 cm dbh) and frequently overtopped the balsam fir (11.9 cm dbh and 15 m in height). Total shrub cover was 14%, with 7% in hazel and 5% in alder (Alnus spp. P. Mill.). By 1995, 93% of the balsam fir, 50% of the white spruce and 33% of the black spruce were dead (Fig. 2). Aspen dominated the stand, with some trees up to 50 cm dbh (average dbh 19.6 cm) and over 20m in height. Where groups of balsam fir had died, there were openings in the canopy up to a few hundred square meters in area. Total shrub cover had risen to 37%, with 16% in hazel, 11% in raspberry (*Rubus spp*.) and 3% in dogwood (*Cornus stolonifera*). Although many of the dead trees had fallen, there were still standing dead trees in various states of decay.

FOREST BIRD COMMUNITY

Through the late 1960s, the number of territories on the 10.4 ha BSL plot remained fairly constant between 32 and 36 (Table 1). From 1977, there was a steady increase in the number of territories to a peak in 1983, followed by a decline back to the starting level in 1998. The most consistently abundant species on the BSL plot over the 33 years of the study was Ovenbird (*Seiurus aurocapillus*), with never less than two territories in any year. Three other species were present in every sample: Golden-crowned Kinglet (*Regulus satrapa*), Red-eyed Vireo (*Vireo olivaceus*) and Swainson's Thrush (*Catharus ustulatus*).

Changes in the bird community of the BSL plot were correlated with the progression of the local spruce budworm outbreak. In the NMS ordination diagram, the sample points (representing bird community composition at varying points in time) progress from left to right across the plot during increasing budworm years, cluster on the right side of the diagram during peak budworm years, and shift back toward the left as budworm numbers begin to decline (Fig. 3a).

During the late 1960s, when budworm numbers were low, Nashville Warbler (*Vermivora ruficapilla*), Magnolia Warbler (*D. magnolia*), Ovenbird and White-throated Sparrow (*Zonotrichia albicollis*) dominated the BSL bird

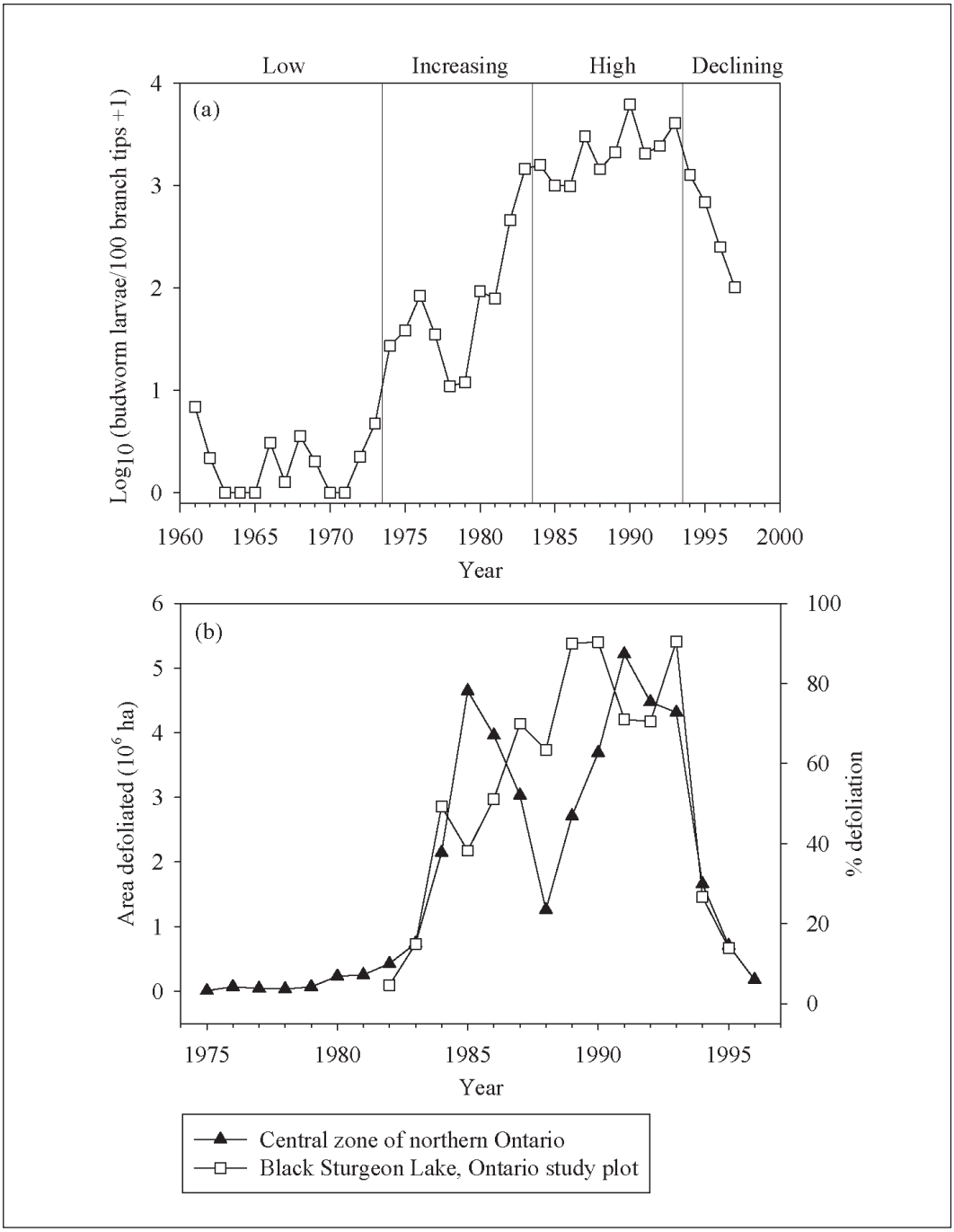

FIGURE 1. Progress of the spruce budworm outbreak locally at Black Sturgeon Lake and regionally in the central zone of northern Ontario: (a) Spruce budworm densities (larvae/100 branch tips) in the Black Sturgeon Lake, Ontario, study plot (1961-1997). Vertical reference lines separate periods of low (1961-1973), increasing (1974-1983), high (1984-1993) and declining (1994-1997) budworm densities; (b) Percent defoliation by budworm in the Black Sturgeon Lake, Ontario, study plot (1982-1995) and area defoliated in the central zone of northern Ontario (1975-1996). Regional data are from Candau et al. (1998).

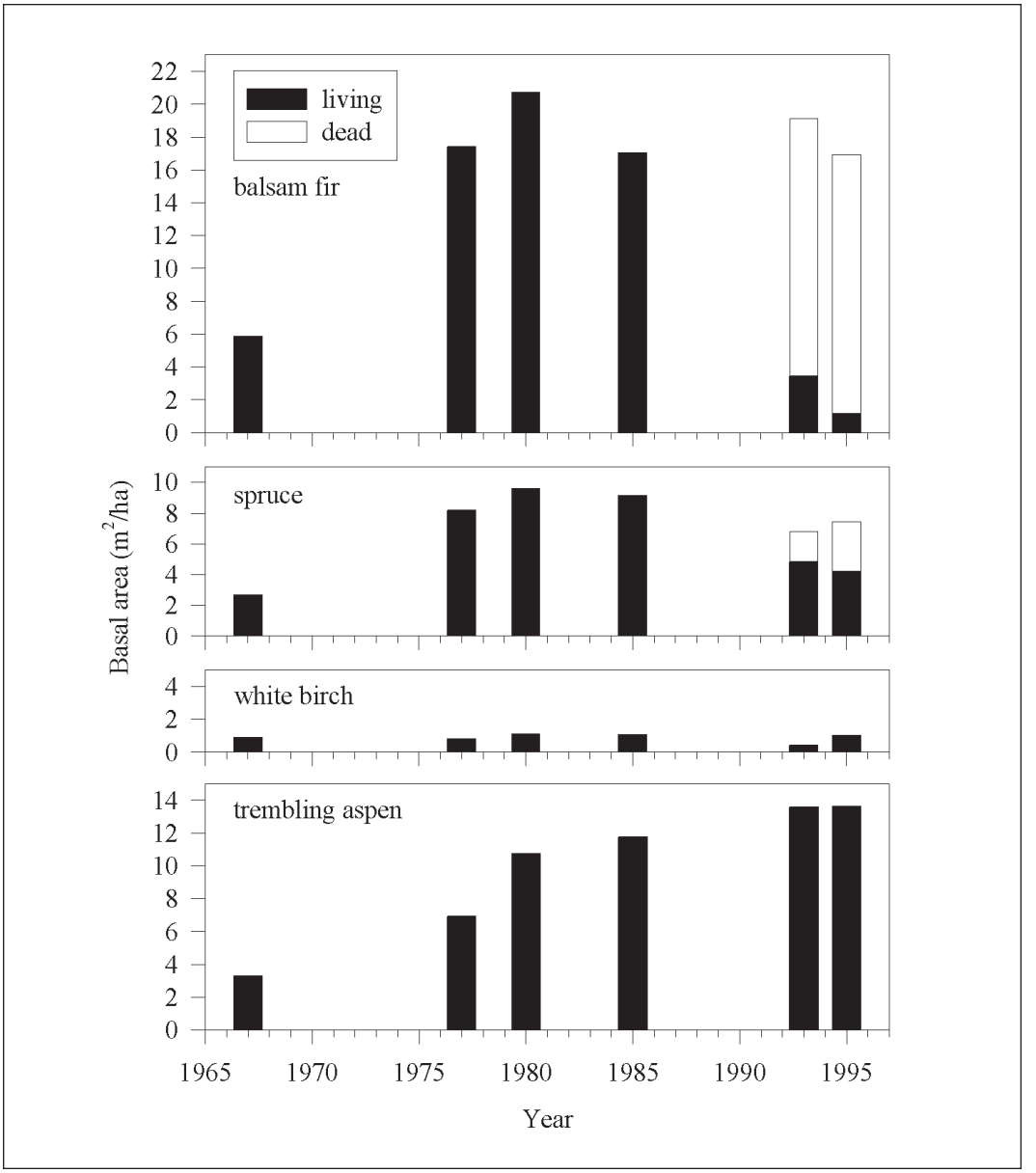

FIGURE 2. Basal areas of dominant tree species (balsam fir, black and white spruce, white birch and trembling aspen) in the Black Sturgeon Lake, Ontario, study plot (1967-1995).

community (Table 1, Fig. 3b). Least Flycatcher (*Empidonax minimus*), Chestnut-sided Warbler (*D. pensylvanica*) and Black-and-white Warbler (*Mniotilta varia*) were also relatively common. As budworm numbers increased through the 1970s and early 1980s, Least Flycatcher, Chestnut-sided Warbler, Black-and-white Warbler and White-throated Sparrow declined in abundance as other species increased, including Red-eyed Vireo, Golden-crowned Kinglet, Ruby-crowned Kinglet (*R. calendula*), Swainson's Thrush, Tennessee Warbler, Nashville Warbler, Magnolia Warbler, Cape May Warbler, Yellow-rumped Warbler (*D. coronata*) , Blackburnian Warbler,

TABLE 1. Number of territories in the 10.4 ha Black Sturgeon Lake, ON, study plot (1966-1998).

Species	1966	1967	1968	1977	1978	1979	1980	1981	1983	1984	1985	1986	1988	1989	1992	1995	1998
OVEN	2	3	4	7.4	7.5	13.6	13.5	11	14.3	13	9	8.8	8.8	6.9	11.8	6.6	5
BBWA	0	0	0	3	2	14	14	14.1	18.2	11.1	9.2	12	10	12	7.5	6	1
GCKI	1	1	1	2	1	5	5.9	8.8	37.5	15.1	5	4	3	5	1	0.1	1
NAWA	2.5	2.5	3.5	5.9	7	7.3	4.6	2.9	5.5	6.9	5.6	5	1	0.1	1	4.3	0
REVI	1	0.5	1	4	1	3	4.7	2	8	4.2	5.5	6	1.9	4.5	6.3	4.8	5.5
CMWA	0	0	0	0	0	0	2	0	14.8	18.8	4.5	9	6	2	3	1	0
SWTH	1	0.5	0.5	6.5	4	4.5	4	3.5	2.2	5	1	6.3	3.9	3.8	4	1.5	5
MAWA	4	4	3.5	5.8	6	8.2	10	3.6	2.4	0.8	1	0	0.6	1.8	3.3	1	0.5
BLBW	0	0	0	1	2.9	4	2	6.9	4.5	6	2	2	4	2	3	3	5
YRWA	1.5	1	0	1	2	5.8	6	3.6	10.1	2	2	3	1	1	0	0.1	0
RCKI	1	1.5	0	1.6	1.7	3.9	6	2	6	1	0.1	6	0	0	1	1	0
TEWA	0	0	0	0	0	0.1	0.1	0.1	8.5	5.2	2	7.8	2	1	0	1	0
YBFL	2	2	2	0	0	0.1	0	1	2	3	2	1	0.1	0	2	4	2
WTSP	4	4	4.5	0	0.1	0.1	0	0	1	0	0	0	0	0.1	0.5	3	1.8
RBNU	0	0	2	0	1	0	3	3	1	2	0	2	1	0	1	2	1
LEFL	3	2	2	0	4	2	1.8	1	0	0	0	0	0	0	0	1	0
AMRO	0	0.1	0.5	1	2	1	0.8	0.5	1	1	0	1	0	0.1	1.3	0.5	0.1
YBSA	1	1	1	0.1	0	1	1.8	0	1	0	0	0	0	0	0.1	0	0
BAWW	2	2	1	0.1	0.1	0.9	0.1	0	0	0	0	0	0	0	0	0	0
CSWA	1.5	1	1	0	0.1	0	0	0.9	0	0	0.1	0	0	0	0	0	0
Other	4.7	6.7	8.1	5.1	6.3	16	15.9	8.2	27.8	11.4	7.1	3.4	2.2	5	9.7	5.6	6.3
Total	32.2	32.8	35.6	44.5	48.7	90.5	96.2	73.1	165.8	106.5	56.1	77.3	45.5	45.3	56.5	46.5	34.2

Note: The 20 most common species (those ranked among the 10 most abundant species on at least three sampling dates) are presented in decreasing order of total abundance. OVEN = ovenbird; BBWA = bay-breasted warbler; GCKI = golden-crowned kinglet; NAWA = Nashville warbler; REVI = red-eyed vireo; CMWA = Cape May warbler; SWTH = Swainson's thrush; MAWA = magnolia warbler; BLBW = Blackburnian warbler; YRWA = yellow-rumped warbler; RCKI = ruby-crowned kinglet; TEWA = Tennessee warbler; YBFL = yellow-bellied flycatcher; WTSP = white-throated sparrow; RBNU = red-breasted nuthatch; LEFL = least flycatcher; AMRO = American robin; YBSA = yellow-bellied sapsucker; BAWW = black-and-white warbler; CSWA = chestnut-sided warbler.

Bay-breasted Warbler and Ovenbird. By 1983, when songbird numbers were at their peak, more than half of the BSL bird community was composed of just four species (Golden-crowned Kinglet, Cape May Warbler, Bay-breasted Warbler and Ovenbird). Golden-crowned Kinglet alone accounted for >22% of the territories on the BSL plot. Through the peak years of budworm abundance (1984-1992), populations of these four species and several others, including Tennessee and Yellow-rumped warblers, declined. By 1995-1998, White-throated Sparrows were starting to return to the plot, but not Least Flycatchers nor Chestnut-sided or Black-and-white warblers.

The timing of bird population responses to the budworm outbreak was not consistent among species (Fig. 4). Nashville and Magnolia warblers and Ovenbird all responded to increasing budworm numbers relatively early in the outbreak. However, Magnolia Warbler numbers declined again before budworm numbers peaked. Tennessee and Cape May warblers were the latest to respond, and Golden-crowned Kinglet and Yellow-rumped, Black-burnian and Bay-breasted warblers were intermediate. Golden-crowned Kinglet and Tennessee, Cape May and Yellow-rumped warbler numbers were elevated for only a relatively short period (4-5 yr), whereas Bay-breasted Warbler and Ovenbird maintained high population levels for most of the outbreak.

For many species, such as Yellow-bellied Flycatcher (*E. flaviventris*), Red-breasted Nuthatch (*Sitta canadensis*), Golden-crowned Kinglet, Ruby-crowned Kinglet, Swainson's Thrush, Tennessee Warbler, Nashville Warbler, Yellow-rumped Warbler, Ovenbird and White-

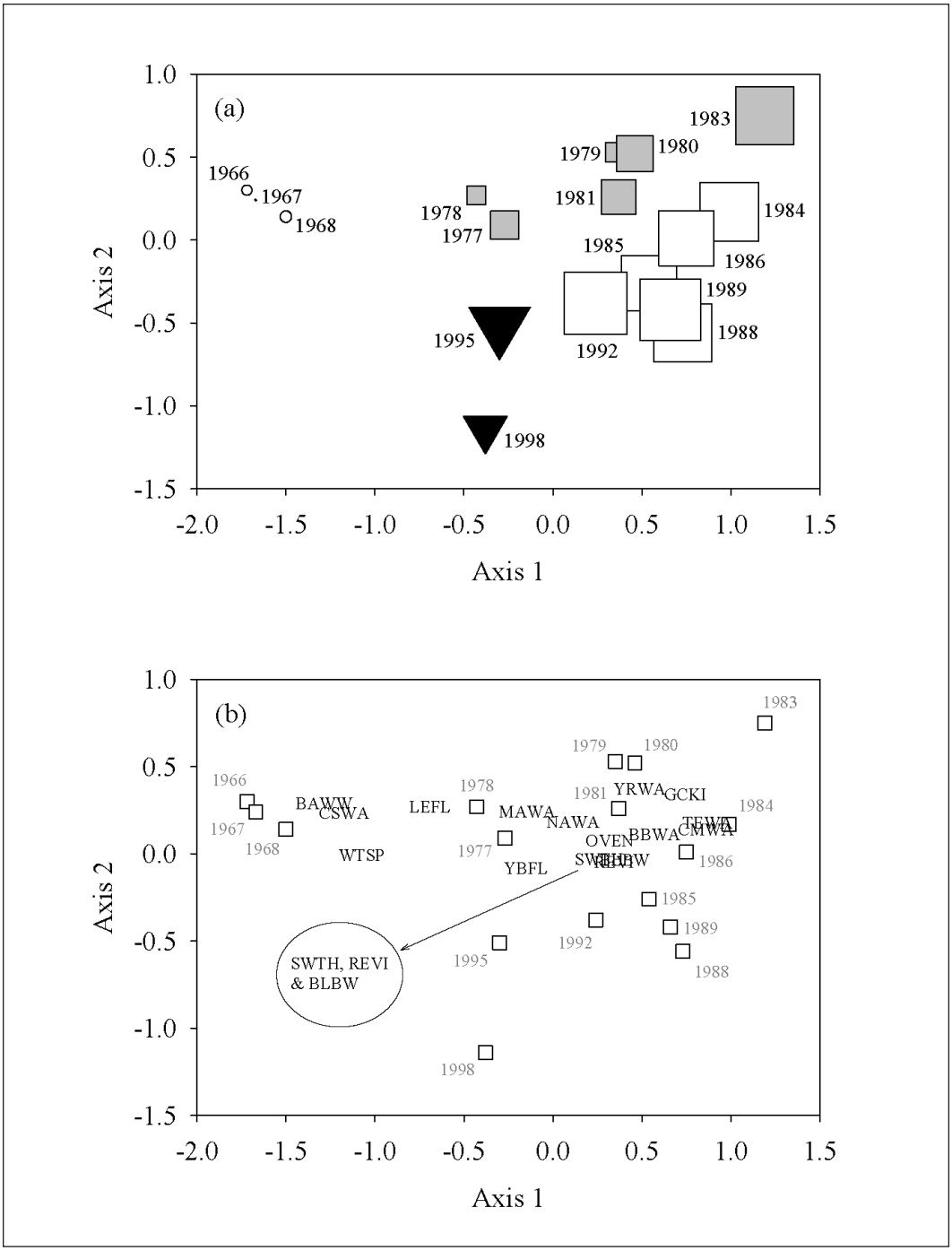

FIGURE 3. Non-metric multidimensional scaling of the Black Sturgeon Lake, ON, bird community on 17 sampling dates between 1966 and 1998: (a) Symbol sizes for sample units (years) are scaled proportionally to spruce budworm abundance, O = low budworm densities, ■ = increasing budworm densities, □ = high budworm densities, ▼ = declining budworm densities; (b) Symbols denote location of samples (in species space) only. Species scores are derived by weighted averaging of the abundances of each species in each sample unit.

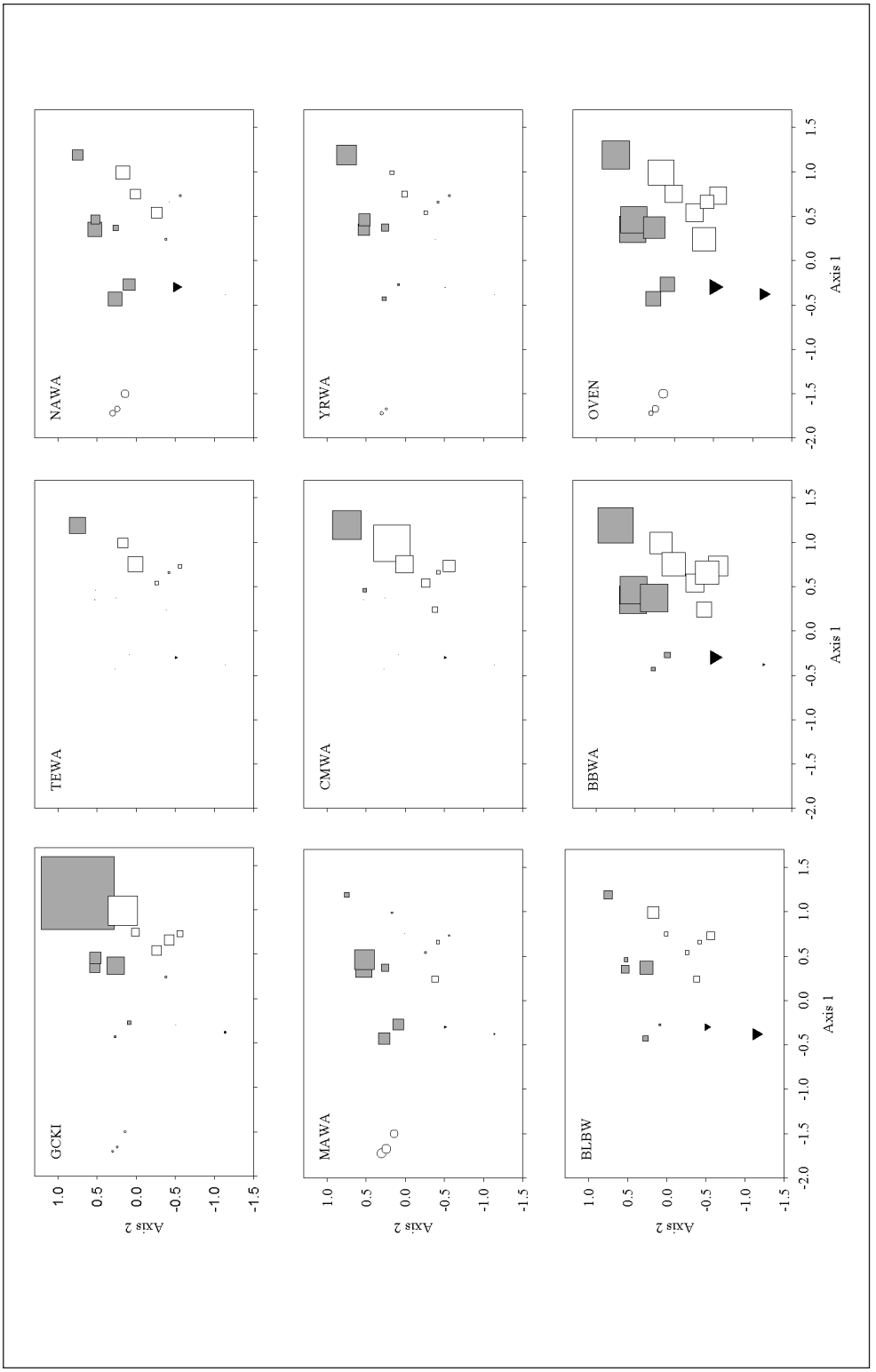

FIGURE 4. Non-metric multidimensional scaling of the Black Sturgeon Lake, ON, bird community on 17 sampling dates between 1966 and 1998. Symbol sizes are scaled proportionally to individual bird species' abundances. Species codes are the same as in Table 1, symbols the same as in Figure 3.

throated Sparrow, population trends in the BSL plot resembled regional trends (Fig. 5). For others, there were differences between local and regional trends that can be classified into two main types: 1) species that were virtually eliminated from the BSL plot, but not regionally, over time [Yellow-bellied Sapsucker (*Sphyrapicus varius*), Least Flycatcher, and Chestnut-sided and Black-and-white warblers]; and 2) species with local peaks in abundance during the increasing phase of the budworm cycle that were not seen regionally until several years later [Red-eyed Vireo, American Robin (*Turdus migratorius*) and Magnolia, Cape May, Blackburnian and Bay-breasted warblers].

DISCUSSION

Many bird species clearly responded to the budworm outbreak at Black Sturgeon Lake, but the relationship between bird and budworm numbers was not a simple one. We saw a fivefold increase in the total number of breeding pairs of forest birds in the BSL plot between 1966 and 1983. However, the peak in bird numbers occurred 7 years before the peak in budworm numbers (1983 and 1990, respectively). When budworm numbers were at their highest (>10 larvae per branch tip between 1984 and 1993), populations of many bird species were declining, suggesting that at high budworm densities the advantages of a superabundant food supply may be at least partially offset by negative changes in habitat associated with defoliation. Defoliation jumped from 15% to 49% between 1983 and 1984 and remained high through to 1993.

The reason for the population declines may be related to predation or food supply. Defoliation by gypsy moth has been shown to increase nest predation rates (Thurber et al. 1994). Defoliation may also reduce the abundance of insects other than the pest that require the foliage for food, or as a surface for mating, oviposition, foraging or perching (Pelech and Hannon 1995). Even during budworm outbreaks, the diets of most insectivorous bird species contain substantial numbers of other insects (Mitchell 1952, McMartin et al. 2002). A reduction in food later in the breeding season, when budworm are no longer readily available, could have negative consequences for the survival of recently fledged young (Martin 1987).

Although there has been much written in the scientific and popular literature about the connection between spruce budworm and forest birds, there have been relatively few actual field studies that have directly addressed this relationship. Kendeigh's (1947) work in Ontario in 1945 was the first systematic examination of the numerical and functional responses of some bird species to a budworm outbreak. The effectiveness of birds in controlling budworm populations was studied in Maine in 1949-1950 by comparing an area where much of the bird community was removed by shooting to areas that were undisturbed (Hensley and Cope 1951, Stewart and Aldrich 1951, Dowden et al. 1953). This study also included an analysis of the bird stomach contents (Mitchell 1952). The numerical response of birds to budworm was investigated by Morris et al. (1958) and Gage and Miller (1978), and the functional response by Mook (1963), as part of the New Brunswick Green River Project (1947-1968). The functional and numerical responses of birds to budworm were also investigated in Maine and New Hampshire in two experiments conducted in 1976-1977 (Crawford et al. 1983) and 1982-1983 (Crawford and Jennings 1989, Crawford et al. 1990). Finally, Zach and Falls (1975) compared observations on the feeding and breeding biology of ovenbirds during a spruce budworm outbreak in Ontario in 1973 to historical data collected during a period of low budworm abundance, and Morse (1978) examined the food supply, foraging patterns and densities of Bay-breasted Warbler and Cape May Warbler during a budworm outbreak in Maine in 1976. There are also indirect analyses of monitoring data by Patten and Burger (1998) and Bolgiano (2004).

Given the immense spatial scale and temporal variability of budworm infestations (Blais 1983, Candau et al. 1998), and the relatively few bird/budworm studies that have been conducted at widely scattered locations across the budworm's range (see above), the inconsistency in the literature regarding individual species' responses is not surprising. Nevertheless, it is generally agreed that Tennessee, Cape May and Bay-breasted warblers, the so-called 'budworm specialists' of Morse (1989), respond strongly and positively to budworm outbreaks, and our data would support this conclusion. Other species that

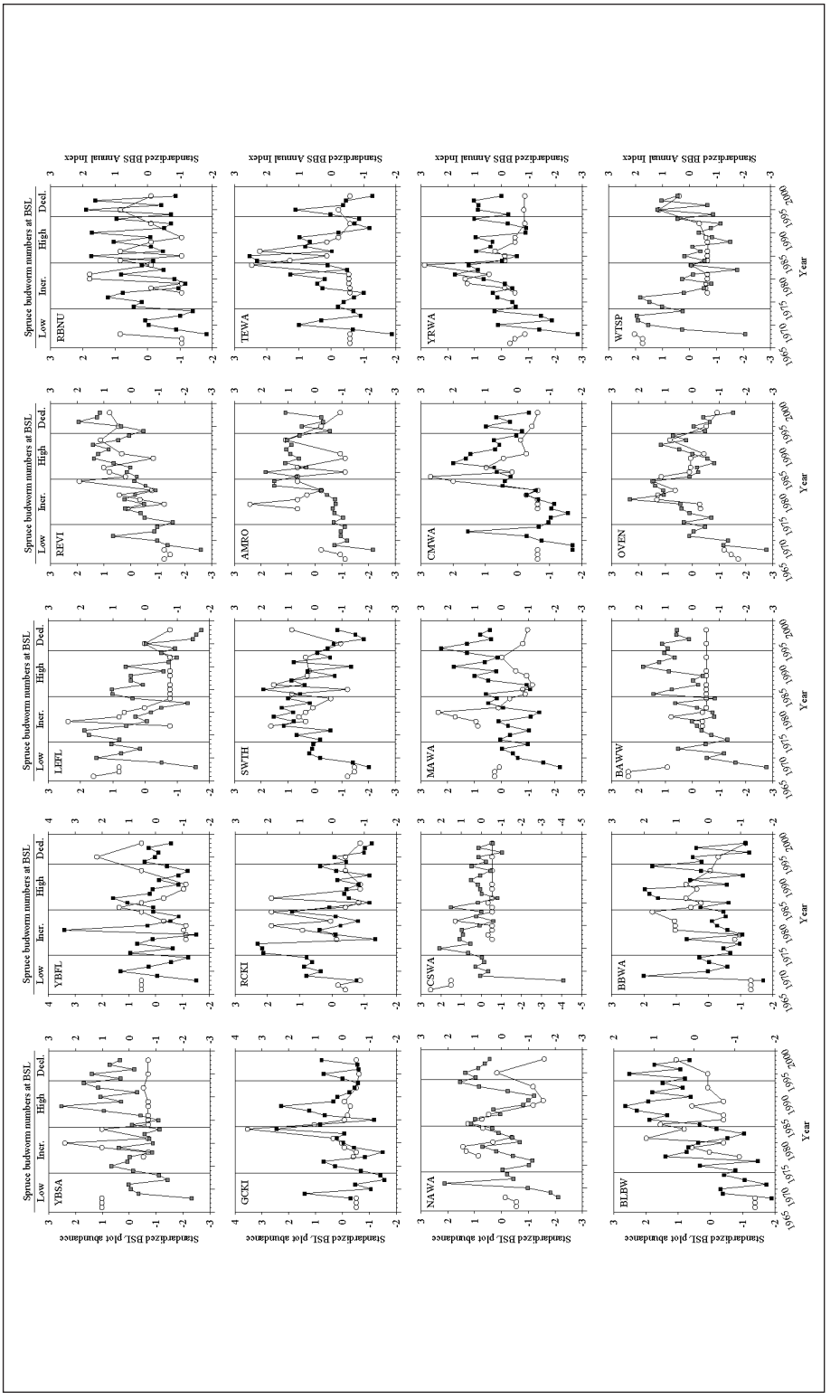

FIGURE 5. Population trends for selected bird species in the Black Sturgeon Lake, ON, study plot and the province of Ontario (1966-1998). Ontario data are from the Ontario Breeding Bird Survey (available from http://www.cws-scf.ec.gc.ca/mgbc/trends/index.cfm [accessed 15 September 2008]). Data were standardized to allow comparisons on the same scale. For BBS data, grey symbols denote species with a distribution that includes a significant portion of southern Ontario, whereas black symbols denote species that are primarily northern (the portion of the province affected by budworm). Vertical reference lines divide the plots into periods of low (1961-1973), increasing (1974-1983), high (1984-1993) and declining (1994-1997) budworm populations at Black Sturgeon Lake. Species codes are the same as in Table 1.

responded positively to budworm in our study area, and that have been shown to do the same elsewhere, include Golden-crowned Kinglet (Gage and Miller 1978, Morse 1978, Crawford and Jennings 1989), Swainson's Thrush (Hensley and Cope 1951, Morris et al. 1958, Gage and Miller 1978), Magnolia Warbler (Hensley and Cope 1951, Stewart and Aldrich 1951, Gage and Miller 1978), Yellow-rumped Warbler (Gage and Miller 1978), Blackburnian Warbler (Hensley and Cope 1951, Morris et al. 1958, Gage and Miller 1978) and Ovenbird (Kendeigh 1947, Morris et al. 1958, Zak and Falls 1975).

The three 'budworm specialists' (Tennessee Warbler, Cape May Warbler and Bay-breasted Warbler) had very different patterns of response to the budworm outbreak on the BSL study plot. None of the three was present in the 1960s when the budworm population was at an endemic (low) level. Bay-breasted Warbler responded relatively early to increasing budworm numbers (late 1970s) compared to Cape May and Tennessee warblers (1983), suggesting that the Bay-breasted Warbler may be better adapted for exploiting low budworm densities. Bay-breasted Warbler numbers also built up gradually over time, presumably as a result of increased reproductive success (MacArthur 1958), whereas Cape May and Tennessee warbler numbers peaked abruptly, possibly reflecting a redistribution of individuals across the landscape in response to local differences in budworm density (MacArthur 1958, Royama 1984), rather than increased local reproduction. Finally, declines in Cape May and Tennessee warbler numbers occurred sooner than for Bay-breasted Warbler. This disparity may be related to differences in nesting and/or foraging location. Cape May and Tennessee warbler forage primarily on the outer branches and foliage near the tops of trees, whereas Bay-breasted Warbler forages mostly at mid-level close to the trunk (MacArthur 1958, Morse 1978, Rimmer and McFarland 1998). Cape May Warbler nests are also usually located near the tops of trees, as opposed to mid- to lower level for Bay-breasted Warbler and ground level for Tennessee Warbler (Harrison 1978). Since budworm damage tends to be most severe in the upper crowns of spruce and fir trees, with top killing becoming common after a few successive years of defoliation (Prebble 1975), it is possible that degradation of habitat due to defoliation may have been an early limiting factor for Cape May and Tennessee warblers.

Cape May and Bay-breasted warblers had local peaks in abundance in 1983-1984 that preceded their regional peaks in 1987-1988. It appears that, while degradation of habitat may have limited populations of these two species at the local level, the process was operating differently at the regional scale. Spruce budworm outbreaks are not spatially homogeneous. Rather, there is considerable variation in the frequency, duration and amplitude of local and regional outbreaks (Nealis and Régnière 2004). Although there was a general increase in the severity of the budworm outbreak locally on the BSL block between 1983 and 1990, the area of moderate to severe defoliation in the Lake Nipigon zone of the budworm outbreak temporarily declined between 1986 and 1988. Thus, the life history requirements of the Cape May and the Bay-breasted warblers may have been maintained at a regional level through the mid to late 1980s, even though local populations on the BSL block were declining.

At least some of the population change we saw in Ovenbird may have been due only indirectly to budworm. In the 1960s, defoliation and tree mortality resulting from the previous budworm outbreak had created a relatively open stand with a well developed shrub layer. Through the 1970s, when Ovenbird numbers were increasing, tree basal area was higher, the canopy was closed and the shrub layer was suppressed, all parameters that have been shown to be important in determining the placement of ovenbird territories (Van Horn and Donovan 1994). This pattern was reversed in the 1990s, by which point several years of continuous defoliation had resulted in significant mortality of spruce and fir, an opening up of the canopy and a re-emergence of the shrub layer. The fact that the local Ovenbird trend very closely tracked the provincial trend also suggests that other regional factors may have had a predominant influence on the BSL population.

We saw a distinct early peak in Magnolia Warbler numbers at the BSL study site, apparently in response to a low, but increasing, budworm population in the late 1970s. During

the previous budworm outbreak at Black Sturgeon Lake, Magnolia Warbler showed a strong negative response to budworm, although this study was conducted relatively late in the outbreak, "just preceding the killing of many trees" (Kendeigh 1947). Morris et al. (1958) also suggested an inverse relationship between budworm and Magnolia Warbler. The early decrease in Magnolia Warbler numbers on the BSL plot occurred when budworm numbers were still increasing and there had yet to be any significant change in habitat due to defoliation or tree mortality. It was also coincident with a peak in Bay-breasted Warbler numbers. These observations provide some support for Kendeigh's (1947) suggestion that Magnolia Warbler numbers decrease during budworm outbreaks as a result of interspecific competition with the more aggressive Bay-breasted Warbler.

Both Magnolia and Blackburnian warbler showed distinct peaks in abundance on the BSL plot, but no such peaks were seen regionally. Unlike the "budworm specialists", neither species has a particularly high reproductive potential (average clutch size of 4 for Magnolia and Blackburnian warbler versus 5 for Tennessee, 6.5 for Cape May and 5.5 for Bay-breasted warbler; data available from http://wildspace.ec.gc.ca/ [accessed 18 June 2007]). This suggests that the local peaks in abundance on the BSL plot were more likely the result of immigration (an aggregational response), or possibly increased breeding opportunities for floaters, than the classic numerical response described by Morris et al. (1958).

We saw a strong, but relatively short-lived, response to budworm by the Yellow-rumped Warbler. In other studies, this species has been variously reported to respond positively (Hensley and Cope 1951, Gage and Miller 1978) and negatively (Kendeigh 1947, Morris et al. 1958) to budworm outbreaks. The reasons for this discrepancy are unclear, but may also be related to interspecific competition, since the sharp decline in Yellow-rumped Warbler numbers takes place at a time when other *Dendroica* species are still peaking. Like Magnolia Warbler, the Yellow-rumped has a low level of interspecific dominance (Morse 1976) and thus may have been excluded from the BSL plot by the socially dominant Bay-breasted Warbler.

Although not generally considered to be a budworm specialist, the species that showed the greatest response to budworm in our study was the Golden-crowned Kinglet. We believe the large peak in Golden-crowned Kinglet numbers in 1983 (14 times as many as in the 1970s) is a special case and can be attributed to a unique combination of factors. The Golden-crowned Kinglet is a short distance migrant/resident, with some central North American populations wintering as far north as the southern portions of Minnesota, Wisconsin, Michigan and Ontario (Ingold and Galati 1997). Populations wintering near the northern limits of the winter range may suffer high (up to 100% local) mortality during severe winters, which could affect breeding densities during the next breeding season (Ingold and Galati 1997). This susceptibility to winter mortality may explain why the Golden-crowned Kinglet has evolved a relatively high reproductive potential [frequently double brooded, average clutch size 8.6 (range 5-11) for *R. s. satrapa* (Ingold and Galati 1997)]. MacArthur (1958) suggests that a large and variable clutch size may also be beneficial in taking advantage of a periodically abundant, but unpredictable, food source like spruce budworm. Over the 20-yr period from December 1976 to February 1996, the winter preceding the peak in Golden-crowned Kinglet numbers was the warmest winter on record in southern Ontario and lower Michigan (based on mean daily temperatures and mean daily minimum temperatures for December, January and February at London, ON (data available from http://climate.weatheroffice.ec.gc.ca/ [accessed 25 June 2007]) and Lansing, MI (data available from http://www.wunderground.com/history/airport/KLAN/ [accessed 25 June 2007]) weather stations. As an example, the mean daily minimum temperature for the winter of 1982-1983 at London, ON (-5° C) was 4.1° C above the 20-yr normal. We believe that a high survival of broods during the 1982 breeding season (due to the presence of an abundant food source) combined with a low mortality during the winter of 1982-1983 (due to an unusually warm winter) resulted in an extremely high breeding density of Golden-crowned Kinglets in 1983. If such were the case, one would expect to see the same trend both regionally and locally, although not

necessarily of the same magnitude due to spatial variability in budworm densities, and indeed we did. Following two colder winters in 1983-1984 [mean daily minimum temperature at London, ON (-9.7º C) was 0.7º C below normal] and 1984-1985 [(-8.8º C) 0.3º C above normal], Golden-crowned Kinglet densities dropped to 1970s levels.

Previous studies have shown that many species of birds consume large numbers of budworm when budworm populations are high, but that this represents only a small fraction (1-7%) of the total budworm population (Kendeigh 1947, George and Mitchell 1948, Morse 1978, Crawford et al. 1983). At low budworm densities, the proportion of the budworm population consumed is much higher, however, leading several authors to suggest that birds may play a significant role in regulating budworm numbers at endemic population levels (Morris et al. 1958, Gage and Miller 1978, Crawford et al. 1983, Crawford and Jennings 1989). The avian species most effective in suppressing budworm populations during the endemic period of the budworm cycle, or during the early years of population release, should be those that respond quickly to changes in the insect's density (Crawford et al. 1983). In our study, this would include Swainson's Thrush and Nashville, Magnolia, Blackburnian and Bay-breasted warblers. There is some suggestion that birds may play a role in suppressing residual budworm populations after the major outbreak has run its course (Blais and Parks 1964, Buckner 1971). However, we found that populations of most bird species started to decline well before the collapse of the budworm outbreak, presumably in response to the deteriorating condition of the stand, which probably limited their effectiveness in suppressing the already declining budworm population.

In conclusion, for most bird species, budworm outbreaks tend to be positive events, but only during the increasing phase of the budworm cycle. When budworm numbers are high and defoliation is severe, the negative effects of habitat change tend to outweigh the advantages of a superabundant food supply. While the overall response of the bird community to increasing budworm numbers was positive, the pattern of response differed among species. Factors that appeared to influence individual species' responses to budworm included habitat, weather, competition and reproductive biology.

ACKNOWLEDGEMENTS

This paper is dedicated to the memory of our late colleagues Chris Sanders and Dan Welsh. They left us much too soon. We acknowledge the enthusiasm and dedication of the skilled volunteers and coordinators who have participated in the Breeding Bird Survey in Canada over the past 40 years.

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POWER TO DETECT DIFFERENCES AND TRENDS IN APPARENT SURVIVAL RATES[1]

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Abstract. A major goal of demographic monitoring is the detection of trends in vital rates or differences in vital rates between populations. Here we apply Cormack-Jolly-Seber models to simulated capture-recapture data to assess the statistical power to detect trends or differences in adult apparent survival rates. Simulations were based on the complete range of parameter values, from 0.1 to 0.9 for survival and from 0.05 to 0.95 for recapture probability. Sample sizes needed to detect the smallest effect size (5%) with 80% power were large, ranging from hundreds to thousands of individuals released per year, depending on the alpha-level and combination of survival and recapture probabilities. Larger effect sizes were relatively easily detected, with effect sizes of 15% and higher requiring from just a few individuals to tens of individuals released per year. Power increased with higher survival and recapture rates, with the largest gains achieved by increasing p at the low end of its range, particularly for p = 0.05 to 0.35.

Key words: Cormack-Jolly-Seber models, demographic monitoring, landbirds, power analysis, survival rate estimation.

PODER PARA DETECTAR DIFERENCIAS Y TENDENCIAS EN TASAS DE SOBREVIVENCIA APARENTE

Resumen. Una meta principal del monitoreo de poblaciones es la detección de tendencias en tasas vitales o diferencias en tasas vitales entre poblaciones. Aquí aplicamos modelos de Cormack-Jolly-Seber para simular datos de marcaje-recaptura y estimar el poder estadístico para detectar tendencias o diferencias en tasas de sobrevivencia aparente. Las simulaciones se basaron en el rango completo de valores parametrales, entre 0.1 y 0.9 para sobrevivencia y entre 0.05 y 0.95 para la probabilidad de recaptura. Los tamaños de muestra necesarios para detectar el efecto mínimo (5%) con poder del 80% fueron grandes, entre cientos y miles de individuos marcados por año, dependiendo del nivel de alfa y la combinación de probabilidades de sobrevivencia y recaptura. Efectos mayores fueron detectados con relativa facilidad, con efectos de 15% y más pudiendo ser detectados con unos pocos individuos a algunas decenas. El poder aumentó con tasas de sobrevivencia y recaptura más altas, con las mejoras más importantes obtenidas mediante el aumento de p en el extremo inferior de su rango, particularmente para p = 0.05 a 0.35.

Palabras clave: modelos Cormack-Jolly-Seber, monitoreo demográfico, aves terrestres, análisis de poder, estimación de tasas de sobrevivencia.

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INTRODUCTION

Although a focus on abundance and trends of animal populations is of fundamental interest to models of population dynamics, it is also essential to acquire information about the biological processes of survival, reproduction, and movement that are responsible for changes in abundance (Williams et al. 2002). The increasing emphasis in population dynamics models on the estimation of primary demographic parameters, and on quantifying variability in these parameters, has led to the development of various demographic monitoring efforts for birds, including the British Constant Effort Sites (CES) scheme (Peach et al. 1996) and the North American Monitoring Avian Productivity and Survivorship (MAPS) program (DeSante et al. 1995), as well as for other animals (e.g., Burnham et al. 1987). A major goal of demographic monitoring is the detection of differences in vital rates between populations or trends in vital rates over time. Achievement of this goal necessitates consideration of statistical power, or the ability to reject null hypotheses when they are false.

Among the principal vital rates addressed by demographic monitoring is the annual apparent survival rate of adult animals (hereafter "survival"). Because survival is a population parameter that often incorporates a large amount of stochasticity (accidental deaths), its underlying sample distribution tends to have high variance; indeed, the capture-mark-recapture (CMR) models used in estimating survival are often thought of as "data-hungry." It is appropriate, therefore, to inquire as to how many animals must be captured, marked, and released back into the population each sampling period in order to have sufficient power to detect differences or trends in survival. Moreover, many authors have stressed the importance of making such inquiries before implementing a demographic monitoring study, particularly one involving estimations of survival (e.g., Cohen 1988, Thomas 1997).

Pollock et al. (1990) presented comparisons of the precision of survival estimates that would be obtained for a range of population sizes, survival and recapture probabilities, and sampling events, but these cannot easily be converted to power estimates. More recently, the power of between-model likelihood ratio tests can be computed from the computer program POWER (www.mbr-pwrc.usgs.gov/software.html). This program, however, requires the user to generate data by computing expected values under the alternative model for specified sample sizes, to compute estimates under the alternative and null models, and to compute a likelihood-ratio test between models that will provide the χ^2 value and degrees of freedom needed for the power analysis.

Here we apply Cormack-Jolly-Seber models to simulated capture-mark-recapture data to assess the statistical power to detect differences in survival between populations or linear trends in survival, given 20 sampling periods (i.e., years of data for monitoring annual survival) and a range of survival rates, recapture probabilities, effect sizes, and numbers of animals released. We present results in graphical form so that the numbers of animals that must be released each sampling period for each combination of survival and recapture probabilities and effect size can easily be determined.

METHODS

We investigated the statistical power to detect (1) differences in survival between populations and (2) linear declines in survival over time for a range of survival and recapture probabilities. We considered the relatively complete range of survival probabilities (from 0.1 to 0.9 at intervals of 0.1) and recapture probabilities (from 0.05 to 0.95 at intervals of 0.15). We report results for two alpha-levels (0.10 and 0.20) reported by other studies that have evaluated power of monitoring data (e.g., Bart et al. 2004). We considered five effect sizes between 5 and 25%. For the two-population scenario (1 above), effect sizes represent differences in survival between two populations that begin with equal population sizes. For the linear decline scenario (2 above), effect sizes represent incremental proportional changes in survival that would halve the population in the same number of years as a population whose survival initially declined by that effect size and then remained constant. For example, a population with an initial survival rate of 0.50 and a decrease in survival of 5% after the initial time period (to

0.475) would halve in 28 years (i.e., year 28 was the first year for which the population size was equal to or less than 50% of its initial value). The corresponding linear "5%" decline (that would exactly halve the population in 28 years) would be a proportional annual decrease in survival of 0.00373. Our calculations assume initially stable populations (i.e., $\lambda = 1$) and constant recruitment at a level that balances losses at the start of the study. The number of years needed to halve populations under each scenario (given the assumed constant recruitment rate) and annual proportional changes used for the linear decline models are given in Table 1.

For each scenario (two populations or a single declining population) and combination of survival and recapture probabilities, we simulated capture-mark-recapture data sets of various sizes using the deterministic mode of program GENCAPH1 (www.mbr-pwrc.usgs.gov/software.html) for 20 capture periods (i.e., years for estimates of annual survival). For all sets of simulations we chose an initial sample size of 10 individual marked animals released per year. We repeated this process for a series of sample sizes ranging from 20-2000 annual releases of marked animals. We input simulated capture histories into Program MARK (White and Burnham 1999) and estimated survival with Cormack-Jolly-Seber (CJS) models representing null hypotheses (equal survival between populations or time-constant survival) and with CJS models representing "true" alternative hypotheses (Pollock et al. 1990). Power was calculated for each scenario, combination of initial survival rate and recapture probability, and sample size, by entering χ^2 values (and their associated degrees of freedom) from a likelihood-ratio test comparing null and true models into program POWER (www.mbr-pwrc.usgs.gov/software.html).

We plotted power curves (i.e., sample size vs. power) to determine numbers of individuals needed to be released annually to achieve 80% power of rejecting null hypotheses (i.e., $1 - \beta = 0.80$). Needed sample sizes were calculated using inverse prediction (i.e., we predicted the x values at $y = 0.80$) from a line connecting the two power estimates that bracketed power of 0.80. Because power curves were concave (particularly near 0.80 power), predicted needed sample sizes from straight lines are biased slightly high.

RESULTS

The numbers of individual animals needed to be released at each capture period to detect differences in survival between populations (Fig. 1) or trends in survival (Fig. 2) with 80% power are presented as a function of effect size for each combination of survival rate, recapture probability, and α-level (see Appendix). Because needed numbers range variously from <10 to >2000, we present them on a log scale (Fig. 1 and 2). The slight increase in numbers needed to detect larger linear declines (25 and 20%) for species with high survival rates (0.9 and 0.8; Fig. 2 and italicized numbers in the Appendix) was an artifact of calculating linear effect sizes from exact 50% population declines and forcing them to occur over year integers when the number of years to halve the population was small (e.g., 3 or 4 years) and the percent of the population remaining after halving was substantially <50% (Table 1).

Sample sizes needed to detect the smallest effect sizes (5%) with 80% power were large, ranging from hundreds to thousands of individuals released per year, depending on the alpha-level and combination of survival rates and recapture probabilities. Larger effect sizes were relatively easily detected, with effect sizes of 15% and higher requiring from just a few individuals to tens of individuals released per year. The ability to reject null hypotheses was strongly dependent on recapture probabilities; the biggest gains in power came from increasing p at the low end of the range, particularly $p = 0.05$-0.35. The ability to reject null hypotheses was also dependent on survival rates themselves; again, the largest increase in power arose from increased survival rates at the low end of the range, but the proportional gains in power from higher survival rates were not as great as from increased recapture probabilities. Sample sizes required to detect large effect sizes were typically smaller for the linear decline models than for the two-population comparisons, while small effect sizes were more easily detected in the two-population scenarios. Overall, from all of the values presented in the Appendix and shown in Figs. 1 and 2, the sample sizes needed to detect effect sizes with 80% power at a = 0.1 averaged 37% greater than the sample sizes needed at $\alpha = 0.2$.

TABLE 1. Summary of effect sizes for each survival rate considered in simulations.

Higher ϕ (or starting ϕ for linear decline scenarios) [a]	Effect size -- % difference in ϕ (or "% change in ϕ") [b]	Lower ϕ [c]	No. years (t) to halve population with lower ϕ	% of population remaining after t years	Prop. annual change for linear decline scenarios
0.9	5	0.855	16	48	0.00644
	10	0.810	8	47	0.02771
	15	0.765	5	48	0.07799
	20	0.720	4	45	0.13054
	25	0.675	3	47	0.26328
0.8	5	0.760	17	50	0.00642
	10	0.720	9	47	0.02442
	15	0.680	6	46	0.05911
	20	0.640	4	50	0.15007
	25	0.600	4	41	0.30614
0.7	5	0.665	20	49	0.00527
	10	0.630	10	48	0.02249
	15	0.595	7	46	0.04874
	20	0.560	5	47	0.10411
	25	0.525	4	46	0.17654
0.6	5	0.570	23	50	0.00463
	10	0.540	12	48	0.01801
	15	0.510	8	47	0.04315
	20	0.480	6	46	0.08204
	25	0.450	5	44	0.12511
0.5	5	0.475	28	49	0.00373
	10	0.450	14	49	0.01579
	15	0.425	9	50	0.04087
	20	0.400	7	48	0.07153
	25	0.375	6	45	0.10186
0.4	5	0.380	35	49	0.00297
	10	0.360	17	50	0.01332
	15	0.340	12	48	0.02803
	20	0.320	9	47	0.05274
	25	0.300	7	48	0.09344
0.3	5	0.285	46	50	0.00229
	10	0.270	23	50	0.00961
	15	0.255	16	48	0.02076
	20	0.240	12	48	0.03887
	25	0.225	9	50	0.07444
0.2	5	0.190	69	50	0.00152
	10	0.180	35	49	0.00616
	15	0.170	23	50	0.01498
	20	0.160	17	50	0.02889
	25	0.150	14	49	0.04462
0.1	5	0.005	120	50	0.00074
	10	0.090	69	50	0.00315
	15	0.085	46	50	0.00740
	20	0.080	35	49	0.01333
	25	0.075	28	49	0.02183

[a] Higher (two-population scenario) or initial (linear decline scenario) survival rate.
[b] Percent difference in survival rate (two-population scenario) or percent change in survival rate (linear decline scenario).
[c] Survival rate of the population with lower survival (two-population scenario).

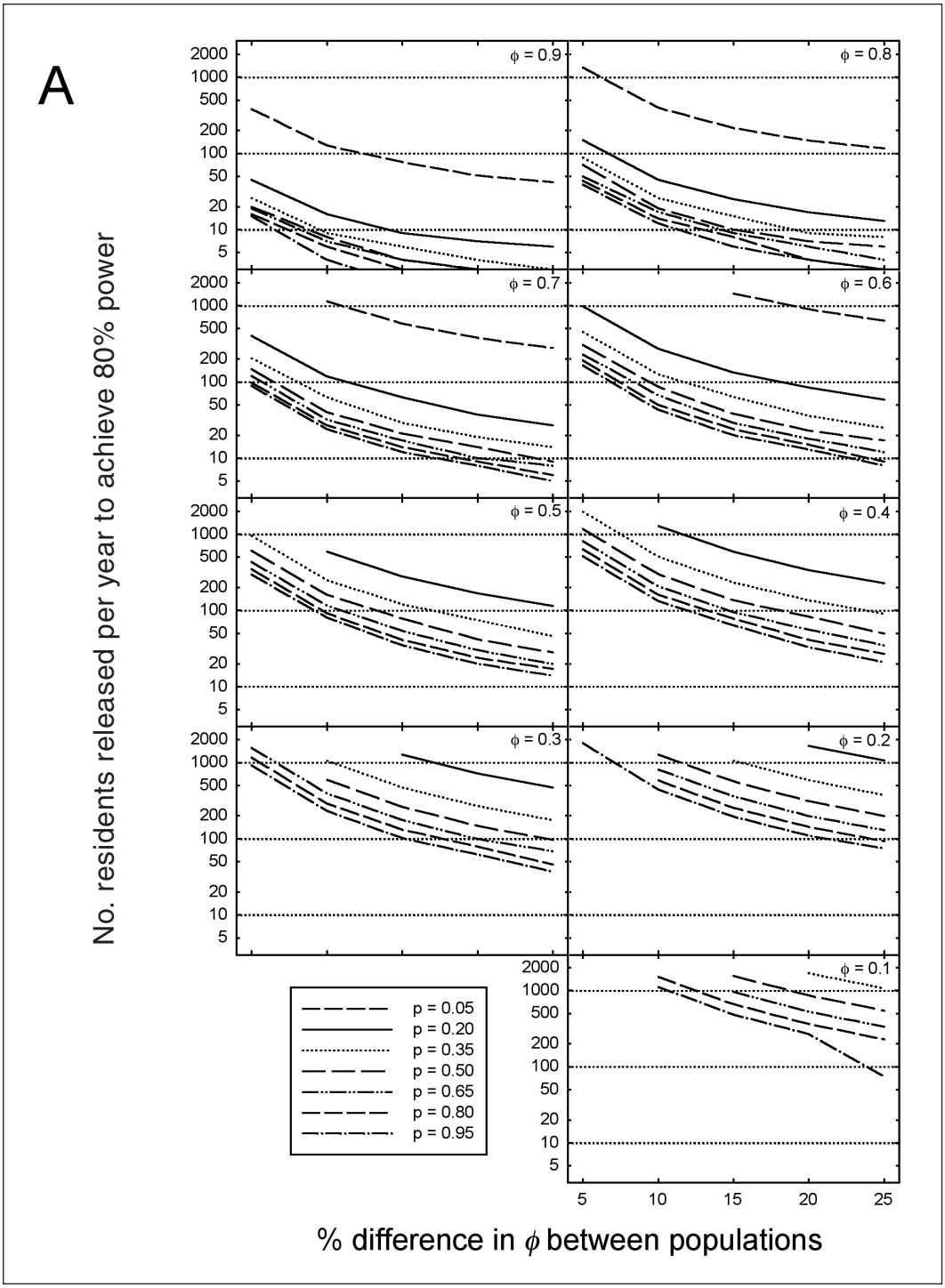

FIGURE 1. Numbers of resident adult birds needed to be released per year to achieve 80% power to detect differences in survival (ϕ) between populations for birds with annual apparent survival rates between 0.10 and 0.90 and α-levels of 0.10 (A) and 0.20 (B).

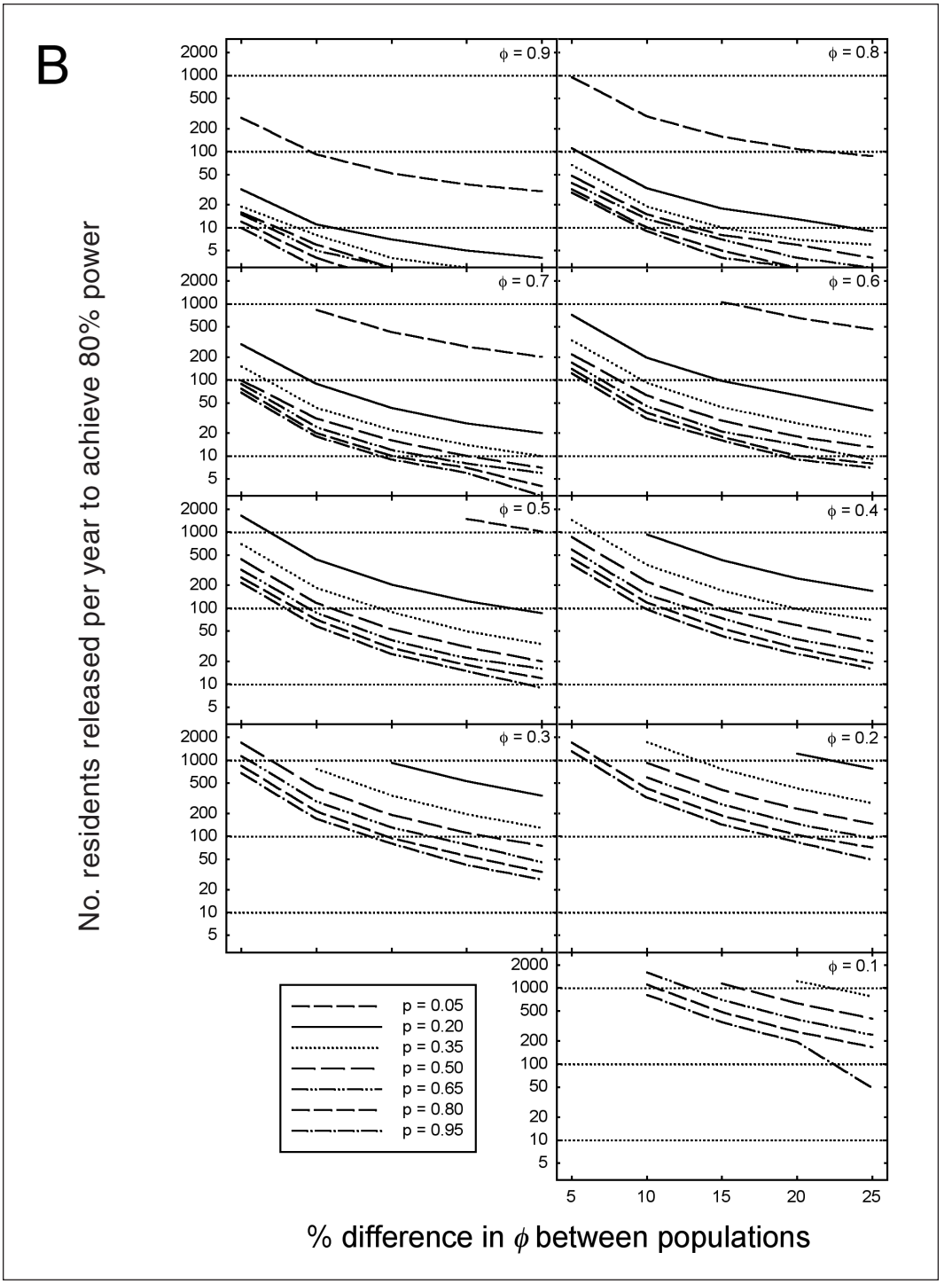

FIGURE 1. Continued.

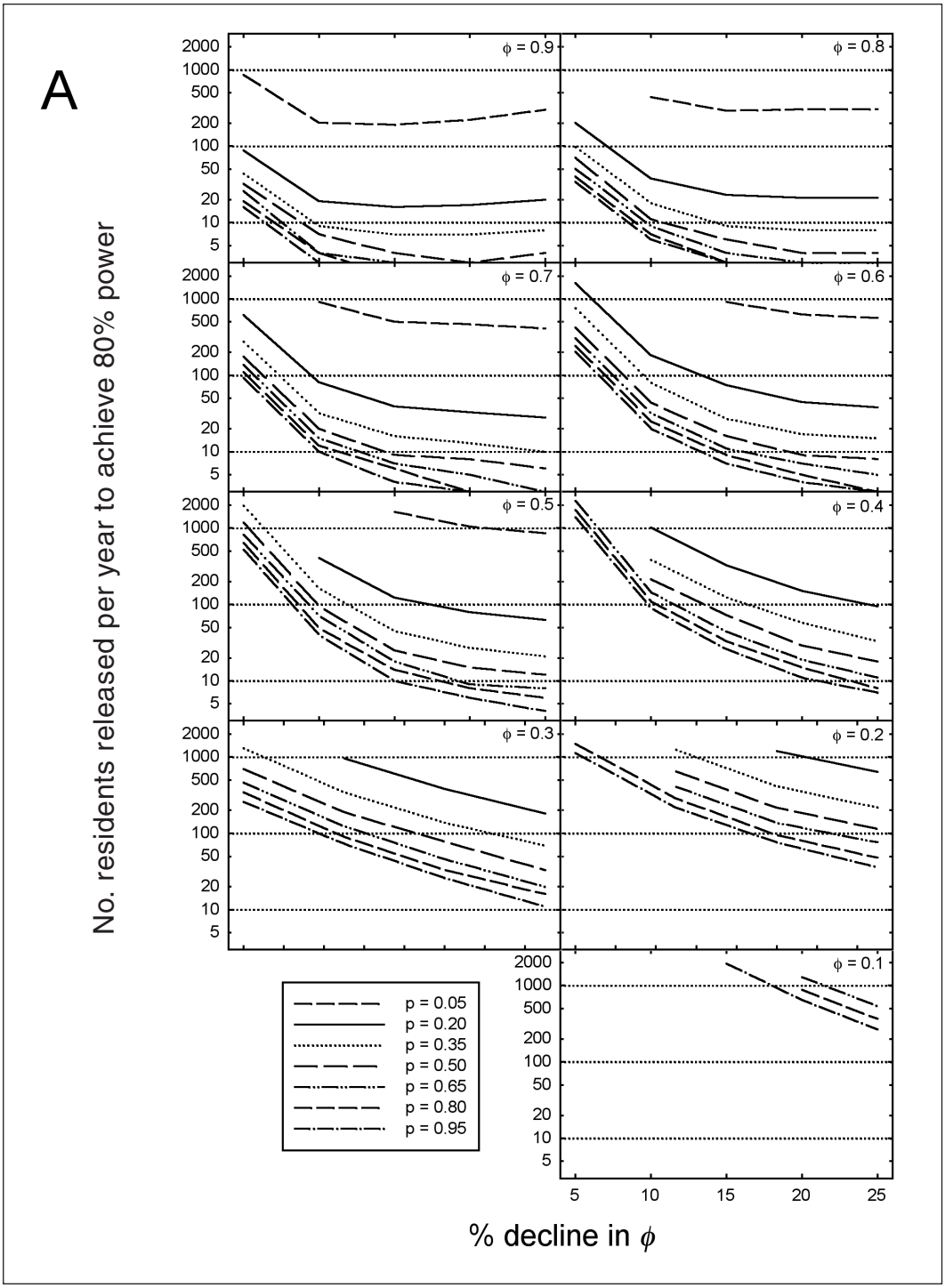

FIGURE 2. Numbers of resident adult birds needed to be released per year to achieve 80% power to detect linear declines in survival (ϕ) for birds with annual apparent survival rates between 0.10 and 0.90 and α-levels of 0.10 (A) and 0.20 (B).

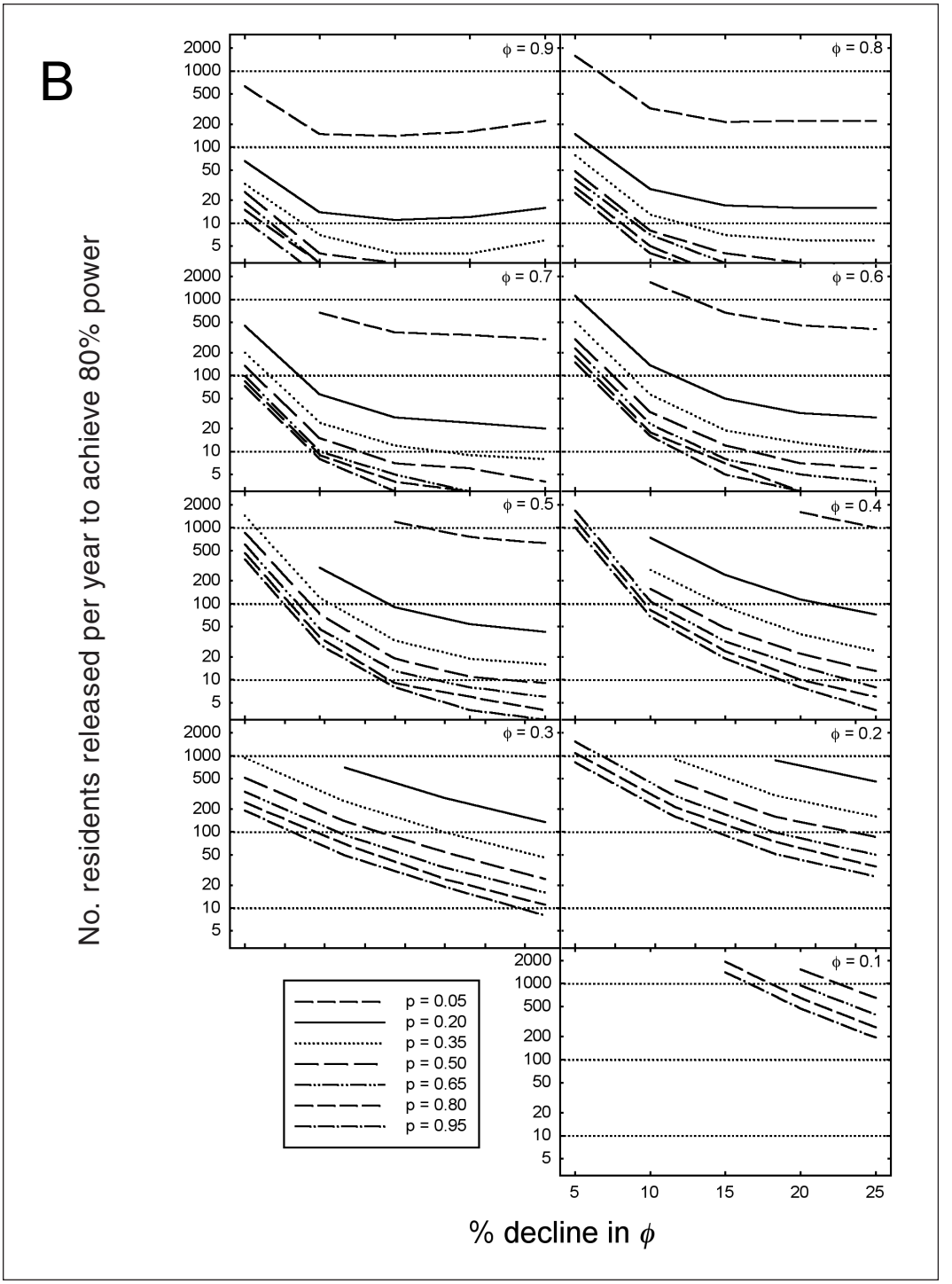

FIGURE 2. Continued.

DISCUSSION

Our power analyses demonstrate that large sample sizes are needed to detect small (5-10%) differences in survival between populations or linear declines in survival in a single population, but that larger effect sizes (15-25%) can be detected with relatively modest sample sizes. Although the larger effect sizes could halve population sizes over very short time intervals, at least for species with higher survival rates, differences of this magnitude are often observed in avian survival data. For example, the largest effect size (25%) is similar to the mean maximum difference in survival rates between MAPS regions for 89 species for which 10-yr time-constant estimates of survival were available from multiple regions (mean maximum difference = 23%; DeSante and Kaschube 2006). Indeed, analyses of MAPS data suggest that differences and declines in survival of the magnitude of differences typically seen between MAPS regions or between clusters of MAPS stations can be detected with 80% power for 84 and 105 species, respectively, at the continental scale, and for 40 and 47 species, respectively, in the Northwest region (the region with the largest number of MAPS stations; DeSante and Saracco 2009).

Adult apparent survival rates of landbirds obtained from pooling CMR data from monitoring stations operated for 6-9 d over three-month periods typically range from about 0.4 (or slightly lower for very small-bodied species such as kinglets (*Regulus* spp.) to 0.6 (or up to nearly 0.7 for jay-sized passerines; DeSante and Kaschube 2009). Clearly, differences and trends in survival are easier to detect for larger species with higher survival rates than for smaller species. For example, differences between two populations can be detected with 80% power at $\alpha = 0.2$ for a species with $\phi = 0.6$ and $p = 0.15$ (a low recapture rate) by releasing 97 birds per year. One would need to release about 429 birds per year to obtain the same result for a species with $\phi = 0.4$ and $p = 0.15$; or would need to increase p to 0.50 to get the same result by releasing 97 birds per year for a species with $\phi = 0.4$.

The largest and most efficient gains in power are provided by increases in p, especially at its lower range of values (e.g., 0.15 to 0.35). Gains provided by increasing p at its higher range of values (e.g., 0.65 to 0.95) tend to be relatively limited in extent. This suggests that intensive color-band resighting efforts, which typically produce p-values of 0.95 or greater, run simultaneously with constant-effort-type monitoring schemes, would not greatly increase power for those species, which are often ground- or shrub-inhabiting species, for which $\hat{p}$ is already often >0.5.

In nature, the population sizes of animals that must be sampled to provide 80% power to detect differences and trends in survival are likely to be somewhat greater than indicated here for several reasons. First, transient individuals of the species targeted occur on most areas where animals are sampled. These individuals, which in landbirds can be floaters that have not yet acquired a breeding territory or mate, failed breeders searching for new territories or mates, or post-breeding individuals dispersing to molting or pre-migration staging areas, have essentially zero probability of still being present in the next sampling period and thus have an expected $\phi = 0.0$. Thus, they cannot be counted in the number of "resident" animals needed to detect differences or trends in survival. CMR models are available that can correct for the existence of these transients (Pradel et al. 1997, Nott and DeSante 2002, Hines et al. 2003). Additional sources of heterogeneity deriving from spatial and temporal variation in survival and recapture probability (e.g., due to environmental variation, age/sex, or other behavioral effects) could further lower precision of parameter estimates and result in the need for larger samples than those reported here. Nevertheless, given the difficulty of incorporating all such sources of variation in the planning stages of a study, we feel that the guidelines presented here provide a reasonable starting point for designing capture-recapture studies and for evaluating the likely efficacy of existing studies for detecting effect sizes that are meaningful for a particular population.

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APPENDIX. Sample sizes (numbers of marked animals released per year) needed to detect effect sizes from 5-25% for varying apparent survival rates (ϕ) and recapture probabilities (p). Data are presented graphically in Figures 1 and 2. Sample sizes >2000 are indicated with "—".

	% difference in ϕ between populations										% decline in ϕ									
	$\alpha = 0.10$					$\alpha = 0.20$					$\alpha = 0.10$					$\alpha = 0.20$				
	5%	10%	15%	20%	25%	5%	10%	15%	20%	25%	5%	10%	15%	20%	25%	5%	10%	15%	20%	25%
$\phi = 0.90$																				
p=0.05	381	127	77	51	42	279	92	52	37	30	857	203	191	*221*	*300*	627	148	140	*161*	*221*
p=0.20	45	16	9	7	6	32	11	7	5	4	88	19	16	*17*	*20*	66	14	11	*12*	*16*
p=0.35	26	9	6	4	3	19	8	4	3	2	44	9	7	7	*8*	33	7	4	4	*6*
p=0.50	20	8	4	3	3	16	6	3	2	2	32	7	4	3	*4*	26	4	3	3	3
p=0.65	19	7	4	3	2	15	5	3	2	2	26	4	3	2	2	19	3	2	2	2
p=0.80	16	6	3	2	2	12	4	2	2	2	19	4	2	2	2	15	3	2	2	2
p=0.95	15	4	2	2	2	10	3	2	2	2	16	3	2	2	2	11	2	2	2	2
$\phi = 0.80$																				
p=0.05	1338	396	215	147	116	953	290	157	108	87	—	442	291	*303*	*303*	1599	323	213	*222*	*222*
p=0.20	150	45	25	17	13	111	33	18	13	9	202	38	23	21	*21*	149	28	17	16	16
p=0.35	88	26	15	9	8	67	19	10	7	6	98	18	9	8	8	78	13	7	6	6
p=0.50	71	19	10	7	6	48	15	8	6	4	71	11	6	4	4	48	8	4	3	3
p=0.65	50	17	9	6	4	39	13	7	4	3	51	9	4	3	3	38	7	3	2	2
p=0.80	44	14	8	4	3	32	10	5	3	2	40	7	3	2	2	30	5	2	2	2
p=0.95	39	12	6	4	3	29	9	4	3	2	34	6	3	2	2	25	4	2	2	2
$\phi = 0.70$																				
p=0.05	—	1142	583	378	278	—	828	425	275	201	—	912	503	464	412	—	665	367	338	300
p=0.20	406	119	63	37	27	296	89	43	27	20	620	81	39	33	28	451	57	28	24	20
p=0.35	205	63	29	19	14	151	43	22	14	10	278	32	16	13	10	200	24	12	9	8
p=0.50	147	40	21	14	9	99	31	16	10	7	176	20	9	8	6	134	15	7	6	4
p=0.65	120	32	17	10	8	89	24	12	8	6	137	15	7	5	3	99	10	5	3	3
p=0.80	98	27	14	9	6	77	20	10	7	4	110	12	6	3	2	84	9	4	3	2
p=0.95	89	24	12	8	5	68	18	9	6	3	93	10	4	3	2	72	8	3	2	2

APPENDIX. Continued.

	% difference in ϕ between populations										% decline in ϕ									
	α = 0.10					α = 0.20					α = 0.10					α = 0.20				
	5%	10%	15%	20%	25%	5%	10%	15%	20%	25%	5%	10%	15%	20%	25%	5%	10%	15%	20%	25%
ϕ = 0.60																				
p=0.05	—	—	1454	900	636	—	—	1058	657	463	—	—	912	627	560	—	1676	666	455	406
p=0.20	989	271	134	85	59	718	197	97	63	40	1623	184	75	45	38	1124	135	50	32	28
p=0.35	452	126	64	36	25	332	92	44	27	18	755	80	27	17	15	505	56	19	13	10
p=0.50	308	86	38	23	17	218	62	29	18	13	422	44	16	9	8	301	33	12	7	6
p=0.65	230	67	29	18	12	169	45	21	14	9	308	32	11	7	5	226	23	8	5	4
p=0.80	191	50	24	15	9	140	37	18	10	8	245	25	9	5	3	180	18	7	3	3
p=0.95	166	43	20	13	8	122	31	16	9	7	203	20	7	4	3	149	16	5	3	1
ϕ = 0.50																				
p=0.05	—	—	—	—	1389	—	—	—	1492	1014	—	—	1638	1038	857	—	—	1192	755	625
p=0.20	—	593	280	168	115	1641	434	205	124	86	—	408	122	79	63	—	298	90	54	43
p=0.35	953	250	121	75	46	699	185	89	50	34	1978	162	45	27	21	1441	120	33	19	16
p=0.50	610	161	78	42	28	441	117	53	31	20	1182	95	25	15	12	862	73	19	11	9
p=0.65	433	116	54	30	20	320	87	38	22	16	823	71	18	9	8	603	47	13	8	6
p=0.80	348	92	41	24	17	254	71	30	18	12	642	49	14	8	6	465	36	9	6	4
p=0.95	295	81	35	20	14	216	58	25	15	9	525	40	10	6	4	381	29	8	4	3
ϕ = 0.40																				
p=0.05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1375	—	—	—	1594	999
p=0.20	—	1282	589	340	228	—	934	429	247	168	—	1020	327	151	94	—	738	239	113	73
p=0.35	1976	509	234	136	91	1442	371	171	98	70	—	384	124	58	33	—	280	91	40	24
p=0.50	1179	299	136	83	50	863	223	98	60	37	—	214	73	29	18	—	157	48	22	13
p=0.65	816	208	95	56	35	594	151	74	39	26	2292	145	44	19	11	1673	107	32	15	8
p=0.80	633	161	78	41	27	458	119	54	30	19	1726	110	33	15	8	1259	83	24	10	6
p=0.95	517	133	64	33	21	378	96	43	25	16	1382	89	26	11	7	1008	68	19	8	4

APPENDIX. Continued.

	% difference in ϕ between populations										% decline in ϕ									
	$\alpha = 0.10$					$\alpha = 0.20$					$\alpha = 0.10$					$\alpha = 0.20$				
	5%	10%	15%	20%	25%	5%	10%	15%	20%	25%	5%	10%	15%	20%	25%	5%	10%	15%	20%	25%
$\phi = 0.30$																				
p=0.05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1985
p=0.20	—	—	1274	721	469	—	—	922	528	343	—	—	966	385	183	—	—	702	281	135
p=0.35	—	1059	473	270	176	—	770	344	196	129	—	1302	346	138	69	—	944	252	99	46
p=0.50	—	591	263	147	96	1716	431	190	111	75	—	703	188	78	33	—	516	138	54	24
p=0.65	1570	392	177	99	69	1144	287	131	78	46	—	460	124	46	20	—	336	91	34	16
p=0.80	1164	290	132	79	46	849	213	95	55	34	—	344	90	33	16	—	244	69	24	11
p=0.95	926	232	102	62	37	676	170	80	42	27	—	260	73	26	11	—	190	49	19	8
$\phi = 0.20$																				
p=0.05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
p=0.20	—	—	—	1668	1069	—	—	—	1215	775	—	—	—	1194	633	—	—	—	871	460
p=0.35	—	—	1060	590	376	—	1736	767	430	274	—	—	1243	414	218	—	—	903	301	159
p=0.50	—	1277	565	312	199	—	926	406	229	146	—	—	650	216	114	—	—	471	157	86
p=0.65	—	815	359	199	130	—	593	262	146	94	—	—	408	137	76	—	1536	297	98	50
p=0.80	—	583	255	143	93	1714	424	187	104	71	—	1489	287	95	48	—	1087	210	74	35
p=0.95	1800	444	195	110	75	1316	324	143	84	49	—	1128	217	76	36	—	818	158	51	26
$\phi = 0.10$																				
p=0.05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
p=0.20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
p=0.35	—	—	—	1694	1069	—	—	—	1235	776	—	—	—	—	1745	—	—	—	—	1274
p=0.50	—	—	1564	862	544	—	—	1138	630	395	—	—	—	—	881	—	—	—	1544	643
p=0.65	—	—	961	531	333	—	1603	699	386	242	—	—	—	1299	539	—	—	—	943	391
p=0.80	—	1517	661	363	229	—	1106	480	265	167	—	—	—	882	365	—	—	1937	644	266
p=0.95	—	1120	485	268	75	—	812	353	195	49	—	—	1947	647	267	—	—	1418	470	194

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POWER OF THE MAPS PROGRAM TO DETECT DIFFERENCES AND TRENDS IN SURVIVAL AND A VISION FOR PROGRAM EXPANSION[1]

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Abstract. A major goal of the Monitoring Avian Productivity and Survivorship (MAPS) program is to provide information on spatial and temporal variation in vital rates of North American landbirds. Here we identify landbird species for which the MAPS program could likely detect differences or trends in adult apparent survival rates with 80% statistical power ($\alpha = 0.10$ or 0.20) and 20 years of data based on MAPS survival-rate and recapture probability estimates, sample sizes typical of the current (2001) MAPS program, and results of power analyses applied to simulated capture-recapture data. We summarize numbers of species for which the MAPS program could likely detect differences or trends in survival at continental, MAPS-regional, and "cluster" (six-station) scales. We suggest that differences or trends in survival of ≤ 25% would be detectable ($1 - \beta = 0.80$ and $\alpha = 0.20$) for 105 species at the continental scale, and for 19 (Alaska/Boreal Canada Region) to 47 species (Northwest Region) at the MAPS-regional scale. A cluster-scale analysis of MAPS stations on Pacific Northwest national forests suggested that at least 15 species could be effectively monitored at that scale. We estimate that, through targeted enhancement and expansion of the MAPS program (increasing its size by 69%), an additional 41 species could be adequately monitored at the continental scale, and 16 (Northwest Region) to 27 (South-central Region) additional species could be adequately monitored at MAPS-regional scales. We provide lists of species that MAPS currently monitors (and could potentially monitor) effectively at those two spatial scales, show that coverage is widespread for most major non-grassland habitat types, and suggest that coverage of chaparral/sagebrush shrubsteppe, boreal conifer, and boreal hardwood habitats could be improved through targeted enhancement of MAPS.

Key words: Cormack-Jolly-Seber models, demographic monitoring, landbirds, MAPS program, power analysis, survival rate estimation, trends.

PODER DEL PROGRAMA MAPS PARA DETECTAR DIFERENCIAS Y TENDENCIAS EN SOBREVIVENCIA Y UNA VISION PARA LA EXPANSION DEL PROGRAMA

Resumen. Una meta principal del programa MAPS es aportar información sobre variación espacial y temporal en tasas vitales en aves terrestres de Norteamérica. Aquí identificamos especies de aves terrestres para las que el programa MAPS podría detectar diferencias o tendencias en tasas de sobrevivencia aparente de adultos con un poder estadístico del 80% ($\alpha = 0.10$ ó 0.20) y 20 años de datos basados en las estimas de tasa de sobrevivencia y probabilidad de recaptura de MAPS, y resultados del análisis de poder aplicado a datos simulados de captura-recaptura. Resumimos las especies

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para las que el programa MAPS podría detectar diferencias o tendencias en sobrevivencia a escalas continentales, regiones MAPS, y "racimos" de seis estaciones. Sugerimos que las diferencias o tendencias de sobrevivencia de ≤ 25% serían detectables (1 - β = 0.80 y α = 0.20) para 105 especies a escala continental, y para 19 (Región Alaska/Canadá Boreal) a 47 especies (Región Noroeste) a la escala de las regiones MAPS. Un análisis a la escala de racimos en los bosques nacionales del Noroeste Pacífico sugiere que al menos 15 especies podrían ser monitoreadas a esa escala. Estimamos que, mediante el aumento selectivo y expansión del programa MAPS (aumentando su tamaño un 69%), 41 especies adicionales podrían ser adecuadamente monitoreadas a la escala continental, y 16 (Región Noroeste) a 27 (Región Centro-sur) especies adicionales podrían ser monitoreadas a escala de las regiones MAPS. Aportamos listas de especies que el programa MAPS monitorea efectivamente en la actualidad a esas dos escalas, mostramos que la cobertura es amplia para la mayoría de hábitats no relacionados con praderas, y mostramos que la cobertura de los hábitats estepa arbustiva/chaparral, conífera boreal y latifoliadas boreales podrían ser mejoradas mediante aumentos selectivos de MAPS.

Palabras clave: modelos Cormack-Jolly-Seber, monitoreo demográfico, aves terrestres, programa MAPS, análisis de poder, estimación de tasas de sobrevivencia, tendencias.

INTRODUCTION

The Monitoring Avian Productivity and Survivorship (MAPS) program was established in 1989 to monitor primary demographic parameters (vital rates) of landbirds in North America (DeSante 1992), to use those data to identify the proximate demographic cause(s) of population declines (DeSante et al. 2001, Saracco et al. 2008), and to formulate and evaluate management actions and conservation strategies to reverse those declines (DeSante and Rosenberg 1998, DeSante et al. 2005). The MAPS program consists of a cooperative continental-scale network of mist-netting and bird-banding stations operated each summer. The highest densities of stations occur towards the coasts (where human population densities are greater) and within the lower 48 U.S. states (Fig. 1). Many MAPS stations (227 or about 25% of all stations that have ever registered with the program) are long-running stations, having operated for ≥ 10 years. MAPS uses a standardized "constant-effort" protocol to provide estimates or indices of a broad suite of population parameters (Saracco et al. 2008, DeSante and Kaschube 2009). MAPS complements efforts that focus on abundance and trend estimation (e.g., the North American Breeding Bird Survey [BBS]), and could fill an important niche in the developing North American Coordinated Bird Monitoring (CBM) program (Coordinated Bird Monitoring Working Group 2004, Bart 2005, Bart and Ralph 2005).

Among the principal metrics monitored by MAPS is the annual apparent survival rate of adult birds (hereafter "survival"). Survival can be estimated at spatial scales ranging from single banding stations (occasionally), through local clusters of banding stations, to regional and continent-wide scales (Rosenberg et al. 1999, 2000). Here we identify species for which the MAPS program could likely detect trends or differences in adult apparent survival rates with 80% statistical power (α = 0.10 or 0.20) and 20 years of data based on MAPS survival-rate and recapture probability estimates, sample sizes typical of the current (2001) program, and results of power analyses applied to simulated capture-recapture data (DeSante et al. 2009a). We summarize numbers of species for which the program could likely detect differences or trends in survival at continental, MAPS-regional (DeSante et al. 1993), and "cluster" (six-station) scales. We list species that are "adequately" monitored across a range of effect sizes at continental and MAPS-regional scales. In addition to assessing the current program, we suggest a strategy for expanding MAPS, so that it can contribute optimally to a continental-scale CBM effort. We report improvements in the ability to detect smaller effect sizes under such expansion, as well as a list of additional species that could be monitored with MAPS methodology.

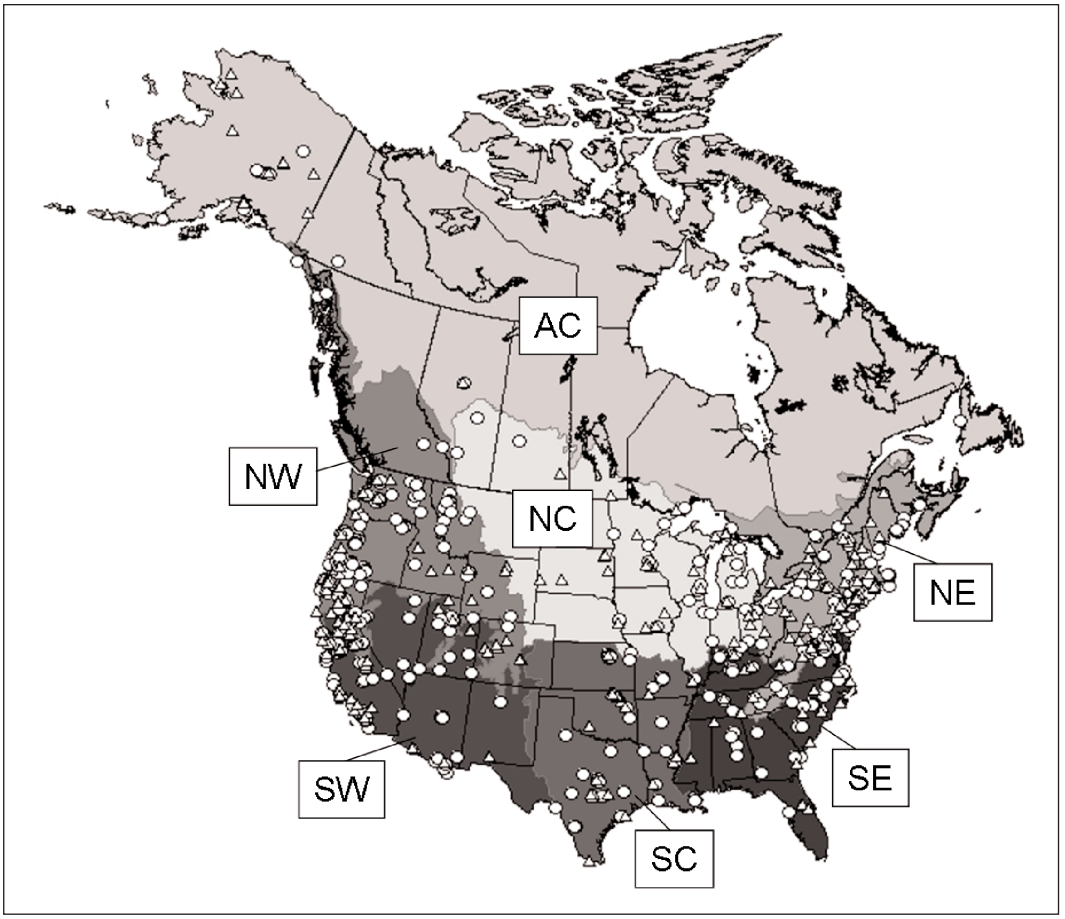

FIGURE 1. MAPS stations (through 2001) and regions: AC = Alaska/Boreal Canada (considered as two regions by DeSante 1992), NW = Northwest, NC = North-central, NE = Northeast, SW = Southwest, SC = South-central, and SE = Southeast. Stations still operating in 2001 are indicated by open circles; those established and operated, but that stopped prior to 2001, are indicated by open triangles.

METHODS

The MAPS program is a cooperative network of constant-effort mist-netting stations operated during the breeding season (May to August) across the United States and southern Canada. DeSante and Kaschube (2009) provide an overview of the design and operation of the program; detailed protocols for establishing and operating MAPS stations are provided in DeSante et al. (2009b) and can be found at 2009 MAPS Manual. Over 1,000 MAPS stations have been operated for at least one year since the program's inception in 1989 and over 450 stations were operated annually during the latter part of the 10-yr period (1992-2001) used in the analyses presented here. Stations were established in 20-ha study areas where long-term mist netting was permissible and practical. In general, the locations of MAPS stations were chosen by station operators (often according to a hypothesis-driven strategy) and not by a probabilistic sampling design, although elements of a random sampling strategy were sometimes employed.

We assessed the ability of MAPS to detect with 80% power (i.e., $1 - \beta = 0.80$) (1) differences in survival between two populations and (2) trends in survival for a single population. We report results for two alpha-levels (0.10 and 0.20) reported by other studies that have evaluated

power of monitoring data (e.g., Bart et al. 2004). We considered five effect sizes ranging from 5 to 25%. For the two-population scenario (1 above), effect sizes represent differences in survival between two populations that begin with equal population sizes. For the linear decline scenario (2 above), effect sizes represent incremental proportional changes in survival that would halve the population in the same number of years as a population whose survival initially declined by that effect size and then remained constant. Our calculations assume initially stable populations (i.e., $\lambda = 1$) and constant recruitment at a level that balances losses at the start of the study. Although the larger effect sizes considered here could (potentially) halve populations over short time intervals (see DeSante et al. 2009a), differences in survival rates of this magnitude are typically observed in MAPS data. For example, the largest effect size (25%) is similar to the mean maximum difference in survival rates between MAPS regions for 89 species for which we were able to obtain 10-yr time-constant estimates of survival in multiple regions (mean maximum difference = 23%; DeSante and Kaschube 2006).

We assessed whether a species was captured in sufficient numbers to reject null hypotheses (no difference between populations or no change in a population) at program-wide (i.e., continental) and MAPS-regional scales (see Fig. 1 for regional boundaries) based on (1) their current sample sizes (see below for detail), (2) the magnitude of their 10-yr "time-constant" adult apparent survival and recapture probability estimates, and (3) the predicted sample sizes needed to reject hypotheses from analyses of 20 yr of data simulated from populations with similar survival and recapture probability estimates (see DeSante et al. 2009a for more detail). We simulated capture-mark-recapture data sets of various sizes using the deterministic mode of program GENCAPH1 (www.mbr-pwrc.usgs.gov/software.html) for 20 capture periods (i.e., years for estimates of annual survival). For all sets of simulations we chose an initial sample size of 10 individual marked animals released per year. We repeated this process for a series of sample sizes ranging from 20-2000 annual releases of marked animals. We input simulated capture histories into Program MARK (White and Burnham 1999) and estimated survival with Cormack-Jolly-Seber (CJS) models.

Each species was binned according to its survival and recapture probability estimate at each spatial scale (see Table 1 for bin ranges and for the number of species in each bin at the continent-wide scale). We then determined, for each species, whether current sample sizes were ≥ the number of individuals needed to detect a given effect size as based on simulation results using the survival and recapture probabilities for the bin in which the species was placed.

We also estimated the numbers of species that MAPS samples in sufficient numbers to detect differences in survival among "clusters" of six stations on six national forests in Oregon and

TABLE 1. Combinations of apparent survival and recapture probabilities within which bird species were binned according to 10-yr time-constant parameter estimates from the MAPS program. Here we indicate numbers of species that fell within each of these bins at the program-wide (continental) scale.

	Recapture (p)						
Survival (ϕ)	0.05 (0.000-0.125)	0.20 (0.125-0.275)	0.35 (0.275-0.425)	0.50 (0.425-0.575)	0.65 (0.575-0.725)	0.80 (0.725-0.875)	Total
0.20 (0.15-0.25)	1	2	1	1	0	0	5
0.30 (0.25-0.35)	1	6	3	1	1	2	14
0.40 (0.35-0.45)	4	14	5	13	2	1	39
0.50 (0.45-0.55)	3	12	37	19	7	1	79
0.60 (0.55-0.65)	7	7	9	3	1	0	27
0.70 (0.65-0.75)	4	5	4	0	0	0	13
0.80 (0.75-0.85)	0	1	1	0	0	0	2
Total	20	47	60	37	11	4	179

Washington. MAPS stations are often set up in this manner (clusters of six) on particular landholdings (e.g., a national park, national forest, or military installation) for logistical reasons, as a team of two banders can operate six stations in each 10-d period, even accounting for 2-3 days of rain.

Current sample size at each spatial scale (for each species) was determined by estimating the number of marked resident birds of each species released per year under a stable MAPS program at its current (2001) level of effort. To obtain these estimates, we first estimated the proportions of resident birds among newly-banded adult birds of unknown residency status (i.e., birds caught once in the season in which they were banded or birds caught more than once but not ≥7 d after banding) in the 10-yr (1992-2001) data set using time-constant *ad hoc* Robust Design models (Nott and DeSante 2002, Hines et al. 2003). We multiplied these proportions by the numbers of unknown-status birds in the data set and then added to these the numbers of known residents (i.e., birds recaptured ≥7 d after banding in their initial year of capture). Although these totals could simply be divided by 10 (for the 10 years in the data set) to obtain estimates of the mean numbers of birds released annually by MAPS, such estimates would underestimate current MAPS sample sizes because the program grew rapidly during 1992-1997 (from 179 to 459 stations). MAPS remained relatively constant in size from 1997 through 2001 (with an annual mean of about 478 stations), and we multiplied our estimated total numbers of resident birds by an inflation factor to reflect this stable MAPS program prior to obtaining per-year averages.

We determined inflation factors for each region and at the continental scale through a two-step process. First we calculated the proportion of stations that were usable for survival analyses (i.e., that were operated for four consecutive years) for each of the ten years 1992-2001. These proportions increased during the first three years 1992-1994 (because all stations that stopped operating during those years could not be included in survival analyses), stayed constant during the middle years 1995-1998 (at the stable proportion of stations that operated for at least four consecutive years), and decreased during the final three years 1999-2001 (because all stations that started operating during any of those three years could not be included in survival analyses). We then multiplied the number of stations operated in each of the final three years of the 10-yr time period (1999-2001) by the mean proportion of stations usable for survival analyses during the middle years (1995-1998) to estimate the number of stations that would be usable for survival analyses during each of those final three years in an on-going MAPS program.

In the second step in our inflation factor calculations, we summed the number of stations usable for survival analyses during the stable latter half of the 10-yr period (i.e., the actual numbers of usable stations during 1997 and 1998 plus the estimated numbers of usable stations during 1999, 2000, and 2001), and multiplied this sum by 2 to estimate the number of station-years useable for survival analyses over any 10-yr period of the current-sized MAPS Program. Finally, we divided this number by the actual number of station-years useable for survival analyses during 1992-2001 to provide the appropriate inflation factor. The continental-scale inflation factor was 1.30, while regional inflation factors ranged from 1.13 for Alaska/Boreal Canada to 1.67 for the Southwest (regional mean = 1.30).

Finally, we classified each species "adequately" monitored in each MAPS region into one or more of 14 major landbird habitat types found across North America, north of Mexico (Table 2). We excluded grassland and tundra habitats because MAPS field protocol (operation of about 10 fixed-location mist nets) does not effectively sample the landbirds of those habitats.

EVALUATION OF AN EXPANDED MAPS PROGRAM

The Northwest Region currently hosts the largest number of MAPS stations, with 128 stations operated annually with data usable for survival analyses (i.e., stations operated for ≥4 yr). The Southeast, Southwest, and Northeast regions each host about half the number of stations as the Northwest (70, 66, and 65, respectively). We suggest that 20 additional stations could be established and maintained in the Northwest Region, and that the number of stations in the Southwest, Southeast, and

TABLE 2. Major landbird habitat types used in this study.

Habitat type (code)	MAPS Regions	Description
Scrub/successional/ disturbed (SSD)	NW, SW, NC, SC, NE, SE, and AK&BC	Includes wet meadows in forested habitats and marshy areas in shrubsteppe habitats as well as areas modified by human disturbance, but excludes extensive areas of chaparral or shrubsteppe habitat
Pacific Northwest coniferous forest (PNC)	NW	Includes forests generally dominated by spruces, cedars hemlocks, and firs, but can include some pines and a limited hardwood component
Western coniferous forest (WC)	NW and SW	Includes forests generally dominated by pines, but can include substantial amounts of firs and a limited hardwood component
Western oak or juniper woodland (OJW)	NW and SW	Includes relatively open-canopy oak woodland and, away from the Pacific slope, open juniper, pinyon-juniper, or mountain mahogany woodland
Western riparian forest (WR)	NW and SW	Includes relatively extensive riparian areas generally dominated by willows and cottonwoods, often embedded in shrubsteppe or grassland habitat; does not include narrow riparian strips in forest or woodland habitat
Chaparral/sagebrush shrub-steppe (CSS)	NW and SW	Includes generally extensive areas dominated by woody shrubs, such as California coastal scrub, chaparral, and sagebrush shrubsteppe; does not include montane chaparral intermixed with western coniferous forest
Desert scrub (DS)	SW	Includes generally extensive areas dominated by relatively widely spaced woody or cactus vegetation
Eastern northern coniferous forest (NC)	NC and NE	Includes forests generally dominated by red spruce and balsam fir, sometimes with a limited jack pine or hardwood component
Eastern northern hardwood forest (NH)	NC, SC, NE, and SE	Includes forests generally dominated by maple, beech, and yellow birch, often with a coniferous component of white pine and hemlock
Eastern southern hardwood forest (SH)	NC, SC, NE, and SE	Includes both upland and bottomland forests generally dominated by oak, hickory, maple, cherry, tulip-poplar, or sweet gum, sometimes with a coniferous component of upland pine or bottomland bald cypress
Eastern southern coniferous forest (SC)	SC, NE, and SE	Includes southern pine savannah and pine forest, often mixed with a hardwood component of oak or hickory
Southern broadleaf evergreen forest (SBE)	SC	Includes live oak forests and woodland, as well as semi-tropical hammocks of southern Florida and brushlands of southern Texas
Boreal coniferous forest (BC)	AK&BC	Includes both upland and flooded forest dominated by spruces and tamaracks, often with a limited hardwood component of birches
Boreal hardwood forest (BH)	AK&BC	Includes relatively extensive closed birch forests as well as open aspen parklands

Northeast regions could be increased to the current effort in the Northwest. The South-central, North-central, and Alaska/Boreal Canada regions have fewer stations still, with 50, 32, and 22 stations, respectively, operated annually with data suitable for survival analyses. We suggest that the numbers of stations in these remaining regions, which have considerably smaller human population densities, more grassland habitat (unfavorable for passive mist netting), or both, be increased to the average current level of coverage in the Southwest, Northeast, and Southeast (67 stations). Such expansion would increase the size of the MAPS program by 300 stations (a 69% increase, or 733 total stations operated annually for ≥4 yr).

We used two methods to identify species for which survival could potentially be monitored effectively under such an expanded MAPS program. In the first method, which we call the expanded (non-targeted) program, we assume that, within each region, the relative geographic and habitat coverage and effectiveness of capturing birds in the expanded program would remain essentially the same as in the current program. Thus, new "monitorable species" were those for which expected sample size increases, calculated as proportional increases in annual releases of residents equal to proportional increases in the number of stations, reach a level that our power analyses suggest we can detect a ≤25% difference in survival between populations or ≤25% decline in survival with 80% power, $\alpha = 0.20$, and 20 years of data. We did not apply this method to the Northwest, as we believe that the current number and distribution of stations there is sufficient to effectively monitor an adequate number of species in the habitats sampled.

In the second method, which we call the expanded and targeted program, we assumed that new stations would be sited specifically to target species currently under-represented in the MAPS database, including species identified as monitorable in the expanded (but non-targeted) program. For the Northwest Region, target species were selected based on a formal analysis of the MAPS program funded by the U.S. Bureau of Land Management (Pyle et al. 2005). Specifically, we selected Northwest target species based on (1) their identification as focal or priority species in at least one priority habitat in at least one of 13 published Partners In Flight (PIF) bird conservation plans for the Northwest, or (2) their having negative population trends according to BBS or MAPS data in one or more states or Bird Conservation Regions (BCRs) in the Northwest. A few species with positive population trends were also selected for comparison. Priority habitats were identified by examining PIF habitat designations for Physiographic Areas in the Pacific Northwest and selecting those that can be effectively sampled by MAPS (i.e., forest and scrub areas). For the remaining regions, target species were selected as those thought to be monitorable, based on their habitats, ecology, and behavior, provided that a sufficient number of MAPS stations were operated.

RESULTS

POWER OF THE CURRENT MAPS PROGRAM

Our estimates of the numbers of resident birds released per year in the MAPS program suggest that we can detect differences in survival between populations or linear declines in survival with 80% power with 20 yr of data at the continental scale for 105 species (Table 3). About one third (36) are Partners In Flight (PIF) Species of Continental Importance ("Watch List" or "Additional Stewardship" species; Rich et al. 2004). Current MAPS sample sizes suggest we can detect (at $\alpha = 0.20$) effect sizes of 5% for nine species, 10% for an additional 38 species, 15% for an additional 33 species, 20% for an additional 13 species, and 25% for an additional 12 species. Increasing α from 0.10 to 0.20 resulted in relatively small increases in the numbers of species for which we can reject null hypotheses (Figs. 2-3).

MAPS program coverage is greatest in the Northwest Region, where we can currently detect differences in survival between populations or linear declines in survival with 80% power for 47 species (Figs. 2-3, Appendix 1). Five-percent effect sizes (for at least one of the hypothesis tests and $\alpha = 0.20$) could likely be detected for five of these species in the Northwest Region, while larger effect sizes could likely be detected for an additional 13 species at the 10% level, 21 species at the 15% level, six

TABLE 3. Effect sizes (%) currently detectable by MAPS with 20 yrs of data, and likely detectable under an expanded MAPS program, with 80% power at the program-wide (i.e., continental) scale. Two effect types were considered: (1) a two-population comparison of survival (2P), and (2) a population with linearly declining survival (LD). Effect sizes are given for two alpha-levels, 0.10 and 0.20.

						Current				Expanded			
						$\alpha = 0.10$		$\alpha = 0.20$		$\alpha = 0.10$		$\alpha = 0.20$	
Species	Sta[1]	Ind[2]	Res[3]	$\hat{\phi}$[4]	$\hat{p}$[5]	2P[6]	LD[7]	2P[6]	LD[7]	2P[6]	LD[7]	2P[6]	LD[7]
Red-naped Sapsucker *(Sphyrapicus nuchalis)*	32	489	55	0.413	0.602	25	15	20	15	20	15	15	15
Red-breasted Sapsucker (*Sphyrapicus ruber*)	49	701	77	0.458	0.369	20	15	20	15	15	15	15	10
Ladder-backed Woodpecker (*Picoides scalaris*)	16	98	10	0.552	0.292				25		25		20
Nuttall's Woodpecker (*Picoides nuttallii*)	16	195	22	0.551	0.381		20	25	15	25	15	20	15
Downy Woodpecker (*Picoides pubescens*)	227	1915	137	0.500	0.354	15	15	15	10	15	10	10	10
Hairy Woodpecker (*Picoides villosus*)	154	630	59	0.665	0.208	20	15	15	10	15	10	10	10
Western Wood-Pewee (*Contopus sordidulus*)	73	1456	135	0.486	0.362	15	15	15	10	15	10	10	10
Eastern Wood-Pewee (*Contopus virens*)	101	616	44	0.494	0.278		20	25	15	25	15	20	15
Acadian Flycatcher (*Empidonax virescens*)	66	2285	183	0.508	0.518	10	10	10	10	10	10	10	10
"Traill's" Flycatcher (*Empidonax alnorum/traillii*)	80	3105	198	0.485	0.491	10	10	10	10	10	10	10	10
Least Flycatcher (*Empidonax minimus*)	24	1044	73	0.379	0.435	25	15	20	15	20	15	15	15
Hammond's Flycatcher (*Empidonax hammondii*)	56	1155	114	0.452	0.403	20	15	15	15	15	10	10	10
Dusky Flycatcher (*Empidonax oberholseri*)	52	1986	147	0.485	0.425	15	10	10	10	10	10	10	10
"Western" Flycatcher (*E. difficilis/occidentalis*)	69	2573	161	0.504	0.282	15	15	15	10	10	10	10	10
Black Phoebe (*Sayornis nigricans*)	16	195	12	0.460	0.481				20		20		15
Ash-throated Flycatcher (*Myiarchus cinerascens*)	35	723	63	0.666	0.135	15	15	15	10	15	10	10	10
Great Crested Flycatcher (*Myiarchus crinitus*)	96	574	33	0.615	0.216				20		20	25	15
Brown-crested Flycatcher (*Myiarchus tyrannulus*)	4	225	30	0.492	0.276		20		20	25	15	20	15
White-eyed Vireo (*Vireo griseus*)	82	2719	267	0.537	0.509	10	10	10	10	10	10	10	10
Bell's Vireo (*Vireo bellii*)	17	562	57	0.581	0.404	20	15	15	10	15	10	10	10
Warbling Vireo (*Vireo gilvus*)	118	5017	379	0.483	0.428	10	10	10	10	5	10	5	10
Red-eyed Vireo (*Vireo olivaceus*)	159	4798	427	0.595	0.253	10	10	10	10	10	10	10	10
Steller's Jay (*Cyanocitta stelleri*)	60	303	20	0.731	0.184			25	25	25	20	20	15
Carolina Chickadee (*Poecile carolinensis*)	121	1312	95	0.499	0.229		20	25	15	25	15	20	15
Black-capped Chickadee (*Poecile atricapilla*)	144	3069	294	0.468	0.367	10	10	10	10	10	10	10	10
Mountain Chickadee (*Poecile gambeli*)	51	1145	93	0.452	0.385	20	15	15	15	15	15	15	10
Chestnut-backed Chickadee (*Poecile rufescens*)	51	1043	88	0.419	0.396		20	25	20	20	15	20	15
Boreal Chickadee (*Poecile hudsonica*)	10	132	19	0.492	0.365				25		20		20
Tufted Titmouse (*Baeolophus bicolor*)	137	1840	189	0.491	0.386	15	10	10	10	10	10	10	10
Bushtit (*Psaltriparus minimus*)	43	1117	152	0.295	0.146				25		25		25
White-breasted Nuthatch (*Sitta carolinensis*)	88	358	20	0.477	0.306				20		20		20

TABLE 3. Continued.

						Current				Expanded			
						α = 0.10		α = 0.20		α = 0.10		α = 0.20	
Species	Sta[1]	Ind[2]	Res[3]	$\hat{\phi}$[4]	$\hat{p}$[5]	2P[6]	LD[7]	2P[6]	LD[7]	2P[6]	LD[7]	2P[6]	LD[7]
Carolina Wren (*Thryothorus ludovicianus*)	124	2713	270	0.397	0.541	15	10	10	10	10	10	10	10
Bewick's Wren (*Thryomanes bewickii*)	72	1695	180	0.430	0.515	15	15	15	10	15	10	10	10
House Wren (*Troglodytes aedon*)	97	2863	267	0.341	0.420	25	20	20	15	20	15	15	15
Winter Wren (*Troglodytes troglodytes*)	46	967	78	0.376	0.506	25	15	20	15	20	15	15	15
Arctic Warbler (*Phylloscopus borealis*)	2	249	29	0.339	0.605		25		25		20	25	20
Veery (*Catharus fuscescens*)	54	2274	290	0.581	0.566	10	10	5	10	5	5	5	5
Gray-cheeked Thrush (*Catharus minimus*)	6	253	31	0.459	0.683	20	15	20	15	20	15	15	10
Swainson's Thrush (*Catharus ustulatus*)	109	10175	1113	0.581	0.624	5	5	5	5	5	5	5	5
Hermit Thrush (*Catharus guttatus*)	75	2170	229	0.474	0.607	10	10	10	10	10	10	5	10
Wood Thrush (*Hylocichla mustelina*)	128	4973	455	0.440	0.490	10	10	10	10	10	10	10	10
American Robin (*Turdus migratorius*)	269	7874	682	0.523	0.275	10	10	10	10	5	10	5	10
Varied Thrush (*Ixoreus naevius*)	40	493	34	0.471	0.394		20	25	15	25	15	20	15
Wrentit (*Chamaea fasciata*)	37	1325	145	0.534	0.627	10	10	10	10	10	10	10	10
Gray Catbird (*Dumetella carolinensis*)	121	9446	874	0.511	0.464	5	10	5	5	5	5	5	5
Brown Thrasher (*Toxostoma rufum*)	58	643	48	0.522	0.292	25	15	25	15	20	15	20	15
Long-billed Thrasher (*Toxostoma longirostre*)	3	133	14	0.628	0.396				20		20	25	15
Blue-winged Warbler (*Vermivora pinus*)	35	994	79	0.521	0.394	20	15	20	15	15	15	15	10
Orange-crowned Warbler (*Vermivora celata*)	72	3875	268	0.441	0.435	15	10	10	10	10	10	10	10
Nashville Warbler (*Vermivora ruficapilla*)	34	1111	60	0.338	0.331				25		25		25
Virginia's Warbler (*Vermivora virginiae*)	12	463	30	0.473	0.339		20		20	25	15	25	15
Yellow Warbler (*Dendroica petechia*)	123	9049	816	0.534	0.474	5	10	5	10	5	5	5	5
Chestnut-sided Warbler (*Dendroica pensylvanica*)	22	839	88	0.431	0.545	20	15	20	15	15	15	15	15
Magnolia Warbler (*Dendroica magnolia*)	15	514	39	0.321	0.769		20	25	20	25	20	20	20
Yellow-rumped Warbler (*Dendroica coronata*)	97	4216	328	0.451	0.276	10	10	10	10	10	10	10	10
Black-thr. Green Warbler (*Dendroica virens*)	19	372	39	0.396	0.557		20	25	20	25	20	20	15
Townsend's Warbler (*Dendroica townsendi*)	27	978	101	0.428	0.224		25		25		20		20
Blackpoll Warbler (*Dendroica striata*)	7	177	14	0.313	0.735				25		25		25
Black-and-white Warbler (*Mniotilta varia*)	75	1105	91	0.518	0.298	20	15	15	15	15	15	15	10
American Redstart (*Setophaga ruticilla*)	60	3204	264	0.509	0.338	10	10	10	10	10	10	10	10
Prothonotary Warbler (*Protonotaria citrea*)	20	479	49	0.509	0.206				25		20		20
Worm-eating Warbler (*Helmitheros vermivorus*)	30	781	60	0.529	0.402	25	15	20	15	20	15	15	15
Ovenbird (*Seiurus aurocapillus*)	112	3873	324	0.550	0.430	5	10	5	5	5	5	5	5
Northern Waterthrush (*Seiurus noveboracensis*)	20	491	37	0.498	0.550	25	15	20	15	20	15	15	15

TABLE 3. Continued.

Species	Current									Expanded			
						α = 0.10		α = 0.20		α = 0.10		α = 0.20	
	Sta[1]	Ind[2]	Res[3]	$\hat{\phi}$[4]	$\hat{p}$[5]	2P[6]	LD[7]	2P[6]	LD[7]	2P[6]	LD[7]	2P[6]	LD[7]
Louisiana Waterthrush (*Seiurus motacilla*)	35	561	50	0.514	0.583	20	15	15	10	15	10	15	10
Kentucky Warbler (*Oporornis formosus*)	53	1834	197	0.539	0.585	10	10	10	10	10	10	5	10
Mourning Warbler (*Oporornis philadelphia*)	7	230	30	0.444	0.389				25		25		20
MacGillivray's Warbler (*Oporornis tolmiei*)	92	5887	596	0.477	0.612	5	10	5	10	5	5	5	5
Common Yellowthroat (*Geothlypis trichas*)	175	8523	777	0.481	0.500	5	10	5	10	5	5	5	5
Hooded Warbler (*Wilsonia citrina*)	47	1221	109	0.489	0.536	15	10	15	10	10	10	10	10
Wilson's Warbler (*Wilsonia pusilla*)	82	9116	593	0.416	0.530	10	10	10	10	10	10	5	10
Canada Warbler (*Wilsonia canadensis*)	10	314	23	0.443	0.544		25		20		20	25	20
Yellow-breasted Chat (*Icteria virens*)	74	3044	328	0.468	0.474	10	10	10	10	10	10	5	10
Summer Tanager (*Piranga rubra*)	57	566	49	0.486	0.417	25	15	25	15	20	15	20	15
Western Tanager (*Piranga ludoviciana*)	86	1769	120	0.542	0.141	25	20	25	15	20	15	20	15
Olive Sparrow (*Arremonops rufivirgatus*)	3	208	27	0.510	0.738	20	15	20	15	15	15	15	10
Green-tailed Towhee (*Pipilo chlorurus*)	13	297	28	0.541	0.355		20		20		15	25	15
Spotted Towhee (*Pipilo maculatus*)	78	2125	223	0.487	0.465	10	10	10	10	10	10	10	10
Eastern Towhee (*Pipilo erythrophthalmus*)	97	907	98	0.484	0.331	20	15	15	15	15	15	15	10
California Towhee (*Pipilo crissalis*)	18	398	49	0.539	0.353	25	15	25	15	20	15	20	15
Rufous-crowned Sparrow (*Aimophila ruficeps*)	14	175	17	0.545	0.334				25		20		20
American Tree Sparrow (*Spizella arborea*)	7	199	17	0.483	0.500		20		20		15	25	15
Chipping Sparrow (*Spizella passerina*)	77	1326	129	0.410	0.231		25		20		20	25	20
Field Sparrow (*Spizella pusilla*)	67	2032	219	0.447	0.350	20	15	15	15	15	15	15	10
Lark Sparrow (*Chondestes grammacus*)	17	422	17	0.522	0.275				25		20		20
Savannah Sparrow (*Passerculus sandwichensis*)	12	504	43	0.536	0.360		20	25	15	25	15	20	15
Fox Sparrow (*Passerella iliaca*)	41	991	92	0.534	0.502	15	15	15	10	15	10	10	10
Song Sparrow (*Melospiza melodia*)	185	10465	1160	0.465	0.560	5	10	5	5	5	5	5	5
Lincoln's Sparrow (*Melospiza lincolnii*)	52	2528	329	0.424	0.634	10	10	10	10	10	10	10	10
Swamp Sparrow (*Melospiza georgiana*)	14	332	29	0.402	0.748	25	20	25	15	20	15	20	15
White-throated Sparrow (*Zonotrichia albicollis*)	19	992	97	0.351	0.532	20	15	20	15	15	15	15	10
White-crowned Sparrow (*Zonotrichia leucophrys*)	30	1260	140	0.459	0.479	15	10	10	10	10	10	10	10
Golden-crowned Sparrow (*Zonotrichia atricapilla*)	5	279	34	0.533	0.490	25	15	20	15	20	15	15	15
Dark-eyed Junco (*Junco hyemalis*)	121	6505	722	0.442	0.503	10	10	10	10	5	10	5	10
Northern Cardinal (*Cardinalis cardinalis*)	177	6027	631	0.568	0.370	5	10	5	5	5	5	5	5
Black-headed Grosbeak (*Pheucticus melanocephalus*)	104	3796	295	0.550	0.303	10	10	10	10	5	10	5	10
Lazuli Bunting (*Passerina amoena*)	47	1719	99	0.496	0.297	20	15	15	15	15	10	15	10

TABLE 3. Continued.

	Current									Expanded			
						α = 0.10		α = 0.20		α = 0.10		α = 0.20	
Species	Sta[1]	Ind[2]	Res[3]	$\hat{\phi}$[4]	$\hat{p}$[5]	2P[6]	LD[7]	2P[6]	LD[7]	2P[6]	LD[7]	2P[6]	LD[7]
Indigo Bunting (*Passerina cyanea*)	112	3698	352	0.490	0.371	10	10	10	10	10	10	10	10
Painted Bunting (*Passerina ciris*)	32	1592	115	0.558	0.439	10	10	10	10	10	10	10	10
Red-winged Blackbird (*Agelaius phoeniceus*)	69	1934	96	0.612	0.200	20	15	20	15	15	15	15	10
Brown-headed Cowbird (*Molothrus ater*)	210	2023	180	0.473	0.460	10	10	10	10	10	10	10	10
Baltimore Oriole (*Icterus galbula*)	43	687	46	0.534	0.287	25	15	25	15	20	15	20	15
Bullock's Oriole (*Icterus bullockii*)	39	1141	68	0.469	0.365	25	15	20	15	20	15	15	15
Purple Finch (*Carpodacus purpureus*)	51	3459	259	0.460	0.340	10	10	10	10	10	10	10	10
American Goldfinch (*Carduelis tristis*)	135	6624	514	0.430	0.266	20	15	15	15	15	15	15	10

[1] Number of stations that were operated for at least four consecutive years during the 10-yr period 1992-2001 at which (a) at least one adult individual of the species was captured and (b) the species was a regular or usual breeder. Stations within 1 km of each other were merged into a single "super-station" to prevent individuals whose home range encompassed parts of both stations from being treated as two individuals.

[2] Total number of individual adult birds captured during the 10-yr period 1992-2001 at stations where the species was a regular or usual breeder; thus the total number of capture histories upon which the estimate of survival probability was based.

[3] Estimated number of resident birds released per year as part of a stable MAPS program at the current level of effort. See text for detail.

[4] Estimated time-constant annual apparent survival rate from MAPS data pooled across all stations from 1992-2001.

[5] Estimated time-constant recapture probability from MAPS data pooled across all stations from 1992-2001.

[6] Effect size (% difference) that can be detected when comparing the adult apparent survival rates between two populations, based on results of simulated data and current MAPS sample sizes and parameter estimates.

[7] Effect size (% change) that can be detected for a population experiencing a linear decline in adult apparent survival, based on results of simulated data and current MAPS sample sizes and parameter estimates.

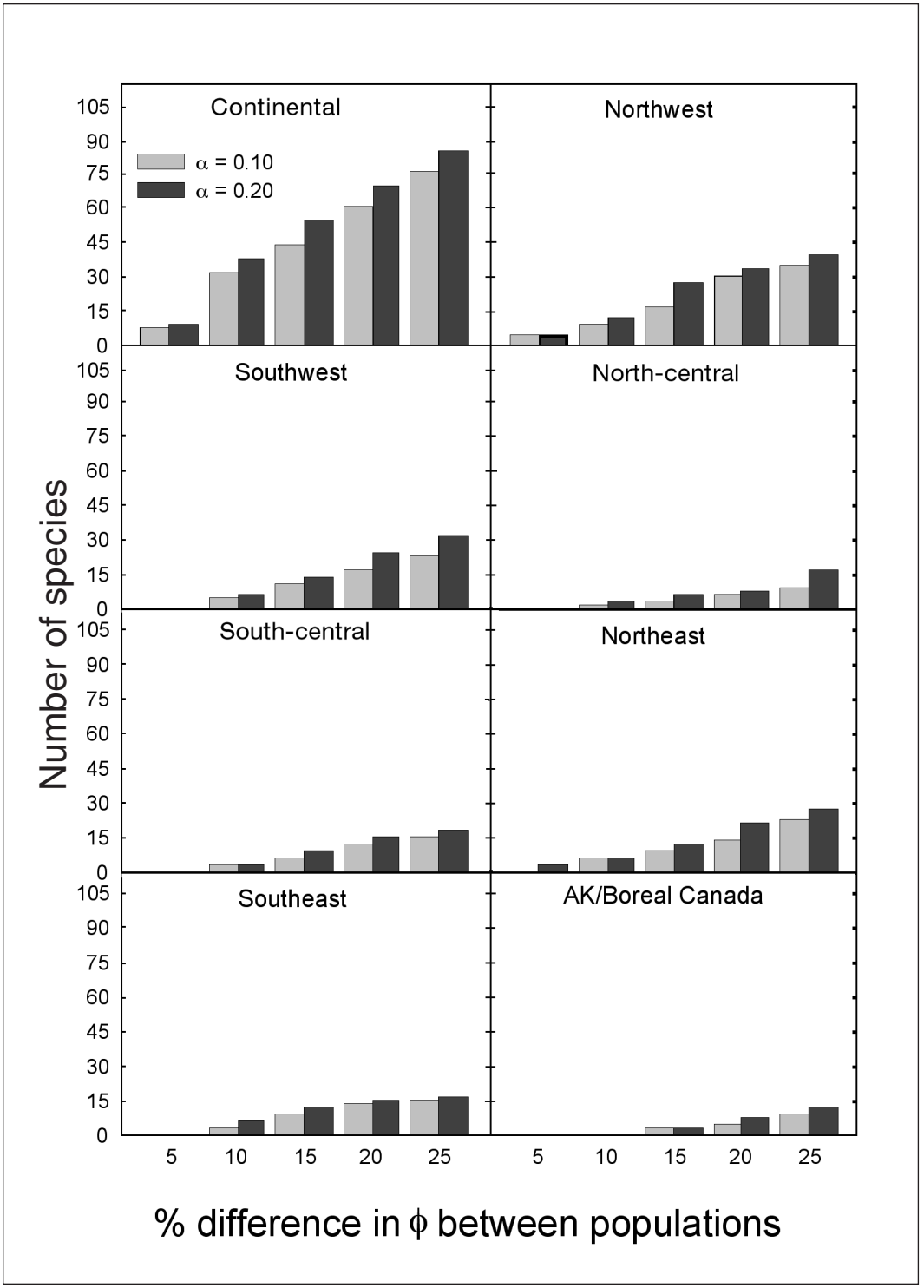

FIGURE 2. Numbers of species for which current MAPS sample sizes suggest that we could likely detect differences in adult apparent survival (ϕ) between populations with 20 yr of data.

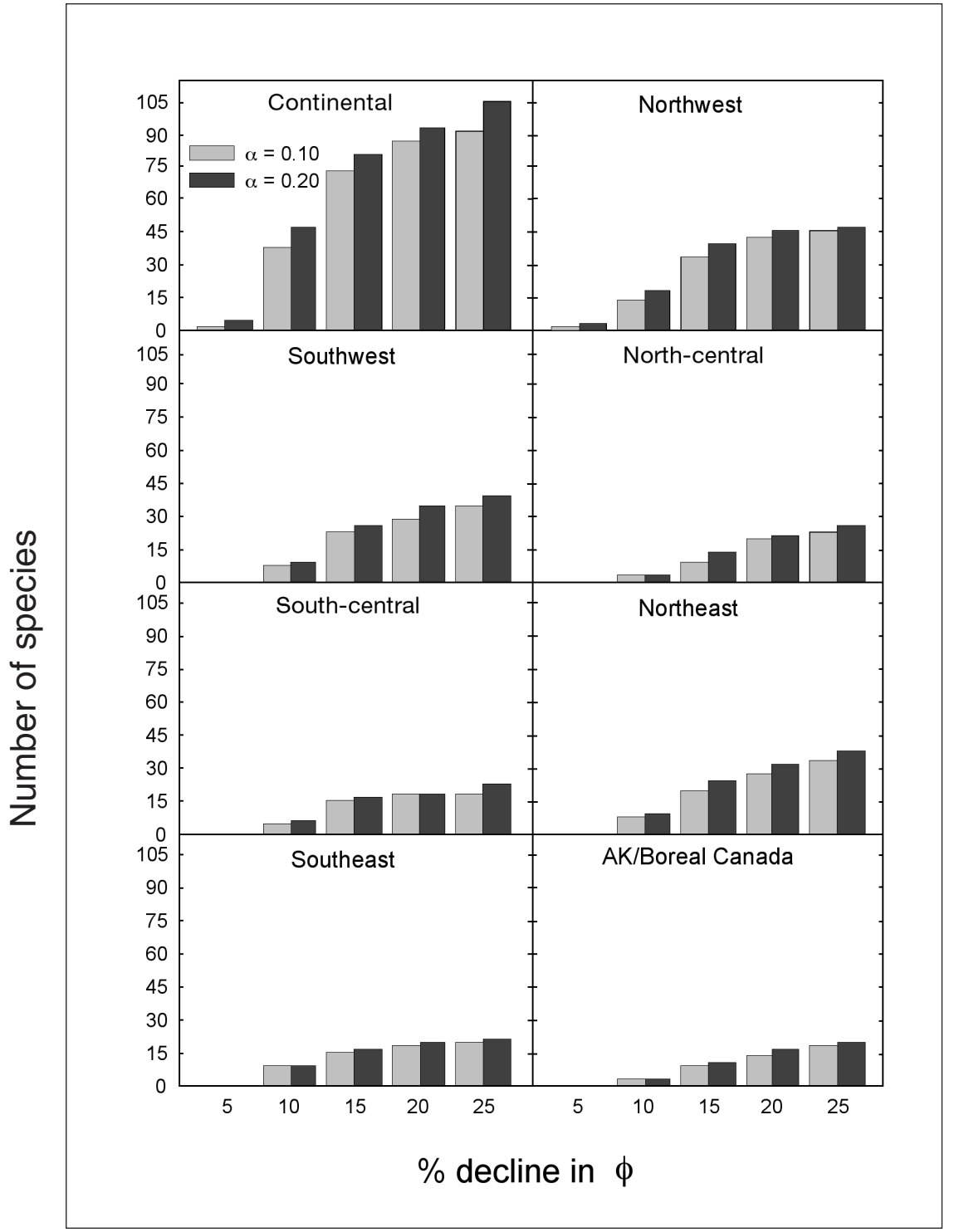

FIGURE 3. Numbers of species for which current MAPS sample sizes suggest that we could likely detect linear declines in adult apparent survival (ϕ) with 20 yr of data.

species at the 20% level, and two species at the 25% level. Scrub/successional/disturbed, Pacific Northwest conifer forest, western conifer forest, and western riparian forest habitats were all well represented as "adequately" monitored with 25, 27, 24, and 22 species, respectively (Appendix 1). Western oak or juniper woodland and chaparral/sagebrush shrub-steppe habitats were not well monitored with only five "adequately" monitored species each.

Lists of currently monitorable species and the effect sizes that can be detected with 80% power in the remaining six regions are also shown graphically in Figures 2 and 3 and presented in Appendices 2-7. Numbers of currently monitorable species are similar for the Southwest and Northeast regions, with tallies of 42 and 38 species, respectively (Appendices 2 and 5). Current sample sizes are sufficient to detect a 5% difference in survival between populations with $\alpha = 0.20$ and 20 yr of data for two species in the Northeast (Appendix 5), but are insufficient to detect 5% effect sizes for any other species or scenario in either of these two regions. At the 10% effect size, nine species are currently monitorable in the Southwest Region (Appendix 2) and an additional six species are monitorable in the Northeast Region (Appendix 5). The remaining species are sampled in sufficient numbers to detect only larger effect sizes. Scrub/successional/disturbed, western conifer forest, and western riparian forest habitats were well represented in the Southwest Region by 21, 18, and 20 "adequately" monitored species, respectively (Appendix 2). Western oak or juniper woodland habitat had 14 "adequately" monitored species but chaparral/sagebrush shrub-steppe habitat had only five "adequately" monitored species. In the Northeast Region, scrub/successional/disturbed, northern hardwood, and southern hardwood habitats were well represented by 17, 18, and 19 "adequately" monitored species, respectively (Appendix 5), while northern conifer habitat had only 11 "adequately" monitored species and southern conifer habitat, which has a very limited distribution in the Northeast Region, had only four "adequately" monitored species.

Currently monitorable species in the four remaining MAPS regions ranged from 19 in the Alaska/Boreal Canada Region to 25 in the North-central Region (Figs. 2-3; Appendices 3-4 and 6-7). No species was sampled sufficiently to detect 5% effect sizes with 80% power in any of these remaining regions. However, 10% effect sizes can likely be detected in the North-central, South-central, Southeast, and Alaska/Boreal Canada regions for 3, 6, 9, and 3 species respectively, while 15% effect sizes can likely be detected for 10, 10, 7, and 7 additional species, respectively. In general, scrub/successional/disturbed, northern hardwood, and southern hardwood habitats were well represented according to the extent of their distributions by "adequately" monitored species in each of the North-central, South-central, and Southeast regions; both northern conifer and southern conifer habitats were less well represented in those regions. Scrub/successional/disturbed, boreal conifer, and boreal hardwood habitats were represented by 11, 9, and 6 "adequately" monitored species, respectively, in the Alaska/Boreal Canada Region, likely substantially below the numbers of potentially monitorable species.

We were able to estimate survival rates on at least two of the six Pacific Northwest national forests for 21 species. At $\alpha = 0.20$, we found we could detect 10% differences in survival for one species (Swainson's Thrush), 15% differences in survival for five additional species (American Robin, MacGillivray's Warbler, Wilson's Warbler, Lincoln's Sparrow, and Dark-eyed Junco), 20% differences for three additional species (Dusky Flycatcher, Warbling Vireo, and Song Sparrow), and 25% differences for six additional species (Hammond's Flycatcher, "Western" Flycatcher, Winter Wren, Yellow Warbler, Yellow-rumped Warbler, and Common Yellowthroat), for a total of 15 of the 21 species (Fig. 4). Interestingly, the mean maximum difference in survival between forests for the 13 species with $CV(\hat{\phi}) < 20\%$ at both forests was 14.8%; the mean maximum difference for all 21 species (regardless of $CV(\hat{\phi})$) was 25.5%. It is not surprising, therefore, that we had 80% power to detect the magnitude of the difference in survival that actually existed between the two national forests for eight of the 15 species for which we could detect at least a 25% difference in survival

POWER OF AN EXPANDED MAPS PROGRAM

Under the expanded (i.e., non-targeted) MAPS program, the number of species whose survival

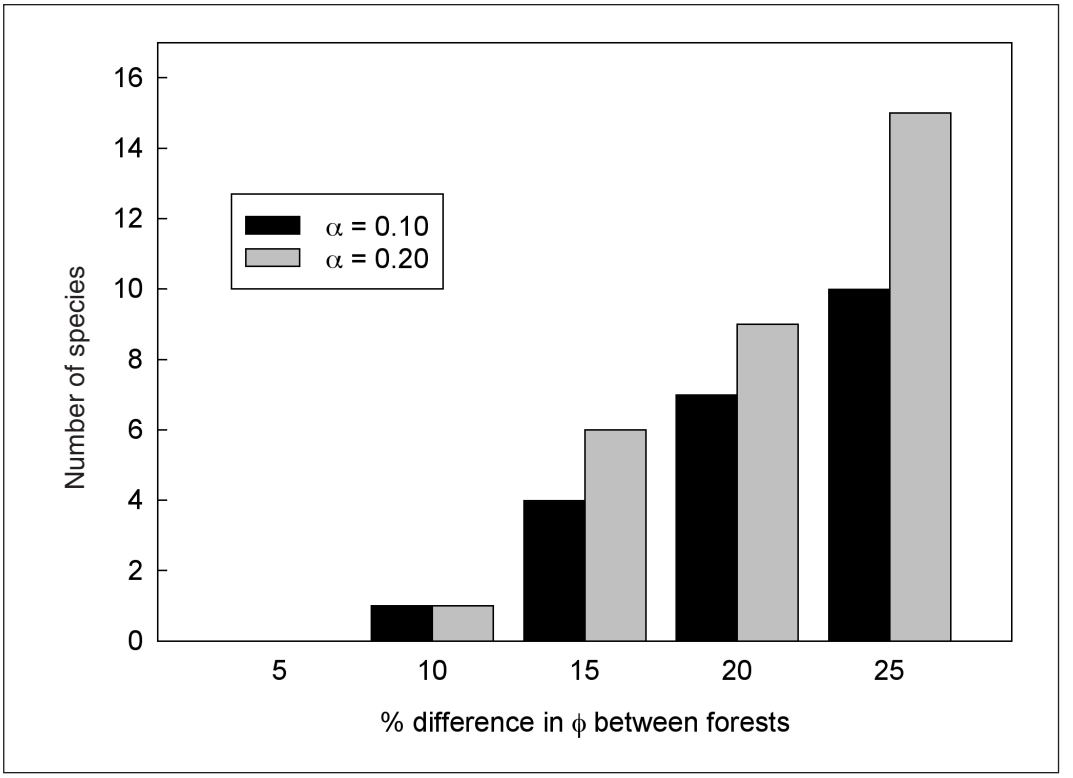

FIGURE 4. Numbers of species for which we would be able to detect differences in survival between clusters of six stations on national forest lands in the Pacific Northwest with 80% power over 20 yr. Calculations assume that capture rates, proportions of residents captured, and survival and recapture probabilities all remained as documented on each national forest during 1992-2001.

would likely be monitorable at the continental scale would increase by just 13%, despite an overall increase in the number of stations of 65% (to 713 stations) (Table 4; new species under expanded (E) or expanded and targeted (T) scenarios are listed in Table 5). The gain in monitorable species under the expanded scenario was also small at the MAPS-regional scale. The number of new monitorable species increased by an average of only 22% over the six expanded regions (ranging from 9% in the South-central Region to 37% in the Alaska/Boreal Canada Region), despite the number of stations increasing by an average of 104% over these regions (ranging from 34% in the South-central Region to 205% in the Alaska/Boreal Canada Region). The numbers of species monitorable at smaller effect sizes, however, increased markedly under the expanded program for both the continental and regional scales (Figs. 5-6; changes in monitorable effect sizes for individual species are listed in Table 3 for continental and Appendices 1-7 for MAPS regions). For example, the number of species for which 5% linear declines would likely be detectable at the continental scale under the expanded program increased by 160% (from 5 to 13 species). As perhaps expected, the 14 monitorable species added at the continental scale by the expanded but not targeted program scenario (Table 5) were typical of habitats already well represented by "adequately" monitored species. Only one boreal forest species (Olive-sided Flycatcher) and two western oak or juniper woodland species (Oak and Juniper titmice) were added.

Under the expanded and targeted program scenario, survival rates of many additional species could likely be monitored effectively by MAPS (Table 4). At the continental scale, the

TABLE 4. Numbers of monitorable species in the current MAPS program and expected numbers under expanded or expanded/targeted MAPS programs.

	Region[1]							
	NW	SW	NC	SC	NE	SE	AC	Continental
No. of stations[2]								
Current	128	66	32	50	65	70	22	433
Expanded	128	128	67	67	128	128	67	713
Expanded/targeted	148	128	67	67	128	128	67	733
No. of species[3]								
Current	47	42	25	22	38	21	19	105
Expanded	47	50	34	24	47	23	26	119
Expanded/targeted	63	65	49	49	62	40	43	146

[1] See Fig. 1 for region definitions and boundaries.
[2] Number of stations operated annually that are operated for at least four consecutive years.
[3] Number of species for which survival can be monitored effectively (i.e., for which 25% differences in survival between two populations or a "25%" linear decline in survival in a single population can be detected with 80% power at alpha = 0.2 with 20 years of data).

expanded and targeted scenario would result in a 39% increase in monitorable species (from 105 to 146 species), and a 23% increase over the expanded program (from 119 to 146 species). The 27 new monitorable species at the continental scale from the expanded and targeted scenario (Tables 4 and 5) include (asterisks indicate species for which MAPS can currently obtain continental-scale survival-rate estimates): (1) five species typical of western oak or juniper woodland habitat (Gray Flycatcher, *Plumbeous Vireo, *Hutton's Vireo, *Bridled Titmouse, *Black-throated Gray Warbler); (2) seven species typical of sagebrush shrubsteppe or desert scrub and canyons of the West and Southwest (*Verdin, Sage Thrasher, Canyon Towhee, Brewer's Sparrow, *Vesper Sparrow, *Black-throated Sparrow, *Sage Sparrow); (3) 12 species that breed in the boreal forest and, for some, also in northern conifer habitat (*Yellow-bellied Sapsucker, Yellow-bellied Flycatcher, *Blue-headed Vireo, Philadelphia Vireo, *Gray Jay, *Ruby-crowned Kinglet, *Bicknell's Thrush, Tennessee Warbler, *Black-throated Blue Warbler, Palm Warbler, Bay-breasted Warbler, and *Clay-colored Sparrow); and (4) three other species from central and eastern North America (*Blue Jay, *Swainson's Warbler, and *Dickcissel).

At the regional scale, targeted expansion of just 20 stations in the Northwest (a 16% increase in stations) could result in a 34% increase the number of effectively monitored species there (Tables 4 and 5). Targeted expansion in the remaining MAPS regions could increase the number of monitorable species by an average of 96% (ranging from 55% in the Southwest to 132% in the South-central Region; Tables 4 and 5).

DISCUSSION

Although our power analyses demonstrate the difficulty of detecting small (5-10%) differences in survival between populations or linear declines in survival in a single population given sample sizes currently being obtained by the MAPS program, the typical effect sizes seen in MAPS data are often much larger. Indeed, our results suggest that we can detect differences and declines in survival of the magnitudes of differences typically seen between MAPS regions or between clusters of MAPS stations with 80% power for 84 and 105 species, respectively, at the continental scale, and for 40 and 47 species, respectively, in the Northwest Region (the region with the largest number of MAPS stations). The numbers of adequately monitored species are smaller in the remaining six regions; clearly, expansion of MAPS in those regions will increase its usefulness as a component of continental scale CBM.

Whether a particular species is captured in sufficient numbers to detect differences in survival between populations or changes in survival within a given population over time

TABLE 5. Additional species that would likely be monitorable with 20 yr of data under an expanded (E) or targeted and expanded (T) MAPS program at continental and regional scales. (Note, √ indicates already monitorable under the current program.)

	Region[1]							
	NW	SW	NC	SC	NE	SE	AC	Cont[2]
Yellow-bellied Sapsucker (*Sphyrapicus varius*)					T		T	T
Red-breasted Sapsucker (*Sphyrapicus ruber*)	√	E						√
Ladder-backed Woodpecker (*Picoides scalaris*)				T				√
Downy Woodpecker (*Picoides pubescens*)	T	√	E	T	√	√		√
Hairy Woodpecker (*Picoides villosus*)	√	E	E		T	T		√
Olive-sided Flycatcher (*Contopus cooperi*)		√						E
Western Wood-Pewee (*Contopus sordidulus*)	√	√	E				E	√
Eastern Wood-Pewee (*Contopus virens*)			T	T	E	T		√
Yellow-bellied Flycatcher (*Empidonax flaviventris*)							T	T
Acadian Flycatcher (*Empidonax virescens*)				√	T	√		√
Gray Flycatcher (*Empidonax wrightii*)	T	T						T
Black Phoebe (*Sayornis nigricans*)		E						√
Eastern Phoebe (*Sayornis phoebe*)					√			E
Great Crested Flycatcher (*Myiarchus crinitus*)			E	T	T	T		√
Brown-crested Flycatcher (*Myiarchus tyrannulus*)				T				√
Bell's Vireo (*Vireo belli*)		T						√
Plumbeous Vireo (*Vireo plumbeus*)		T						T
Cassin's Vireo (*Vireo cassinii*)	T							E
Blue-headed Vireo (*Vireo solitarius*)					T		T	T
Hutton's Vireo (*Vireo huttoni*)	T							T
Warbling Vireo (*Vireo gilvus*)	√	√	T					√
Philadelphia Vireo (*Vireo philadelphicus*)							T	T
Red-eyed Vireo (*Vireo olivaceus*)	T		√	√	√	√		√
Gray Jay (*Perisoreus canadensis*)							E	T
Blue Jay (*Cyanocitta cristata*)			T		√	T		T
Tree Swallow (*Tachycineta bicolor*)								E
Barn Swallow (*Hirundo rustica*)								E
Carolina Chickadee (*Poecile carolinensis*)				T	√	√		√
Chestnut-backed Chickadee (*Poecile rufescens*)	T	√						√
Bridled Titmouse (*Baeolophus wollweberi*)		E						T
Oak Titmouse (*Baeolophus inornatus*)		√						E
Juniper Titmouse (*Baeolophus ridgwayi*)		√						E
Black-crested Titmouse (*Baeolophus atricristatus*)				T				E
Verdin (*Auriparus flaviceps*)		T						T
Bushtit (*Psaltriparus minimus*)	T	√						√
White-breasted Nuthatch (*Sitta carolinensis*)		E	T		T			√
Carolina Wren (*Thryothorus ludovicianus*)			E	√	E	√		√
House Wren (*Troglodytes aedon*)	√	√	√	E	E	T		√
Ruby-crowned Kinglet (*Regulus calendula*)	√						T	T
Bicknell's Thrush (*Catharus bicknelli*)					T			T
Wood Thrush (*Hylocichla mustelina*)			√	T	√	√		√
American Robin (*Turdus migratorius*)	√	√	√	T	√	T	E	√
Sage Thrasher (*Oreoscoptus montanus*)	T	T						T
Brown Thrasher (*Toxostoma rufum*)			T	√	T	T		√
Blue-winged Warbler (*Vermivora pinus*)			E	√	√	√		√
Tennessee Warbler (*Vermivora peregrina*)							T	T
Nashville Warbler (*Vermivora ruficapilla*)	T		T		T		T	√
Virginia's Warbler (*Vermivora virginiae*)	T		√					√
Lucy's Warbler (*Vermivora luciae*)		E						E
Northern Parula (*Parula americana*)				T	E	T		E

TABLE 5. Continued.

	Region[1]							
	NW	SW	NC	SC	NE	SE	AC	Cont[2]
Yellow Warbler (*Dendroica petechia*)	√	√	√	√	√	T	√	√
Magnolia Warbler (*Dendroica magnolia*)			T		√		T	√
Black-throated Blue Warbler (*Dendroica caerulescens*)					E			T
Yellow-rumped Warbler (*Dendroica coronata*)	√	T	T		√		√	√
Black-throated Gray Warbler (*Dendroica nigrescens*)	T	T						T
Black-throated Green Warbler (*Dendroica virens*)			T		√		T	√
Townsend's Warbler (*Dendroica townsendi*)	√						E	√
Prairie Warbler (*Dendroica discolor*)				T		T		E
Palm Warbler (*Dendroica palmarum*)							T	T
Bay-breasted Warbler (*Dendroica castanea*)							T	T
Blackpoll Warbler (*Dendroica striata*)					T		E	√
Black-and-white Warbler (*Mniotilta varia*)			E	T	√	T	T	√
American Redstart (*Setophaga ruticilla*)	√		√	T	√	T	√	√
Prothonotary Warbler (*Protonotaria citrea*)				T		E		√
Worm-eating Warbler (*Helmitheros vermivorus*)				T	√	√		√
Swainson's Warbler (*Limnothlypis swainsonii*)				T		T		T
Ovenbird (*Seiurus aurocapillus*)			E	T	√	√	T	√
Northern Waterthrush (*Seiurus noveboracensis*)	T		T		E		√	√
Louisiana Waterthrush (*Seiurus motacilla*)				T	√	√		√
Kentucky Warbler (*Oporornis formosus*)			√	√	E	√		√
Mourning Warbler (*Oporornis philadelphia*)			√		T		T	√
MacGillivray's Warbler (*Oporornis tolmiei*)	√	T						√
Common Yellowthroat (*Geothlypis trichas*)	√	√	√	√	√	√	T	√
Hooded Warbler (*Wilsonia citrina*)				T	√	√		√
Canada Warbler (*Wilsonia canadensis*)			T		T		√	√
Summer Tanager (*Piranga rubra*)				√		E		√
Western Tanager (*Piranga ludoviciana*)	√	E						√
Eastern Towhee (*Pipilo erythrophthalmus*)			T	T	√	√		√
Canyon Towhee (*Pipilo fuscus*)		T						T
Rufous-crowned Sparrow (*Aimophila ruficeps*)		T		T				√
Chipping Sparrow (*Spizella passerina*)	T	T	T		E		T	√
Clay-colored Sparrow (*Spizella pallida*)			T					T
Brewer's Sparrow (*Spizella breweri*)	T	T						T
Field Sparrow (*Spizella pusilla*)			√	√		T		√
Vesper Sparrow (*Pooecetes gramineus*)	T	T						T
Lark Sparrow (*Chondestes grammacus*)		E		T				√
Black-throated Sparrow (*Amphispiza bilineata*)		T						T
Sage Sparrow (*Amphispiza belli*)	T	T						T
Savannah Sparrow (*Passerculus sandwichensis*)	√						E	√
Grasshopper Sparrow (*Ammodramus savannarum*)				E				E
Lincoln's Sparrow (*Melospiza lincolnii*)	√		E				E	√
White-throated Sparrow (*Zonotrichia albicollis*)			√				T	√
Dark-eyed Junco (*Junco hyemalis*)	√				E		√	√
Rose-breasted Grosbeak (*Pheucticus ludovicianus*)			T		T			E
Blue Grosbeak (*Passerina caerulea*)		√		T		T		E
Dickcissel (*Spiza americana*)				T				T
Brown-headed Cowbird (*Molothrus ater*)	√	√	√	√	T	T		√
Purple Finch (*Carpodacus purpureus*)	√	√			T			√
American Goldfinch (*Carduelis tristis*)	√		√	T	√	T		√

[1] See Fig. 1 for region definitions.
[2] Continental scale.

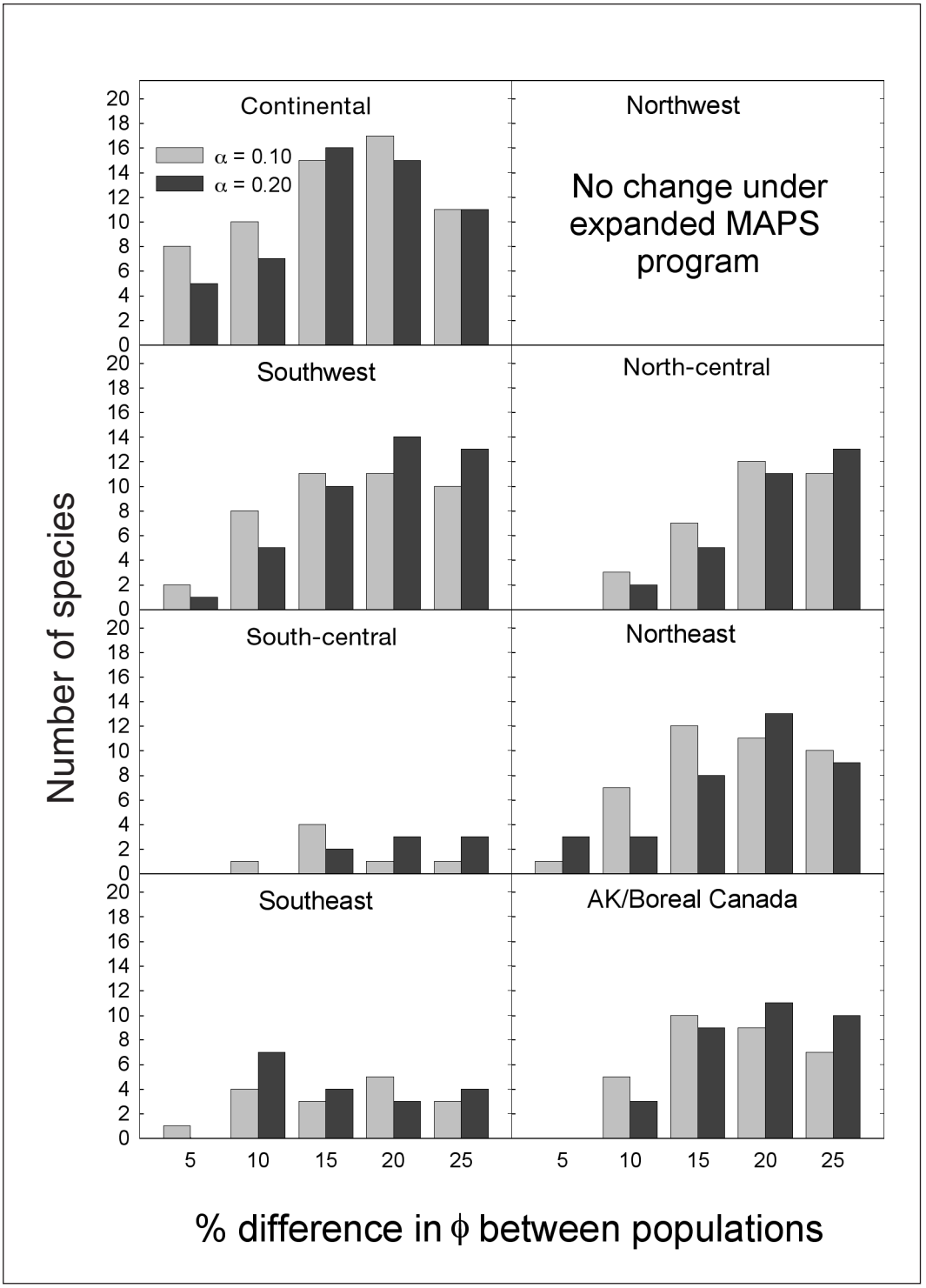

FIGURE 5. Numbers of new species for which we would likely be able to detect differences in survival (ϕ) between populations with 20 yr of data under an expanded (but not targeted) MAPS program.

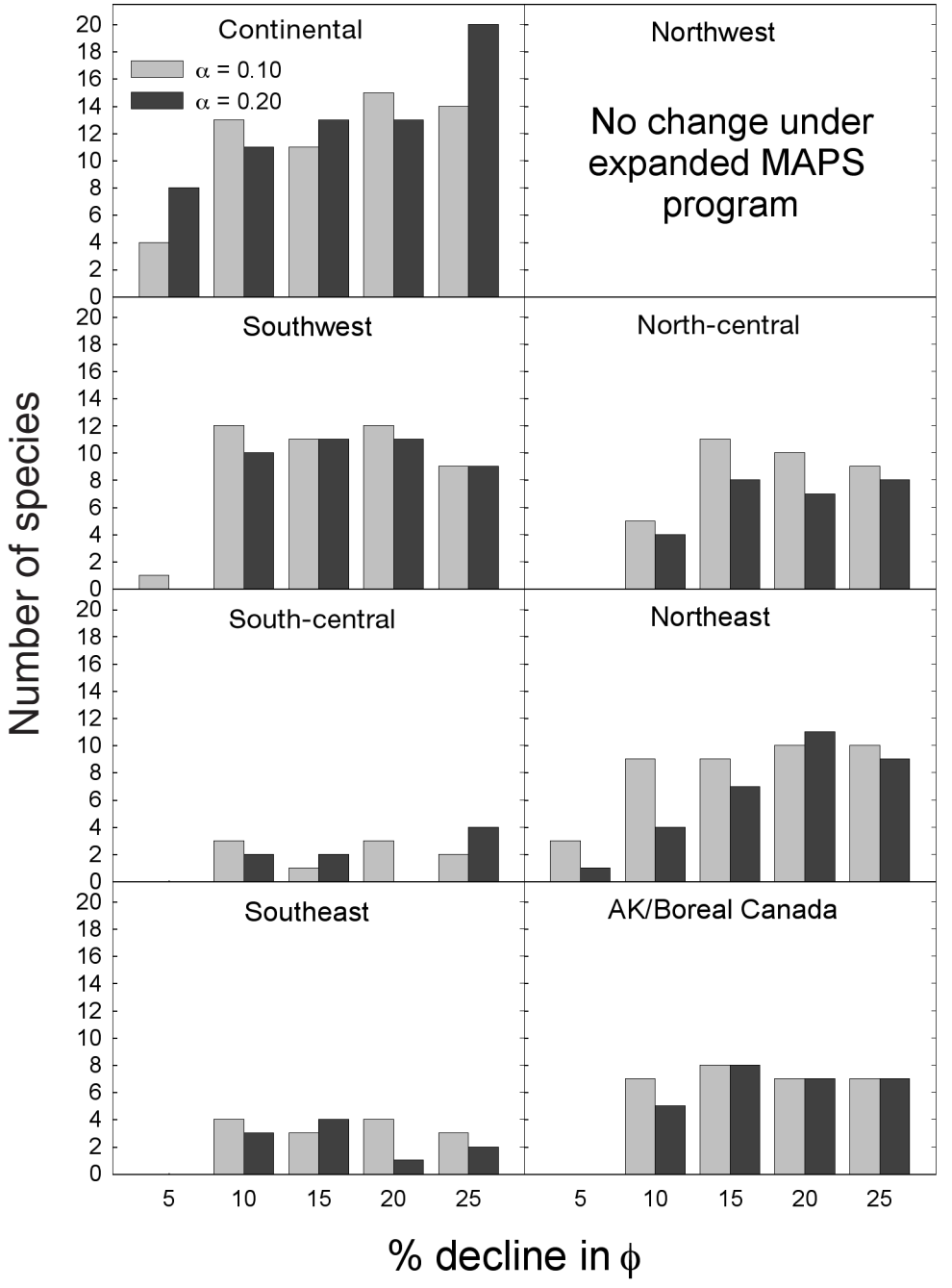

FIGURE 6. Numbers of new species for which we would likely be able to detect linear declines in survival (ϕ) with 20 yr of data under an expanded (but not targeted) MAPS program.

depends to some degree on annual variation in survival rates. As such, our calculations of the numbers of species for which survival may be effectively monitored (i.e., "monitorable species", see Methods: Evaluation of an Expanded Maps Program) at particular spatial scales may be slightly overestimated. Nevertheless, we rarely find strong evidence of time-dependent survival in MAPS data. In fact, only 46 (11%) of 411 species/region combinations for which we were able to obtain survival rate estimates with the 10-yr 1992-2001 data set showed strong evidence of time dependence (i.e., models with temporally varying survival were within 2 AIC units of time-constant models in only 11% of these cases; DeSante and Kaschube 2006). Thus, our estimates of numbers of currently monitorable species are likely reasonable.

Our assessment of program expansion options indicates that a focused approach targeting under-represented species and habitats will be required to maximize the number of species and habitats adequately monitored by MAPS. We suggest that target species be selected based not only on their habitats and ecology (and thus their inherent monitorability), but also on their status as species of conservation concern or whether they represent habitats of special management concern. This is the approach that we used to identify new target species in both the Northwest (Pyle et al. 2005) and Northeast (DeSante et al. 2008); similar analyses will need to be conducted for the remaining regions to best direct respective sampling strategies. The addition and redistribution of stations in the Northwest, as well as the undertaking of analyses to guide MAPS in the remaining six regions, would clearly be facilitated by the integration of MAPS into a broader CBM effort.

In order to address finer-scale monitoring needs, we suggest that MAPS will be most useful if sampling is targeted to capture a limited number of focal species and habitats (or management regimes), or possibly by sampling along a simple habitat gradient. For example, in our cluster-scale analysis of Pacific Northwest national forests, we were able to compare survival rate estimates for 21 species between various 6-station clusters. About half of these species met our criteria for being "adequately monitorable", and many of these were monitorable at an effect size that was actually seen (based on our estimates) between clusters of stations. Yet, an individual species being compared between clusters was often either absent or rare at many of the stations in the two clusters because stations were set up to sample a broad range of species and habitats. For example, the average number of stations at which a species was present (as a breeding resident) on the two clusters where it was most abundant was just 9.1 (out of 12 possible stations). A more focused sampling strategy would be to select a species (or set of species) of conservation concern and two habitats (e.g., three stations in each of two habitat types in each cluster) or a single habitat gradient. Such a hypothesis-driven design would require only two teams of banders (each operating six stations) and should be capable of providing inference on habitat factors influencing survival and reproduction.

The targeted hypothesis-driven sampling strategy described above lends itself well to management, as it provides testable hypotheses regarding habitat types or characteristics that promote better survival (or productivity) in populations of species of conservation concern. A similar sampling strategy can be employed to monitor demographic responses to management actions (i.e., effectiveness monitoring). Each of these targeted hypothesis-driven monitoring efforts directly supports management, has been referred to as "management-based" monitoring by the Coordinated Bird Monitoring Working Group (2004) or "targeted" monitoring by the NABCI Monitoring Subcommittee (2006), and was distinguished in those reports from "surveillance" (Coordinated Bird Monitoring Working Group 2004) or "broad-scale" (NABCI Monitoring Subcommittee 2006) monitoring, for which the goals were, among others, to provide essential information for prioritizing species for conservation actions and to identify emerging conservation issues. We feel that the distinction between "management-based" monitoring and "surveillance" monitoring is somewhat artificial, and suggest that they reflect, to some extent, the spatio-temporal continuum of questions that monitoring data can address. What is usually considered to be "management-based" monitoring typically requires a spatially intensive sampling effort that can assess changes

over relatively short time frames, while what is usually considered to be "surveillance" monitoring typically requires a spatially extensive sampling effort over a long time scale.

We argue that the MAPS is well-suited to fulfilling both "management-based" and "surveillance" monitoring goals. Indeed, the optimal sampling design of the overall MAPS program can be envisioned as collections of targeted, hypothesis-driven sampling strategies at local spatial scales that are integrated into larger regional sampling schemes. The latter, in turn, can provide much of the necessary effort required for "surveillance" monitoring at regional and continental scales. In such an overall strategy, each local hypothesis-driven sampling scheme of about 12 stations would aim for the 20-yr time horizon, which according to the power analyses presented above, would likely provide statistically significant results at the local scale. Such sets of stations would not need to be operated indefinitely to achieve the targeted monitoring objective they were designed to address. Moreover, if a number of such hypothesis-driven sampling schemes were integrated through a CBM framework, the termination of a few of the stations, even after as few as 4-5 yr, would still provide important data for the broader-scale program, provided that new stations were initiated in similar habitats within the region of interest. This is, in large part, how the current MAPS program operates – as a collection of smaller scale studies. Until now, however, little direction has been given to the establishment of new stations in such a way as to maximize the ability of the program to address monitoring questions at broader spatial scales.

We also suggest, however, that collections of integrated hypothesis-driven sampling schemes for target species and habitats involving 20-yr time horizons, even when fully coordinated at regional and continental scales, may not provide all of the broad-scale, long-term needs of a coordinated demographic monitoring program. Priority species and habitats and specific hypotheses driving any current sampling scheme may need to change as new and unforeseen threats and environmental driving forces arise (e.g., through large-scale processes such as climate change, soil and water acidification, and airborne environmental contamination) that may affect or otherwise interact with efforts to monitor habitat-specific demographic rates or demographic effects of habitat management. We suggest that some level of spatially extensive, long-term "surveillance" monitoring should be a critical component of demographic monitoring efforts, and that some number MAPS stations be operated indefinitely across the continent. We further suggest that national parks, research natural areas, and other protected areas might be optimal for this monitoring, as they tend to be relatively pristine and not subject to complicating effects of on-going land management. It is also possible that researchers utilizing protocols other than that of MAPS to collect capture-recapture data on North American landbirds could also contribute to continental-scale demographic monitoring (provided that their within- and between-year time periods of data collection are sufficient). An additional future direction of MAPS may be the solicitation of such data and the development of analytical methods that integrate them with MAPS data.

Our final discussion addresses the fact that MAPS stations, in general, are not sited according to a probabilistic sampling strategy. Thus, inferences cannot be made beyond the sample of stations being considered for any particular analysis. While it might be useful to provide inferences regarding demographic parameters for specific geographical areas at various scales, the greatest value of MAPS lies in its ability to inform conservation by identifying demographic causes of population change, inferring ultimate ecological causes of population change by relating avian demographic rates to habitat and weather variables, and evaluating the effectiveness of management strategies designed to reverse population declines and enhance depressed populations. To optimize these processes, it is appropriate to site stations according to hypothesis-driven sampling strategies that, ideally, incorporate a probabilistic element as to the exact locations of the stations. This, in fact, is the manner in which many MAPS stations are sited.

Despite the non-random distribution of stations, program-wide (continental) MAPS population trends (lambda) have been shown to be correlated with survey-wide (continental) BBS population trends derived from randomly-

sited (albeit roadside) BBS routes (Saracco et al. 2008). Interestingly, MAPS trends tended to be slightly more positive than BBS trends, likely reflecting the fact that MAPS stations often cannot be operated in poor quality habitats, such as extensive agricultural fields and highly developed or urbanized areas, in contrast to BBS routes that often traverse those habitats. Thus, the distribution of stations resulting from multiple collections of hypothesis-driven sampling schemes across the continent may not be too unrepresentative of the overall environment, at least at the program-wide (continental) scale, and the trade-off in the ability to make inferences at large geographic scales in favor of inferences regarding the effectiveness of more local habitat management actions may not be very severe.

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APPENDIX 1. Effect sizes (%) currently detectable by MAPS with 80% power and 20 years of data for 47 species in the Northwest Region. Two effect types were considered: a two-population comparison of survival (2P) and a population with linearly declining survival (LD). Effect sizes are given for two alpha-levels, 0.10 and 0.20. Note that we do not propose an expanded but not targeted program in the Northwest. See Table 2 for major habitats, Table 3 for field definitions, and Tables 3 and 5 for scientific names.

							$\alpha = 0.10$		$\alpha = 0.20$	
Species	Major habitat(s)	Sta	Ind	Res	$\hat{\phi}$	$\hat{p}$	2P	LD	2P	LD
Red-naped Sapsucker	PNC,WC,WR	28	370	36	0.366	0.544		20		20
Red-breasted Sapsucker	PNC,WC,WR	47	671	70	0.449	0.371		20		20
Hairy Woodpecker	PNC,WC,WOJ,WR	56	249	25	0.550	0.286		20	25	15
Western Wood-Pewee	PNC,WC,WR	54	1015	86	0.513	0.336	20	15	20	15
“Traill's” Flycatcher	SSD,WR	32	1115	77	0.524	0.460	20	15	15	10
Hammond's Flycatcher	PNC,WC	53	1142	105	0.453	0.404	20	15	15	15
Dusky Flycatcher	SSD,PNC,WC	47	1903	133	0.488	0.421	15	15	15	10
“Western” Flycatcher	PNC,WC	54	1681	118	0.481	0.314	20	15	15	15
Warbling Vireo	PNC,WC,WR	86	3560	306	0.479	0.422	10	10	10	10
Black-capped Chickadee	PNC,WC,WR	43	831	73	0.466	0.443	20	15	15	15
Mountain Chickadee	PNC,WC	41	891	60	0.471	0.414	25	15	20	15
Bewick's Wren	SSD,CSS	13	168	22	0.452	0.461		20	25	15
House Wren	SSD,WR	27	597	57	0.278	0.373				25
Winter Wren	PNC,WC	37	926	70	0.375	0.521	25	20	20	15
Ruby-crowned Kinglet	PNC,WC	14	628	50	0.255	0.275				25
Veery	PNC,WR	4	92	12	0.714	0.386		25	25	20
Swainson's Thrush	PNC,WC,WR	78	7394	856	0.586	0.629	5	5	5	5
Hermit Thrush	PNC,WC	35	808	66	0.461	0.537	20	15	15	15
American Robin	SSD,PNC,WC,WOJ,WR	116	3947	370	0.575	0.258	10	10	10	10
Varied Thrush	PNC	30	388	26	0.494	0.407		25		20
Wrentit	SSD,CSS	21	487	58	0.527	0.637	15	15	15	10
Gray Catbird	SSD,WR	12	584	51	0.561	0.450	15	10	15	10
Orange-crowned Warbler	SSD,WOJ	40	1468	94	0.481	0.418	20	15	15	15
Yellow Warbler	SSD,WR	49	4086	363	0.571	0.493	5	10	5	5
Yellow-rumped Warbler	PNC,WC	60	2906	217	0.486	0.208	20	15	15	15
Townsend's Warbler	PNC	23	823	82	0.451	0.216		20		20
American Redstart	WR	7	304	24	0.443	0.526		25		20
MacGillivray's Warbler	SSD,PNC,WC	85	5763	542	0.479	0.614	5	10	5	10

APPENDIX 1. Continued.

Species	Major habitat(s)	Sta	Ind	Res	$\hat{\phi}$	$\hat{p}$	$\alpha = 0.10$ 2P	$\alpha = 0.10$ LD	$\alpha = 0.20$ 2P	$\alpha = 0.20$ LD
Common Yellowthroat	SSD	27	1452	153	0.499	0.556	15	10	10	10
Wilson's Warbler	SSD,PNC,WC	56	3638	265	0.438	0.526	15	10	10	10
Yellow-breasted Chat	SSD,WR	15	873	89	0.448	0.560	20	15	20	15
Western Tanager	PNC,WC	73	1386	100	0.538	0.129		20	25	15
Green-tailed Towhee	SSD,CSS	5	209	21	0.602	0.360		20	25	15
Spotted Towhee	SSD,WR,CSS	42	955	88	0.476	0.508	15	15	15	10
Savannah Sparrow	SSD	2	321	31	0.585	0.285	25	15	20	15
Fox Sparrow	SSD,PNC,WC	25	505	44	0.553	0.451	15	10	15	10
Song Sparrow	SSD.WR	98	5868	643	0.470	0.598	5	10	5	5
Lincoln's Sparrow	SSD,PNC,WC	37	2091	267	0.432	0.631	10	10	10	10
White-crowned Sparrow	SSD	14	598	61	0.474	0.544	20	15	15	15
Dark-eyed Junco	SSD,PNC,WC	83	5217	533	0.461	0.500	10	10	5	10
Black-headed Grosbeak	PNC,WC,WOJ,WR	68	2057	155	0.568	0.280	10	10	10	10
Lazuli Bunting	SSD,WR,CSS	25	1074	62	0.552	0.245	25	20	25	15
Red-winged Blackbird	SSD	18	799	42	0.784	0.148	15	10	10	10
Brown-headed Cowbird	SSD,WR	60	748	68	0.486	0.485	20	15	15	15
Bullock's Oriole	WOJ,WR	19	497	25	0.454	0.429		15	25	15
Purple Finch	PNC,WC	32	2386	155	0.434	0.364	20	15	20	15
American Goldfinch	SSD,WR	20	1434	108	0.470	0.328	20	15	15	15

APPENDIX 2. Effect sizes (%) currently detectable by MAPS with 80% power and 20 yrs of data, and likely detectable under an expanded MAPS program, for 42 species in the Southwest Region. Two effect types were considered: a two-population comparison of survival (2P) and a population with linearly declining survival (LD). Effect sizes are given for two alpha-levels, 0.10 and 0.20. See Table 2 for major habitats, Table 3 for field definitions, and Tables 3 and 5 for scientific names.

		Current									Expanded			
							$\alpha = 0.10$		$\alpha = 0.20$		$\alpha = 0.10$		$\alpha = 0.20$	
Species	Major habitat(s)	Sta	Ind	Res	$\hat{\phi}$	$\hat{p}$	2P	LD	2P	LD	2P	LD	2P	LD
Red-naped Sapsucker	WC,WR	4	119	23	0.494	0.665	25	15	20	15	20	15	15	15
Nuttall's Woodpecker	WOJ,WR	16	195	28	0.551	0.381	25	15	20	15	20	15	15	15
Downy Woodpecker	SSD,WOJ,WR	20	217	24	0.605	0.431	20	15	20	15	15	10	15	10
Olive-sided Flycatcher	WC	2	55	3	0.870	0.724	25	20	20	15	15	10	10	10
Western Wood-Pewee	WC,WOJ,WR	15	278	27	0.384	0.446		25		20	25	20	25	15
"Western" Flycatcher	WC	15	892	43	0.595	0.183		25	25	20	25	15	20	15
Ash-throated Flycatcher	WOJ,CSS	31	676	80	0.659	0.137	15	15	15	10	10	10	10	10
Bell's Vireo	WR	5	112	15	0.482	0.596		20		15	25	15	20	15
Warbling Vireo	WC,WR	15	1253	52	0.539	0.460	20	15	20	15	15	10	15	10
Steller's Jay	WC	9	98	13	0.762	0.234			25		20	15	15	15
Black-capped Chickadee	WC,WR	7	110	17	0.366	0.600		25		20		20	25	15
Mountain Chickadee	WC	10	254	39	0.408	0.292		25		25		20	25	20
Chestnut-backed Chickadee	WC	6	259	41	0.501	0.512	25	15	20	15	15	15	15	10
Oak Titmouse	WOJ	11	153	18	0.514	0.358				25		20	25	15
Juniper Titmouse	WOJ	4	44	9	0.655	0.409				25	25	15	20	15
Bushtit	SSD,WOJ,CSS	30	975	171	0.300	0.152				25		25		20
Bewick's Wren	SSD,CSS	38	1047	137	0.424	0.538	15	15	15	15	15	10	10	10
House Wren	SSD,WOJ,WR	27	941	113	0.388	0.439	20	15	15	15	15	10	15	10
Swainson's Thrush	WC,WR	8	1819	121	0.619	0.578	10	10	10	10	5	10	5	5
Hermit Thrush	WC	9	410	75	0.450	0.400	25	15	20	15	15	15	15	10
American Robin	SSD,WC,WOJ,WR	27	706	90	0.529	0.309	20	15	15	15	15	10	15	10
Wrentit	SSD,CSS	16	838	106	0.540	0.618	15	10	10	10	10	10	10	10
Orange-crowned Warbler	SSD,WOJ	15	1076	79	0.413	0.318		20	25	20	20	15	20	15
Virginia's Warbler	SSD,WOJ	9	283	23	0.484	0.395		25		20		15	25	15
Yellow Warbler	SSD,WR	18	1097	110	0.479	0.526	15	10	15	10	10	10	10	10
Common Yellowthroat	SSD	22	1624	178	0.525	0.426	10	10	10	10	10	10	10	10
Wilson's Warbler	SSD,WC	9	2609	124	0.446	0.510	20	15	15	15	15	10	10	10
Yellow-breasted Chat	SSD,WR	17	750	108	0.522	0.521	15	10	15	10	10	10	10	10

APPENDIX 2. Continued.

							Current				Expanded			
							α = 0.10		α = 0.20		α = 0.10		α = 0.20	
Species	Major habitat(s)	Sta	Ind	Res	$\hat{\phi}$	$\hat{p}$	2P	LD	2P	LD	2P	LD	2P	LD
Summer Tanager	WR	6	125	23	0.506	0.451		20	25	15	20	15	20	15
Spotted Towhee	SSD,WOJ,WR,CSS	36	1170	165	0.496	0.430	10	10	10	10	10	10	10	10
California Towhee	SSD	17	392	62	0.536	0.356	25	15	20	15	20	15	15	10
Fox Sparrow	SSD,WC	3	95	11	0.519	0.551				20		20	25	15
Song Sparrow	SSD,WR	26	2101	288	0.520	0.479	10	10	10	10	10	10	5	10
Lincoln's Sparrow	SSD,WC	3	112	18	0.437	0.876		20	25	20	20	15	20	15
Dark-eyed Junco	SSD,WC	8	336	49	0.387	0.560	20		25	15	20	15	20	15
Black-headed Grosbeak	WC,WOJ,WR	35	1684	157	0.526	0.345	15	15	15	10	10	10	10	10
Blue Grosbeak	WR	11	187	17	0.409	0.408				25		20		20
Lazuli Bunting	SSD,WR,CSS	21	643	41	0.372	0.473		20	25	20	25	15	20	15
Red-winged Blackbird	SSD	9	232	41	0.880	0.037			20		15		15	
Brown-headed Cowbird	SSD,WR	30	275	38	0.463	0.568	25	15	20	15	20	15	15	10
Bullock's Oriole	WOJ,WR	18	566	46	0.458	0.377	15		25	15	20	15	20	15
Purple Finch	WC	7	932	96	0.531	0.304	20	15	15	15	15	10	10	10

APPENDIX 3. Effect sizes (%) currently detectable by MAPS with 80% power and 20 yrs of data, and likely detectable under an expanded MAPS program, for 25 species in the North-central Region. Two effect types were considered: a two-population comparison of survival (2P) and a population with linearly declining survival (LD). Effect sizes are given for two alpha-levels, 0.10 and 0.20. See Table 2 for major habitats, Table 3 for field definitions, and Tables 3 and 5 for scientific names.

		Current									Expanded			
							$\alpha = 0.10$		$\alpha = 0.20$		$\alpha = 0.10$		$\alpha = 0.20$	
Species	Major habitat(s)	Sta	Ind	Res	$\hat{\phi}$	$\hat{p}$	2P	LD	2P	LD	2P	LD	2P	LD
"Traill's" Flycatcher	SSD,NC,NH	12	649	49	0.484	0.509	20	15	20	15	15	10	15	10
Least Flycatcher	NH	12	847	68	0.368	0.431	25	20	20	15	15	15	15	15
Red-eyed Vireo	NH,SH	24	631	42	0.534	0.391		20	25	15	20	15	20	15
Black-capped Chickadee	NC,NH	28	654	50	0.417	0.394		25		20	25	20	20	15
Tufted Titmouse	NH,SH	10	163	17	0.555	0.407		20		20	20	15	20	15
House Wren	SSD	18	892	83	0.322	0.440		20	25	20	20	20	20	15
Veery	NH	9	390	45	0.575	0.586	15	10	10	10	10	10	10	10
Wood Thrush	NH,SH	12	263	31	0.453	0.317		20		20	25	15	20	15
American Robin	SSD,NC,NH,SH	26	787	39	0.380	0.423		25		25		20	25	20
Gray Catbird	SSD,NH,SH	23	2196	196	0.497	0.478	10	10	10	10	10	10	10	10
Yellow Warbler	SSD	15	1336	123	0.548	0.398	15	15	15	10	10	10	10	10
Chestnut-sided Warbler	SSD,NH	4	380	42	0.378	0.572		20	25	20	20	15	20	15
American Redstart	NH,SH	11	605	44	0.454	0.282		20	25	15	20	15	15	15
Kentucky Warbler	SH	2	88	12	0.610	0.698		15	25	15	20	15	15	10
Mourning Warbler	SSD,NC	3	122	15	0.421	0.608		25		25		20	25	20
Common Yellowthroat	SSD	24	1299	117	0.433	0.498	20	15	15	15	15	10	10	10
Field Sparrow	SSD	8	593	61	0.426	0.392		20		20	25	15	20	15
Song Sparrow	SSD	22	1137	117	0.444	0.517	20	15	15	15	15	10	10	10
Swamp Sparrow	SSD	6	201	14	0.386	0.776		25		20	25	20	25	15
White-throated Sparrow	NC	3	309	33	0.383	0.621		20	25	15	20	15	20	15
Northern Cardinal	SSD,NH,SH	18	603	50	0.539	0.355	25	15	25	15	20	15	15	15
Indigo Bunting	SSD	16	793	70	0.518	0.312	25	15	20	15	15	15	15	10
Brown-headed Cowbird	SSD	22	219	18	0.487	0.411				25		20	25	15
Baltimore Oriole	NH,SH	14	309	29	0.615	0.184				25	25	20	25	15
American Goldfinch	SSD	21	1635	164	0.347	0.360		20	25	20	20	20	15	15

APPENDIX 4. Effect sizes (%) currently detectable by MAPS with 80% power and 20 yrs of data, and likely detectable under an expanded MAPS program, for 22 species in the South-central Region. Two effect types were considered: a two-population comparison of survival (2P) and a population with linearly declining survival (LD). Effect sizes are given for two alpha-levels, 0.10 and 0.20. See Table 2 for major habitats, Table 3 for field definitions, and Tables 3 and 5 for scientific names.

		Current									Expanded			
							$\alpha = 0.10$		$\alpha = 0.20$		$\alpha = 0.10$		$\alpha = 0.20$	
Species	Major habitat(s)	Sta	Ind	Res	$\hat{\phi}$	$\hat{p}$	2P	LD	2P	LD	2P	LD	2P	LD
Acadian Flycatcher	SH	6	349	27	0.583	0.478	20	15	20	15	20	15	15	10
White-eyed Vireo	SSD,SH	24	1380	117	0.601	0.498	10	10	10	10	10	10	10	10
Bell's Vireo	SSD	12	450	41	0.593	0.377	20	15	20	15	20	15	15	15
Red-eyed Vireo	NH,SH	15	328	30	0.575	0.221				25		25	25	20
Tufted Titmouse	NH,SH	24	318	36	0.486	0.296		20	25	15	25	15	25	15
Carolina Wren	SH,SC	31	888	79	0.459	0.517	15	15	15	10	15	10	15	10
Bewick's Wren	SSD	21	480	44	0.431	0.498		20	25	20	25	20	25	15
Gray Catbird	SSD,NH,SH	9	741	57	0.581	0.467	15	10	15	10	15	10	10	10
Brown Thrasher	SSD	15	288	15	0.408	0.572				25		25		25
Long-billed Thrasher	SSD,SBE	3	133	12	0.628	0.396				25		25		20
Blue-winged Warbler	SSD,SH	4	244	18	0.555	0.490	25	15	20	15	20	15	20	15
Yellow Warbler	SSD	3	103	13	0.353	0.515				25				25
Kentucky Warbler	SH	11	457	41	0.608	0.535	15	15	15	10	15	10	15	10
Common Yellowthroat	SSD	14	440	36	0.471	0.478	25	15	20	15	20	15	20	15
Yellow-breasted Chat	SSD	8	651	72	0.521	0.391	25	15	20	15	20	15	15	15
Summer Tanager	SH,SC	19	223	17	0.531	0.377				25		25		20
Olive Sparrow	SBE	3	208	24	0.510	0.738	20	15	20	15	20	15	15	15
Field Sparrow	SSD	31	1108	108	0.482	0.343	20	15	15	15	15	15	15	10
Northern Cardinal	SSD,NH,SH,SC	48	2475	245	0.581	0.356	10	10	10	10	10	10	10	10
Indigo Bunting	SSD	23	1181	111	0.459	0.422	20	15	15	15	15	15	15	10
Painted Bunting	SSD	31	1591	103	0.558	0.439	10	10	10	10	10	10	10	10
Brown-headed Cowbird	SSD	39	477	40	0.474	0.364		20	25	15	25	15	20	15

APPENDIX 5. Effect sizes (%) currently detectable by MAPS with 80% power and 20 yrs of data, and likely detectable under an expanded MAPS program, for 38 species in the Northeast Region. Two effect types were considered: a two-population comparison of survival (2P) and a population with linearly declining survival (LD). Effect sizes are given for two alpha-levels, 0.10 and 0.20. See Table 2 for major habitats, Table 3 for field definitions, and Tables 3 and 5 for scientific names.

		Current									Expanded			
							$\alpha = 0.10$		$\alpha = 0.20$		$\alpha = 0.10$		$\alpha = 0.20$	
Species	Major habitat(s)	Sta	Ind	Res	$\hat{\phi}$	$\hat{p}$	2P	LD	2P	LD	2P	LD	2P	LD
Downy Woodpecker	NH,SH	49	414	28	0.445	0.525		25		20	25	20	25	15
"Traill's" Flycatcher	SSD,NC,NH	17	636	30	0.502	0.541	25	15	25	15	20	15	15	15
Eastern Phoebe	SSD,NH,SH	24	238	11	0.571	0.405				25		20	25	15
White-eyed Vireo	SSD,SH	13	295	37	0.479	0.396		20	25	15	25	15	20	15
Red-eyed Vireo	NH,SH	55	1459	130	0.582	0.295	10	10	10	10	10	10	10	10
Blue Jay	NH,SN	43	268	7	0.869	0.164	25		20		15		10	15
Carolina Chickadee	SH	19	187	9	0.484	0.449				25		20		20
Black-capped Chickadee	NC,NH	50	1099	114	0.514	0.294	20	15	15	15	15	10	10	10
Tufted Titmouse	NH,SH	36	411	51	0.393	0.298		25		20	25	20	20	15
Veery	NH	41	1792	244	0.577	0.574	10	10	5	10	5	5	5	5
Swainson's Thrush	NC	6	91	13	0.621	0.686	25	15	25	15	20	15	15	10
Hermit Thrush	NC,NH	21	328	47	0.457	0.631	20	15	15	15	15	10	10	10
Wood Thrush	NH,SH	53	1981	177	0.424	0.403	20	15	15	15	15	15	15	10
American Robin	SSD,NC,NH,SH,SC	54	1479	115	0.429	0.329	25	20	20	15	20	15	15	15
Gray Catbird	SSD,NH,SH	50	4849	495	0.515	0.460	10	10	5	10	5	10	5	5
Blue-winged Warbler	SSD,SH	18	352	26	0.442	0.387				25		25		20
Yellow Warbler	SSD	28	1268	108	0.509	0.475	15	10	15	10	10	10	10	10
Chestnut-sided Warbler	SSD,NH	18	459	47	0.475	0.527	20	15	20	15	15	15	15	10
Magnolia Warbler	NC	11	401	31	0.346	0.738		25		20	25	20	20	20
Yellow-rumped Warbler	NC	11	292	31	0.460	0.501	25	15	20	15	20	15	15	15
Black-thr. Green Warbler	NC,SC	17	337	39	0.402	0.589	25	20	25	15	20	15	15	15
Black-and-white Warbler	NC,NH,SH	40	667	72	0.502	0.301	25	15	20	15	15	15	15	10
American Redstart	NH,SH	36	1943	171	0.525	0.331	15	10	15	10	10	10	10	10
Worm-eating Warbler	SH	12	405	32	0.520	0.395		20		20	25	15	20	15
Ovenbird	NC,NH,SH	51	1752	166	0.557	0.425	10	10	10	10	5	10	5	5
Louisiana Waterthrush	SH	11	185	13	0.477	0.745		20	25	15	20	15	20	15
Common Yellowthroat	SSD	45	2263	209	0.502	0.493	10	10	10	10	10	10	10	10
Hooded Warbler	SH	15	499	45	0.460	0.610	20	15	15	15	15	10	10	10

APPENDIX 5. Continued.

		Current									Expanded		
							α = 0.10		α = 0.20		α = 0.10		α = 0.20	
Species	Major habitat(s)	Sta	Ind	Res	$\hat{\phi}$	$\hat{p}$	2P	LD	2P	LD	2P	LD	2P	LD
Yellow-breasted Chat	SSD	7	214	22	0.501	0.356		25		20		20	25	15
Eastern Towhee	SSD,SC	35	543	61	0.489	0.331	25	15	20	15	20	15	15	10
Song Sparrow	SSD	37	1192	117	0.336	0.511	25	20	20	20	20	15	15	15
Swamp Sparrow	SSD	8	131	15	0.422	0.721		25		25		20	25	20
White-throated Sparrow	NC	14	537	58	0.289	0.583		20	25	20	20	20	20	15
Northern Cardinal	SSD,NH,SH,SC	41	826	76	0.618	0.365	15	15	15	10	10	10	10	10
Indigo Bunting	SSD	26	504	41	0.465	0.543	25	15	20	15	15	15	15	10
Red-winged Blackbird	SSD	20	471	24	0.587	0.320		20	25	15	20	15	15	15
Baltimore Oriole	NH,SH	22	305	18	0.418	0.476				25		20		20
American Goldfinch	SSD	39	1780	102	0.442	0.209		25		25		20	25	20

APPENDIX 6. Effect sizes (%) currently detectable by MAPS with 80% power and 20 yrs of data, and likely detectable under an expanded MAPS program, for 21 species in the Southeast Region. Two effect types were considered: a two-population comparison of survival (2P) and a population with linearly declining survival (LD). Effect sizes are given for two alpha-levels, 0.10 and 0.20. See Table 2 for major habitats, Table 3 for field definitions, and Tables 3 and 5 for scientific names.

		Current									Expanded			
							$\alpha = 0.10$		$\alpha = 0.20$		$\alpha = 0.10$		$\alpha = 0.20$	
Species	Major habitat(s)	Sta	Ind	Res	$\hat{\phi}$	$\hat{p}$	2P	LD	2P	LD	2P	LD	2P	LD
Downy Woodpecker	NH,SH	61	381	16	0.620	0.344		25		20	25	15	20	15
Acadian Flycatcher	SH	47	1786	150	0.483	0.556	15	10	10	10	10	10	10	10
White-eyed Vireo	SSD,SH	43	1012	103	0.465	0.561	15	10	15	10	10	10	10	10
Red-eyed Vireo	NH,SH	56	2230	224	0.620	0.212	15	10	10	10	10	10	10	10
Carolina Chickadee	SH	65	569	44	0.493	0.282		20	25	15	20	15	20	15
Tufted Titmouse	NH,SH	67	948	93	0.511	0.434	15	15	15	10	10	10	10	10
Carolina Wren	SH,SC	65	1367	149	0.369	0.582	15	10	15	10	10	10	10	10
Wood Thrush	NH,SH	56	2635	258	0.455	0.552	10	10	10	10	15	15	15	15
Gray Catbird	SSD,NH,SH	25	1054	86	0.428	0.477	20	15	20	15	10	10	5	10
Blue-winged Warbler	SSD,SH	9	286	31	0.558	0.279	25	15	20	15	20	15	15	10
Worm-eating Warbler	SH	16	309	28	0.529	0.404		20		20	25	15	20	15
Ovenbird	NH,SH	46	1588	136	0.528	0.480	15	10	10	10	20	15	15	15
Louisiana Waterthrush	SH	19	295	31	0.520	0.516	25	15	25	15	10	10	10	10
Kentucky Warbler	SH	35	1232	137	0.507	0.600	10	10	10	10	10	10	10	10
Common Yellowthroat	SSD	41	1422	116	0.439	0.503	20	15	15	15	15	10	15	10
Hooded Warbler	SH	29	619	59	0.514	0.525	20	15	15	15	15	15	15	10
Yellow-breasted Chat	SSD	24	524	65	0.292	0.323				25		25		20
Eastern Towhee	SSD,SC	45	279	31	0.472	0.344		20		20	25	15	20	15
Song Sparrow	SSD	2	167	15	0.410	0.520				25		25		20
Northern Cardinal	SSD,NH,SH,SC	69	2105	237	0.543	0.392	15	10	10	10	10	10	10	10
Indigo Bunting	SSD	47	1220	120	0.521	0.306	20	15	15	15	15	10	10	10

APPENDIX 7. Effect sizes (%) currently detectable by MAPS with 80% power and 20 yrs of data, and likely detectable under an expanded MAPS program, for 19 species in the Alaska/Boreal Canada Region. Two effect types were considered: a two-population comparison of survival (2P) and a population with linearly declining survival (LD). Effect sizes are given for two alpha-levels, 0.10 and 0.20. See Table 2 for major habitats, Table 3 for field definitions, and Tables 3 and 5 for scientific names.

		Current									Expanded			
							$\alpha = 0.10$		$\alpha = 0.20$		$\alpha = 0.10$		$\alpha = 0.20$	
Species	Major habitat(s)	Sta	Ind	Res	$\hat{\phi}$	$\hat{p}$	2P	LD	2P	LD	2P	LD	2P	LD
"Traill's" Flycatcher	SSD	13	584	28	0.383	0.506		25		20	20	15	20	15
Black-capped Chickadee	BH	10	244	28	0.426	0.401				25		20	25	20
Boreal Chickadee	BC	10	132	16	0.492	0.365				25	25	15	25	15
Arctic Warbler	SSD	2	249	25	0.339	0.605		25		25	25	20	25	20
Gray-cheeked Thrush	SSD,BC	6	253	27	0.459	0.683	25	15	20	15	15	10	15	10
Swainson's Thrush	BC	16	837	76	0.456	0.590	15	10	15	10	10	10	10	10
Hermit Thrush	BC,BH	9	611	57	0.499	0.766	15	10	15	10	10	10	10	10
Orange-crowned Warbler	SSD	16	1324	96	0.413	0.504	20	15	20	15	15	10	10	10
Yellow Warbler	SSD	9	1114	80	0.445	0.456	25	15	20	15	15	10	10	10
Yellow-rumped Warbler	BC,BH	16	680	48	0.367	0.432		20	25	20	15	15	15	15
American Redstart	BH	2	256	21	0.571	0.308		20	25	15	15	15	15	10
Northern Waterthrush	SSD,BC	9	213	15	0.528	0.725		15	25	15	15	15	15	10
Wilson's Warbler	SSD,BC	15	2861	182	0.366	0.565	15	15	15	10	10	10	10	10
Canada Warbler	BH	2	149	14	0.462	0.475		20		25	25	15	20	15
American Tree Sparrow	SSD	7	199	15	0.483	0.500		20		25	20	15	20	15
Fox Sparrow	SSD	13	391	31	0.518	0.556	25	15	20	15	15	10	15	10
White-crowned Sparrow	SSD	13	626	65	0.435	0.412		20		20	20	15	15	15
Golden-crowned Sparrow	SSD,BC	5	279	30	0.533	0.490	25	15	25	15	15	15	15	10
Dark-eyed Junco	BC,BH	15	630	67	0.309	0.636		20	25	20	15	15	15	15

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THE ILLEGAL PARROT TRADE IN LATIN AMERICA AND ITS CONSEQUENCES TO PARROT NUTRITION, HEALTH AND CONSERVATION[1]

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Abstract. Second only to the trafficking of narcotics, the illegal wildlife trade is booming in neotropical countries such as those in Latin America which are rich in the diversity of some of the world's most enigmatic species. Parrots are one of the species most affected by this trade, which has occurred for over a thousand years but has become one of the leading reasons why so many parrot species are on the brink of extinction. There is a high demand for parrots as pets not only by people in developed nations, such as the United States, but also from people in countries where parrots are native. Sadly, few people who keep parrots truly understand their requirements for survival and the majority of parrots involved in the trade are kept in poor conditions and on inadequate diets. Hypovitaminosis A is the nutritional disorder most commonly seen in captive parrots in Latin American countries. This paper presents a review of the parrot trade in Latin America and of hypovitaminosis A in parrots. A relationship between these two subjects is established to show how knowledge of proper nutrition may aid conservation.

Key words: Latin America, hypovitaminosis A, malnourishment, parrot conservation, Parrot trade.

EL COMERCIO ILÍCITO DE LOROS EN AMÉRICA LATINA Y SUS CONSECUENCIAS PARA LA NUTRICIÓN, SALUD Y CONSERVACIÓN DE LOS LOROS

Resumen. El comercio ilícito de fauna silvestre, sólo superado por el narcotráfico, está en pleno auge en países neotropicales como los de América Latina, ricos en especies de entre las más enigmáticas del mundo. Los loros son de las especies más afectadas por este comercio, cuya historia se remonta a miles de años, pero que se ha convertido una de las principales causas de que muchas especies de loros estén al borde de la extinción. Existe una gran demanda de loros para mascotas no sólo en países desarrollados como EEUU, sinó también en países donde los loros son nativos. Lamentablemente, poca gente que tiene loros comprende sus necesidades y la mayoría de loros en el comercio ilícito sufren condiciones y dietas inadecuadas. Hipovitaminosis A es la dolencia más común observada en loros en cautiverio en países de América Latina. Este artículo revisa el comercio de loros en América Latina y el efecto de la hipovitaminosis A. Establecemos una relación entre estos dos temas para mostrar cómo conocimientos sobre nutrición pueden ayudar a la conservación.

Palabras clave: América Latina, hipovitaminosis A, desnutrición, conservación de loros, comercio de loros.

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INTRODUCTION

Here is a common scene in, for example, downtown Lima, Peru: a Cherry-headed Conure (*Aratinga erythrogenys*) perches precariously against the bars of an old rusted bird cage with a door too small to exit safely. The cage is dented on one side and tossed haphazardly onto the top of a trash heap inside a small dumpster. The bird is emaciated, severely dehydrated and plucked. A half eaten corncob sits in one corner of the cage, a fresh layer of fuzzy mold growth coats one end. A mob of people passes down a walkway next to the dumpster. It is a chaotic site as the people press forward into the small pet stores lining the path. Inside, there are dirty cages filled with puppies, kittens, parakeets, fish and lovebirds as well as a host of different pet supplies. Nervous shopkeepers watch potential customers carefully, each vying for the buying attention of the market's clientele. One person stops beside the dumpster and takes note of the conure in the cage. An anxious shopkeeper rushes over and declares the bird can be purchased for $6.00 and if this particular bird is not satisfactory, arrangements can be made to find another one. This dirty, though seemingly legally operating pet store is in fact a front for one of Peru's most lucrative illegal markets. Above the store in rooms the size of a warehouse, parrots recently shipped in from the Amazon jungle are housed. A potential buyer need only quietly ask one of the shopkeepers in the store below if they know where a parrot can be found. "What kind of a parrot?" would be the return question asked (which is usually followed by "a parrot that talks.") "I have just the thing for you!" The shopkeeper disappears and within minutes, one of the 148 species of South American parrots is presented. Its wing feathers are hacked off, it is stuffed into a small rusted wire cage and its proud new owner is told to feed it a corncob a day.

This scenario occurs on a daily basis in the parrot markets of Latin American countries. Parrots are harvested from the lands of their birth and sold from one trader to another. This chain of people may take any one parrot to a crowded city far from its known habitat and food sources, placed into the care of people with no knowledge of a parrot's unique requirements for survival in captivity. Malnutrition and disease leading to death is common. A parrot's life span in the trade is typically so short that there is a constant demand for more, and more of the world's habitats are increasingly drained of its parrot species.

The authors of this paper were able to observe many of these events first hand through work with avian veterinarians in Peru and Costa Rica. Herein, we will briefly review the Latin America parrot trade, and will discuss as well the conditions under which "pet" parrots are living in these countries. The most common disease condition observed in these birds is hypovitaminosis A (Rivero Salinas 2007). This paper also presents a review of hypovitaminosis A in parrots and the diseases to which it predisposes. In all, this paper aims to demonstrate the close relationship between hypovitaminosis A and the never-ending cycle of the parrot trade, and ultimately the effects on parrot populations.

THE PARROT TRADE

The history of the parrot trade goes back thousands of years. People have always desired to own something beautiful, a piece of nature that cannot quite be tamed. Alexander the Great, Marie Antoinette, Henry VIII, and Theodore Roosevelt all had parrots. Christopher Columbus brought Cuban Amazons (*Amazona leucocephala*) back to Spain after discovering the New World. In the southwest United States (US), petroglyphs depicting parrots can be seen, indicating that there existed a trade in psittacine birds among the cultures of Middle America (Graham 1998). A common southwestern figure, the kokopelli, was frequently depicted with non-native macaws (*Ara* spp.). In addition, skeletal remains of scarlet macaws *Ara macao* can be found in burial sites of the Mogollon people in southern Arizona. These are but a few examples of the history human beings have shared with psittacine birds, a relationship continuing to the present day.

According to the *US Pet Ownership and Demographics Sourcebook* (American Veterinary Medical Association 2008), in the US, 3.9% of the nation's households own birds. These pet birds include finches, canaries, chickens, doves and parrots. That equates to over 11,199,000 pet birds, 75% of which are psittacines. The psittacine species in the US are not native; they are either domestically bred or imported from other countries. While this demonstrates a

strong presence of parrot species within the US, these figures pale in comparison to the number of parrots kept in captivity within their native countries. One study found that 24% of Costa Rican households keep one or more parrots (Drews 2002). This same study determined that despite sentimental feelings towards their pets, birds in general were kept in enclosures too small, isolated from con-specifics, maintained with an inadequate diet, had rare veterinary care and a high mortality rate. This high mortality rate caused owners to seek replacements from the wild (Drews 2002). This kind of "parrot culture" can be seen in many Latin American countries and is the driving force behind the local parrot trade.

In Peru, there are two forms of the parrot trade. The first is the legal trade, in which a "quota" of certain species is established by the government and parrot harvesters operate under a government license. The quota is supposedly based on thorough population and habitat studies and is meant to remove "surplus" individuals from the wild population (Munn 2006). The problem with this method is that the agency responsible for determining the quotas is understaffed and underpaid. Therefore, there is no real basis on which to establish numbers of parrots that can be safely removed from the wild without significantly harming the species (Munn 2006, Mendoza 2008). Parrots taken for the legal trade are most likely to be exported to other countries.

The second type of trade in Peru (and other Latin American countries) is the illegal one. This is much more common since it is not necessary to obtain permission and a license (Mendoza 2008). This illegal take has been banned in Peru since 1973, but it is still a common practice in many parts of the country (Gonzalez 2003).

The multi-million dollar parrot trade has three main markets: international, local, and the extended local market. The international market is where parrots are exported (legally or illegally) from their country of origin to another country. Until 1992, the US represented 80% of the international market for neotropical psittacines (Munn 2006). In 1992, the Wild Bird Conservation Act banned the importation of parrots into the US and significantly diminished demand in the international trade. In 2007, the European Union passed a similar act.

Currently, the local or extended local markets are the bulk of the parrot trade in Latin America, for instance particularly in Costa Rica (Mendoza 2008, Gonzalez 2003, Guzman et al. 2007). The local markets are where parrots are taken from their habitats and either kept by the family who caught them, given to a friend as a gift or sold in nearby villages. This activity was described to us as going to the market to buy fruit or bread for one's family and adding a parrot to the list of purchases (Mendoza 2008). Very little money is gained for this transaction, although selling a large number of parrots may be a way to supplement a family's income.

Extended local markets are seen in Lima, Peru. This is where parrots are taken from the Amazon jungle and transported hundreds of kilometers away to the capital city. In this was several chains of people can make a living, and parrots eventually end up in a city dweller's apartment (with an owner who knows nothing about it), surrounded by unknown foods, an unknown climate and an alien habitat (Rivero Salinas 2007, Mendoza 2008).

There are approximately 300 species of parrots in the world, and nearly a third is highly endangered (Snyder et al. 2000). Latin America contains almost 44% of the world's avifauna including 148 species in 27 different genera of parrots. Sizes range from the pocket-sized parrotlets (*Forpus* spp.), to the hyacinth macaw (*Anodorhynchus hyacinthinus*), the largest parrot in the world. Forty-two of these species are at risk from extinction (Snyder et al. 2000). The two most common reasons for threatened parrot populations include habitat destruction and exploitation of parrots for the pet trade (Snyder et al. 2000, Collar and Juniper 1992). During 1990 to 1994, nearly two million parrots were traded on the world market (Snyder et al. 2000). Few additional studies have been done to accurately quantify the numbers of parrots involved. Even fewer studies have been done to quantify the magnitude of local trades despite there being a strong tradition in neotropical countries for keeping parrots in captivity (Gonzales 2003, Guzman et al. 2007).

In Peru, one study related to the local trade was undertaken in the southern part of the Pacaya-Samiria National reserve near Victoria village (Gonzalez 2003). This study found at least 33 species of parrots that frequently were

taken and sold in local markets with parakeets (*Brotogeris versicolorus, B. cyanoptera, B. sanctithomae*), amazons (*Amazona amazonica, A. festiva, A. ochrocephala*), and macaws (*Ara ararauna, A. macao*) being the most commonly traded species. The White or Canary-winged Parakeet (*B. versicolorus*) is the most frequently sold pet in the area, but Orange-winged Amazon (*A. amazonica*), Festive Amazon (*A. festiva*) and Blue and Yellow Macaw (*A. ararauna*) are the most important species in terms of gross profit for local people and from a conservation standpoint (Gonzalez 2003). This activity, locally called loreada, is practiced from February to April by many residents of Victoria and the neighboring villages. The trade represents an important source of income for local families during the flood season, when fish and agricultural products are scarce. We found that the trade chain was organized through intermediaries and commercial dealers who bought parrot nestlings from the trappers at Victoria and shipped them hidden in boats to the city markets of Iquitos and Pucallpa. On these boats, birds were transported enclosed in wooden boxes in groups of 50 to 150, and were soaked in water when approaching governmental controls so that they would remain quiet. Most of the smuggled birds were sold in the local markets of Iquitos and Pucallpa, but occasionally some birds were transported by road to the larger pet markets in Lima to be sold at a higher prices (Gonzalez 2003).

Between 1996 and 1999, seven species of parrots were collected by local poachers (loreros) in one study site, with Orange-winged Amazon (61.1% of the captures) and Blue and Yellow Macaw (25.9%) being the most commonly taken. The total number of nestlings taken during the 4-yr study was 1,718 (Gonzalez 2003). Two methods were generally used to collect nestlings: cutting down the nesting tree (for species like macaws that nest very high), or cutting open the nest cavities in order to remove all the chicks. Both methods are very destructive because sites become useless for future nesting. Mortality rates in the captures were 8% in Amazon species and as high as 48% in macaws (Gonzalez 2003). Other methods of parrot capture include netting or the use of fishing line snares; these are especially effective when capturing adult birds (Engebretson 2006). Capture, subsequent transport, and lack of an adequate diet is very stressful for these birds. Researchers in Nicaragua estimate that, in order to compensate for mortalities, up to four times as many parrots are captured than make it to market (Engebretson 2006).

A thoroughly researched report has been generated by the Defenders of Wildlife characterizing the parrot trade in Mexico (Guzman et al. 2007). The report discovered that 65,000 to 78,500 Mexican parrots are captured each year and that the overall mortality rate for trapped parrots exceeds 75% before reaching a purchaser. This means that 50,000 to 60,000 parrots per year die in the trade. About 86-96% of all trapped Mexican parrots staying within local markets. Approximately 15,000 parrots a year enter the Mexico City pet markets alone. It is estimated that between 3,100 and 9,400 Mexican parrots are illegally smuggled across the border into the US each year (Guzman et al. 2007). This is because a parrot that would sell for $15 in Mexico can be sold for $250 to $1000 in the US.

An average 31% of parrots die during transport. Parrots have to be transported across the country in a manner that escapes detection by authorities; during the trip, they are rarely fed or cared for. Transporters rely on volume to make a profit so they can withstand high mortalities. We interviewed government inspectors who occasionally were able to intercept parrot shipments, and found that many parrots were already dead or dying due to stress, rough handling, sickness, crushing, asphyxiation, temperature shock, dehydration and diarrhea. Guzman et al. (2007) stated, "The conditions of transport are appalling; 50 parrots will be stuffed into an 18 in. x 12 in. x 6 in. wooden box where they can barely move, much less seek food and water." The report concluded that efforts must be made to modify the parrot trade or else several of Mexico's native parrot species will go extinct.

People are attracted to having parrots as pets for various reasons, including companionship, entertainment, beauty, intelligence and vocal ability (Engebretson 2006). At present, owning wild parrots as pets remains socially acceptable in most neotropical countries, even where it is known that their ownership is illegal (Snyder et al 2000). Even though most countries ban trade

in wild birds, as has been discussed, it is still possible to see wild parrots being sold in markets, along rural roads, and even in pet shops. Legislation in most neotropical countries criminalizes trade but not the ownership of wild birds. As a result, enforcement is usually negligible or erratic, and in most cases government agencies are legally unable to confiscate parrots owned by individuals (Guzman et al. 2007, Snyder et al. 2000). Even when government officials are able to intervene and confiscate parrots before they have been sold in the markets, these birds are rarely released; they are placed into overly full zoos or "wildlife sanctuaries" where they are condemned to a life of captivity and fed an inadequate diet of corn, sunflower seeds and possibly fruit (Mendoza 2008, Vargas 2006). The Mexican study found that the mortality rate of parrots in rescue centers from 1995-2005 was almost 45% (Guzman et al 2007).

One study in Brazil examined the diseases seen in parrots confiscated from the illegal trade. This study found chlamydiosis in several captured Blue-fronted Amazon parrots (*Amazona aestiva*; Freitas Raso et al. 2004). Captured chicks were fed maize flour. Soon after confiscation, chicks exhibited signs of respiratory disease and malnutrition and subsequently died. All birds had signs of vitamin A deficiency and candidiasis. The chicks had been subjected to many stressors (overcrowding, inadequate and prolonged transportation, poor nutrition, and substandard sanitary conditions), increasing their susceptibility to infection (Freitas Raso et al. 2004).

VITAMIN A AND PARROT NUTRITION

Research into the nutritional requirements of psittacine species is limited and exists only for the past 20 years in developed countries (Harrison 1998). Few studies have been done on wild parrot diets partly because the diet varies according to the season, the species, and the food niche it occupies (Brue 1994). For example, the diet of Scaly-headed Parrot (*Pionus maximiliani*) in the wild (semideciduous forests in southeastern Brazil) varies according to the wet or dry season: seeds, 13 different species of flowers, corn and 29 species of fruit pulp. The parrots eat a variety of seeds throughout the year but during the dry season more fruit is eaten than seeds (Galetti 1993). Another example is the Lilac-crowned Parrots (*Amazona finschi*) that live in deciduous forests in Mexico. These parrots were observed to consume 33 different foods during a year: seeds 81.8% of the diet, fruit 8.8%, insect larvae 6.6%, and bromeliad stems 2.9% (Renton 2001). It is very difficult if not impossible to replicate this in a captive situation, let alone be able to form a balanced diet based on an individual species' needs. Twenty years ago in the US, for instance, malnutrition was the most common problem veterinarians would see in birds (Harrison 1998). For this reason, using the nutritional needs of poultry as a guide, several companies have produced formulated psittacine diets that are in common use today (Harrison 1998).

In developing countries, such as Peru and Costa Rica, there are no commercially available psittacine feeds (Rivero Salinas 2007, Vargas 2006). Owners determine what their pet's diet will be. This all depends on that person's time and ability to seek out a variety of fresh vegetables, fruits, nuts and seeds, and the person's willingness to supply their bird with a constant fresh supply. Most people have neither the time nor knowledge to formulate a proper diet. Most people can barely afford to properly feed their own families let alone worry about a bird's dietary health. Under the widespread belief that birds eat only seeds, many birds are simply placed on seed diets out of convenience and affordability. Some efforts are made to import commercial diets produced in the US but the cost of importation plus the cost of the product are not within the majority of the bird owning public's budgets (Rivero Salins 2007).

All seed diets are deficient in many vital nutrients. These include vitamins such as A and B; minerals such as calcium and phosphorus; trace minerals such as selenium, copper, lysine and methionine; soluble and insoluble fiber; and omega 3 fatty acids (Henzler 1990). Additionally, all seed diets are very high in fat, which means a bird can meet its caloric needs relatively quickly when consuming seeds before having consumed sufficient amounts of essential nutrients. Long-term seed diets can lead to hepatic lipidosis, which can accelerate clinical signs seen in vitamin A deficiency (Henzler 1990). Seed diets also have an improper calcium:phosphorus ratio. For example, sunflower seeds contain a 1:7

ratio, while the ideal proportion for any animal is 2:1 (Henzler 1990).

Vitamins are generally not synthesized by the body in amounts sufficient to meet the animal's physiologic requirements and must be acquired through food (Brue 1994). Vitamin A is a fat-soluble vitamin and occurs in three forms, retinol (an alcohol; the storage form), retinal (an aldehyde; important in vision and the maintenance of epithelial tissues), and retinoic acid (regulatory actions, important in growth and reproduction).

The nutritional value of Vitamin A is varied and complex and the amount required varies across species and individuals depending upon reproductive status, activity level and age. Foods high in vitamin A include fish liver oil, liver, alfalfa meal, carrots, sweet potato, egg, greens such as spinach, and red peppers. Seeds and nuts are low in vitamin A (McDonald 2006). More information about Vitamin A can be found in Brue (1994), Macwhirter (1994), Klasing (1998), and McDonald (2006).

Psittacine species have evolved and adapted to a variety of habitats each with its own unique nutritional provisions. Species that have adapted to arid climates, such as the cockatiel (*Nymphicus hollandicus*) or budgerigar (*Melopsittacus undulatus*) are able to conserve nutrients within their bodies. However, those that have adapted to the neotropics, where a higher level of nutrition is routinely available, have less ability to store nutrients (Brue 1994). This is one reason why birds taken for the trade and fed a minimal diet of seeds or corn decline in health so rapidly. These birds are also under high levels of stress which, combined with the breakdown of body stores, affects the normal metabolism and levels of vitamin A as well as other vitamins and minerals (Brue 1994).

HYPOVITAMINOSIS A

According to Harrison (1998) and other experienced avian practitioners, malnutrition is responsible for up to 90% of all clinical conditions seen in birds. Hypovitaminosis A occurs when vitamin A levels in the liver are <50 IU/g wet weight (Macwhirter 1994). Signs of deficiency and length of time required before a deficiency is seen vary across species. For example, turkey chicks exhibit signs of deficiency after only five weeks, while cockatiels can go for two years devoid of vitamin A before signs are seen (McDonald 2006). Chicks from domestic hens consuming diets high in vitamin A will have sufficient stores from the yolk to buffer 2-3 months of a diet devoid of vitamin A. However, the chicks from hens with a marginally adequate vitamin A level have low stores and may exhibit signs of deficiency soon after hatching (Klasing 1998).

Numerous clinical problems are associated with hypovitaminosis A and can be divided based on location and body system affected. In general, in the absence of vitamin A, the epithelial basal cells of mucous membranes undergo squamous metaplasia, which can drastically alter the function of the respiratory, gastrointestinal, and urogenital/ reproductive systems as well as the external appearance of a parrot's skin and feathers, which in turn leads to concurrent disease in several body systems (Macwhirter 1994). Affected birds are also severely immuno-compromised and susceptible to secondary infections. For example, in a study of cockatiels with hypovitaminosis A, diarrhea, pneumonia, and hyperkeratosis of the beak and nails were seen (McDonald 2006). For further information on hypovitaminosis A, see: Macwhirter (1994), McDonald (2006), Lumeij (1994), Echols (2006), Williams (1994), Joyner (1994), Klasing (1998), Bauck (1994), Koutsos and Klasing (2005), and Brue (1994).

A Vicious Cycle: The Parrot Trade and Hypovitaminosis A. Parrots involved in the bird trade are prime candidates for the development of hypovitaminosis A. Once birds have entered the trade, usually when they are quite young, and are fed only corn, plantains or sunflower seeds, the bird becomes accustomed to this food. Most parrots are finicky eaters and tend to eat the most familiar foods. If not offered a variety of food at a young age, they will usually gravitate to eating only one type of food (Brue 1994). Birds in the trade, accustomed to eating this poor diet, become difficult to accept new, nutritionally improved foods such as grains, nuts, fruits, vegetables or even commercially prepared food (Rivero Salinas 2007). After trying repeatedly with little success, the owner of the bird will often give up and continue to give the bird its accustomed diet even if detrimental to the bird's health. Parrots on a poor diet for a prolonged amount of time will

eventually succumb to hypovitaminosis A and associated diseases. The bird's death will prompt the owner to purchase another parrot thereby creating a demand in the parrot market.

CONCLUSION

Despite government laws, people continue to take parrots from the wild and continue to house parrots in their homes. Several research groups are attempting to find ways of sustainable take or are trying to promote other options such as ecotourism as a way for families to generate income without harming parrot populations. Nevertheless, people continue to want parrots as pets. In the US and Europe, a shift in how a pet parrot is acquired has occurred whereby importation of wild parrots has decreased and the numbers of domestically bred parrots has increased. In these developed nations, this has led to parrots more suitable to life in captivity and has spawned an awareness of parrot owners, breeders, and veterinarians to the special needs parrots require in order to survive and thrive. In countries such as those in Latin America where parrots are native, this has not occurred. Few people in these countries have been able to breed parrots successfully in captivity due to failure to provide an adequate diet for reproduction (Rivero Salinas 2007, Guzman 2007). Hypovitaminosis A and the parrot trade go hand in hand. It is obvious that more education of potential parrot owners is needed in order to decrease the demand for wild caught parrots and to increase the health and longevity of existing captive parrots. Without this essential education, conservation of these unique species will fail. This paper has shown that nutrition plays a vital role in conservation and that without proper nutrition the parrot trade will continue to promote suffering and an early demise of some of the world's most intelligent, long-lived, and enigmatic creatures.

"*Many have forgotten this truth, but you must not forget it. You remain responsible, forever, for what you have tamed.*" Antoine de Saint-Exupery. The Little Prince.

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BIRD POPULATIONS

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REPORTS OF AVIAN MONIOTORING PROGRAMS

INTRODUCTION TO THE REPORTS

One of the initial goals of demographic monitoring programs, including the Monitoring Avian Productivity and Survivorship (MAPS) program in North America and the increasing number of Constant Effort Sites (CES) schemes being operated in Europe, is to determine the proximate demographic cause(s) of the population trends documented by these and other population monitoring schemes, such as the North American and British Breeding Bird Surveys. This determination is especially important for migratory species because it can suggest whether management actions should be directed toward increasing a species' reproductive success on its breeding grounds, or toward lowering its mortality rate on its wintering grounds or migration route, or both.

Progress toward achieving this goal has been boosted by MAPS results indicating that spatial variation in BBS trends for Yellow Warbler appeared to derive primarily from spatial variation in survival of both first-year and adult birds (Saracco et al. 2008. J. Wildl. Manage. 72:1665-1673). These results were recently expanded through spatial analyses of MAPS data on 28 species of Nearctic-Neotropical migratory landbirds (Saracco and DeSante. 2008. Unpubl. Report, The Institute for Bird Populations). That report found recruitment to have strong effects on MAPS population trends (lambda) for 25 of the 28 species, while productivity had strong effects on lambda for only 9 species, thereby implicating first-year survival as a driving force for population trends in at least 16 species. Adult survival also had a strong effect on lambda for 10 species. In addition, species for which first-year survival was important in driving population trends tended to have substantially declining populations, while those for which adult survival was important tended to have slightly declining or stable populations, and those for which productivity was important tended to have increasing populations. These results suggest that enhancing survival, especially of first-year birds, will be critical for slowing declines and stabilizing declining populations, while enhancing productivity may be critical for recovering depressed populations whose declines have been arrested.

Discovery of the importance of enhancing survival as a critical first step in efforts to stabilize declining populations presents a whole new array of problems for avian conservation, particularly because survival of migratory birds is likely determined by conditions and events away from the birds' breeding ranges — the locations where most avian monitoring and management effort has thus far been directed. Consequently, there exists a pressing need to understand the weather events and habitat conditions on the wintering grounds that influence annual rates of survival (presumably by directly affecting overwintering survival and indirectly affecting survival during migration through their effects on late-winter body condition). Indeed, evidence is accumulating to indicate that even annual breeding performance may also depend to a large extent upon weather and habitat conditions on the wintering grounds, again through their effects on late-winter body condition. That climate change, through

variations in amount and timing of rainfall, may exert a strong effect on tropical ecosystems, perhaps second only to its effect on polar ecosystems, adds even more urgency to efforts to monitor and understand the effects of weather and habitat on overwintering landbirds.

Monitoring and managing for the effects of weather and habitat on migratory birds on their wintering grounds will be challenging to say the least. Difficult logistics and the general lack of financial resources in the countries that comprise the tropical wintering ranges of many migratory birds are obvious problems, but uncertainty still exists regarding the optimal avian metrics to monitor. The Institute for Bird Populations (IBP) has begun to address these problems on the wintering grounds of Nearctic-Neotropical migratory birds in Middle America, the Caribbean, and northern South America through its Monitoreo de Sobrevivencia Invernal (MoSI – Monitoring Overwintering Survival) program. MoSI operates through partnerships between IBP and avian conservation organizations in the tropics, and consists of a cooperative network of mist-netting stations that aims to monitor monthly overwintering survival rates (site persistence) and body condition of migratory landbirds through the winter and to relate these metrics to local and remote-sensed weather and habitat information.

It is likely that population trends among Palearctic-African migratory bird species, like Nearctic-Neotropical species, may also be driven by processes affecting first-year and adult survival that operate on their wintering ranges (as results from some of the British Trust for Ornithology's monitoring programs have already suggested). If so, partnerships between organizations operating European CES programs and avian conservation organizations in Africa to initiate (or continue) winter monitoring efforts may provide some of the critical information needed to manage and conserve populations of Palearctic-African migratory birds. Finally, it may not be unrealistic to suggest that combined analyses of large-scale breeding and wintering range monitoring programs (such as MAPS and MoSI in the Western hemisphere) could help to further the conservation of migratory birds, or that combined analyses of MAPS and European CES programs could produce generalized results regarding responses of bird populations to climate and weather variables. A willingness to share data and results is perhaps the basic requirement that could make such cooperation possible. It is to this end that *Bird Populations* prints the reports that follow. — David F. DeSante.

Bird Populations 9:86-169

THE MONITORING AVIAN PRODUCTIVITY AND SURVIVORSHIP (MAPS) PROGRAM 2004, 2005, AND 2006 REPORT[1]

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Abstract. This report summarizes regional and program-wide results of the Monitoring Avian Productivity and Survivorship (MAPS) Program during 2004, 2005, and 2006 using data from 452, 422, and 422 MAPS stations, respectively. Changes in adult population size and productivity (i.e., reproductive index, defined as young/adult) from 2003 to 2004, 2004 to 2005, and 2005 to 2006 were derived from data from 343, 352, and 357 stations, respectively, operated in a constant-effort manner during each pair of years. The generally alternating, out-of-phase patterns of annual changes in productivity and adult population size that have characterized MAPS data for the previous 12 years were much less evident during 2004 to 2006, presumably because the annual changes in productivity and adult population size during these latter years were generally small and non-significant. Notable exceptions were as follows: significant decreases in adult population size in the Northwest and South-central regions as well as program-wide in 2005, and in the South-central Region in 2006; significant increases in adult population size in the North-central and Northeast regions in 2006; significant increases in productivity in the Northeast and Southeast regions in 2004 followed by significant decreases in both regions in 2005; and a near-significant increase in productivity in the Southwest in 2005 followed by a significant decrease there in 2006. Patterns of annual changes in both adult population size and productivity over the entire 15 years have generally been similar in the Northeast, Southeast, and North-central regions, and often opposite to those in the Northwest, Southwest, and South-central regions, which generally tended to be similar to each other. In addition, patterns in the Alaska/Boreal Canada Region generally tended to be different from those in all of the other more northerly regions. We used modified Cormack-Jolly-Seber (CJS) mark-recapture analyses, with ad-hoc between- and within-year transient models, on 15 years (1992-2006) of data pooled from 653 stations, each operated for at least four consecutive years, to estimate regional and program-wide annual adult apparent survival (φ) and recapture probabilities and proportions of residents among newly captured adults for 192 species. The mean number of stations per region contributing data (93 stations) and the mean number of species per region for which survival could be estimated (65 species) were 17.7% and 4.9% greater, respectively, than the analogous means (79 stations and 62 species) based on analyses of 12 years (1992-2003) of data. The increased number of stations and years of data resulted in continued increases in the precision of survival estimates: the mean number of species per region with CV(φ) < 30%, < 20%, and < 10% increased by 10%, 13%, and 19%, respectively, using 15 years of data, rather than 12. As in previous years, a pattern was detected in which mean regional adult survival rates

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tended to be lower at more northerly regions. Mean regional survival rates also tended to be lower in each of the seven regions for the 15-yr (1992-2006) compared to the 12-yr (1992-2003) data set, continuing the pattern noted in previous reports and suggesting that survival has been decreasing in each region. For all species pooled at the program-wide scale, we used (a) chain indices to estimate a highly significant 15-yr (1992-2006) decline in adult population size of -1.77% yr^{-1}, and a widely fluctuating temporal pattern in productivity with a decreasing tendency of -0.25% yr^{-1}; and (b) both time-dependent and linear trend CJS models to estimate a nearly significant 13-yr (1993-2005) decline in adult apparent survival of -0.46% yr^{-1}. These long-term declines in vital rates will likely increase the difficulty of reversing population declines in these landbird species. Finally, we found a tendency for the annual changes in survival rates to have the same sign as the subsequent annual changes in productivity, suggesting that factors that drive annual variation in survival might also drive some of the annual variation in productivity, and that these factors may act during the non-breeding season.

Key words: constant-effort mist netting and banding; landbird demographics; MAPS Program; population trends; productivity indices; survival rates.

INFORME DE 2004, 2005 Y 2006 DEL PROGRAMA MAPS (MONITOREO DE PRODUCTIVIDAD Y SOBREVIVENCIA DE AVES)

Resumen. Este informe resume los resultados regionales y globales del programa MAPS durante 2004, 2005 y 2006 utilizando datos de 452, 422 y 422 estaciones MAPS respectivamente. Los cambios en tamaño poblacional y sobrevivencia de adultos (es decir, índice reproductivo, definido como adultos/juveniles) de 2003 a 2004, 2004 a 2005 y 2005 a 2006, fueron derivados de datos provenientes de 343, 352 y 357 estaciones respectivamente, operadas de forma constante durante cada par de años. El patrón general alternante y fuera de fase de los cambios en productividad y tamaño poblacional que ha caracterizado los datos de MAPS durante los 12 años anteriores fue mucho menos evidente entre 2004 y 2006, presumiblemente porque los cambios anuales fueron generalmente leves y no significativos. Excepciones importantes son las siguientes: declives significativos en tamaño poblacional de adultos en las regiones Noroeste y Centro-sur así como globales en 2005, y en la región Centro-sur en 2006; aumentos significativos en tamaño poblacional de adultos en las regiones Centro-norte y Noreste en 2006; aumentos significativos en productividad en las regiones Noreste y Suroeste en 2004 seguidos por declives significativos en ambas regiones en 2005; y un casi significativo aumento en productividad en el Suroeste en 2005 seguido de un declive significativo en 2006. Los patrones de cambio anual en tamaño poblacional y sobrevivencia en los 15 años totales han sido generalmente similares en las regiones Noreste, Sureste y Centro-norte, y a menudo contrarios a los de las regiones Noroeste, Suroeste y Centro-sur, las cuales tendieron a ser similares entre ellas. Asimismo, los patrones en Alaska y la región boreal de Canadá fueron diferentes de los del resto de regiones norteñas. Utilizamos análisis de marcaje-recaptura Cormack-Jolly-Seber (CJS) con datos combinados de 653 estaciones, cada una operada al menos durante cuatro años consecutivos, para estimar la sobrevivencia aparente de adultos (φ) a escala regional y global así como probabilidades de recaptura y proporciones de residentes entre adultos capturados para 192 especies. El número promedio de estaciones por región que contribuyó datos (93 estaciones) y el número promedio de especies por región para las que se pudo estimar sobrevivencia (65 especies) aumentaron en un 17.7% y 4.9% respectivamente, con respecto a los promedios análogos (79 estaciones y 62 especies) basados en análisis de 12 años (1992-2003) de datos. El aumento en el

número de estaciones y años de datos resultó en un contínuo aumento de la precisión de las estimaciones de sobrevivencia: el número de especies promedio por región con CV(φ) <30%, <20% y <10% aumentó en 10%, 13% y 19% respectivamente utilizando 15 años en lugar de 12. Al igual que en años anteriores, se detectó un patrón que indica que las tasas de sobrevivencia anual de adultos tienden a ser más bajas en regiones norteñas. Las tasas de sobrevivencia promedio por región también tendieron a ser más bajas en cada una de las siete regiones para el periodo de 15 años (1992-2006) comparado con los datos de 12 años (1992-2003), continuando el patrón resaltado en informes previos que sugiere que la sobrevivencia ha estado en declive en cada región. Para todas las especies combinadas a escala global, utilizamos (a) índices de cadena para estimar un declive altamente significativo en tamaño poblacional en 15 años (1992-2006) de -1.77% por año, y un patrón temporal altamente fluctuante en productividad con una tendencia negativa de -0.25% por año; y (b) modelos CJS tanto tiempo-dependientes como de tendencia lineal para estimar un declive casi significativo de 13 años (1993-2005) en sobrevivencia aparente de adultos de -0.46% por año. Estos declives a largo plazo en parámetros vitales dificultarán seguramente la recuperación de declives poblacionales en estas especies de aves. Por último, hallamos una tendencia que consiste en que los cambios anuales de sobrevivencia tienen el mismo signo que los subsiguientes cambios anuales en productividad, lo cual sugiere que los factores responsables de la variación anual en sobrevivencia afectan también a la variación anual en productividad, y que estos factores pueden actuar durante la temporada no reproductiva.

Palabras clave: redeo y anillamiento de esfuerzo constante; demografía de aves terrestres; programa MAPS; tendencias poblacionales; índices de productividad; tasas de sobrevivencia.

INTRODUCTION

The Monitoring Avian Productivity and Survivorship (MAPS) Program is a continent-wide, cooperative network of nearly 450 constant-effort mist-netting stations operated annually during the breeding season (DeSante and Kaschube 2007). MAPS was established by The Institute for Bird Populations (IBP) in 1989 to collect long-term data on the vital rates (primary demographic parameters such as productivity and survivorship) of North American landbirds at multiple spatial scales ranging from station-specific and local-landscape to program-wide (DeSante et al. 1995). MAPS now provides productivity indices from young/adult ratios of captured birds, and estimates of adult apparent survival, recruitment, and population growth rates from Cormack-Jolly-Seber (CJS) analyses of capture-mark-recapture data on adult birds for nearly 200 landbird species.

The research goals of MAPS are to describe temporal and spatial patterns in these vital rates, as well as relationships between these patterns and (1) ecological characteristics and population trends of species, (2) station-specific and landscape-scale habitat characteristics, and (3) spatially-explicit weather variables. The management goals of MAPS are to use these patterns and relationships to (1) determine the proximate demographic cause(s) of population change, (2) formulate management actions and conservation strategies to reverse population declines and maintain stable or increasing populations, and (3) evaluate the effectiveness of the management actions and conservation strategies implemented.

Baillie (1990) was among the first to argue that monitoring vital rates must be a component of any successful integrated avian population monitoring scheme. DeSante (1995), DeSante and Rosenberg (1998), and DeSante et al. (2005) extended these ideas by arguing that effective avian management must also be based on vital rates as well as population sizes and trends. The reasons for this are many. First, abundance metrics and the trends derived from them may not accurately reflect habitat quality (Van Horne

1983) because of source-sink dynamics (Pulliam 1988, Donovan et al. 1995) and evolutionary and ecological traps (Schlaepfer et al. 2002). Second, populations of migratory species could be limited by processes acting at times other than those when abundance is measured, thus further obscuring the link between abundance and habitat quality (Marra et al. 1998). Third, vital rates provide crucial information about the stage of the life cycle at which population change is being effected (DeSante 1992, DeSante et al. 2001). This information is particularly important for migratory species because it can suggest whether management actions should be directed toward a species' breeding grounds, wintering grounds, or both. Fourth, environmental stressors and management actions affect vital rates directly and usually without the time lags that often occur with population size (Temple and Wiens 1989, DeSante and George 1994). Finally, demographic rate estimates can be incorporated into predictive population models to assess potential effects of a variety of land use or climate factors (Noon and Sauer 1992). Thus, demographic monitoring not only complements abundance monitoring, but also has the potential to provide more timely and insightful information for management and conservation applications.

In this report we present results of the MAPS Program during 2004, 2005, and 2006 using data from 452, 422, and 422 stations, respectively. For all species with adequate data (and for all species pooled), we compare, in a constant-effort manner, the regional and program-wide indices of adult population size and post-fledging productivity obtained during each of these three years to the analogous indices obtained during the immediately preceding year. Then, using data from 653 stations each operated for four or more consecutive years during the 15-yr period 1992-2006, we present regional and program-wide estimates of time-constant annual adult apparent survival probability, recapture probability, and proportion of residents among newly captured adults, along with estimates of the extent of time-dependence in these parameters. Finally, for all species pooled at the program-wide scale, we use chain indices to estimate 15-yr trends in adult population size and productivity, and use both time-dependent and linear-trend CJS models to estimate a 13-yr trend in adult survival rate.

METHODS

The overall design of the MAPS Program and the general field methods are described in DeSante et al. (1996, 1998) and discussed in DeSante et al. (2004). Detailed, standardized methods and instructions for the establishment and operation of MAPS stations are provided by DeSante et al. (2008). Briefly, MAPS stations were established in 20-ha study areas at locations where long-term mist netting was practical and permissible. In general, the locations of MAPS stations were chosen by the station operators (often according to a hypothesis-driven strategy) and not by a probability-based sampling design, although elements of a random sampling strategy were sometimes employed. Operators generally adhered to MAPS site-selection criteria (DeSante et al. 2008), but some aspects of site selection were dictated by logistical concerns.

NUMBER AND DISTRIBUTION OF STATIONS

A total of 459 MAPS stations was operated during 2004, a 0.7% increase over the 456 operated during 2003. Of these, 40 (8.7%) were new in 2004, while 390 were operated during 2003 and 29 were not operated during 2003 but were operated during one or more years prior to 2003. A total of 85.5% of the stations operated in 2003 continued to be operated in 2004. We received data useable for productivity and/or survivorship analyses in time to be included in this report from 452 of the 459 stations that were operated during 2004. A total of 440 MAPS stations was operated during 2005, 19 (4.1%) fewer than were operated during 2004. Of these, 42 (9.5%) were new in 2005, while 398 were in operation during a previous year. A total of 84.7% of the stations in operation during 2004 continued to be operated during 2005. We received data useable for productivity and/or survivorship analysis in time to be included in this report from 422 of the 440 stations that were operated during 2005. A total of 438 MAPS stations was operated during 2006, 2 (0.5%) fewer than were operated during 2005. Of these, 37 (8.4%) were new in 2006, while 401 were in operation during a previous year. A total of 88.0% of the stations in operation during 2005 continued to be operated during 2006. We

received data useable for productivity and/or survivorship analysis in time to be included in this report from 422 of the 438 stations that were operated during 2006. The principal operator, sponsoring organization, location, elevation, and habitat(s) for each station newly established in 2004, 2005, or 2006 (or that was established prior to 2004 but not previously reported) are presented in the Appendix. See previous annual reports (DeSante et al. 1993b, 1996, 1998, DeSante and Burton 1994, DeSante and Kaschube 2006, 2007, and DeSante and O'Grady 2000) for these data for stations established prior to 2004.

We divided North America north of Mexico into eight major geographic regions based on biogeographical and meteorological considerations and delineated along lines consistent with physiographic strata established in conjunction with the North American Breeding Bird Survey (BBS; Robbins et al. 1986). These eight MAPS regions are Northwest, Southwest, North-central, South-central, Northeast, Southeast, Alaska, and Boreal Canada (see maps in DeSante et al. 1993a and DeSante and Burton 1994). Because of the small number of stations in the two northernmost regions, we generally pooled data from them into a single Alaska/Boreal Canada Region for analyses.

The proportions of stations located in each of the eight MAPS regions (Fig. 1) were very similar during 2004 to analogous proportions in 2003, except for slightly higher proportions in the South-central and Southeast regions and slightly lower proportions in the Northwest and Northeast regions. The proportions during 2005 and 2006 were also very similar to those during 2004, except for a progressive decrease in proportions in the Southwest, small progressive increases in proportions in the North-central and Northeast regions, and a 2006 decrease in the Northwest coupled with the establishment of 15 new stations in Alaska. A total of 975 MAPS stations were operated for at least one year between 1992 and 2006; station operators have provided latitude and longitude coordinates for 966 of these stations. The locations of these 966 stations are mapped in Figure 2.

DATA COLLECTION

Typically, 10 permanent net sites were distributed rather uniformly throughout the central eight ha of each 20-ha study area, but were placed at specific locations where birds could be captured most efficiently. One mist net (typically 12-m length, 30-mm mesh) was erected at each net site and the type and location of all nets were kept constant for the duration of the study. Typically, nets were operated for six hours per day, beginning at local sunrise, for one day per 10-d period, and for six to 10 consecutive 10-d periods beginning between May 1 and June 10 (later at more northerly latitudes and higher altitudes) and continuing through August 8. To facilitate constant-effort comparisons of data, nets were opened, checked, and closed in the same order on all days of operation.

Each bird captured was marked with a uniquely-numbered aluminum leg band provided by the U.S. Geological Survey or the Canadian Wildlife Service. Band number, capture status, species, age, sex, ageing and sexing criteria (skull pneumatization, breeding condition, feather wear, molt, molt limits, plumage characteristics), physical condition (mass, wing chord, fat content), date, time, station, and net number were recorded for all birds captured, including recaptures. The times of opening and closing the nets and beginning each net run were recorded each day so that effort could be calculated for each 10-d period and standardized between years. The breeding (summer residency) status of each species recorded at the station was determined by the station operator using methods similar to those employed in breeding bird atlas projects.

DATA ENTRY AND VERIFICATION

Computer data entry and proofing were conducted by MAPS operators or, in those cases where operators were unable to enter their own data, by John W. Shipman of Zoological Data Processing (entry) and by IBP staff biologists (proofing). MAPS data were then run through verification routines that screened: (1) the validity and ranges of all data; (2) each banding record by comparing the species, age, and sex determinations to the ageing and sexing criteria used; (3) all banding data for inconsistent species, age, or sex determinations for all records of each band number; and (4) all banding, effort, and breeding status data for inconsistencies among them. These verification routines were conducted, for about 2/3 of the stations, by the MAPS station operators themselves through the

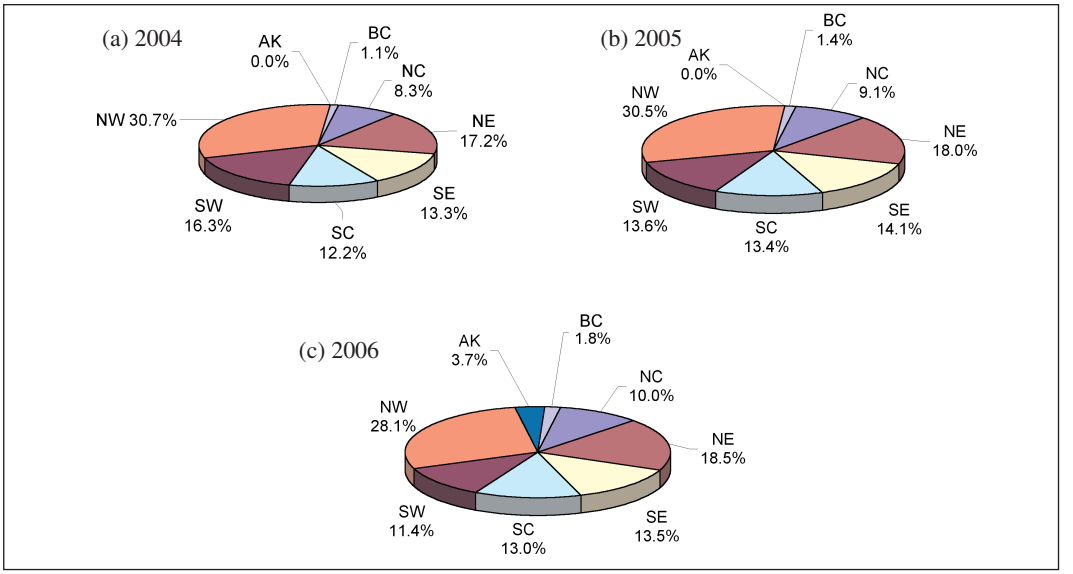

FIGURE 1. Proportions of MAPS stations in each of the eight major geographical regions (NW - Northwest; SW - Southwest; NC - North-central; SC - South-central; NE - Northeast; SE - Southeast; AK - Alaska; BC - Boreal Canada) during (a) 2004, (b) 2005, and (c) 2006.

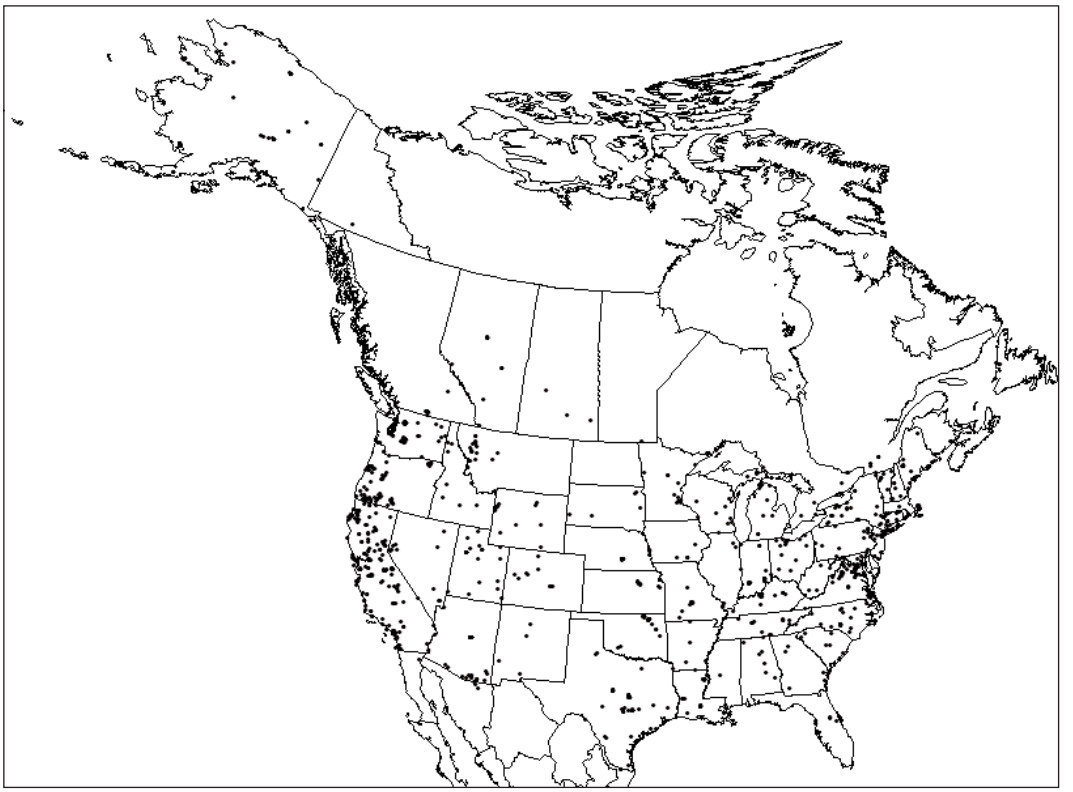

FIGURE 2. Locations of 966 MAPS stations operated during one or more years between 1992 and 2006. Some of the larger "individual" squares can represent as many as 11 stations.

use of MAPSPROG, a user-friendly Visual dBASE data entry/import, verification/editing, and error-tracking program that operates on a Windows platform (Froehlich et al. 2006); data from the remainder of stations were verified by IBP biologists.

DATA ANALYSES

Methods of data analysis have been described in DeSante and Burton (1994), DeSante et al. (1998), and DeSante and O'Grady (2000); discussed in DeSante et al. (2004); and are briefly summarized here. Throughout, we use alpha levels of $P < 0.05$ and $P < 0.01$ to indicate significant and highly significant results, respectively. In Tables 1-3 and in the text, we also identify species for which differences were nearly significant at $0.05 \leq P < 0.10$. Means throughout are presented with plus-minus the standard error (SE).

1. *Population Size and Productivity Indices* — The numbers of individual adult birds of each species captured each year, pooled over all stations within each region (and over all regions) that were located within the breeding range of the species, were used as annual regional (or program-wide) indices of adult population size for the species. Similarly, for each species in each region (and over all regions), the pooled number of individual young birds divided by the pooled number of individual adult birds ("reproductive indices"), was used as an annual regional (or program-wide) index of post-fledging productivity. Reproductive index (young/adult) is more consistent with other commonly-used measures of reproductive success than "productivity index," defined as the proportion of young in the catch [young/(young+adult)], the latter being used in earlier MAPS reports. Data from a given station in a given year were included in population size and productivity analyses if the station was operated for at least five 10-d periods that year, of which at least three periods occurred during the earlier and at least two during the later parts of the season [adult and young superperiods, respectively; see DeSante et al. (2008) for definitions].

Year-to-year changes in the numbers of adult and young birds were calculated using net-opening and -closing times and net-run times on a net-by-net and period-by-period basis to exclude captures that occurred in a given net in a given period in one year at a time when that net was not operated in that period in the other year. This allowed captures during the two years to be compared in a rigorous, constant-effort manner. The statistical significance of annual changes in the regional (or program-wide) indices of adult population size and productivity were inferred for each species from confidence intervals calculated from the standard errors of the mean percentage changes. Changes were considered significant if confidence intervals did not include zero. Formulae for these standard errors and confidence intervals were given in Peach et al. (1996) as derived from those given in Cochran (1977). We also inferred, by means of binomial tests, the statistical significance of regional (or program-wide) changes in adult population size and productivity indices from the proportion of target species that increased or decreased in each region. Significance of these proportional changes was considered relative to a 50% up or down change. We included species in these regional population size and productivity analyses for which adults were captured at two or more stations in the region and for which at least 50 aged individuals were captured at all stations pooled in at least one of the two years being compared.

We estimated 15-yr (1992-2006) trends for the indices of adult population size and productivity *for all species pooled* at the *program-wide* scale by "chaining" the 14 constant-effort (as defined above) year-to-year changes in these annual indices and calculating the slope of the regression of the "chain" indices. For the trend in adult population size, we used an arbitrary starting index of 100 in 1992 and calculated chain indices in each subsequent year by first multiplying the proportional change between the two years times the index of the previous year and then adding that amount to the index of the previous year. Trends in productivity were calculated in an analogous manner, except that we started with the actual reproductive index in 1992 (0.702) and chained the annual proportional changes in the reproductive index over the 15 years.

2. *Survival Rate Estimates* — We calculated maximum-likelihood estimates and standard errors for annual adult apparent survival probabilities (φ) and recapture probabilities (p) for all species in each region for which adequate data were obtained. These survival estimates are

called apparent survival because permanent emigration from the station is not distin guishable from actual mortality. We used Cormack-Jolly-Seber (CJS) capture-mark-recapture analyses (Clobert et al. 1987, Pollock et al. 1990, Lebreton et al. 1992) that incorporated a between-yr transient model (Pradel et al. 1997), as well as an ad-hoc length-of-stay within-yr transient model (Nott and DeSante 2002, Hines et al. 2003). These transient models also permit estimation of τ (the proportion of residents among those newly captured adults that were not recaptured seven or more days later during their first year of capture), and provide apparent survival rate estimates that are unbiased with respect to transient individuals (Pradel et al.1997, Hines et al. 2003).

Parameter estimates were calculated from the capture histories of all adult birds captured at all stations in the region at which the species was a usual breeder (i.e., attempted to breed during more than half of the years the station was operated). Data from a given station were included in survivorship analyses if the station was operated for at least four consecutive years during the 15-yr period 1992-2006, and was operated during each of those four or more years for at least three periods during the adult superperiod (see above). Stations within 1 km of each other were merged into a single "super-station" and data from those stations were pooled prior to creating capture histories of individual birds. This prevented individuals whose home range encompassed parts of both stations from being treated as two different individuals. We included species in these survivorship analyses for which an average of at least 2.5 individual adult birds were captured during each of the 15 years 1992-2006 (at least 38 year-unique adult individuals) from all stations pooled, and for which there were at least two returns (between-year recaptures) from all stations pooled. We considered survival probability to be "better estimated" for species for which: (1) φ was based on at least five returns over the 15 years; (2) τ (the estimate of the proportion of residents among those newly captured adults that were not recaptured seven or more days later during their first year of capture) was < 1.00; (3) SE(φ) < 0.20; and (4) CV(φ) < 50%.

We modeled all eight combinations of time-dependence (and -independence) for each of the three parameters, φ (survival probability), p (recapture probability), and τ (proportion of residents), contained in the transient model using TMSURVIV (Hines et al. 2003), a version of the computer program SURVIV (White 1983) modified by J. E. Hines. We used the Akaike Information Criterion (QAIC$_C$) to select appropriate models for each species such that the selected model was the one with the lowest QAIC$_C$ (Burnham and Anderson 1992). We considered models having QAIC$_C$ values within two QAIC$_C$ units of each other to be equivalent models.

We further estimated the relative likelihood of each of the eight models using QAIC$_C$ weights (w_i; Burnham and Anderson 1998). Statistical support for time-dependence in survival and recapture probabilities and in proportion of residents was assessed by summing the w_i for all models in which time-dependence in the parameter of interest occurred. This method of multi-model inference enabled us to use the entire set of eight models to judge the importance of time-dependence, rather than basing conclusions on a single best-fit model. A w_i value > 0.5 indicates strong support for time-dependence in the given parameter, while $0.50 \geq w_i > 0.25$ suggests some support for time-dependence in that parameter.

Finally, in order to gain additional insight into the issues of time-dependence and temporal trend in survival, we used the ad-hoc transient model in Program MARK (White and Burnham 1999) to model *program-wide* survival (φ) and recapture (p) probabilities for *all species pooled* as (1) time-constant, (2) time-dependent, and (3) a linear function of time. We again used QAIC$_C$ (Burnham and Anderson 1992) and QAIC$_C$ weights (w_i; Burnham and Anderson 1998) to select among the nine possible models.

RESULTS

ADULT POPULATION SIZE AND PRODUCTIVITY

1. *Changes between 2003 and 2004* — Constant-effort data were obtained for 2003 and 2004 from 343 MAPS stations operated comparably in both years. The changes between years in the numbers of adult and young birds captured and the reproductive index (young/adult) are

presented for the entire continent (program-wide) and for each MAPS region in Table 1 for those species that met the productivity selection criteria (see Methods – Data Analysis) and for all species pooled. These included 130 species program-wide, 65 species in the Northwest, 34 in the Southwest, 23 in the North-central, 26 in the South-central, 36 in the Northeast, 24 in the Southeast, and 4 in the combined Alaska/Boreal Canada Region.

(a) *Changes in adult population size* — The index of adult population size for all species pooled (number of adults captured) showed decreases ranging from -1.6% to -7.9% between years in the four more easterly regions and increases of 2.6% and 4.8% in the Northwest and Southwest regions, respectively, but none of these six changes was significant or nearly significant (Table 1). Adults of all species pooled decreased by a highly significant -32.0% in the Alaska/Boreal Canada Region (where, however, only four stations where operated in both years and all were near Lesser Slave Lake). The proportion of increasing species was nearly significant in the Alaska/Boreal Canada (100%) and Southwest (65%) regions and non-significant in each of the other five regions. Summing over the five regions where adult populations tended to decrease between years, 20 species had significant or nearly significant decreases in number of adults, while only six species showed significant or nearly significant increases. Summing over the Northwest and Southwest regions, where adult populations tended to increase, 11 species had significant or nearly significant increases in number of adults and 10 species had significant or nearly significant decreases.

Program-wide, the index for adult population size for all species pooled decreased by a non-significant -0.3% (Table 1). The program-wide proportion of decreasing species (49%) was also non-significant. Program-wide, 21 species had significant or nearly significant decreases in number of adults while 13 species had significant or nearly significant increases.

(b) *Changes in productivity* — Productivity increased significantly and dramatically between 2003 and 2004 in both the Northeast and Southeast regions (Table 1). The number of young birds of all species pooled showed highly significant increases of 31.3% and 36.3% in these two regions, respectively, while the reproductive index (young/adult) of all species pooled showed highly significant and significant increases of 36.4% and 48.0%, respectively. The proportions of species with increasing number of young and increasing reproductive index for these two regions ranged from 63% to 78% and were significant for all but number of young in the Southeast. Summing over these two regions, a total of seven and 10 species had significant or nearly significant increases between years in number of young birds captured and reproductive index, respectively, while no species had significant or nearly significant decreases in either of these two parameters. The number of young and reproductive index of all species pooled also tended to increase in the Northwest Region by 4.6% and 1.9%, respectively, but neither of these increases was even nearly significant. Similarly, the proportions of increasing species for these two parameters in the Northwest were 58% and 60%, respectively, but only the proportion of species with an increasing reproductive index was even nearly significant. A total of seven and three species had significant or nearly significant increases in number of young birds captured and reproductive index, respectively, in the Northwest Region, while six and two species had significant or nearly significant decreases in these two parameters, respectively. In contrast, the number of young and reproductive index of all species pooled tended to decrease in each of the other four regions, but only the decrease in young in the Alaska/Boreal Canada Region (-66.8%) was significant, and only the proportions of species with decreasing numbers of young and decreasing reproductive indices in the Alaska/Boreal Canada Region (100% in each case) were nearly significant. Summing over these four regions, a total of 17 and five species had significant or nearly significant decreases in number of young birds captured and reproductive index, respectively, while only three species each had significant or nearly significant increases in these two parameters.

Program-wide, the number of young for all species pooled increased by a non-significant 4.2% while the reproductive index for all species pooled increased by a non-significant 4.6% from 0.467 in 2003 to 0.488 in 2004 (Table 1). The program-wide proportions of species with increasing number of young and increasing

TABLE 1. Program-wide and regional changes between 2003 and 2004 in the numbers of adult and young individuals captured and in the reproductive index (young /adult) for 130 species and all species pooled (excluding gallinaceous birds and hummingbirds) at the 343 MAPS stations run comparably during both years. For each species, data were included only from stations within the breeding range of the species. Only species for which adults were captured at two or more stations and for which 50 or more aged individuals were captured in either year are included.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2003	2004	%chg.	SE[b]	n[c]	2003	2004	%chg.	SE[d]	n[e]	2003	2004	change	SE[f]	%chg.
PROGRAM-WIDE																
Common Ground-Dove	10	48	33	-31.3	8.5 ***	3	8	2	-75.0	28.6	10	0.167	0.061	-0.106	0.063	-63.6
Red-bellied Woodpecker	41	38	41	7.9	21.8	20	8	17	112.5	103.5	48	0.211	0.415	0.204	0.145	97.0
Red-naped Sapsucker	32	64	81	26.6	18.0	27	39	34	-12.8	21.3	36	0.609	0.420	-0.190	0.156	-31.1
Red-breasted Sapsucker	54	133	149	12.0	14.2	37	45	68	51.1	32.3 **	56	0.338	0.456	0.118	0.094	34.9
Nuttall's Woodpecker	19	33	38	15.2	39.7	21	34	48	41.2	52.9	22	1.030	1.263	0.233	0.487	22.6
Downy Woodpecker	180	251	261	4.0	9.4	153	247	261	5.7	10.7	206	0.984	1.000	0.016	0.150	1.6
Hairy Woodpecker	110	84	102	21.4	18.3	57	33	48	45.5	38.4	135	0.393	0.471	0.078	0.130	19.8
Northern Flicker	99	88	75	-14.8	14.4	48	38	36	-5.3	26.2	114	0.432	0.480	0.048	0.147	11.2
Western Wood-Pewee	90	269	261	-3.0	10.0	42	49	37	-24.5	19.0	94	0.182	0.142	-0.040	0.048	-22.2
Eastern Wood-Pewee	55	81	78	-3.7	23.5	20	19	19	0.8	42.5	61	0.235	0.244	0.009	0.149	3.8
Acadian Flycatcher	54	274	252	-8.0	8.3	25	26	37	42.3	37.8	57	0.095	0.147	0.052	0.036	54.7
Traill's Flycatcher	115	413	431	4.4	10.7	41	43	57	32.6	39.8	118	0.104	0.132	0.028	0.035	27.0
Least Flycatcher	33	61	65	6.6	15.0	14	19	7	-63.2	16.0 **	36	0.312	0.108	-0.204	0.116 *	-65.4
Hammond's Flycatcher	58	121	130	7.4	11.2	28	43	30	-30.2	25.6	63	0.355	0.231	-0.125	0.141	-35.1
Dusky Flycatcher	77	305	328	7.5	12.5	33	48	45	-6.3	33.2	81	0.157	0.137	-0.020	0.044	-12.8
Western Flycatcher	95	228	276	21.1	12.3 *	66	117	176	50.4	25.3 **	103	0.513	0.638	0.125	0.129	24.3
Black Phoebe	32	50	42	-16.0	15.9	37	81	84	3.7	18.9	42	1.620	2.000	0.380	0.653	23.5
Eastern Phoebe	44	45	34	-24.4	19.7	31	33	38	15.2	35.4	54	0.733	1.118	0.384	0.407	52.4
Ash-throated Flycatcher	37	134	140	4.5	15.0	19	23	25	8.7	41.4	38	0.172	0.179	0.007	0.071	4.0
Great Crested Flycatcher	54	47	68	44.7	30.3 *	4	3	3	0.8	77.0	55	0.064	0.044	-0.020	0.055	-30.9
White-eyed Vireo	66	347	396	14.1	9.0	48	112	110	-1.8	15.9	70	0.323	0.278	-0.045	0.066	-13.9
Bell's Vireo	11	43	55	27.9	26.6	9	18	20	11.1	54.8	12	0.419	0.364	-0.055	0.149	-13.1
Cassin's Vireo	42	89	78	-12.4	14.1	30	34	37	8.8	26.9	54	0.382	0.474	0.092	0.132	24.2
Warbling Vireo	133	577	549	-4.9	7.0	53	90	60	-33.3	17.0 *	140	0.156	0.109	-0.047	0.037	-29.9
Red-eyed Vireo	125	364	324	-11.0	9.6	33	18	52	188.9	87.2 ***	128	0.050	0.161	0.111	0.034 ***	224.6
Blue Jay	63	98	51	-48.0	10.4 ***	23	29	22	-24.1	27.8	69	0.296	0.431	0.136	0.170	45.8
Western Scrub-Jay	25	33	23	-30.3	19.6	18	17	12	-29.4	30.4	30	0.515	0.522	0.007	0.259	1.3
Tree Swallow	32	51	41	-19.6	20.8	8	8	1	-87.5	12.5 ***	35	0.157	0.024	-0.133	0.059 **	-84.5
Carolina Chickadee	66	132	172	30.3	18.5 *	57	75	113	50.7	31.6 *	74	0.568	0.657	0.089	0.162	15.6
Black-capped Chickadee	109	467	378	-19.1	6.6 ***	97	408	419	2.7	10.8	118	0.874	1.109	0.235	0.169	26.9
Mountain Chickadee	53	177	151	-14.7	11.1	43	109	113	3.7	22.5	58	0.616	0.748	0.133	0.190	21.5
Chestnut-backed Chick.	51	170	116	-31.8	10.4 ***	42	175	239	36.6	26.5	54	1.029	2.060	1.031	0.521 **	100.1

TABLE 1. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2003	2004	%chg.	SE[b]	n[c]	2003	2004	%chg.	SE[d]	n[e]	2003	2004	change	SE[f]	%chg.
Oak Titmouse	12	29	30	3.4	33.5	12	44	29	-34.1	27.8	13	1.517	0.967	-0.551	0.612	-36.3
Tufted Titmouse	93	254	179	-29.5	8.0 ***	89	209	243	16.3	16.5	106	0.823	1.358	0.535	0.178 ***	65.0
Black-crested Titmouse	7	23	22	-4.3	31.4	7	27	21	-22.2	23.1	8	1.174	0.955	-0.219	0.422	-18.7
Bushtit	55	199	243	22.1	19.7	50	181	222	22.7	24.0	61	0.909	0.914	0.004	0.210	0.4
Red-breasted Nuthatch	62	67	88	31.3	19.7 *	50	98	100	2.0	32.8	80	1.463	1.136	-0.326	0.528	-22.3
White-breasted Nuthatch	47	55	52	-5.5	20.4	25	18	17	-5.6	40.2	57	0.327	0.327	0.000	0.152	-0.1
Brown Creeper	66	90	77	-14.4	14.4	67	101	81	-19.8	16.4	87	1.122	1.052	-0.070	0.285	-6.3
Carolina Wren	84	416	450	8.2	7.7	84	344	520	51.2	15.3 ***	95	0.827	1.156	0.329	0.145 **	39.7
Bewick's Wren	74	334	355	6.3	8.1	76	506	532	5.1	11.1	83	1.515	1.499	-0.016	0.267	-1.1
House Wren	90	475	419	-11.8	6.7	91	359	370	3.1	9.9	102	0.756	0.883	0.127	0.150	16.8
Winter Wren	34	68	78	14.7	18.4	31	65	53	-18.5	24.6	44	0.956	0.680	-0.276	0.286	-28.9
Golden-crowned Kinglet	42	110	57	-48.2	9.6 **	38	289	139	-51.9	20.8 **	57	2.627	2.439	-0.189	1.165	-7.2
Ruby-crowned Kinglet	28	145	57	-60.7	10.9 ***	17	55	55	0.8	26.6	30	0.379	0.965	0.586	0.482	154.4
Blue-gray Gnatcatcher	42	69	77	11.6	20.9	32	51	59	15.7	25.2	55	0.739	0.766	0.027	0.349	3.7
Eastern Bluebird	22	28	27	-3.6	29.0	18	19	58	205.3	82.6 ***	27	0.679	2.148	1.470	0.730 **	216.6
Veery	47	221	255	15.4	9.1	29	37	48	29.7	22.6	48	0.167	0.188	0.021	0.041	12.4
Swainson's Thrush	117	1096	1247	13.8	7.1 **	69	212	182	-14.2	11.3	119	0.193	0.146	-0.048	0.035	-24.5
Hermit Thrush	59	126	135	7.1	12.5	45	51	60	17.6	27.4	77	0.405	0.444	0.040	0.121	9.8
Wood Thrush	83	358	315	-12.0	6.9	63	111	131	18.0	19.4	93	0.310	0.416	0.106	0.074	34.1
American Robin	208	993	855	-13.9	5.4 **	142	410	348	-15.1	11.2	219	0.413	0.407	-0.006	0.070	-1.4
Wrentit	37	217	179	-17.5	7.4 **	37	200	248	24.0	19.4	41	0.922	1.386	0.464	0.310	50.3
Gray Catbird	119	1277	1431	12.1	4.6 ***	81	604	635	5.1	11.8	125	0.473	0.444	-0.029	0.076	-6.2
Northern Mockingbird	19	18	38	111.1	78.8	11	9	15	66.7	84.2	23	0.500	0.395	-0.105	0.250	-21.1
Brown Thrasher	51	75	77	2.7	16.2	27	32	20	-37.5	19.2	53	0.427	0.260	-0.167	0.125	-39.1
European Starling	18	59	26	-55.9	11.9 ***	8	22	8	-63.6	20.4	21	0.373	0.308	-0.065	0.212	-17.5
Cedar Waxwing	87	383	429	12.0	13.1	15	26	19	-26.9	41.6	88	0.068	0.044	-0.024	0.029	-34.8
Blue-winged Warbler	26	108	101	-6.5	15.4	14	25	32	28.0	67.0	27	0.232	0.317	0.085	0.150	36.9
Tennessee Warbler	11	61	28	-54.1	7.3 ***	7	68	40	-41.2	23.6	13	1.115	1.429	0.314	1.779	28.2
Orange-crowned Warbler	65	231	192	-16.9	10.9	56	162	188	16.0	21.5	77	0.701	0.979	0.278	0.260	39.6
Nashville Warbler	47	125	135	8.0	23.1	40	55	96	74.5	74.1	53	0.440	0.711	0.271	0.215	61.6
Virginia's Warbler	11	70	54	-22.9	30.4	6	32	13	-59.4	9.3 ***	11	0.457	0.241	-0.216	0.239	-47.3
Lucy's Warbler	11	114	126	10.5	10.4	10	52	47	-9.6	37.2	11	0.456	0.373	-0.083	0.173	-18.2
Northern Parula	30	57	36	-36.8	14.1 *	14	16	22	37.5	68.6	33	0.281	0.611	0.330	0.292	117.7
Yellow Warbler	143	1507	1536	1.9	5.6	104	647	572	-11.6	11.3	150	0.429	0.372	-0.057	0.071	-13.3
Chestnut-sided Warbler	21	83	83	0.8	9.7	10	38	46	21.1	47.0	22	0.458	0.554	0.096	0.283	21.1
Magnolia Warbler	17	55	58	5.5	20.9	10	15	13	-13.3	31.9	18	0.273	0.224	-0.049	0.144	-17.8

TABLE 1. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2003	2004	%chg.	SE[b]	n[c]	2003	2004	%chg.	SE[d]	n[e]	2003	2004	change	SE[f]	%chg.
Black-thrtd. Blue Warbler	12	19	38	100.0	39.6 ***	9	27	35	29.6	28.0	14	1.421	0.921	-0.500	1.129	-35.2
Yellow-rumped Warbler	94	422	400	-5.2	8.5	56	299	289	-3.3	41.5	98	0.709	0.723	0.014	0.331	2.0
Black-thrtd. Green Warb.	17	31	49	58.1	37.1	8	13	15	15.4	38.4	22	0.419	0.306	-0.113	0.279	-27.0
Townsend's Warbler	17	89	108	21.3	13.1 *	12	143	50	-65.0	6.8 **	19	1.607	0.463	-1.144	0.651 *	-71.2
Hermit Warbler	35	132	108	-18.2	12.1	23	33	111	236.4	195.2	38	0.250	1.028	0.778	0.436 *	311.1
Pine Warbler	14	14	17	21.4	44.0	8	2	110	5400.0	6466.6	18	0.143	6.471	6.328	4.621	4429.4
Prairie Warbler	20	93	82	-11.8	21.4	14	37	30	-18.9	25.7	20	0.398	0.366	-0.032	0.136	-8.0
Black-and-white Warbler	63	102	99	-2.9	14.8	39	44	42	-4.5	28.5	73	0.431	0.424	-0.007	0.140	-1.7
American Redstart	71	259	250	-3.5	10.0	30	70	80	14.3	40.8	77	0.270	0.320	0.050	0.116	18.4
Prothonotary Warbler	28	131	93	-29.0	9.0 **	15	25	13	-48.0	27.6	28	0.191	0.140	-0.051	0.081	-26.8
Worm-eating Warbler	42	96	65	-32.3	10.2 **	19	46	50	8.7	20.1	46	0.479	0.769	0.290	0.455	60.5
Ovenbird	98	273	334	22.3	12.1 **	58	138	118	-14.5	13.5	100	0.506	0.353	-0.152	0.098	-30.1
Northern Waterthrush	28	36	41	13.9	23.4	14	14	7	-50.0	27.2	35	0.389	0.171	-0.218	0.167	-56.1
Louisiana Waterthrush	42	79	86	8.9	16.2	29	41	58	41.5	31.8	47	0.519	0.674	0.155	0.284	29.9
Kentucky Warbler	37	197	174	-11.7	10.6	29	71	82	15.5	22.3	41	0.360	0.471	0.111	0.114	30.8
MacGillivray's Warbler	108	759	844	11.2	5.2 **	86	350	336	-4.0	11.1	117	0.461	0.398	-0.063	0.067	-13.7
Common Yellowthroat	175	1151	1245	8.2	5.6	114	479	453	-5.4	15.3	184	0.416	0.364	-0.052	0.073	-12.6
Hooded Warbler	39	129	136	5.4	15.6	29	39	56	43.6	39.9	46	0.302	0.412	0.109	0.109	36.2
Wilson's Warbler	96	697	896	28.6	12.6 **	64	335	363	8.4	14.1	107	0.481	0.405	-0.075	0.127	-15.7
Canada Warbler	19	65	46	-29.2	13.7	12	29	14	-51.7	22.5	22	0.446	0.304	-0.142	0.168	-31.8
Yellow-breasted Chat	76	512	531	3.7	7.6	44	109	112	2.8	18.5	79	0.213	0.211	-0.002	0.048	-0.9
Summer Tanager	58	184	146	-20.7	7.6 **	18	18	10	-44.4	22.4	59	0.098	0.068	-0.029	0.035	-30.0
Scarlet Tanager	39	45	46	2.2	25.5	17	10	19	90.0	105.4	46	0.222	0.413	0.191	0.203	85.9
Western Tanager	106	271	297	9.6	11.7	45	145	104	-28.3	20.0	108	0.535	0.350	-0.185	0.160	-34.6
Green-tailed Towhee	23	60	55	-8.3	14.0	21	28	29	3.6	38.3	29	0.467	0.527	0.061	0.211	13.0
Spotted Towhee	78	387	333	-14.0	7.7	72	241	307	27.4	18.0	89	0.623	0.922	0.299	0.174 *	48.0
Eastern Towhee	60	96	74	-22.9	12.5	32	32	28	-12.5	27.3	68	0.333	0.378	0.045	0.127	13.5
California Towhee	17	42	49	16.7	34.5	14	20	10	-50.0	27.0 *	20	0.476	0.204	-0.272	0.183	-57.1
Chipping Sparrow	92	215	203	-5.6	12.8	50	116	74	-36.2	14.1 *	96	0.540	0.365	-0.175	0.128	-32.4
Clay-colored Sparrow	6	59	104	76.3	61.5	3	43	17	-60.5	7.5 **	6	0.729	0.164	-0.565	0.255 *	-77.6
Brewer's Sparrow	15	41	22	-46.3	18.1 *	17	29	37	27.6	55.3	20	0.707	1.682	0.975	0.572	137.8
Field Sparrow	43	193	177	-8.3	10.4	32	73	51	-30.1	18.1	47	0.378	0.288	-0.090	0.091	-23.8
Savannah Sparrow	16	65	47	-27.7	13.1 *	6	11	21	90.9	74.1	16	0.169	0.447	0.278	0.393	164.0
Grasshopper Sparrow	8	81	73	-9.9	18.3	6	47	24	-48.9	20.5	8	0.580	0.329	-0.252	0.258	-43.3
Fox Sparrow	27	77	72	-6.5	17.2	16	17	27	58.8	89.7	34	0.221	0.375	0.154	0.139	69.9
Song Sparrow	186	1784	1633	-8.5	3.5 **	191	1590	1583	-0.4	6.9	204	0.891	0.969	0.078	0.089	8.8

TABLE 1. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2003	2004	%chg.	SE[b]	n[c]	2003	2004	%chg.	SE[d]	n[e]	2003	2004	change	SE[f]	%chg.
Lincoln's Sparrow	50	243	248	2.1	12.3	40	106	137	29.2	18.1	57	0.436	0.552	0.116	0.121	26.6
Swamp Sparrow	16	32	40	25.0	40.4	11	49	38	-22.4	24.9	18	1.531	0.950	-0.581	0.466	-38.0
White-throated Sparrow	17	92	88	-4.3	12.4	18	31	38	22.6	50.2	20	0.337	0.432	0.095	0.157	28.2
White-crowned Sparrow	18	76	79	3.9	9.5	15	75	59	-21.3	16.0	21	0.987	0.747	-0.240	0.383	-24.3
Dark-eyed Junco	85	554	805	45.3	9.1 ***	88	494	646	30.8	19.4 *	97	0.892	0.803	-0.089	0.175	-10.0
Northern Cardinal	129	942	735	-22.0	4.8 ***	112	359	388	8.1	13.7	132	0.381	0.528	0.147	0.065 **	38.5
Rose-breasted Grosbeak	30	66	69	4.5	18.7	17	18	15	-16.7	37.6	35	0.273	0.217	-0.055	0.138	-20.3
Black-headed Grosbeak	118	440	503	14.3	10.3	68	168	179	6.5	18.1	123	0.382	0.356	-0.026	0.122	-6.8
Blue Grosbeak	30	143	143	0.8	11.1	9	13	4	-69.2	24.3	30	0.091	0.028	-0.063	0.033 *	-69.2
Lazuli Bunting	73	221	202	-8.6	15.8	34	56	55	-1.8	33.0	78	0.253	0.272	0.019	0.094	7.5
Indigo Bunting	90	569	516	-9.3	7.8	43	55	49	-10.9	24.2	91	0.097	0.095	-0.002	0.029	-1.8
Painted Bunting	19	166	164	-1.2	17.1	15	41	38	-7.3	31.5	20	0.247	0.232	-0.015	0.079	-6.2
Dickcissel	9	87	70	-19.5	11.1	3	5	0	-100.0	0.8	9	0.058	0.000	-0.058	0.024 **	-100.0
Red-winged Blackbird	72	326	326	0.8	12.0	22	32	43	34.4	44.7	73	0.098	0.132	0.034	0.050	34.4
Common Grackle	46	79	103	30.4	28.9	18	21	37	76.2	78.8	48	0.266	0.359	0.093	0.155	35.1
Brown-headed Cowbird	166	326	277	-15.0	7.4 *	56	49	38	-22.4	21.7	172	0.150	0.137	-0.013	0.041	-8.7
Orchard Oriole	23	63	73	15.9	25.2	10	11	6	-45.5	30.3	25	0.175	0.082	-0.092	0.112	-52.9
Bullock's Oriole	64	174	192	10.3	11.6	34	58	55	-5.2	26.0	68	0.333	0.287	-0.047	0.099	-14.1
Baltimore Oriole	38	71	61	-14.1	19.6	19	31	26	-16.1	60.0	43	0.437	0.426	-0.010	0.338	-2.4
Purple Finch	48	246	261	6.1	14.4	36	56	128	128.6	63.9 **	53	0.228	0.490	0.263	0.165	115.4
Cassin's Finch	33	80	80	0.8	25.3	16	13	16	23.1	44.1	35	0.163	0.200	0.038	0.085	23.1
House Finch	47	174	209	20.1	21.3	43	185	227	22.7	34.5	57	1.063	1.086	0.023	0.435	2.2
Pine Siskin	51	176	175	-0.6	20.9	24	171	100	-41.5	19.6 **	55	0.972	0.571	-0.400	0.342	-41.2
Lesser Goldfinch	44	141	196	39.0	28.6 *	31	73	144	97.3	58.7 **	49	0.518	0.735	0.217	0.266	41.9
American Goldfinch	130	771	724	-6.1	6.3	20	23	18	-21.7	24.3	130	0.030	0.025	-0.005	0.014	-16.7
Evening Grosbeak	16	185	107	-42.2	9.2 ***	7	12	8	-33.3	73.6	16	0.065	0.075	0.010	0.076	15.3
All species pooled	**343**	**31345**	**31240**	**-0.3**	**1.6**	**341**	**14622**	**15239**	**4.2**	**4.3**	**343**	**0.467**	**0.488**	**0.021**	**0.028**	**4.6**
	Number decreasing: 64/130 (49%)					Number increasing: 65/130 (50%)					Number increasing: 65/130 (50%)					
NORTHWEST MAPS REGION																
Red-naped Sapsucker	32	64	81	26.6	18.0	27	39	34	-12.8	21.3	36	0.609	0.420	-0.190	0.156	-31.1
Red-breasted Sapsucker	54	133	149	12.0	14.2	37	45	68	51.1	32.3 **	56	0.338	0.456	0.118	0.094	34.9
Downy Woodpecker	54	75	67	-10.7	16.2	36	41	41	0.8	22.1	57	0.547	0.612	0.065	0.178	11.9
Hairy Woodpecker	50	37	49	32.4	27.5	26	11	24	118.2	78.1 **	59	0.297	0.490	0.193	0.158	64.8
Northern Flicker	45	48	43	-10.4	20.7	26	21	19	-9.5	34.5	52	0.438	0.442	0.004	0.183	1.0

TABLE 1. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2003	2004	%chg.	SE[b]	n[c]	2003	2004	%chg.	SE[d]	n[e]	2003	2004	change	SE[f]	%chg.
Western Wood-Pewee	67	224	206	-8.0	10.0	34	45	29	-35.6	18.4 *	70	0.201	0.141	-0.060	0.056	-29.9
Traill's Flycatcher	63	255	294	15.3	14.3	22	23	35	52.2	60.1	65	0.090	0.119	0.029	0.041	32.0
Hammond's Flycatcher	57	121	129	6.6	11.1	28	43	30	-30.2	25.6	62	0.355	0.233	-0.123	0.142	-34.6
Dusky Flycatcher	70	279	308	10.4	13.4	31	46	45	-2.2	35.1	74	0.165	0.146	-0.019	0.046	-11.4
Western Flycatcher	66	145	163	12.4	14.8	46	68	89	30.9	33.0	74	0.469	0.546	0.077	0.152	16.4
Cassin's Vireo	42	89	78	-12.4	14.1	29	34	36	5.9	26.4	53	0.382	0.462	0.079	0.131	20.8
Warbling Vireo	91	468	444	-5.1	7.3	31	51	41	-19.6	23.5	92	0.109	0.092	-0.017	0.035	-15.3
Black-capped Chickadee	39	187	175	-6.4	9.8	40	212	210	-0.9	12.8	43	1.134	1.200	0.066	0.237	5.8
Mountain Chickadee	50	176	148	-15.9	11.0	43	109	113	3.7	22.5	55	0.619	0.764	0.144	0.192	23.3
Chestnut-backed Chick.	40	117	88	-24.8	12.7 *	30	91	140	53.8	46.9	42	0.778	1.591	0.813	0.581	104.5
Bushtit	24	75	69	-8.0	29.2	20	52	73	40.4	64.6	26	0.693	1.058	0.365	0.414	52.6
Red-breasted Nuthatch	53	63	80	27.0	19.7	46	95	96	1.1	33.4	67	1.508	1.200	-0.308	0.564	-20.4
Brown Creeper	56	81	73	-9.9	16.0	58	95	74	-22.1	17.1	70	1.173	1.014	-0.159	0.303	-13.6
Bewick's Wren	25	61	80	31.1	19.5 *	26	103	157	52.4	29.7 **	30	1.689	1.963	0.274	0.611	16.2
House Wren	34	181	176	-2.8	8.4	36	155	133	-14.2	10.7	41	0.856	0.756	-0.101	0.206	-11.8
Winter Wren	28	65	73	12.3	18.1	26	60	53	-11.7	27.5	35	0.923	0.726	-0.197	0.297	-21.3
Golden-crowned Kinglet	37	104	51	-51.0	9.5 ***	32	287	130	-54.7	19.6 ***	48	2.760	2.549	-0.211	1.230	-7.6
Ruby-crowned Kinglet	24	141	54	-61.7	11.0 ***	15	52	54	3.8	27.4	25	0.369	1.000	0.631	0.505	171.2
Swainson's Thrush	79	783	933	19.2	8.2 ***	48	128	133	3.9	16.6	80	0.164	0.143	-0.021	0.041	-12.8
Hermit Thrush	30	61	60	-1.6	18.7	27	29	34	17.2	32.3	42	0.475	0.567	0.091	0.193	19.2
American Robin	108	599	547	-8.7	6.5	69	202	152	-24.8	16.6	110	0.337	0.278	-0.059	0.072	-17.6
Wrentit	16	62	66	6.5	9.8	18	60	110	83.3	34.5 *	20	0.968	1.667	0.699	0.346 *	72.2
Gray Catbird	24	256	307	19.9	11.8 **	14	90	53	-41.1	14.9	24	0.352	0.173	-0.179	0.092 *	-50.9
European Starling	10	54	22	-59.3	11.3 ***	5	15	5	-66.7	28.1 *	11	0.278	0.227	-0.051	0.179	-18.2
Cedar Waxwing	39	191	227	18.8	18.1	12	20	18	-10.0	57.7	40	0.105	0.079	-0.025	0.049	-24.3
Orange-crowned Warbler	42	155	130	-16.1	13.6	35	104	126	21.2	27.8	50	0.671	0.969	0.298	0.341	44.5
Nashville Warbler	29	74	95	28.4	29.5	29	26	80	207.7	114.5 ***	35	0.351	0.842	0.491	0.266 *	139.7
Virginia's Warbler	4	47	25	-46.8	27.6	2	26	9	-65.4	2.1	4	0.553	0.360	-0.193	0.348	-34.9
Yellow Warbler	74	1000	1089	8.9	7.7	63	476	407	-14.5	13.0	79	0.476	0.374	-0.102	0.094	-21.5
Yellow-rumped Warbler	70	379	355	-6.3	9.0	46	214	276	29.0	51.4	73	0.565	0.777	0.213	0.331	37.7
Townsend's Warbler	17	89	108	21.3	13.1 *	12	143	50	-65.0	6.8 **	19	1.607	0.463	-1.144	0.651 *	-71.2
Hermit Warbler	35	132	108	-18.2	12.1	23	33	111	236.4	195.2	38	0.250	1.028	0.778	0.436 *	311.1
American Redstart	12	42	60	42.9	36.6	3	7	14	100.0	113.4	13	0.167	0.233	0.067	0.120	40.0
MacGillivray's Warbler	93	734	813	10.8	5.3 **	83	345	335	-2.9	11.2	102	0.470	0.412	-0.058	0.070	-12.3
Common Yellowthroat	40	167	189	13.2	12.7	21	84	111	32.1	34.7	44	0.503	0.587	0.084	0.246	16.8
Wilson's Warbler	76	542	731	34.9	15.2 **	52	143	185	29.4	25.3	87	0.264	0.253	-0.011	0.089	-4.1

TABLE 1. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2003	2004	%chg.	SE[b]	n[c]	2003	2004	%chg.	SE[d]	n[e]	2003	2004	change	SE[f]	%chg.
Yellow-breasted Chat	21	105	114	8.6	10.2	12	26	39	50.0	61.3	22	0.248	0.342	0.094	0.119	38.2
Western Tanager	86	236	253	7.2	12.5	39	107	88	-17.8	25.0	87	0.453	0.348	-0.106	0.126	-23.3
Green-tailed Towhee	21	59	52	-11.9	13.6	20	23	29	26.1	45.4	27	0.390	0.558	0.168	0.204	43.1
Spotted Towhee	47	197	173	-12.2	10.9	40	146	188	28.8	19.5	53	0.741	1.087	0.346	0.267	46.6
Chipping Sparrow	51	154	140	-9.1	11.8	28	90	55	-38.9	14.7 *	53	0.584	0.393	-0.192	0.158	-32.8
Brewer's Sparrow	13	39	22	-43.6	19.4	16	28	37	32.1	58.1	17	0.718	1.682	0.964	0.579	134.3
Savannah Sparrow	12	60	42	-30.0	12.7	5	11	20	81.8	72.9	12	0.183	0.476	0.293	0.457	159.7
Fox Sparrow	26	76	72	-5.3	17.4	16	17	27	58.8	89.7	33	0.224	0.375	0.151	0.139	67.6
Song Sparrow	97	958	818	-14.6	4.2 ***	102	865	876	1.3	9.8	105	0.903	1.071	0.168	0.126	18.6
Lincoln's Sparrow	42	234	242	3.4	12.7	36	101	136	34.7	18.7 *	48	0.432	0.562	0.130	0.124	30.2
White-crowned Sparrow	16	76	77	1.3	8.9	14	74	59	-20.3	16.4	18	0.974	0.766	-0.208	0.388	-21.3
Dark-eyed Junco	72	529	783	48.0	9.4 ***	72	428	567	32.5	22.3	78	0.809	0.724	-0.085	0.158	-10.5
Black-headed Grosbeak	83	281	319	13.5	12.6	47	108	129	19.4	27.3	87	0.384	0.404	0.020	0.169	5.2
Lazuli Bunting	58	192	181	-5.7	17.6	30	45	55	22.2	43.7	62	0.234	0.304	0.069	0.101	29.7
Red-winged Blackbird	28	112	115	2.7	12.5	10	11	15	36.4	71.1	29	0.098	0.130	0.032	0.092	32.8
Brown-headed Cowbird	64	141	117	-17.0	10.0	28	29	26	-10.3	34.1	67	0.206	0.222	0.017	0.086	8.0
Bullock's Oriole	34	78	92	17.9	15.4	18	32	30	-6.3	33.2	35	0.410	0.326	-0.084	0.189	-20.5
Purple Finch	32	213	229	7.5	15.9	26	47	113	140.4	76.3 *	34	0.221	0.493	0.273	0.187	123.6
Cassin's Finch	33	80	80	0.8	25.3	16	13	16	23.1	44.1	35	0.163	0.200	0.038	0.085	23.1
House Finch	13	48	43	-10.4	13.1	17	49	64	30.6	41.2	18	1.021	1.488	0.468	0.351	45.8
Pine Siskin	49	175	174	-0.6	21.0	23	170	100	-41.2	19.9 **	53	0.971	0.575	-0.397	0.344	-40.8
Lesser Goldfinch	17	87	75	-13.8	15.1	16	53	76	43.4	41.5	21	0.609	1.013	0.404	0.428	66.3
American Goldfinch	32	243	204	-16.0	9.7	11	14	15	7.1	34.0	32	0.058	0.073	0.016	0.043	27.6
Evening Grosbeak	16	185	107	-42.2	9.2 ***	7	12	8	-33.3	73.6	16	0.065	0.075	0.010	0.076	15.3
All species pooled	**122**	**13568**	**13922**	**2.6**	**2.2**	**122**	**6578**	**6881**	**4.6**	**7.9**	**122**	**0.485**	**0.494**	**0.009**	**0.047**	**1.9**
	Number increasing: 30/65 (46%)					Number increasing: 38/65 (58%)					Number increasing: 39/65 (60%)*					
SOUTHWEST MAPS REGION																
Nuttall's Woodpecker	19	33	38	15.2	39.7	21	34	48	41.2	52.9	22	1.030	1.263	0.233	0.487	22.6
Downy Woodpecker	23	35	31	-11.4	22.5	20	36	17	-52.8	18.4 **	25	1.029	0.548	-0.480	0.250 *	-46.7
Western Flycatcher	29	83	113	36.1	21.2 *	20	49	87	77.6	37.2 *	29	0.590	0.770	0.180	0.238	30.4
Black Phoebe	24	37	31	-16.2	16.7	29	67	65	-3.0	20.6	30	1.811	2.097	0.286	0.789	15.8
Ash-throated Flycatcher	32	121	138	14.1	16.5	17	20	25	25.0	48.2	33	0.165	0.181	0.016	0.072	9.6
Bell's Vireo	7	32	41	28.1	33.7	7	11	16	45.5	75.6	8	0.344	0.390	0.047	0.140	13.5
Warbling Vireo	25	94	87	-7.4	23.1	13	27	17	-37.0	33.2	27	0.287	0.195	-0.092	0.136	-32.0
Chestnut-backed Chick.	11	53	28	-47.2	15.9 *	12	84	99	17.9	22.4	12	1.585	3.536	1.951	1.051 *	123.1

TABLE 1. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2003	2004	%chg.	SE[b]	n[c]	2003	2004	%chg.	SE[d]	n[e]	2003	2004	change	SE[f]	%chg.
Oak Titmouse	12	29	30	3.4	33.5	12	44	29	-34.1	27.8	13	1.517	0.967	-0.551	0.612	-36.3
Bushtit	29	121	173	43.0	25.0 *	30	129	149	15.5	23.6	33	1.066	0.861	-0.205	0.258	-19.2
Bewick's Wren	40	223	220	-1.3	10.0	42	323	352	9.0	13.0	43	1.448	1.600	0.152	0.324	10.5
House Wren	22	131	91	-30.5	11.5 **	21	97	108	11.3	20.9	23	0.740	1.187	0.446	0.289	60.3
Swainson's Thrush	20	244	254	4.1	18.9	11	56	35	-37.5	11.2 **	20	0.230	0.138	-0.092	0.063	-40.0
American Robin	24	65	46	-29.2	21.2	14	29	8	-72.4	10.0 ***	24	0.446	0.174	-0.272	0.172	-61.0
Wrentit	21	155	113	-27.1	8.3 **	19	140	138	-1.4	18.4	21	0.903	1.221	0.318	0.417	35.2
Orange-crowned Warbler	22	72	58	-19.4	19.4	18	57	60	5.3	33.8	24	0.792	1.035	0.243	0.403	30.7
Lucy's Warbler	11	114	126	10.5	10.4	10	52	47	-9.6	37.2	11	0.456	0.373	-0.083	0.173	-18.2
Yellow Warbler	27	123	149	21.1	17.8	13	46	47	2.2	53.0	27	0.374	0.315	-0.059	0.172	-15.7
Common Yellowthroat	28	315	336	6.7	12.2	21	128	93	-27.3	16.0 *	29	0.406	0.277	-0.130	0.121	-31.9
Wilson's Warbler	17	153	163	6.5	14.9	12	192	178	-7.3	15.7	17	1.255	1.092	-0.163	0.299	-13.0
Yellow-breasted Chat	18	162	174	7.4	9.0	10	19	22	15.8	45.4	18	0.117	0.126	0.009	0.065	7.8
Summer Tanager	8	69	46	-33.3	11.5 **	5	7	2	-71.4	17.4 **	8	0.101	0.044	-0.058	0.051	-57.1
Western Tanager	18	35	42	20.0	35.7	5	36	16	-55.6	13.5 **	18	1.029	0.381	-0.648	0.781	-63.0
Spotted Towhee	30	188	156	-17.0	11.1	32	95	119	25.3	34.7	35	0.505	0.763	0.258	0.221	51.0
California Towhee	17	42	49	16.7	34.5	14	20	10	-50.0	27.0 *	20	0.476	0.204	-0.272	0.183	-57.1
Song Sparrow	37	439	469	6.8	5.9	37	455	383	-15.8	12.5	38	1.036	0.817	-0.220	0.179	-21.2
Black-headed Grosbeak	34	149	175	17.5	19.1	20	52	50	-3.8	21.7	35	0.349	0.286	-0.063	0.159	-18.1
Blue Grosbeak	19	132	133	0.8	11.9	7	12	3	-75.0	23.4	19	0.091	0.023	-0.068	0.034 *	-75.2
Red-winged Blackbird	9	44	58	31.8	11.2 **	3	9	2	-77.8	14.8 **	9	0.205	0.035	-0.170	0.048 ***	-83.1
Brown-headed Cowbird	34	54	60	11.1	22.0	5	4	1	-75.0	31.3	34	0.074	0.017	-0.057	0.043	-77.5
Bullock's Oriole	26	82	90	9.8	16.9	13	16	20	25.0	48.4	29	0.195	0.222	0.027	0.071	13.9
House Finch	28	118	162	37.3	31.2	22	131	157	19.8	46.0	30	1.110	0.969	-0.141	0.601	-12.7
Lesser Goldfinch	26	52	121	132.7	56.8 ***	15	20	68	240.0	177.4 *	27	0.385	0.562	0.177	0.247	46.1
American Goldfinch	16	60	59	-1.7	19.3	5	6	2	-66.7	34.0	16	0.100	0.034	-0.066	0.057	-66.1
All species pooled	**48**	**4572**	**4793**	**4.8**	**4.0**	**48**	**2838**	**2751**	**-3.1**	**7.3**	**48**	**0.621**	**0.574**	**-0.047**	**0.076**	**-7.5**
	Number increasing: 22/34 (65%)*					Number decreasing: 19/34 (56%)					Number decreasing: 20/34 (59%)					
NORTH-CENTRAL MAPS REGION																
Downy Woodpecker	19	32	33	3.1	18.7	16	34	38	11.8	29.9	19	1.063	1.152	0.089	0.488	8.4
Traill's Flycatcher	16	67	49	-26.9	27.5	7	11	10	-9.1	66.0	17	0.164	0.204	0.040	0.126	24.3
Black-capped Chickadee	18	95	68	-28.4	16.4	16	84	55	-34.5	19.6	19	0.884	0.809	-0.075	0.375	-8.5
House Wren	16	120	112	-6.7	17.6	17	75	85	13.3	26.1	18	0.625	0.759	0.134	0.332	21.4
American Robin	19	91	94	3.3	22.3	16	75	74	-1.3	33.7	19	0.824	0.787	-0.037	0.358	-4.5
Gray Catbird	20	336	354	5.4	9.2	20	170	168	-1.2	22.3	20	0.506	0.475	-0.031	0.176	-6.2

TABLE 1. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2003	2004	%chg.	SE[b]	n[c]	2003	2004	%chg.	SE[d]	n[e]	2003	2004	change	SE[f]	%chg.
Cedar Waxwing	16	54	70	29.6	59.9	1	2	0	-100.0		16	0.037	0.000	-0.037	0.041	-100.0
Tennessee Warbler	2	48	21	-56.3	4.9	4	6	6	0.8	112.2	4	0.125	0.286	0.161	0.465	128.6
Yellow Warbler	16	195	166	-14.9	11.8	13	76	40	-47.4	14.7 *	16	0.390	0.241	-0.149	0.123	-38.2
American Redstart	10	69	51	-26.1	11.0 *	6	3	7	133.3	200.0	12	0.044	0.137	0.094	0.064	215.7
Ovenbird	10	39	44	12.8	27.6	5	6	8	33.3	100.9	10	0.154	0.182	0.028	0.101	18.2
Common Yellowthroat	22	244	280	14.8	12.3	18	127	56	-55.9	18.6 ***	23	0.521	0.200	-0.321	0.195 *	-61.6
Clay-colored Sparrow	3	59	101	71.2	67.5	3	43	17	-60.5	7.5 **	3	0.729	0.168	-0.561	0.285	-76.9
Field Sparrow	14	70	59	-15.7	11.2	10	19	15	-21.1	26.2	15	0.271	0.254	-0.017	0.108	-6.3
Grasshopper Sparrow	6	58	42	-27.6	10.1	4	17	13	-23.5	63.2	6	0.293	0.310	0.016	0.192	5.6
Song Sparrow	17	189	143	-24.3	10.1 *	18	107	94	-12.2	12.3	19	0.566	0.657	0.091	0.171	16.1
Northern Cardinal	14	77	53	-31.2	8.3 **	10	22	18	-18.2	41.2	14	0.286	0.340	0.054	0.128	18.9
Rose-breasted Grosbeak	13	43	49	14.0	20.3	4	4	2	-50.0	61.2	14	0.093	0.041	-0.052	0.088	-56.1
Indigo Bunting	14	74	60	-18.9	13.8	6	4	7	75.0	185.0	14	0.054	0.117	0.063	0.069	115.8
Red-winged Blackbird	12	91	100	9.9	34.3	5	6	13	116.7	209.2	12	0.066	0.130	0.064	0.074	97.2
Brown-headed Cowbird	17	49	33	-32.7	16.8	9	2	7	250.0	297.6	17	0.041	0.212	0.171	0.083 *	419.7
Baltimore Oriole	16	40	38	-5.0	31.0	7	27	2	-92.6	8.1 ***	16	0.675	0.053	-0.622	0.561	-92.2
American Goldfinch	24	180	221	22.8	15.0	2	1	1	0.8	200.0	24	0.006	0.005	-0.001	0.007	-18.6
All species pooled	**27**	**2946**	**2900**	**-1.6**	**6.5**	**26**	**1086**	**924**	**-14.9**	**13.2**	**27**	**0.369**	**0.319**	**-0.050**	**0.063**	**-13.6**
	Number decreasing: 13/23 (57%)					Number decreasing: 14/23 (61%)					Number decreasing: 11/23 (48%)					
SOUTH-CENTRAL MAPS REGION																
Downy Woodpecker	21	32	51	59.4	35.6 **	18	48	43	-10.4	23.3	23	1.500	0.843	-0.657	0.457	-43.8
Acadian Flycatcher	19	137	137	0.8	11.0	12	18	25	38.9	46.8	20	0.131	0.183	0.051	0.060	38.9
White-eyed Vireo	31	234	288	23.1	11.0 **	24	65	67	3.1	21.8	31	0.278	0.233	-0.045	0.079	-16.3
Red-eyed Vireo	20	39	47	20.5	36.2	5	1	5	400.0	632.5	20	0.026	0.106	0.081	0.053	314.9
Carolina Chickadee	32	79	106	34.2	21.5	24	34	42	23.5	37.5	34	0.430	0.396	-0.034	0.147	-7.9
Tufted Titmouse	28	95	78	-17.9	16.4	27	103	89	-13.6	14.6	30	1.084	1.141	0.057	0.215	5.2
Black-crested Titmouse	7	23	22	-4.3	31.4	7	27	21	-22.2	23.1	8	1.174	0.955	-0.219	0.422	-18.7
Carolina Wren	31	225	198	-12.0	8.5	29	194	240	23.7	16.9 *	32	0.862	1.212	0.350	0.181 *	40.6
Bewick's Wren	9	50	55	10.0	10.2	8	80	23	-71.3	7.7 ***	10	1.600	0.418	-1.182	0.558 *	-73.9
Blue-gray Gnatcatcher	16	30	35	16.7	35.4	10	27	27	0.8	37.9	18	0.900	0.771	-0.129	0.688	-14.3
Wood Thrush	13	54	41	-24.1	17.1	5	4	13	225.0	160.3	14	0.074	0.317	0.243	0.153	328.0
Blue-winged Warbler	6	66	51	-22.7	17.9	6	11	20	81.8	163.9	6	0.167	0.392	0.226	0.294	135.3
Prairie Warbler	5	36	41	13.9	50.5	4	9	13	44.4	62.4	5	0.250	0.317	0.067	0.222	26.8
Black-and-white Warbler	15	40	27	-32.5	19.8	10	11	12	9.1	39.8	16	0.275	0.444	0.169	0.191	61.6
Prothonotary Warbler	14	113	76	-32.7	7.9 **	12	25	9	-64.0	20.4 ***	14	0.221	0.118	-0.103	0.091	-46.5

TABLE 1. Continued.

Species	ADULTS n[a]	2003	2004	%chg.	SE[b]	YOUNG n[c]	2003	2004	%chg.	SE[d]	REPRODUCTIVE INDEX n[e]	2003	2004	change	SE[f]	%chg.
Kentucky Warbler	18	122	90	-26.2	9.4 **	18	55	57	3.6	24.7	20	0.451	0.633	0.183	0.176	40.5
Common Yellowthroat	12	47	52	10.6	39.5	8	12	15	25.0	33.8	13	0.255	0.289	0.033	0.154	13.0
Hooded Warbler	11	37	56	51.4	31.2	7	15	17	13.3	18.4	13	0.405	0.304	-0.102	0.169	-25.1
Yellow-breasted Chat	14	173	169	-2.3	15.9	11	39	29	-25.6	25.3	15	0.225	0.172	-0.054	0.070	-23.9
Summer Tanager	27	80	63	-21.3	12.1	4	5	1	-80.0	21.7 **	27	0.063	0.016	-0.047	0.032	-74.6
Field Sparrow	11	80	65	-18.8	13.4	8	35	17	-51.4	21.5	11	0.438	0.262	-0.176	0.158	-40.2
Grasshopper Sparrow	2	23	31	34.8	20.8	2	30	11	-63.3	12.2	2	1.304	0.355	-0.949	0.071	-72.8
Northern Cardinal	37	383	281	-26.6	7.8 **	35	172	128	-25.6	13.2	37	0.449	0.456	0.006	0.102	1.4
Indigo Bunting	22	297	263	-11.4	10.0	17	18	14	-22.2	28.9	22	0.061	0.053	-0.007	0.021	-12.2
Painted Bunting	18	158	153	-3.2	17.8	14	41	28	-31.7	15.0 *	19	0.260	0.183	-0.077	0.063	-29.5
Brown-headed Cowbird	27	54	45	-16.7	20.4	3	1	3	200.0	458.3	27	0.019	0.067	0.048	0.046	260.0
All species pooled	**39**	**3243**	**3045**	**-6.1**	**5.1**	**39**	**1223**	**1089**	**-11.0**	**6.4**	**39**	**0.377**	**0.358**	**-0.020**	**0.043**	**-5.2**
	Number decreasing: 15/26 (58%)					Number decreasing: 12/26 (46%)					Number decreasing: 14/26 (54%)					
NORTHEAST MAPS REGION																
Downy Woodpecker	38	45	46	2.2	22.6	43	53	80	50.9	30.9 **	51	1.178	1.739	0.561	0.422	47.7
Traill's Flycatcher	24	69	63	-8.7	19.2	10	4	12	200.0	166.7	24	0.058	0.191	0.133	0.059 **	228.6
Red-eyed Vireo	52	121	123	1.7	17.4	11	8	20	150.0	129.8 *	52	0.066	0.163	0.097	0.063	145.9
Blue Jay	27	45	16	-64.4	10.3 ***	7	13	11	-15.4	49.0	28	0.289	0.688	0.399	0.415	138.0
Black-capped Chickadee	48	178	132	-25.8	9.7 **	36	101	148	46.5	27.8 *	50	0.567	1.121	0.554	0.305 *	97.6
Tufted Titmouse	29	49	33	-32.7	16.0 *	28	42	69	64.3	47.7	34	0.857	2.091	1.234	0.603 **	143.9
Carolina Wren	17	43	43	0.8	20.9	17	30	57	90.0	57.7	21	0.698	1.326	0.628	0.351 *	90.0
House Wren	15	36	34	-5.6	20.2	16	27	33	22.2	41.8	17	0.750	0.971	0.221	0.316	29.4
Veery	33	164	190	15.9	11.1	23	33	36	9.1	19.8	33	0.201	0.190	-0.012	0.049	-5.8
Swainson's Thrush	8	43	31	-27.9	14.4 *	7	15	10	-33.3	21.5	9	0.349	0.323	-0.026	0.122	-7.5
Hermit Thrush	16	37	48	29.7	25.1	14	16	20	25.0	67.3	22	0.432	0.417	-0.016	0.266	-3.6
Wood Thrush	36	141	124	-12.1	13.0	29	57	60	5.3	24.0	39	0.404	0.484	0.080	0.126	19.7
American Robin	46	213	148	-30.5	11.0 *	33	74	89	20.3	22.6	51	0.347	0.601	0.254	0.152 *	73.1
Gray Catbird	48	645	724	12.2	6.0 **	39	304	370	21.7	18.4	51	0.471	0.511	0.040	0.095	8.4
Cedar Waxwing	29	133	131	-1.5	15.0	2	4	1	-75.0	50.0	29	0.030	0.008	-0.022	0.024	-74.6
Yellow Warbler	20	172	125	-27.3	8.7 **	14	47	78	66.0	50.6	22	0.273	0.624	0.351	0.246	128.4
Chestnut-sided Warbler	19	65	64	-1.5	12.2	8	35	45	28.6	50.9	20	0.539	0.703	0.165	0.299	30.6
Magnolia Warbler	14	45	55	22.2	23.4	7	8	11	37.5	60.8	15	0.178	0.200	0.022	0.133	12.5
Black-thrtd. Blue Warbler	12	19	38	100.0	39.6 ***	9	27	35	29.6	28.0	14	1.421	0.921	-0.500	1.129	-35.2
Black-thrtd. Green Warb.	16	30	48	60.0	38.8	6	12	13	8.3	37.1	19	0.400	0.271	-0.129	0.276	-32.3
Black-and-white Warbler	24	28	37	32.1	29.6	17	15	19	26.7	55.6	29	0.536	0.514	-0.022	0.235	-4.1

TABLE 1. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2003	2004	%chg.	SE[b]	n[c]	2003	2004	%chg.	SE[d]	n[e]	2003	2004	change	SE[f]	%chg.
American Redstart	32	79	87	10.1	20.1	16	37	50	35.1	62.5	35	0.468	0.575	0.106	0.260	22.7
Worm-eating Warbler	16	43	28	-34.9	14.9	6	38	32	-15.8	13.1	18	0.884	1.143	0.259	0.888	29.3
Ovenbird	54	138	174	26.1	19.5	32	75	73	-2.7	19.1	54	0.544	0.420	-0.124	0.142	-22.8
Louisiana Waterthrush	17	25	29	16.0	30.6	12	21	37	76.2	43.1	19	0.840	1.276	0.436	0.717	51.9
Common Yellowthroat	47	278	276	-0.7	8.1	32	77	129	67.5	40.0 **	48	0.277	0.467	0.190	0.094 **	68.7
Field Sparrow	12	20	35	75.0	72.4	11	13	19	46.2	77.0	15	0.650	0.543	-0.107	0.336	-16.5
Song Sparrow	34	195	192	-1.5	9.3	31	154	224	45.5	19.3 **	39	0.790	1.167	0.377	0.188 **	47.7
Swamp Sparrow	11	22	16	-27.3	23.2	8	37	24	-35.1	29.1	13	1.682	1.500	-0.182	0.741	-10.8
White-throated Sparrow	11	46	53	15.2	21.6	11	20	33	65.0	85.9	13	0.435	0.623	0.188	0.260	43.2
Dark-eyed Junco	8	21	13	-38.1	13.5	8	43	65	51.2	19.3	11	2.048	5.000	2.952	2.534	144.2
Northern Cardinal	38	145	132	-9.0	14.4	31	50	88	76.0	41.3 *	40	0.345	0.667	0.322	0.160 **	93.3
Indigo Bunting	23	66	41	-37.9	20.1	9	17	9	-47.1	27.9	24	0.258	0.220	-0.038	0.127	-14.8
Red-winged Blackbird	19	70	52	-25.7	19.5	4	6	13	116.7	90.3	19	0.086	0.250	0.164	0.174	191.7
Common Grackle	20	40	49	22.5	18.9	7	6	20	233.3	273.0	21	0.150	0.408	0.258	0.268	172.1
American Goldfinch	35	213	171	-19.7	8.3 **	0	0	0			35	0.000	0.000	0.000		
All species pooled	**65**	**4401**	**4234**	**-3.8**	**3.8**	**64**	**1737**	**2280**	**31.3**	**8.0** ***	**65**	**0.395**	**0.539**	**0.144**	**0.055** ***	**36.4**
	Number decreasing: 20/36 (56%)					Number increasing: 28/36 (78%)***					Number increasing: 25/36 (69%)**					
SOUTHEAST MAPS REGION																
Downy Woodpecker	24	31	33	6.5	30.0	20	35	42	20.0	31.4	30	1.129	1.273	0.144	0.560	12.7
Acadian Flycatcher	22	124	99	-20.2	12.9	12	8	11	37.5	63.9	24	0.064	0.111	0.047	0.041	72.2
White-eyed Vireo	27	86	84	-2.3	20.5	17	40	35	-12.5	25.5	27	0.465	0.417	-0.048	0.150	-10.4
Red-eyed Vireo	29	140	87	-37.9	9.4 ***	13	9	21	133.3	91.2	31	0.064	0.241	0.177	0.067 ***	275.5
Carolina Chickadee	26	37	58	56.8	45.3 *	27	38	63	65.8	50.6	32	1.027	1.086	0.059	0.410	5.8
Tufted Titmouse	30	99	63	-36.4	12.1 **	29	62	72	16.1	31.6	34	0.626	1.143	0.517	0.248 **	82.5
Carolina Wren	33	142	198	39.4	12.9 ***	33	119	209	75.6	24.2 ***	36	0.838	1.056	0.218	0.276	26.0
Blue-gray Gnatcatcher	15	32	31	-3.1	26.3	12	15	22	46.7	59.1	19	0.469	0.710	0.241	0.322	51.4
Wood Thrush	25	141	121	-14.2	8.1 *	22	40	46	15.0	32.2	30	0.284	0.380	0.097	0.115	34.0
American Robin	9	23	18	-21.7	30.4	9	30	24	-20.0	26.6	12	1.304	1.333	0.029	0.607	2.2
Gray Catbird	17	32	27	-15.6	14.3	8	40	44	10.0	12.0	20	1.250	1.630	0.380	0.746	30.4
Brown Thrasher	19	36	31	-13.9	13.3	11	19	10	-47.4	22.8	20	0.528	0.323	-0.205	0.211	-38.9
Pine Warbler	10	11	12	9.1	51.3	7	2	109	5350.0	6509.6	13	0.182	9.083	8.902	5.941	4895.8
Prairie Warbler	12	55	40	-27.3	18.0	9	27	17	-37.0	29.0	12	0.491	0.425	-0.066	0.180	-13.4
Ovenbird	24	69	79	14.5	21.7	14	37	30	-18.9	24.2	26	0.536	0.380	-0.157	0.220	-29.2
Louisiana Waterthrush	16	42	40	-4.8	22.3	12	12	18	50.0	58.4	18	0.286	0.450	0.164	0.197	57.5
Kentucky Warbler	14	69	76	10.1	24.6	11	16	25	56.3	48.5	16	0.232	0.329	0.097	0.141	41.9

TABLE 1. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2003	2004	%chg.	SE[b]	n[c]	2003	2004	%chg.	SE[d]	n[e]	2003	2004	change	SE[f]	%chg.
Common Yellowthroat	25	100	111	11.0	24.1	14	51	49	-3.9	13.7	26	0.510	0.441	-0.069	0.133	-13.4
Hooded Warbler	16	63	54	-14.3	14.9	15	18	29	61.1	77.4	20	0.286	0.537	0.251	0.166	88.0
Yellow-breasted Chat	14	55	69	25.5	40.9	9	24	21	-12.5	16.3	15	0.436	0.304	-0.132	0.148	-30.3
Eastern Towhee	24	43	29	-32.6	17.1	11	11	10	-9.1	48.7	26	0.256	0.345	0.089	0.166	34.8
Northern Cardinal	35	321	252	-21.5	8.1 **	33	113	147	30.1	27.0	36	0.352	0.583	0.231	0.117 **	65.7
Indigo Bunting	27	125	144	15.2	21.2	10	14	19	35.7	80.1	27	0.112	0.132	0.020	0.077	17.8
American Goldfinch	16	58	44	-24.1	25.2	1	1	0	-100.0		16	0.017	0.000	-0.017	0.019	-100.0
All species pooled	**38**	**2356**	**2170**	**-7.9**	**5.4**	**38**	**901**	**1228**	**36.3**	**15.3** ***	**38**	**0.382**	**0.566**	**0.184**	**0.089** **	**48.0**
	Number decreasing: 15/24 (63%)					Number increasing: 15/24 (63%)					Number increasing: 17/24 (71%)**					
ALASKA AND BOREAL CANADA MAPS REGIONS																
Tennessee Warbler	4	8	7	-12.5	44.6	3	62	34	-45.2	28.6	4	7.750	4.857	-2.893	3.785	-37.3
Yellow-rumped Warbler	4	14	9	-35.7	11.5 *	4	81	7	-91.4	2.7 ***	4	5.786	0.778	-5.008	2.999	-86.6
American Redstart	4	52	34	-34.6	6.1 **	3	22	8	-63.6	47.6	4	0.423	0.235	-0.188	0.278	-44.4
Canada Warbler	4	42	24	-42.9	12.9 **	4	18	8	-55.6	37.1	4	0.429	0.333	-0.095	0.296	-22.2
All species pooled	**4**	**259**	**176**	**-32.0**	**2.7** ***	**4**	**259**	**86**	**-66.8**	**14.4** **	**4**	**1.000**	**0.489**	**-0.511**	**0.482**	**-51.1**
	Number decreasing: 4/4 (100%)*					Number decreasing: 4/4 (100%)*					Number decreasing: 4/4 (100%)*					

[a] Number of stations at which at least one individual adult bird of the species was captured in either year.
[b] Standard error of the percent change in the number of adult birds captured.
[c] Number of stations at which at least one individual young bird of the species was captured in either year.
[d] Standard error of the percent change in the number of young birds captured.
[e] Number of stations at which at least one individual aged bird of the species was captured in either year.
[f] Standard error of the change in the reproductive index.
* $0.05 \leq P < 0.10$; ** $0.01 \leq P < 0.05$; *** $P < 0.01$

reproductive index were each 50%. Program-wide, only nine species had significant or nearly significant increases in number of young and only 10 species had significant or nearly significant decreases. Similarly, only eight species had significant or nearly significant increases in reproductive index and only six species had significant or nearly significant decreases.

2. *Changes between 2004 and 2005* — Constant-effort data were obtained for 2004 and 2005 from 352 MAPS stations operated comparably in both years. The changes between years in the numbers of adult and young birds captured and the reproductive index are presented for the entire continent (program-wide) and for each region in Table 2 for individual species (inclusion criteria as in Table 1) and for all species pooled. These included 125 species program-wide, 63 species in the Northwest, 32 in the Southwest, 22 in the North-central, 23 in the South-central, 35 in the Northeast, 26 in the Southeast, and 4 in the combined Alaska/Boreal Canada Region.

(a) *Changes in adult population size* — Overall, the index of adult population size for all species pooled decreased in 2005 in the four western and central regions, where productivity tended to be reduced during 2004, and increased in the two eastern regions, where productivity significantly increased during 2004 (Table 2). Adult population size for all species pooled also tended to increase in the Alaska/Boreal Canada Region in 2005, despite the significant decrease in productivity there in 2004, but, again, data for these comparisons were received from just five stations there. The -7.8% and -7.7% decreases in the number of adults of all species pooled in the Northwest and South-central regions, respectively, were the only significant changes. Only the proportions of decreasing species from the South-central (74%) Southwest (66%) regions were significant and nearly significant, respectively. Summing over the two western and two central regions where adult populations decreased, a total of 25 species had significant or nearly significant decreases in number of adults, while only three species had significant or nearly significant increases. In contrast, summing over the remaining three regions where adult populations increased, 10 species had significant or nearly significant increases in number of adults, while only three species had significant or nearly significant decreases.

Program-wide, the index for adult population size for all species pooled decreased by a highly significant -5.0% (Table 2). The program-wide proportion of decreasing species (58%) was also nearly significant. Program-wide, 13 species had significant decreases in number of adults and another five species had nearly significant decreases, while only five species showed significant or nearly significant increases.

(b) *Changes in productivity* — Regional changes in productivity for all species pooled between 2004 and 2005 were opposite those between 2003 and 2004 for six of the seven regions (Table 2). The most pronounced and significant decreases in productivity in 2005 occurred in the two eastern regions, where the largest and most significant increases occurred in 2004. The number of young of all species pooled in the Southeast decreased in 2005 by -38.8%, while the reproductive index decreased there by -38.9% (both highly significant). These two parameters decreased in 2005 in the Northeast by -14.2% and -18.8%, respectively (both nearly significant). The proportions of decreasing species for these two parameters in these two regions ranged from 60% to 85% and were highly significant for all but the number of young in the Northeast (60%) which was not significant. Summing over these two regions, 25 species had significant or nearly significant decreases in the number of young captured in 2005, while not a single species had even a nearly significant increase. Similarly, 12 species had significant or nearly significant decreases in reproductive index, while only two species had significant or nearly significant increases. Smaller decreases in productivity (a nearly significant -9.1% decrease in number of young of all species pooled and a non-significant -1.4% decrease in reproductive index) occurred in 2005 in the Northwest Region following non-significant increases in productivity there in 2004. The proportion of species (71%) with decreases in the number of young captured in the Northwest in 2005 was highly significant. Fourteen species in the Northwest showed significant or nearly significant decreases in number of young captured compared to only one species with a nearly significant increase; similarly, six species showed significant or nearly significant decreases in reproductive index compared to only one species with a significant increase. Productivity in the Southwest, North-

TABLE 2. Program-wide and regional changes between 2004 and 2005 in the numbers of adult and young individuals captured and in the reproductive index (young/adult) for 125 species and all species pooled (excluding gallinaceous birds and hummingbirds) at the 352 MAPS stations run comparably during both years. For each species, data were included only from stations within the breeding range of the species. Only species for which adults were captured at two or more stations and for which 50 or more aged individuals were captured in either year are included.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2004	2005	%chg.	SE[b]	n[c]	2004	2005	%chg.	SE[d]	n[e]	2004	2005	change	SE[f]	%chg.
PROGRAM-WIDE																
Red-bellied Woodpecker	39	48	31	-35.4	14.0 *	19	16	13	-18.8	31.5	47	0.333	0.419	0.086	0.186	25.8
Red-naped Sapsucker	34	93	88	-5.4	12.3	22	36	28	-22.2	23.5	36	0.387	0.318	-0.069	0.109	-17.8
Red-breasted Sapsucker	42	108	70	-35.2	10.2 **	30	56	28	-50.0	10.2 ***	45	0.519	0.400	-0.119	0.109	-22.9
Nuttall's Woodpecker	18	46	26	-43.5	15.6 **	16	40	36	-10.0	33.2	20	0.870	1.385	0.515	0.485	59.2
Downy Woodpecker	187	276	258	-6.5	9.1	160	280	249	-11.1	8.1	225	1.015	0.965	-0.049	0.150	-4.9
Hairy Woodpecker	112	98	77	-21.4	12.2	55	45	32	-28.9	16.8	131	0.459	0.416	-0.044	0.123	-9.5
Northern Flicker	84	76	84	10.5	20.8	44	38	30	-21.1	20.3	99	0.500	0.357	-0.143	0.146	-28.6
Western Wood-Pewee	84	216	200	-7.4	10.7	34	32	20	-37.5	18.8	87	0.148	0.100	-0.048	0.041	-32.5
Eastern Wood-Pewee	58	83	85	2.4	24.7	15	25	4	-84.0	13.0 ***	64	0.301	0.047	-0.254	0.095 ***	-84.4
Acadian Flycatcher	68	370	306	-17.3	7.6 *	36	50	31	-38.0	18.3 *	69	0.135	0.101	-0.034	0.033	-25.0
Traill's Flycatcher	110	461	452	-2.0	8.3	33	51	34	-33.3	24.0	111	0.111	0.075	-0.035	0.031	-32.0
Least Flycatcher	30	64	68	6.3	17.8	15	13	16	23.1	50.5	33	0.203	0.235	0.032	0.109	15.8
Hammond's Flycatcher	48	110	70	-36.4	9.2 ***	24	26	25	-3.8	22.0	54	0.236	0.357	0.121	0.124	51.1
Dusky Flycatcher	66	288	312	8.3	13.3	28	47	46	-2.1	42.6	70	0.163	0.147	-0.016	0.065	-9.7
Western Flycatcher	92	256	228	-10.9	8.6	67	176	105	-40.3	9.1 ***	100	0.688	0.461	-0.227	0.140	-33.0
Black Phoebe	32	46	45	-2.2	22.7	32	76	60	-21.1	20.4	43	1.652	1.333	-0.319	0.521	-19.3
Eastern Phoebe	46	38	51	34.2	29.1	41	38	59	55.3	37.0 *	65	1.000	1.157	0.157	0.403	15.7
Ash-throated Flycatcher	34	104	98	-5.8	18.6	17	15	32	113.3	88.7	34	0.144	0.327	0.182	0.181	126.4
Great Crested Flycatcher	57	79	71	-10.1	19.2	7	2	11	450.0	549.4	59	0.025	0.155	0.130	0.088	512.0
White-eyed Vireo	82	645	625	-3.1	9.5	63	285	228	-20.0	15.1	87	0.442	0.365	-0.077	0.085	-17.4
Bell's Vireo	11	46	77	67.4	18.3 *	7	15	23	53.3	52.7	11	0.326	0.299	-0.027	0.108	-8.4
Cassin's Vireo	44	69	69	0.8	18.9	23	27	27	0.8	33.0	52	0.391	0.391	0.000	0.142	0.8
Hutton's Vireo	19	20	27	35.0	43.0	21	24	37	54.2	35.5 *	28	1.200	1.370	0.170	0.674	14.2
Warbling Vireo	128	490	498	1.6	7.7	50	69	63	-8.7	20.6	133	0.141	0.127	-0.014	0.041	-10.2
Red-eyed Vireo	145	412	453	10.0	8.4	45	60	33	-45.0	14.1 ***	152	0.146	0.073	-0.073	0.033 **	-50.0
Blue Jay	62	56	62	10.7	23.9	17	21	11	-47.6	19.3	69	0.375	0.177	-0.198	0.141	-52.7
Carolina Chickadee	76	203	124	-38.9	10.1 ***	68	150	147	-2.0	16.1	89	0.739	1.186	0.447	0.244 *	60.4
Black-capped Chickadee	118	401	432	7.7	9.0	102	472	548	16.1	10.6 *	128	1.177	1.269	0.092	0.196	7.8
Mountain Chickadee	39	102	101	-1.0	15.4	32	65	76	16.9	31.6	45	0.637	0.753	0.115	0.212	18.1
Chestnut-backed Chick.	50	103	113	9.7	19.8	47	232	215	-7.3	15.4	60	2.252	1.903	-0.350	0.688	-15.5
Oak Titmouse	11	44	28	-36.4	17.9	13	35	45	28.6	45.5	13	0.796	1.607	0.812	0.515	102.0
Tufted Titmouse	107	230	186	-19.1	10.5	108	263	203	-22.8	10.1 **	123	1.144	1.091	-0.052	0.202	-4.6

TABLE 2. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2004	2005	%chg.	SE[b]	n[c]	2004	2005	%chg.	SE[d]	n[e]	2004	2005	change	SE[f]	%chg.
Black-crested Titmouse	14	27	26	-3.7	26.5	12	27	22	-18.5	17.7	15	1.000	0.846	-0.154	0.386	-15.4
Bushtit	51	199	147	-26.1	16.2	52	225	156	-30.7	10.2 **	60	1.131	1.061	-0.069	0.284	-6.1
Red-breasted Nuthatch	62	70	60	-14.3	16.2	44	78	47	-39.7	15.6	75	1.114	0.783	-0.331	0.354	-29.7
White-breasted Nuthatch	42	44	49	11.4	22.1	30	25	32	28.0	37.6	59	0.568	0.653	0.085	0.263	14.9
Brown Creeper	48	65	45	-30.8	12.7 **	53	84	65	-22.6	18.2	71	1.292	1.444	0.152	0.444	11.8
Carolina Wren	107	627	544	-13.2	6.3 *	112	599	495	-17.4	9.3 *	122	0.955	0.910	-0.045	0.181	-4.8
Bewick's Wren	73	326	295	-9.5	8.1	78	546	570	4.4	12.4	83	1.675	1.932	0.257	0.299	15.4
House Wren	86	394	456	15.7	8.8 *	91	348	513	47.4	19.7 **	103	0.883	1.125	0.242	0.212	27.4
Winter Wren	39	75	71	-5.3	12.6	36	53	72	35.8	31.7	51	0.707	1.014	0.307	0.244	43.5
Golden-crowned Kinglet	36	58	81	39.7	24.9	39	136	331	143.4	83.5 *	50	2.345	4.086	1.742	1.172	74.3
Ruby-crowned Kinglet	27	61	108	77.0	29.8 ***	17	58	62	6.9	46.4	30	0.951	0.574	-0.377	0.499	-39.6
Blue-gray Gnatcatcher	54	108	80	-25.9	9.5 **	40	92	33	-64.1	11.6 **	66	0.852	0.413	-0.439	0.235 *	-51.6
Eastern Bluebird	22	28	21	-25.0	23.0	21	59	35	-40.7	25.6	29	2.107	1.667	-0.441	0.918	-20.9
Veery	55	310	268	-13.5	6.5 *	33	60	59	-1.7	21.3	56	0.194	0.220	0.027	0.049	13.7
Swainson's Thrush	118	1227	1055	-14.0	3.8 ***	72	211	199	-5.7	12.8	121	0.172	0.189	0.017	0.038	9.7
Hermit Thrush	64	129	141	9.3	13.6	51	54	70	29.6	28.3	83	0.419	0.497	0.078	0.140	18.6
Wood Thrush	101	456	427	-6.4	7.5	73	207	128	-38.2	9.9 ***	110	0.454	0.300	-0.154	0.070 **	-34.0
American Robin	198	794	826	4.0	6.5	136	366	347	-5.2	11.4	209	0.461	0.420	-0.041	0.084	-8.9
Wrentit	34	159	146	-8.2	13.9	34	252	206	-18.3	19.8	38	1.585	1.411	-0.174	0.406	-11.0
Gray Catbird	133	1567	1237	-21.1	4.6 ***	90	727	475	-34.7	6.5 ***	137	0.464	0.384	-0.080	0.070	-17.2
Northern Mockingbird	15	26	30	15.4	43.2	12	20	35	75.0	51.3	20	0.769	1.167	0.397	0.471	51.7
Brown Thrasher	52	71	61	-14.1	19.5	21	22	23	4.5	38.7	56	0.310	0.377	0.067	0.160	21.7
Cedar Waxwing	91	406	372	-8.4	12.2	14	24	12	-50.0	36.2	92	0.059	0.032	-0.027	0.027	-45.4
Blue-winged Warbler	35	119	126	5.9	18.2	20	36	25	-30.6	26.9	38	0.303	0.198	-0.104	0.113	-34.4
Tennessee Warbler	9	31	50	61.3	18.8 **	7	34	78	129.4	288.6	9	1.097	1.560	0.463	1.782	42.2
Orange-crowned Warbler	68	199	235	18.1	13.9	63	189	181	-4.2	14.6	80	0.950	0.770	-0.180	0.217	-18.9
Nashville Warbler	49	151	118	-21.9	16.7	44	104	185	77.9	61.2	55	0.689	1.568	0.879	0.572	127.6
Virginia's Warbler	9	49	57	16.3	19.4	8	14	20	42.9	45.4	10	0.286	0.351	0.065	0.128	22.8
Lucy's Warbler	9	104	73	-29.8	21.2	9	37	41	10.8	52.9	9	0.356	0.562	0.206	0.277	57.9
Northern Parula	30	38	39	2.6	25.3	18	25	13	-48.0	18.5	40	0.658	0.333	-0.325	0.308	-49.3
Yellow Warbler	138	1285	1133	-11.8	6.1 *	88	482	503	4.4	13.9	141	0.375	0.444	0.069	0.078	18.4
Chestnut-sided Warbler	22	83	92	10.8	12.0	12	32	39	21.9	84.6	26	0.386	0.424	0.038	0.226	10.0
Magnolia Warbler	19	67	78	16.4	17.9	11	16	27	68.8	72.1	20	0.239	0.346	0.107	0.124	45.0
Black-thrtd. Blue Warbler	14	41	25	-39.0	12.1 **	12	32	13	-59.4	16.6 ***	16	0.780	0.520	-0.261	0.473	-33.4
Yellow-rumped Warbler	80	333	328	-1.5	11.0	48	284	304	7.0	20.4	84	0.853	0.927	0.074	0.476	8.7
Black-thrtd. Green Warb.	23	49	41	-16.3	14.6	8	20	5	-75.0	13.8 **	24	0.408	0.122	-0.286	0.204	-70.1

TABLE 2. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2004	2005	%chg.	SE[b]	n[c]	2004	2005	%chg.	SE[d]	n[e]	2004	2005	change	SE[f]	%chg.
Townsend's Warbler	15	91	72	-20.9	13.9	16	19	49	157.9	102.6	22	0.209	0.681	0.472	0.212 **	226.0
Hermit Warbler	28	90	85	-5.6	14.3	18	105	86	-18.1	27.2	29	1.167	1.012	-0.155	0.562	-13.3
Pine Warbler	11	18	20	11.1	68.9	10	115	11	-90.4	6.4 **	16	6.389	0.550	-5.839	4.165	-91.4
Prairie Warbler	22	115	93	-19.1	13.9	15	38	26	-31.6	22.3	23	0.330	0.280	-0.051	0.091	-15.4
Black-and-white Warbler	73	111	109	-1.8	12.3	44	51	42	-17.6	25.8	84	0.460	0.385	-0.074	0.143	-16.1
American Redstart	77	282	304	7.8	10.8	42	81	72	-11.1	26.6	84	0.287	0.237	-0.050	0.089	-17.5
Prothonotary Warbler	31	172	170	-1.2	16.0	20	18	88	388.9	214.7 **	31	0.105	0.518	0.413	0.151 ***	394.6
Worm-eating Warbler	44	81	90	11.1	21.8	26	72	41	-43.1	8.3 **	51	0.889	0.456	-0.433	0.336	-48.8
Ovenbird	112	392	390	-0.5	8.1	79	161	181	12.4	18.3	114	0.411	0.464	0.053	0.079	13.0
Northern Waterthrush	28	52	62	19.2	17.3	10	8	21	162.5	190.5	33	0.154	0.339	0.185	0.174	120.2
Louisiana Waterthrush	55	110	109	-0.9	15.2	35	89	89	0.8	13.2	61	0.809	0.816	0.007	0.270	0.9
Kentucky Warbler	55	343	337	-1.7	7.9	46	116	98	-15.5	17.6	57	0.338	0.291	-0.047	0.075	-14.0
MacGillivray's Warbler	96	725	652	-10.1	5.0 **	78	335	327	-2.4	11.4	105	0.462	0.502	0.040	0.080	8.5
Common Yellowthroat	187	1174	1116	-4.9	5.6	118	462	601	30.1	24.4	193	0.394	0.539	0.145	0.118	36.8
Hooded Warbler	49	179	190	6.1	16.2	31	62	44	-29.0	31.5	53	0.346	0.232	-0.115	0.102	-33.1
Wilson's Warbler	99	868	805	-7.3	10.6	68	346	391	13.0	21.9	106	0.399	0.486	0.087	0.159	21.9
Canada Warbler	21	48	80	66.7	35.1 **	12	20	50	150.0	115.8	25	0.417	0.625	0.208	0.284	50.0
Yellow-breasted Chat	83	597	612	2.5	10.2	44	112	179	59.8	47.0	85	0.188	0.293	0.105	0.057 *	55.9
Summer Tanager	65	168	161	-4.2	12.3	15	7	13	85.7	87.7	67	0.042	0.081	0.039	0.031	93.8
Scarlet Tanager	54	58	76	31.0	27.5	18	13	13	0.8	56.0	62	0.224	0.171	-0.053	0.112	-23.7
Western Tanager	92	271	445	64.2	54.8	33	93	62	-33.3	18.8	96	0.343	0.139	-0.204	0.103 **	-59.4
Green-tailed Towhee	17	37	34	-8.1	24.6	13	19	20	5.3	43.3	19	0.514	0.588	0.075	0.264	14.6
Spotted Towhee	82	355	354	-0.3	8.5	72	355	241	-32.1	9.1 **	87	1.000	0.681	-0.319	0.215	-31.9
Eastern Towhee	72	93	116	24.7	17.7	39	38	22	-42.1	14.7 **	80	0.409	0.190	-0.219	0.094 **	-53.6
California Towhee	14	52	40	-23.1	17.3	9	10	11	10.0	71.7	16	0.192	0.275	0.083	0.147	43.0
Chipping Sparrow	74	204	225	10.3	11.0	38	79	102	29.1	52.1	82	0.387	0.453	0.066	0.221	17.1
Brewer's Sparrow	12	20	22	10.0	54.5	14	30	19	-36.7	29.4	16	1.500	0.864	-0.636	0.685	-42.4
Field Sparrow	48	175	176	0.6	10.8	33	59	44	-25.4	19.4	52	0.337	0.250	-0.087	0.087	-25.8
Grasshopper Sparrow	8	108	87	-19.4	14.6	4	47	47	0.8	20.3	8	0.435	0.540	0.105	0.158	24.1
Fox Sparrow	20	63	73	15.9	12.9	14	28	17	-39.3	20.8 *	28	0.444	0.233	-0.212	0.132	-47.6
Song Sparrow	176	1546	1463	-5.4	4.7	179	1547	1788	15.6	12.1	194	1.001	1.222	0.222	0.143	22.1
Lincoln's Sparrow	36	198	211	6.6	14.5	34	99	117	18.2	29.5	44	0.500	0.555	0.055	0.139	10.9
Swamp Sparrow	8	36	28	-22.2	10.4	10	27	33	22.2	58.5	12	0.750	1.179	0.429	0.453	57.1
White-throated Sparrow	19	94	94	0.8	12.3	19	41	34	-17.1	39.7	22	0.436	0.362	-0.074	0.177	-17.1
White-crowned Sparrow	17	50	51	2.0	17.0	13	61	54	-11.5	20.3	20	1.220	1.059	-0.161	0.705	-13.2
Dark-eyed Junco	79	628	443	-29.5	5.7 ***	85	572	490	-14.3	15.8	94	0.911	1.106	0.195	0.263	21.4

TABLE 2. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2004	2005	%chg.	SE[b]	n[c]	2004	2005	%chg.	SE[d]	n[e]	2004	2005	change	SE[f]	%chg.
Northern Cardinal	153	918	974	6.1	5.2	127	538	342	-36.4	9.0 ***	156	0.586	0.351	-0.235	0.070 ***	-40.1
Rose-breasted Grosbeak	28	55	74	34.5	28.0	17	12	22	83.3	84.8	32	0.218	0.297	0.079	0.132	36.3
Black-headed Grosbeak	119	485	469	-3.3	7.6	61	185	149	-19.5	16.4	124	0.381	0.318	-0.064	0.121	-16.7
Blue Grosbeak	24	115	110	-4.3	10.8	5	2	7	250.0	220.1	24	0.017	0.064	0.046	0.047	265.9
Lazuli Bunting	66	220	159	-27.7	10.0 **	31	71	41	-42.3	15.9 **	68	0.323	0.258	-0.065	0.101	-20.1
Indigo Bunting	110	766	598	-21.9	4.5 ***	49	67	56	-16.4	18.8	112	0.088	0.094	0.006	0.023	7.1
Painted Bunting	30	286	309	8.0	12.8	23	68	58	-14.7	29.0	30	0.238	0.188	-0.050	0.072	-21.1
Dickcissel	8	82	61	-25.6	28.1	1	0	1	++++		8	0.000	0.016	0.016	0.015	++++
Bobolink	5	43	81	88.4	80.5	5	3	3	0.8	105.4	5	0.070	0.037	-0.033	0.034	-46.9
Red-winged Blackbird	67	289	241	-16.6	14.1	25	43	44	2.3	44.4	68	0.149	0.183	0.034	0.065	22.7
Common Grackle	48	88	105	19.3	33.5	20	40	13	-67.5	14.6 **	50	0.455	0.124	-0.331	0.145 **	-72.8
Brown-headed Cowbird	158	264	240	-9.1	8.2	42	40	34	-15.0	22.2	167	0.152	0.142	-0.010	0.046	-6.5
Orchard Oriole	23	58	63	8.6	23.6	9	6	12	100.0	132.3	27	0.103	0.191	0.087	0.095	84.1
Bullock's Oriole	59	180	191	6.1	14.8	39	75	98	30.7	65.3	62	0.417	0.513	0.096	0.237	23.1
Baltimore Oriole	32	47	50	6.4	25.0	18	24	66	175.0	164.8	41	0.511	1.320	0.809	0.703	158.5
Purple Finch	52	314	299	-4.8	8.0	35	160	127	-20.6	12.6	56	0.510	0.425	-0.085	0.188	-16.6
Cassin's Finch	25	49	43	-12.2	19.6	12	11	12	9.1	57.7	26	0.225	0.279	0.055	0.138	24.3
House Finch	41	187	134	-28.3	13.3	41	205	122	-40.5	18.9 *	53	1.096	0.910	-0.186	0.463	-16.9
Pine Siskin	50	147	209	42.2	37.7	22	76	22	-71.1	14.3 ***	53	0.517	0.105	-0.412	0.100 ***	-79.6
Lesser Goldfinch	37	143	135	-5.6	17.5	26	132	76	-42.4	16.6	39	0.923	0.563	-0.360	0.348	-39.0
American Goldfinch	125	711	706	-0.7	6.9	20	32	14	-56.3	19.9 **	127	0.045	0.020	-0.025	0.016	-55.9
All species pooled	**352**	**31749**	**30158**	**-5.0**	**1.4 *** **	**352**	**15886**	**15260**	**-3.9**	**4.3**	**352**	**0.500**	**0.506**	**0.006**	**0.033**	**1.1**
	Number decreasing: 72/125 (58%)*					Number decreasing: 71/125 (57%)*					Number increasing: 59/125 (47%)					
NORTHWEST MAPS REGION																
Red-naped Sapsucker	33	93	87	-6.5	12.2	22	36	28	-22.2	23.5	35	0.387	0.322	-0.065	0.109	-16.9
Red-breasted Sapsucker	42	108	70	-35.2	10.2 **	30	56	28	-50.0	10.2 ***	45	0.519	0.400	-0.119	0.109	-22.9
Downy Woodpecker	56	71	61	-14.1	15.1	39	50	40	-20.0	15.5	64	0.704	0.656	-0.049	0.210	-6.9
Hairy Woodpecker	45	40	28	-30.0	19.2	21	19	12	-36.8	21.2	52	0.475	0.429	-0.046	0.195	-9.8
Northern Flicker	41	42	46	9.5	25.1	22	18	13	-27.8	31.0	46	0.429	0.283	-0.146	0.172	-34.1
Western Wood-Pewee	65	172	173	0.6	12.6	27	24	14	-41.7	19.6	67	0.140	0.081	-0.059	0.039	-42.0
Traill's Flycatcher	64	348	290	-16.7	7.7 **	17	32	21	-34.4	34.2	65	0.092	0.072	-0.020	0.040	-21.3
Hammond's Flycatcher	46	109	69	-36.7	9.2 ***	24	26	25	-3.8	22.0	52	0.239	0.362	0.124	0.126	51.9
Dusky Flycatcher	61	273	297	8.8	14.0	26	47	43	-8.5	41.3	65	0.172	0.145	-0.027	0.068	-15.9
Western Flycatcher	63	164	165	0.6	10.6	46	100	70	-30.0	13.3 *	71	0.610	0.424	-0.186	0.157	-30.4
Cassin's Vireo	43	69	68	-1.4	18.6	22	26	27	3.8	34.9	50	0.377	0.397	0.020	0.143	5.4

TABLE 2. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2004	2005	%chg.	SE[b]	n[c]	2004	2005	%chg.	SE[d]	n[e]	2004	2005	change	SE[f]	%chg.
Warbling Vireo	93	407	414	1.7	8.3	35	52	41	-21.2	19.7	95	0.128	0.099	-0.029	0.042	-22.5
Black-capped Chickadee	49	210	190	-9.5	10.3	48	281	293	4.3	13.0	52	1.338	1.542	0.204	0.276	15.2
Mountain Chickadee	37	99	97	-2.0	15.7	32	65	76	16.9	31.6	43	0.657	0.783	0.127	0.220	19.3
Chestnut-backed Chick.	40	80	92	15.0	24.7	37	163	148	-9.2	20.6	49	2.038	1.609	-0.429	0.802	-21.0
Bushtit	21	83	64	-22.9	32.8	25	108	56	-48.1	10.2 ***	27	1.301	0.875	-0.426	0.515	-32.8
Red-breasted Nuthatch	52	64	53	-17.2	16.1	39	72	41	-43.1	14.3 *	62	1.125	0.774	-0.351	0.372	-31.2
Brown Creeper	39	62	39	-37.1	12.1 **	38	77	52	-32.5	17.8	51	1.242	1.333	0.091	0.471	7.4
Bewick's Wren	24	78	71	-9.0	10.8	29	194	115	-40.7	11.3 **	30	2.487	1.620	-0.867	0.585	-34.9
House Wren	36	161	176	9.3	11.2	39	129	228	76.7	32.0	44	0.801	1.296	0.494	0.423	61.7
Winter Wren	30	70	63	-10.0	11.9	32	53	67	26.4	29.7	39	0.757	1.064	0.306	0.266	40.5
Golden-crowned Kinglet	30	52	77	48.1	26.5	32	127	325	155.9	90.3 *	39	2.442	4.221	1.779	1.243	72.8
Ruby-crowned Kinglet	24	59	107	81.4	31.1 ***	15	57	60	5.3	46.7	26	0.966	0.561	-0.405	0.513	-42.0
Veery	10	87	72	-17.2	11.3	7	17	4	-76.5	15.5 **	10	0.195	0.056	-0.140	0.062 *	-71.6
Swainson's Thrush	87	933	762	-18.3	3.7 ***	49	148	132	-10.8	16.1	88	0.159	0.173	0.015	0.046	9.2
Hermit Thrush	34	58	64	10.3	21.1	30	28	42	50.0	39.5	45	0.483	0.656	0.174	0.224	35.9
American Robin	103	507	462	-8.9	6.5	65	160	149	-6.9	16.7	105	0.316	0.323	0.007	0.074	2.2
Wrentit	14	62	58	-6.5	23.9	16	113	57	-49.6	9.0 **	18	1.823	0.983	-0.840	0.273 ***	-46.1
Gray Catbird	29	460	262	-43.0	4.5 ***	18	107	70	-34.6	22.7	29	0.233	0.267	0.035	0.093	14.9
Cedar Waxwing	45	259	260	0.4	17.8	10	24	8	-66.7	32.7	45	0.093	0.031	-0.062	0.040	-66.8
Orange-crowned Warbler	49	149	169	13.4	14.1	47	142	141	-0.7	18.7	59	0.953	0.834	-0.119	0.265	-12.5
Nashville Warbler	31	107	81	-24.3	22.1	32	87	114	31.0	31.3	36	0.813	1.407	0.594	0.402	73.1
Yellow Warbler	76	925	770	-16.8	7.2 *	57	347	360	3.7	16.5	78	0.375	0.468	0.092	0.104	24.6
Yellow-rumped Warbler	57	292	268	-8.2	10.4	34	272	290	6.6	21.0	60	0.932	1.082	0.151	0.553	16.2
Townsend's Warbler	15	91	72	-20.9	13.9	16	19	49	157.9	102.6	22	0.209	0.681	0.472	0.212 **	226.0
Hermit Warbler	28	90	85	-5.6	14.3	18	105	86	-18.1	27.2	29	1.167	1.012	-0.155	0.562	-13.3
American Redstart	14	84	76	-9.5	10.5	7	15	14	-6.7	23.1	15	0.179	0.184	0.006	0.054	3.2
Northern Waterthrush	10	28	39	39.3	34.8	5	4	16	300.0	487.3	12	0.143	0.410	0.267	0.284	187.2
MacGillivray's Warbler	85	700	637	-9.0	5.1 *	77	334	327	-2.1	11.5	94	0.477	0.513	0.036	0.082	7.6
Common Yellowthroat	41	201	219	9.0	11.6	22	126	94	-25.4	21.8	44	0.627	0.429	-0.198	0.229	-31.5
Wilson's Warbler	82	652	555	-14.9	11.6	58	164	148	-9.8	11.7	89	0.252	0.267	0.015	0.092	6.0
Yellow-breasted Chat	24	106	114	7.5	14.5	9	28	38	35.7	26.3	24	0.264	0.333	0.069	0.139	26.2
Western Tanager	75	237	320	35.0	46.4	30	78	59	-24.4	22.2	79	0.329	0.184	-0.145	0.120	-44.0
Green-tailed Towhee	14	34	32	-5.9	26.3	13	19	20	5.3	43.3	16	0.559	0.625	0.066	0.292	11.8
Spotted Towhee	51	192	180	-6.3	10.1	44	255	173	-32.2	7.1 ***	54	1.328	0.961	-0.367	0.304	-27.6
Chipping Sparrow	40	139	144	3.6	13.8	25	57	91	59.6	71.7	44	0.410	0.632	0.222	0.312	54.1
Brewer's Sparrow	11	20	21	5.0	53.8	13	30	18	-40.0	28.5	14	1.500	0.857	-0.643	0.698	-42.9

TABLE 2. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2004	2005	%chg.	SE[b]	n[c]	2004	2005	%chg.	SE[d]	n[e]	2004	2005	change	SE[f]	%chg.
Fox Sparrow	19	63	72	14.3	12.8	14	28	17	-39.3	20.8 *	27	0.444	0.236	-0.208	0.133	-46.9
Song Sparrow	93	743	816	9.8	5.6 *	95	895	788	-12.0	6.6	99	1.205	0.966	-0.239	0.133 *	-19.8
Lincoln's Sparrow	31	192	209	8.9	15.2	33	99	116	17.2	29.3	38	0.516	0.555	0.039	0.141	7.6
White-crowned Sparrow	16	49	51	4.1	17.1	12	61	51	-16.4	18.7	18	1.245	1.000	-0.245	0.711	-19.7
Dark-eyed Junco	65	607	405	-33.3	5.4 ***	69	504	454	-9.9	16.5	74	0.830	1.121	0.291	0.269	35.0
Black-headed Grosbeak	84	335	337	0.6	9.3	45	138	112	-18.8	19.7	89	0.412	0.332	-0.080	0.157	-19.3
Lazuli Bunting	52	197	140	-28.9	10.3 **	29	70	40	-42.9	16.0 **	54	0.355	0.286	-0.070	0.115	-19.6
Red-winged Blackbird	27	92	92	0.8	20.4	11	22	18	-18.2	49.2	27	0.239	0.196	-0.044	0.114	-18.2
Brown-headed Cowbird	58	97	91	-6.2	11.2	14	25	8	-68.0	15.9 ***	59	0.258	0.088	-0.170	0.098 *	-65.9
Bullock's Oriole	37	101	106	5.0	17.5	24	46	27	-41.3	27.6	38	0.455	0.255	-0.201	0.162	-44.1
Purple Finch	32	279	252	-9.7	7.6	22	147	110	-25.2	12.1	34	0.527	0.437	-0.090	0.221	-17.2
Cassin's Finch	25	49	43	-12.2	19.6	12	11	12	9.1	57.7	26	0.225	0.279	0.055	0.138	24.3
House Finch	10	49	18	-63.3	10.8 ***	12	74	40	-45.9	27.8	15	1.510	2.222	0.712	0.809	47.1
Pine Siskin	46	146	199	36.3	37.2	22	76	22	-71.1	14.3 ***	49	0.521	0.111	-0.410	0.101 ***	-78.8
Lesser Goldfinch	16	64	74	15.6	27.1	13	107	58	-45.8	19.1 **	18	1.672	0.784	-0.888	0.639	-53.1
American Goldfinch	31	234	250	6.8	8.9	15	30	8	-73.3	17.3 ***	33	0.128	0.032	-0.096	0.042 **	-75.0
All species pooled	**117**	**13143**	**12112**	**-7.8**	**2.0 *** **	**117**	**7044**	**6400**	**-9.1**	**4.9 ***	**117**	**0.536**	**0.528**	**-0.008**	**0.057**	**-1.4**
	Number decreasing: 35/63 (56%)					Number decreasing: 45/63 (71%)***					Number decreasing: 36/63 (57%)					
SOUTHWEST MAPS REGION																
Nuttall's Woodpecker	18	46	26	-43.5	15.6 **	16	40	36	-10.0	33.2	20	0.870	1.385	0.515	0.485	59.2
Western Flycatcher	29	92	63	-31.5	13.1 **	21	76	35	-53.9	10.7 ***	29	0.826	0.556	-0.271	0.280	-32.7
Black Phoebe	21	30	31	3.3	27.1	20	51	43	-15.7	27.4	26	1.700	1.387	-0.313	0.700	-18.4
Ash-throated Flycatcher	29	100	93	-7.0	19.0	16	12	29	141.7	105.1	29	0.120	0.312	0.192	0.186	159.9
Bell's Vireo	6	39	64	64.1	20.9	6	14	23	64.3	61.7	6	0.359	0.359	0.000	0.129	0.1
Warbling Vireo	20	68	66	-2.9	23.2	10	15	16	6.7	56.4	22	0.221	0.242	0.022	0.157	9.9
Chestnut-backed Chick.	10	23	21	-8.7	25.1	10	69	67	-2.9	16.8	11	3.000	3.191	0.191	1.158	6.3
Oak Titmouse	10	43	22	-48.8	10.2 **	11	32	40	25.0	48.9	11	0.744	1.818	1.074	0.562 *	144.3
Bushtit	29	115	83	-27.8	15.8	27	117	100	-14.5	17.7	32	1.017	1.205	0.187	0.309	18.4
Bewick's Wren	35	189	173	-8.5	11.8	37	316	408	29.1	17.1 *	38	1.672	2.358	0.686	0.391 *	41.1
House Wren	21	94	121	28.7	22.9	19	100	148	48.0	35.3	22	1.064	1.223	0.159	0.370	15.0
Swainson's Thrush	14	224	212	-5.4	13.4	12	47	35	-25.5	10.2 **	15	0.210	0.165	-0.045	0.078	-21.3
American Robin	19	39	59	51.3	47.8	8	10	20	100.0	143.4	21	0.256	0.339	0.083	0.231	32.2
Wrentit	20	97	88	-9.3	17.4	18	139	149	7.2	35.0	20	1.433	1.693	0.260	0.606	18.2
Orange-crowned Warbler	18	46	61	32.6	41.7	15	46	40	-13.0	20.5	19	1.000	0.656	-0.344	0.413	-34.4
Lucy's Warbler	9	104	73	-29.8	21.2	9	37	41	10.8	52.9	9	0.356	0.562	0.206	0.277	57.9

TABLE 2. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2004	2005	%chg.	SE[b]	n[c]	2004	2005	%chg.	SE[d]	n[e]	2004	2005	change	SE[f]	%chg.
Yellow Warbler	24	121	91	-24.8	17.6	10	41	41	0.8	21.2	24	0.339	0.451	0.112	0.206	33.0
Common Yellowthroat	23	234	158	-32.5	8.7 **	16	87	249	186.2	68.2 *	23	0.372	1.576	1.204	0.543 **	323.9
Wilson's Warbler	15	215	249	15.8	18.8	10	182	243	33.5	37.8	15	0.847	0.976	0.129	0.314	15.3
Yellow-breasted Chat	15	143	123	-14.0	8.3	10	23	39	69.6	51.4	16	0.161	0.317	0.156	0.138	97.1
Summer Tanager	7	44	52	18.2	11.1	4	2	6	200.0	141.4	7	0.046	0.115	0.070	0.075	153.8
Western Tanager	15	33	124	275.8	320.9	3	15	3	-80.0	6.1 *	15	0.455	0.024	-0.430	0.366	-94.7
Spotted Towhee	30	159	169	6.3	15.2	27	100	65	-35.0	26.1	32	0.629	0.385	-0.244	0.242	-38.8
California Towhee	13	47	34	-27.7	17.3	8	6	11	83.3	119.2	15	0.128	0.324	0.196	0.129	153.4
Song Sparrow	31	456	317	-30.5	6.2 **	29	313	615	96.5	47.3 *	31	0.686	1.940	1.254	0.398 ***	182.6
Black-headed Grosbeak	34	141	125	-11.3	13.8	16	47	37	-21.3	29.0	34	0.333	0.296	-0.037	0.171	-11.2
Blue Grosbeak	13	102	94	-7.8	11.6	4	1	7	600.0	400.0	13	0.010	0.074	0.065	0.056	659.6
Red-winged Blackbird	6	50	9	-82.0	7.0 **	2	2	2	0.8	100.0	7	0.040	0.222	0.182	0.171	455.6
Bullock's Oriole	19	70	77	10.0	28.4	12	23	66	187.0	200.8	21	0.329	0.857	0.529	0.561	160.9
House Finch	21	131	100	-23.7	17.8	21	124	74	-40.3	27.1	25	0.947	0.740	-0.207	0.558	-21.8
Lesser Goldfinch	21	79	61	-22.8	18.2	13	25	18	-28.0	28.7	21	0.317	0.295	-0.021	0.164	-6.8
American Goldfinch	14	44	49	11.4	26.4	3	1	5	400.0	600.0	14	0.023	0.102	0.079	0.068	349.0
All species pooled	**42**	**4069**	**3740**	**-8.1**	**5.8**	**42**	**2345**	**3102**	**32.3**	**16.9 ***	**42**	**0.576**	**0.829**	**0.253**	**0.131 ***	**43.9**
	Number decreasing: 21/32 (66%)*					Number increasing: 18/32 (56%)					Number increasing: 22/32 (69%)**					
NORTH-CENTRAL MAPS REGION																
Downy Woodpecker	15	25	27	8.0	31.5	14	32	33	3.1	18.5	16	1.280	1.222	-0.058	0.549	-4.5
Traill's Flycatcher	17	42	59	40.5	39.5	6	9	4	-55.6	35.8	17	0.214	0.068	-0.147	0.102	-68.4
Black-capped Chickadee	16	51	55	7.8	31.0	14	45	79	75.6	49.6	18	0.882	1.436	0.554	0.557	62.8
House Wren	13	97	101	4.1	16.3	16	74	97	31.1	41.7	16	0.763	0.960	0.198	0.295	25.9
American Robin	16	75	89	18.7	34.7	13	66	76	15.2	35.3	16	0.880	0.854	-0.026	0.581	-3.0
Gray Catbird	17	332	271	-18.4	8.3 *	16	177	140	-20.9	20.1	17	0.533	0.517	-0.017	0.192	-3.1
Nashville Warbler	5	19	11	-42.1	22.2	3	4	62	1450.0	75.0 ***	5	0.211	5.636	5.426	5.318	2577.3
Yellow Warbler	14	134	154	14.9	9.7	10	38	61	60.5	74.9	14	0.284	0.396	0.113	0.156	39.7
American Redstart	8	45	55	22.2	13.1	7	8	13	62.5	58.4	9	0.178	0.236	0.059	0.096	33.0
Ovenbird	8	45	31	-31.1	27.0	5	8	12	50.0	93.8	8	0.178	0.387	0.209	0.125	117.7
Common Yellowthroat	18	222	192	-13.5	9.6	15	47	70	48.9	76.9	19	0.212	0.365	0.153	0.157	72.2
Field Sparrow	11	52	53	1.9	23.2	7	14	15	7.1	36.9	11	0.269	0.283	0.014	0.143	5.1
Grasshopper Sparrow	5	77	64	-16.9	21.3	3	36	43	19.4	12.4	5	0.468	0.672	0.204	0.156	43.7
Song Sparrow	18	138	124	-10.1	9.8	17	92	112	21.7	33.2	20	0.667	0.903	0.237	0.268	35.5
Northern Cardinal	14	71	45	-36.6	8.8 ***	11	19	15	-21.1	29.9	14	0.268	0.333	0.066	0.139	24.6

TABLE 2. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2004	2005	%chg.	SE[b]	n[c]	2004	2005	%chg.	SE[d]	n[e]	2004	2005	change	SE[f]	%chg.
Rose-breasted Grosbeak	12	44	48	9.1	25.5	8	2	13	550.0	594.0	13	0.046	0.271	0.225	0.126 *	495.8
Indigo Bunting	15	66	61	-7.6	16.8	5	7	5	-28.6	28.7	15	0.106	0.082	-0.024	0.059	-22.7
Bobolink	5	43	81	88.4	80.5	5	3	3	0.8	105.4	5	0.070	0.037	-0.033	0.034	-46.9
Red-winged Blackbird	14	104	89	-14.4	23.6	5	12	16	33.3	142.8	14	0.115	0.180	0.064	0.133	55.8
Brown-headed Cowbird	16	52	52	0.8	25.0	11	7	12	71.4	70.3	17	0.135	0.231	0.096	0.090	71.4
Baltimore Oriole	12	26	24	-7.7	25.1	6	1	42	4100.0	5034.3	13	0.039	1.750	1.712	1.243	4450.0
American Goldfinch	21	198	164	-17.2	11.0	1	1	0	-100.0		21	0.005	0.000	-0.005	0.005	-100.
All species pooled	**23**	**2655**	**2510**	**-5.5**	**5.0**	**23**	**894**	**1156**	**29.3**	**23.5**	**23**	**0.337**	**0.461**	**0.124**	**0.070 ***	**36.8**
	Number decreasing: 11/22 (50%)					Number increasing: 16/22 (73%)**					Number increasing: 15/22 (68%)*					
SOUTH-CENTRAL MAPS REGION																
Downy Woodpecker	22	55	27	-50.9	15.0 **	18	38	25	-34.2	22.1	26	0.691	0.926	0.235	0.373	34.0
Acadian Flycatcher	17	164	122	-25.6	8.0 **	13	22	20	-9.1	42.6	18	0.134	0.164	0.030	0.060	22.2
White-eyed Vireo	39	474	469	-1.1	12.3	32	226	196	-13.3	19.5	39	0.477	0.418	-0.059	0.108	-12.4
Red-eyed Vireo	23	61	75	23.0	22.9	9	8	6	-25.0	54.1	23	0.131	0.080	-0.051	0.069	-39.0
Carolina Chickadee	36	134	53	-60.4	9.2 ***	34	67	82	22.4	28.0	39	0.500	1.547	1.047	0.401 ***	209.4
Tufted Titmouse	30	107	71	-33.6	15.2	32	87	81	-6.9	19.2	34	0.813	1.141	0.328	0.261	40.3
Black-crested Titmouse	14	27	26	-3.7	26.5	12	27	22	-18.5	17.7	15	1.000	0.846	-0.154	0.386	-15.4
Carolina Wren	39	356	294	-17.4	8.5	38	298	244	-18.1	15.8	41	0.837	0.830	-0.007	0.257	-0.9
Bewick's Wren	14	59	51	-13.6	20.5	12	36	47	30.6	25.6	15	0.610	0.922	0.311	0.361	51.0
Blue-gray Gnatcatcher	21	61	45	-26.2	12.1 *	13	59	11	-81.4	9.8 **	23	0.967	0.244	-0.723	0.368 **	-74.7
Blue-winged Warbler	5	54	50	-7.4	26.1	6	21	10	-52.4	27.4	6	0.389	0.200	-0.189	0.253	-48.6
Prairie Warbler	5	37	30	-18.9	13.5	4	14	4	-71.4	16.0 **	5	0.378	0.133	-0.245	0.105 *	-64.8
Prothonotary Warbler	15	146	142	-2.7	17.7	12	10	75	650.0	429.0	15	0.068	0.528	0.460	0.177 **	671.1
Kentucky Warbler	18	141	114	-19.1	12.6	19	47	35	-25.5	34.5	19	0.333	0.307	-0.026	0.143	-7.9
Common Yellowthroat	15	79	110	39.2	30.0	9	24	37	54.2	65.7	16	0.304	0.336	0.033	0.172	10.7
Hooded Warbler	11	87	76	-12.6	20.6	7	16	24	50.0	150.0	12	0.184	0.316	0.132	0.178	71.7
Yellow-breasted Chat	18	254	287	13.0	20.8	12	36	95	163.9	150.1	19	0.142	0.331	0.189	0.077 **	133.5
Summer Tanager	32	90	66	-26.7	14.7	5	1	4	300.0	500.0	33	0.011	0.061	0.050	0.033	445.5
Field Sparrow	13	55	63	14.5	17.6	8	18	12	-33.3	30.5	13	0.327	0.191	-0.137	0.127	-41.8
Northern Cardinal	45	420	481	14.5	8.8 *	42	263	206	-21.7	18.1	45	0.626	0.428	-0.198	0.123	-31.6
Indigo Bunting	26	367	282	-23.2	6.9 ***	17	21	26	23.8	45.2	26	0.057	0.092	0.035	0.030	61.1
Painted Bunting	29	274	303	10.6	13.2	22	59	56	-5.1	33.0	29	0.215	0.185	-0.031	0.070	-14.2
Brown-headed Cowbird	27	52	28	-46.2	12.4 **	4	4	2	-50.0	45.6	28	0.077	0.071	-0.006	0.067	-7.1
All species pooled	**46**	**4270**	**3942**	**-7.7**	**3.5 ** **	**46**	**1603**	**1467**	**-8.5**	**15.8**	**46**	**0.375**	**0.372**	**-0.003**	**0.058**	**-0.9**
	Number decreasing: 17/23 (74%)**					Number decreasing: 15/23 (65%)					Number decreasing: 12/23 (52%)					

TABLE 2. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2004	2005	%chg.	SE[b]	n[c]	2004	2005	%chg.	SE[d]	n[e]	2004	2005	change	SE[f]	%chg.
NORTHEAST MAPS REGION																
Downy Woodpecker	40	49	69	40.8	25.7 *	43	77	81	5.2	15.9	54	1.571	1.174	-0.398	0.380	-25.3
Traill's Flycatcher	15	51	77	51.0	22.0 ***	8	10	7	-30.0	43.1	15	0.196	0.091	-0.105	0.076	-53.6
Eastern Phoebe	26	22	36	63.6	41.9 *	23	24	27	12.5	23.8	33	1.091	0.750	-0.341	0.347	-31.3
Red-eyed Vireo	49	111	146	31.5	20.5 *	11	16	10	-37.5	29.5	50	0.144	0.068	-0.076	0.062	-52.5
Black-capped Chickadee	49	137	185	35.0	16.8 **	36	140	174	24.3	19.5	51	1.022	0.940	-0.081	0.333	-8.0
Tufted Titmouse	25	34	33	-2.9	19.9	25	68	55	-19.1	21.9	31	2.000	1.667	-0.333	0.656	-16.7
Carolina Wren	18	39	49	25.6	24.0	19	51	68	33.3	29.0	22	1.308	1.388	0.080	0.408	6.1
House Wren	13	36	52	44.4	23.7 *	15	33	34	3.0	22.9	17	0.917	0.654	-0.263	0.337	-28.7
Veery	37	198	170	-14.1	8.3	22	37	49	32.4	28.8	37	0.187	0.288	0.101	0.058 *	54.2
Swainson's Thrush	9	29	51	75.9	31.1 **	6	11	15	36.4	56.0	10	0.379	0.294	-0.085	0.146	-22.5
Hermit Thrush	22	55	56	1.8	21.9	14	21	16	-23.8	29.0	26	0.382	0.286	-0.096	0.198	-25.2
Wood Thrush	39	124	123	-0.8	13.7	26	59	49	-16.9	24.6	42	0.476	0.398	-0.077	0.144	-16.3
American Robin	46	147	178	21.1	16.9	37	108	78	-27.8	16.1 *	48	0.735	0.438	-0.297	0.191	-40.4
Gray Catbird	48	641	561	-12.5	8.5	37	349	212	-39.3	6.6 ***	48	0.545	0.378	-0.167	0.098 *	-30.6
Cedar Waxwing	28	106	88	-17.0	16.0	3	0	3	++++		28	0.000	0.034	0.034	0.015 **	++++
Yellow Warbler	20	98	115	17.3	29.9	10	56	38	-32.1	20.0	21	0.571	0.330	-0.241	0.136 *	-42.2
Chestnut-sided Warbler	19	62	71	14.5	15.3	9	31	25	-19.4	51.5	22	0.500	0.352	-0.148	0.245	-29.6
Magnolia Warbler	13	63	70	11.1	17.5	9	14	25	78.6	83.2	14	0.222	0.357	0.135	0.129	60.7
Black-thrtd. Blue Warbler	13	40	25	-37.5	12.4 **	12	32	13	-59.4	16.6 ***	15	0.800	0.520	-0.280	0.486	-35.0
Black-thrtd. Green Warb.	20	44	36	-18.2	15.7	6	18	4	-77.8	13.5 **	20	0.409	0.111	-0.298	0.218	-72.8
Black-and-white Warbler	25	41	45	9.8	21.7	16	21	6	-71.4	16.1 **	29	0.512	0.133	-0.379	0.177 **	-74.0
American Redstart	30	81	77	-4.9	25.0	19	44	35	-20.5	38.2	34	0.543	0.455	-0.089	0.216	-16.3
Worm-eating Warbler	13	29	26	-10.3	22.6	4	32	21	-34.4	20.5	13	1.103	0.808	-0.296	0.796	-26.8
Ovenbird	53	173	175	1.2	11.5	39	74	71	-4.1	22.0	54	0.428	0.406	-0.022	0.115	-5.2
Louisiana Waterthrush	18	25	44	76.0	44.7	9	36	39	8.3	21.4	18	1.440	0.886	-0.554	0.796	-38.4
Common Yellowthroat	47	252	253	0.4	11.8	29	122	96	-21.3	14.3	47	0.484	0.379	-0.105	0.110	-21.6
Scarlet Tanager	24	21	44	109.5	72.3 **	9	7	10	42.9	101.5	28	0.333	0.227	-0.106	0.207	-31.8
Field Sparrow	12	33	20	-39.4	20.8	12	22	12	-45.5	27.4	14	0.667	0.600	-0.067	0.323	-10.0
Song Sparrow	32	198	195	-1.5	7.3	34	240	269	12.1	16.3	40	1.212	1.380	0.167	0.276	13.8
White-throated Sparrow	12	61	60	-1.6	17.8	12	37	10	-73.0	9.3 ***	14	0.607	0.167	-0.440	0.178 **	-72.5
Dark-eyed Junco	7	13	28	115.4	54.0 *	8	56	24	-57.1	28.3 *	10	4.308	0.857	-3.451	2.382	-80.1
Northern Cardinal	38	125	125	0.8	12.7	29	87	45	-48.3	10.3 ***	40	0.696	0.360	-0.336	0.149 **	-48.3
Indigo Bunting	22	40	39	-2.5	28.7	11	12	13	8.3	58.7	23	0.300	0.333	0.033	0.195	11.1

TABLE 2. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2004	2005	%chg.	SE[b]	n[c]	2004	2005	%chg.	SE[d]	n[e]	2004	2005	change	SE[f]	%chg.
Common Grackle	20	32	34	6.3	30.9	9	19	6	-68.4	22.1 **	21	0.594	0.177	-0.417	0.337	-70.3
American Goldfinch	33	165	170	3.0	19.4	1	0	1	++++		33	0.000	0.006	0.006	0.005	++++
All species pooled	**64**	**4012**	**4236**	**5.6**	**3.6**	**64**	**2207**	**1893**	**-14.2**	**6.7 ***	**64**	**0.550**	**0.447**	**-0.103**	**0.054 ***	**-18.8**
	Number increasing: 21/35 (60%)					Number decreasing: 21/35 (60%)					Number decreasing: 28/35 (80%)***					
SOUTHEAST MAPS REGION																
Downy Woodpecker	35	48	51	6.3	21.8	33	70	48	-31.4	15.4 *	45	1.458	0.941	-0.517	0.436	-35.5
Acadian Flycatcher	40	189	170	-10.1	12.8	21	24	11	-54.2	19.1 **	40	0.127	0.065	-0.062	0.038	-49.0
White-eyed Vireo	37	145	142	-2.1	13.8	26	51	29	-43.1	12.9 **	39	0.352	0.204	-0.148	0.076 *	-41.9
Red-eyed Vireo	42	166	171	3.0	12.4	20	29	13	-55.2	19.1 **	46	0.175	0.076	-0.099	0.061	-56.5
Carolina Chickadee	34	62	55	-11.3	20.8	28	75	52	-30.7	18.9	42	1.210	0.945	-0.264	0.426	-21.8
Tufted Titmouse	44	83	76	-8.4	17.0	42	91	56	-38.5	15.3 **	49	1.096	0.737	-0.360	0.256	-32.8
Carolina Wren	46	220	194	-11.8	9.1	49	235	173	-26.4	10.6 **	52	1.068	0.892	-0.176	0.242	-16.5
Blue-gray Gnatcatcher	19	35	22	-37.1	15.9 *	14	23	13	-43.5	24.1	22	0.657	0.591	-0.066	0.319	-10.1
Wood Thrush	41	261	256	-1.9	11.0	35	126	53	-57.9	8.5 ***	45	0.483	0.207	-0.276	0.087 ***	-57.1
American Robin	13	24	38	58.3	34.1	10	21	22	4.8	26.1	15	0.875	0.579	-0.296	0.475	-33.8
Gray Catbird	29	115	126	9.6	16.8	18	94	52	-44.7	10.1 ***	33	0.817	0.413	-0.405	0.338	-49.5
Brown Thrasher	22	35	22	-37.1	24.6	12	15	15	0.8	47.2	24	0.429	0.682	0.253	0.379	59.1
Pine Warbler	8	14	18	28.6	92.7	6	114	6	-94.7	2.4 ***	9	8.143	0.333	-7.810	4.823	-95.9
Prairie Warbler	14	77	58	-24.7	18.9	10	24	20	-16.7	32.5	15	0.312	0.345	0.033	0.116	10.6
Worm-eating Warbler	24	46	56	21.7	36.2	19	35	20	-42.9	10.5 ***	30	0.761	0.357	-0.404	0.247	-53.1
Ovenbird	40	138	121	-12.3	9.9	27	71	68	-4.2	18.4	41	0.515	0.562	0.048	0.127	9.2
Louisiana Waterthrush	27	64	54	-15.6	14.0	23	46	46	0.8	20.6	32	0.719	0.852	0.133	0.254	18.5
Kentucky Warbler	34	195	213	9.2	9.1	26	69	62	-10.1	17.3	35	0.354	0.291	-0.063	0.088	-17.7
Common Yellowthroat	43	186	184	-1.1	14.6	27	56	55	-1.8	21.2	44	0.301	0.299	-0.002	0.099	-0.7
Hooded Warbler	28	68	90	32.4	26.1	18	39	17	-56.4	14.8 **	30	0.573	0.189	-0.385	0.124 ***	-67.1
Yellow-breasted Chat	20	90	81	-10.0	11.9	12	24	6	-75.0	8.3 ***	20	0.267	0.074	-0.193	0.068 **	-72.2
Eastern Towhee	33	40	55	37.5	23.7 *	15	18	8	-55.6	15.8 ***	34	0.450	0.146	-0.305	0.124 **	-67.7
Northern Cardinal	51	289	307	6.2	8.4	42	162	72	-55.6	9.4 ***	52	0.561	0.235	-0.326	0.103 ***	-58.2
Indigo Bunting	44	286	215	-24.8	6.1 ***	16	27	12	-55.6	16.9 **	45	0.094	0.056	-0.039	0.034	-40.9
Common Grackle	17	35	29	-17.1	23.1	6	15	3	-80.0	13.1 ***	18	0.429	0.103	-0.325	0.161 *	-75.9
American Goldfinch	19	52	60	15.4	19.5	0	0	0			19	0.000	0.000	0.000		
All species pooled	**55**	**3380**	**3386**	**0.2**	**2.9**	**55**	**1700**	**1040**	**-38.8**	**5.4 ***	**55**	**0.503**	**0.307**	**-0.196**	**0.057 ***	**-38.9**
	Number increasing: 11/26 (42%)					Number decreasing: 22/26 (85%)***					Number decreasing: 21/26 (81%)***					

TABLE 2. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2004	2005	%chg.	SE[b]	n[c]	2004	2005	%chg.	SE[d]	n[e]	2004	2005	change	SE[f]	%chg.
ALASKA AND BOREAL CANADA MAPS REGIONS																
Tennessee Warbler	4	7	11	57.1	54.5	4	34	68	100.0	280.7	4	4.857	6.182	1.325	5.954	27.3
American Redstart	5	45	45	0.8	21.4	4	11	8	-27.3	84.6	5	0.244	0.178	-0.067	0.227	-27.3
Ovenbird	5	21	39	85.7	71.2	4	1	26	2500.0	2766.5	5	0.048	0.667	0.619	0.341	1300.0
Canada Warbler	5	24	32	33.3	37.5	4	8	31	287.5	329.2	5	0.333	0.969	0.635	0.426	190.6
All species pooled	**5**	**220**	**232**	**5.5**	**9.2**	**5**	**93**	**202**	**117.2**	**192.9**	**5**	**0.423**	**0.871**	**0.448**	**0.444**	**106.0**
	Number increasing: 3/4 (75%)					Number increasing: 3/4 (75%)					Number increasing: 3/4 (75%)					

[a] Number of stations at which at least one individual adult bird of the species was captured in either year.
[b] Standard error of the percent change in the number of adult birds captured.
[c] Number of stations at which at least one individual young bird of the species was captured in either year.
[d] Standard error of the percent change in the number of young birds captured.
[e] Number of stations at which at least one individual aged bird of the species was captured in either year.
[f] Standard error of the change in the reproductive index.
* $0.05 \leq P < 0.10$; ** $0.01 \leq P < 0.05$; *** $P < 0.01$

Central and Alaska/Boreal Canada regions increased in 2005 following generally non-significant decreases in 2004. The 32.3% increase in number of young for all species pooled in the Southwest and 43.9% and 36.8% increases in reproductive index for all species pooled in the Southwest and North-Central regions, respectively, were each nearly significant. The proportions of increasing species for these two parameters ranged between 56% and 75% in these three regions, and were significant or nearly significant for number of young in the North-central Region and reproductive index in both the Southwest and North-central regions. Summing over these three regions, four species had significant or nearly significant increases in number of young captured, compared to three species with nearly significant decreases; similarly, five species showed significant or nearly significant decreases in reproductive index, while no species showed even a nearly significant decrease. In contrast to the other six regions, decreases (non-significant) from the previous year occurred in both 2005 and 2004 in both number of young and reproductive index for all species pooled in the South-Central Region; the proportions of decreasing species in these two parameters were not significant in either year. Two species had significant decreases in 2005 in number of young, while no species had even a nearly significant increase; two species also had significant or nearly significant decreases in reproductive index in 2005 while three species had significant increases.

Program-wide, the number of young for all species pooled decreased by a non-significant -3.9%, while the reproductive index for all species pooled increased by a non-significant 1.1% from 0.500 in 2004 to 0.506 in 2005 (Table 2). The program-wide proportion of species with a decreasing number of young (57%) was nearly significant, while the proportion of species with an increasing reproductive index (47%) was not. Program-wide, 24 species had significant or nearly significant decreases in number of young, while only six species had significant or nearly significant increases. Similarly, nine species had significant or nearly significant decreases in reproductive index, while only four showed significant or nearly significant increases.

3. *Changes between 2005 and 2006* — Constant-effort data were obtained for 2005 and 2006 from 357 MAPS stations operated comparably in both years. The changes between years in the numbers of adult and young birds captured and the reproductive index are presented for the entire continent (program-wide) and for each region in Table 3 for individual species (inclusion criteria as in Table 1) and for all species pooled. These included 135 species program-wide, 59 species in the Northwest, 32 in the Southwest, 23 in the North-central, 25 in the South-central, 37 in the Northeast, 27 in the Southeast, and 6 in the combined Alaska/Boreal Canada Region.

(a) *Changes in adult population size* — The index of adult population size for all species pooled increased in 2006 in the North-central, Northeast, and Southeast regions and decreased in the Northwest, Southwest, South-central, and Alaska/Boreal Canada regions (Table 3). The increases in the North-central (11.2%) and Northeast (10.1%) were significant and highly significant, respectively, while the proportion of increasing species in Northeast (65%) was also significant. The decrease in adult population size for all species pooled in the South-central Region (-14.3%) and proportion of decreasing species there (72%) were also highly significant and significant, respectively. Summing over the three regions with increases in adult population size for all species pooled, 18 species had significant or nearly significant increases in number of adults, while 8 species showed significant or nearly significant decreases. In contrast, summing over the four regions with decreases in adult population size, 12 species had significant or nearly significant increases in number of adults, while 23 species showed significant or nearly significant decreases.

Program-wide, the index of adult population size for all species pooled remained fairly constant between 2005 and 2006 with a non-significant decrease of -0.8% (Table 3). The program-wide proportion of decreasing species (49%) was not significant. Program-wide, 20 species had significant or nearly significant decreases in number of adults, while 20 other species showed significant or nearly significant increases.

(b) *Changes in productivity* — Regional changes in productivity for all species pooled between 2005 and 2006 were in the same direction as regional changes in adults for each of the seven regions, a situation that has never before been

TABLE 3. Program-wide and regional changes between 2005 and 2006 in the numbers of adult and young individuals captured and in the reproductive index (young/adult) for 135 species and all species pooled (excluding gallinaceous birds and hummingbirds) at the 357 MAPS stations run comparably during both years. For each species, data were included only from stations within the breeding range of the species. Only species for which adults were captured at two or more stations and for which 50 or more aged individuals were captured in either year are included.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2005	2006	%chg.	SE[b]	n[c]	2005	2006	%chg.	SE[d]	n[e]	2005	2006	change	SE[f]	%chg.
PROGRAM-WIDE																
Common Ground-Dove	7	52	52	0.0	41.2	6	5	26	420.0	335.0	8	0.096	0.500	0.404	0.213	420.0
Yellow-billed Cuckoo	49	54	33	-38.9	11.3 ***	1	0	1	++++		49	0.000	0.030	0.030	0.031	++++
Red-bellied Woodpecker	42	33	46	39.4	28.1 *	21	18	12	-33.3	25.3	49	0.546	0.261	-0.285	0.207	-52.2
Red-naped Sapsucker	28	77	45	-41.6	8.7 ***	17	25	28	12.0	31.3	30	0.325	0.622	0.298	0.219	91.6
Red-breasted Sapsucker	40	61	92	50.8	19.3 ***	23	29	37	27.6	34.5	41	0.475	0.402	-0.073	0.120	-15.4
Nuttall's Woodpecker	19	29	49	69.0	39.1 **	15	45	28	-37.8	20.9	19	1.552	0.571	-0.980	0.435 **	-63.2
Downy Woodpecker	185	250	286	14.4	11.9	157	241	269	11.6	9.8	221	0.964	0.941	-0.023	0.147	-2.4
Hairy Woodpecker	118	79	93	17.7	19.8	58	37	36	-2.7	25.3	140	0.468	0.387	-0.081	0.123	-17.4
Northern Flicker	83	78	68	-12.8	15.8	40	28	23	-17.9	20.4	100	0.359	0.338	-0.021	0.111	-5.8
Western Wood-Pewee	71	177	189	6.8	12.0	22	16	19	18.8	45.7	74	0.090	0.101	0.010	0.038	11.2
Eastern Wood-Pewee	64	89	89	0.0	16.7	12	5	17	240.0	291.9	67	0.056	0.191	0.135	0.083	240.0
Acadian Flycatcher	75	369	450	22.0	11.5 **	42	34	55	61.8	44.0 *	81	0.092	0.122	0.030	0.030	32.6
Traill's Flycatcher	104	401	377	-6.0	8.1	31	34	36	5.9	38.1	108	0.085	0.095	0.011	0.033	12.6
Least Flycatcher	28	93	91	-2.2	15.0	19	15	34	126.7	82.9 *	33	0.161	0.374	0.212	0.143	131.6
Hammond's Flycatcher	42	71	70	-1.4	18.4	23	26	48	84.6	38.1 **	49	0.366	0.686	0.320	0.235	87.3
Dusky Flycatcher	54	257	169	-34.2	7.3 ***	28	44	34	-22.7	24.8	57	0.171	0.201	0.030	0.068	17.5
Western Flycatcher	88	210	252	20.0	16.1	55	87	72	-17.2	14.1	94	0.414	0.286	-0.129	0.102	-31.0
Black Phoebe	30	64	42	-34.4	12.1 **	29	74	46	-37.8	14.4 **	38	1.156	1.095	-0.061	0.373	-5.3
Eastern Phoebe	41	50	46	-8.0	22.2	42	82	80	-2.4	27.7	62	1.640	1.739	0.099	0.672	6.0
Ash-throated Flycatcher	33	108	92	-14.8	17.7	14	29	26	-10.3	21.1	33	0.269	0.283	0.014	0.158	5.2
Great Crested Flycatcher	58	64	61	-4.7	17.6	6	11	1	-90.9	11.6 ***	60	0.172	0.016	-0.156	0.094 *	-90.5
Brown-crested Flycatcher	10	46	54	17.4	32.1	6	2	7	250.0	302.5	10	0.044	0.130	0.086	0.050	198.1
White-eyed Vireo	84	775	777	0.3	5.1	62	257	271	5.4	14.9	88	0.332	0.349	0.017	0.054	5.2
Bell's Vireo	11	88	49	-44.3	13.0 ***	7	42	12	-71.4	18.1 ***	12	0.477	0.245	-0.232	0.207	-48.7
Cassin's Vireo	35	64	60	-6.3	15.2	21	27	21	-22.2	29.4	41	0.422	0.350	-0.072	0.174	-17.0
Warbling Vireo	115	483	453	-6.2	9.5	49	63	59	-6.3	26.9	119	0.130	0.130	0.000	0.037	-0.1
Red-eyed Vireo	145	475	493	3.8	8.0	32	32	25	-21.9	25.7	148	0.067	0.051	-0.017	0.022	-24.7
Blue Jay	73	63	81	28.6	24.6	26	12	30	150.0	100.4 **	81	0.191	0.370	0.180	0.123	94.4
Tree Swallow	34	37	51	37.8	51.5	13	9	13	44.4	85.4	40	0.243	0.255	0.012	0.177	4.8
Barn Swallow	11	26	13	-50.0	30.1	10	24	5	-79.2	11.4 ***	15	0.923	0.385	-0.539	0.315	-58.3
Carolina Chickadee	87	128	182	42.2	20.7 **	76	137	138	0.7	16.8	98	1.070	0.758	-0.312	0.224	-29.2
Black-capped Chickadee	117	384	348	-9.4	7.4	110	450	432	-4.0	8.8	127	1.172	1.241	0.069	0.214	5.9

TABLE 3. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2005	2006	%chg.	SE[b]	n[c]	2005	2006	%chg.	SE[d]	n[e]	2005	2006	change	SE[f]	%chg.
Mountain Chickadee	33	90	63	-30.0	8.7 ***	31	68	48	-29.4	19.4	42	0.756	0.762	0.006	0.247	0.8
Chestnut-backed Chick.	46	110	94	-14.5	17.8	45	182	147	-19.2	16.3	54	1.655	1.564	-0.091	0.523	-5.5
Oak Titmouse	13	32	35	9.4	31.4	14	56	32	-42.9	10.4 ***	14	1.750	0.914	-0.836	0.470 *	-47.8
Tufted Titmouse	118	200	250	25.0	13.1 **	113	228	296	29.8	16.0 **	136	1.140	1.184	0.044	0.171	3.9
Black-crested Titmouse	16	30	27	-10.0	18.2	10	23	17	-26.1	21.1	17	0.767	0.630	-0.137	0.438	-17.9
Bushtit	48	117	167	42.7	34.2 *	43	140	175	25.0	24.0	53	1.197	1.048	-0.149	0.316	-12.4
Red-breasted Nuthatch	47	63	48	-23.8	13.2	34	46	54	17.4	29.6	56	0.730	1.125	0.395	0.344	54.1
White-breasted Nuthatch	61	49	71	44.9	35.4	32	32	35	9.4	28.7	71	0.653	0.493	-0.160	0.213	-24.5
Brown Creeper	46	45	72	60.0	28.9 **	53	60	86	43.3	32.3	68	1.333	1.194	-0.139	0.439	-10.4
Carolina Wren	124	717	656	-8.5	6.5	115	562	545	-3.0	8.6	132	0.784	0.831	0.047	0.100	6.0
Bewick's Wren	62	267	274	2.6	11.7	69	518	384	-25.9	8.4 **	74	1.940	1.402	-0.539	0.293 *	-27.8
House Wren	78	494	434	-12.1	7.9	78	503	353	-29.8	8.8 **	93	1.018	0.813	-0.205	0.227	-20.1
Winter Wren	42	76	72	-5.3	16.0	35	75	55	-26.7	21.2	52	0.987	0.764	-0.223	0.300	-22.6
Golden-crowned Kinglet	38	82	81	-1.2	17.3	39	325	155	-52.3	14.4 *	47	3.963	1.914	-2.050	1.005 **	-51.7
Ruby-crowned Kinglet	22	77	61	-20.8	14.0	19	42	39	-7.1	24.3	27	0.546	0.639	0.094	0.478	17.2
Blue-gray Gnatcatcher	56	80	83	3.8	20.5	31	27	31	14.8	34.2	65	0.338	0.374	0.036	0.104	10.7
Eastern Bluebird	26	20	36	80.0	43.0 ***	26	58	52	-10.3	33.9	37	2.900	1.444	-1.456	0.968	-50.2
Veery	55	255	281	10.2	7.9	30	58	38	-34.5	20.9	55	0.228	0.135	-0.092	0.055 *	-40.5
Swainson's Thrush	106	944	917	-2.9	5.8	69	154	274	77.9	25.5 ***	108	0.163	0.299	0.136	0.059 **	83.2
Hermit Thrush	55	115	116	0.9	14.4	51	56	49	-12.5	18.7	73	0.487	0.422	-0.064	0.134	-13.3
Wood Thrush	107	469	524	11.7	8.3	76	137	189	38.0	22.4 *	115	0.292	0.361	0.069	0.063	23.5
American Robin	197	784	826	5.4	5.5	134	325	347	6.8	15.9	207	0.415	0.420	0.006	0.079	1.3
Wrentit	26	106	100	-5.7	10.8	28	168	101	-39.9	9.1 **	29	1.585	1.010	-0.575	0.335 *	-36.3
Gray Catbird	126	1261	1415	12.2	4.5 **	78	483	660	36.6	14.0 ***	130	0.383	0.466	0.083	0.074	21.8
Northern Mockingbird	15	33	27	-18.2	32.8	9	37	17	-54.1	31.6	17	1.121	0.630	-0.492	0.722	-43.8
Brown Thrasher	47	68	40	-41.2	13.9 **	25	24	22	-8.3	30.5	55	0.353	0.550	0.197	0.207	55.8
European Starling	18	23	31	34.8	54.1	16	19	19	0.0	66.6	24	0.826	0.613	-0.213	0.578	-25.8
Cedar Waxwing	76	392	324	-17.3	9.8	12	21	17	-19.0	28.5	78	0.054	0.053	-0.001	0.032	-2.1
Blue-winged Warbler	36	119	123	3.4	19.6	22	24	22	-8.3	30.4	38	0.202	0.179	-0.023	0.068	-11.3
Tennessee Warbler	11	29	29	0.0	25.1	5	74	10	-86.5	12.1 ***	11	2.552	0.345	-2.207	1.902	-86.5
Orange-crowned Warbler	53	200	123	-38.5	7.0 ***	47	161	75	-53.4	12.2 ***	59	0.805	0.610	-0.195	0.220	-24.3
Nashville Warbler	33	85	109	28.2	33.5	35	139	130	-6.5	24.3	42	1.635	1.193	-0.443	0.596	-27.1
Virginia's Warbler	5	49	27	-44.9	2.1 ***	5	16	19	18.8	93.9	5	0.327	0.704	0.377	0.596	115.5
Lucy's Warbler	9	99	112	13.1	19.9	8	59	12	-79.7	9.3 ***	9	0.596	0.107	-0.489	0.207 **	-82.0
Northern Parula	37	43	44	2.3	21.2	19	13	22	69.2	76.3	45	0.302	0.500	0.198	0.207	65.4

TABLE 3. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2005	2006	%chg.	SE[b]	n[c]	2005	2006	%chg.	SE[d]	n[e]	2005	2006	change	SE[f]	%chg.
Yellow Warbler	124	953	1002	5.1	5.8	80	447	463	3.6	17.6	132	0.469	0.462	-0.007	0.091	-1.5
Chestnut-sided Warbler	25	92	103	12.0	18.9	18	36	47	30.6	34.4	31	0.391	0.456	0.065	0.140	16.6
Magnolia Warbler	23	85	80	-5.9	12.7	15	28	36	28.6	40.8	23	0.329	0.450	0.121	0.159	36.6
Black-thrtd. Blue Warbler	11	29	32	10.3	24.8	10	13	40	207.7	143.3	13	0.448	1.250	0.802	0.471	178.8
Yellow-rumped Warbler	79	337	313	-7.1	9.8	50	305	208	-31.8	9.8 ***	81	0.905	0.665	-0.241	0.405	-26.6
Black-thrtd Green Warb.	25	44	63	43.2	19.3 **	10	4	21	425.0	438.1	25	0.091	0.333	0.242	0.156	266.7
Townsend's Warbler	17	77	76	-1.3	21.1	18	47	30	-36.2	28.7	22	0.610	0.395	-0.216	0.223	-35.3
Hermit Warbler	22	89	95	6.7	18.8	19	89	71	-20.2	17.2	23	1.000	0.747	-0.253	0.363	-25.3
Pine Warbler	19	18	25	38.9	48.1	11	10	37	270.0	204.4	24	0.556	1.480	0.924	1.072	166.4
Prairie Warbler	20	100	122	22.0	17.8	14	30	23	-23.3	20.2	23	0.300	0.189	-0.112	0.076	-37.2
Black-and-white Warbler	79	108	135	25.0	15.7 *	42	37	63	70.3	43.0 **	86	0.343	0.467	0.124	0.123	36.2
American Redstart	80	258	307	19.0	9.8 **	39	66	90	36.4	30.0	82	0.256	0.293	0.037	0.072	14.6
Prothonotary Warbler	35	257	204	-20.6	9.1 *	26	148	78	-47.3	13.2 **	39	0.576	0.382	-0.194	0.146	-33.6
Worm-eating Warbler	45	108	122	13.0	14.4	28	50	64	28.0	24.7	48	0.463	0.525	0.062	0.165	13.3
Swainson's Warbler	19	113	90	-20.4	8.3 *	13	13	15	15.4	54.1	19	0.115	0.167	0.052	0.062	44.9
Ovenbird	111	369	398	7.9	8.4	81	163	198	21.5	17.0	118	0.442	0.498	0.056	0.086	12.6
Northern Waterthrush	21	48	41	-14.6	13.2	14	28	21	-25.0	31.2	27	0.583	0.512	-0.071	0.284	-12.2
Louisiana Waterthrush	54	112	128	14.3	16.2	40	93	98	5.4	14.5	62	0.830	0.766	-0.065	0.188	-7.8
Kentucky Warbler	68	441	432	-2.0	7.1	55	185	193	4.3	18.8	70	0.420	0.447	0.027	0.085	6.5
MacGillivray's Warbler	88	629	613	-2.5	6.1	69	321	279	-13.1	9.7	94	0.510	0.455	-0.055	0.076	-10.8
Common Yellowthroat	182	1069	1005	-6.0	5.7	118	432	383	-11.3	13.6	190	0.404	0.381	-0.023	0.076	-5.7
Hooded Warbler	62	372	360	-3.2	6.2	43	69	83	20.3	28.0	67	0.186	0.231	0.045	0.052	24.3
Wilson's Warbler	83	516	440	-14.7	9.9	65	246	214	-13.0	11.7	88	0.477	0.486	0.010	0.107	2.0
Canada Warbler	18	77	47	-39.0	12.9 **	12	49	37	-24.5	30.3	21	0.636	0.787	0.151	0.280	23.7
Yellow-breasted Chat	92	744	707	-5.0	5.7	49	201	168	-16.4	8.6	94	0.270	0.238	-0.033	0.061	-12.0
Summer Tanager	80	196	199	1.5	11.0	23	17	19	11.8	31.2	81	0.087	0.095	0.009	0.035	10.1
Scarlet Tanager	59	82	71	-13.4	15.9	7	12	2	-83.3	16.2 ***	59	0.146	0.028	-0.118	0.083	-80.8
Western Tanager	80	414	240	-42.0	19.3	33	58	63	8.6	32.2	84	0.140	0.263	0.122	0.087	87.4
Spotted Towhee	65	255	255	0.0	8.0	57	180	165	-8.3	10.7	73	0.706	0.647	-0.059	0.173	-8.3
Eastern Towhee	77	124	109	-12.1	11.5	39	25	50	100.0	45.8 ***	82	0.202	0.459	0.257	0.111 **	127.5
California Towhee	12	26	39	50.0	37.7 *	10	10	12	20.0	58.7	15	0.385	0.308	-0.077	0.183	-20.0
Abert's Towhee	4	15	25	66.7	71.0	5	55	8	-85.5	4.7 **	5	3.667	0.320	-3.347	1.862	-91.3
Chipping Sparrow	80	232	261	12.5	11.5	37	102	108	5.9	45.8	86	0.440	0.414	-0.026	0.220	-5.9
Brewer's Sparrow	9	5	29	480.0	353.7	9	9	34	277.8	273.2	12	1.800	1.172	-0.628	1.606	-34.9
Field Sparrow	52	213	205	-3.8	11.2	29	55	72	30.9	49.8	60	0.258	0.351	0.093	0.214	36.0

TABLE 3. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2005	2006	%chg.	SE[b]	n[c]	2005	2006	%chg.	SE[d]	n[e]	2005	2006	change	SE[f]	%chg.
Black-throated Sparrow	6	13	46	253.8	245.3	3	30	6	-80.0	19.6 *	6	2.308	0.130	-2.177	1.537	-94.3
Grasshopper Sparrow	13	158	230	45.6	20.4 **	12	58	65	12.1	42.6	13	0.367	0.283	-0.084	0.130	-23.0
Fox Sparrow	20	49	50	2.0	20.1	13	10	19	90.0	91.8	25	0.204	0.380	0.176	0.156	86.2
Song Sparrow	166	1204	1351	12.2	5.9 **	163	1502	1287	-14.3	6.2 **	180	1.248	0.953	-0.295	0.134 **	-23.6
Lincoln's Sparrow	35	241	195	-19.1	9.4 *	32	123	111	-9.8	25.1	42	0.510	0.569	0.059	0.163	11.5
Swamp Sparrow	17	28	41	46.4	34.1 *	14	33	28	-15.2	40.3	20	1.179	0.683	-0.496	0.439	-42.1
White-throated Sparrow	20	93	103	10.8	21.5	18	38	50	31.6	25.2	22	0.409	0.485	0.077	0.165	18.8
White-crowned Sparrow	17	46	64	39.1	30.2	12	49	50	2.0	9.5	20	1.065	0.781	-0.284	0.588	-26.7
Dark-eyed Junco	79	456	524	14.9	8.7 *	76	502	535	6.6	17.7	89	1.101	1.021	-0.080	0.259	-7.3
Northern Cardinal	169	1134	1026	-9.5	4.9 *	127	413	427	3.4	10.0	170	0.364	0.416	0.052	0.052	14.3
Rose-breasted Grosbeak	30	68	64	-5.9	20.0	20	18	20	11.1	35.6	33	0.265	0.313	0.048	0.121	18.1
Black-headed Grosbeak	101	384	365	-4.9	9.0	49	123	121	-1.6	22.7	106	0.320	0.332	0.011	0.115	3.5
Blue Grosbeak	28	159	95	-40.3	7.9 **	3	5	0	-100.0	0.0	28	0.031	0.000	-0.031	0.021	-100.0
Lazuli Bunting	56	115	162	40.9	22.1 **	27	36	64	77.8	38.7 **	61	0.313	0.395	0.082	0.126	26.2
Indigo Bunting	128	760	662	-12.9	5.2 **	45	82	69	-15.9	17.8	128	0.108	0.104	-0.004	0.031	-3.4
Varied Bunting	4	60	22	-63.3	16.8 **	0	0	0			4	0.000	0.000	0.000		
Painted Bunting	35	377	344	-8.8	13.9	25	91	72	-20.9	30.0	35	0.241	0.209	-0.032	0.063	-13.3
Dickcissel	14	82	167	103.7	47.3 ***	6	1	11	1000.0	1368.2	15	0.012	0.066	0.054	0.023 **	440.1
Bobolink	11	150	110	-26.7	14.4 *	8	8	63	687.5	613.8	11	0.053	0.573	0.519	0.139 ***	973.9
Red-winged Blackbird	67	288	271	-5.9	13.0	24	53	39	-26.4	41.7	69	0.184	0.144	-0.040	0.087	-21.8
Western Meadowlark	10	29	42	44.8	39.6	8	5	25	400.0	406.8	10	0.172	0.595	0.423	0.242	245.2
Common Grackle	44	103	65	-36.9	15.1 *	16	12	22	83.3	98.2	44	0.117	0.339	0.222	0.129 *	190.5
Brown-headed Cowbird	153	298	317	6.4	10.9	53	43	44	2.3	22.9	166	0.144	0.139	-0.006	0.038	-3.8
Orchard Oriole	30	76	62	-18.4	17.7	11	18	23	27.8	62.9	35	0.237	0.371	0.134	0.193	56.6
Bullock's Oriole	49	185	158	-14.6	16.1	34	98	78	-20.4	35.9	53	0.530	0.494	-0.036	0.246	-6.8
Baltimore Oriole	33	50	49	-2.0	20.7	14	40	12	-70.0	14.4 ***	39	0.800	0.245	-0.555	0.340	-69.4
Purple Finch	58	289	259	-10.4	16.0	36	119	75	-37.0	12.2 *	63	0.412	0.290	-0.122	0.138	-29.7
Cassin's Finch	24	40	52	30.0	41.9	8	11	8	-27.3	55.0	25	0.275	0.154	-0.121	0.134	-44.1
House Finch	45	156	185	18.6	20.8	39	131	106	-19.1	22.8	52	0.840	0.573	-0.267	0.332	-31.8
Pine Siskin	42	214	60	-72.0	10.5 ***	15	24	24	0.0	64.5	44	0.112	0.400	0.288	0.173 *	256.7
Lesser Goldfinch	32	162	127	-21.6	22.2	19	88	41	-53.4	12.2 ***	32	0.543	0.323	-0.220	0.181	-40.6
American Goldfinch	129	702	748	6.6	6.5	11	11	22	100.0	55.6	130	0.016	0.029	0.014	0.020	87.7
Evening Grosbeak	16	25	54	116.0	86.3	2	0	5	++++		16	0.000	0.093	0.093	0.073	++++
All species pooled	**357**	**30539**	**30290**	**-0.8**	**1.6**	**355**	**14643**	**13750**	**-6.1**	**3.3 ***	**357**	**0.480**	**0.454**	**-0.026**	**0.027**	**-5.3**
	Number decreasing: 66/135 (49%)					Number decreasing: 67/135 (50%)					Number decreasing: 70/135 (52%)					

TABLE 3. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2005	2006	%chg.	SE[b]	n[c]	2005	2006	%chg.	SE[d]	n[e]	2005	2006	change	SE[f]	%chg.
NORTHWEST MAPS REGION																
Red-naped Sapsucker	27	77	44	-42.9	8.5 ***	17	25	28	12.0	31.3	29	0.325	0.636	0.312	0.224	96.0
Red-breasted Sapsucker	40	61	92	50.8	19.3 ***	23	29	37	27.6	34.5	41	0.475	0.402	-0.073	0.120	-15.4
Downy Woodpecker	41	50	53	6.0	28.7	34	37	39	5.4	24.2	51	0.740	0.736	-0.004	0.245	-0.6
Western Wood-Pewee	53	146	150	2.7	12.7	18	10	18	80.0	68.0	56	0.068	0.120	0.052	0.040	75.2
Traill's Flycatcher	54	231	247	6.9	10.0	17	20	20	0.0	53.6	56	0.087	0.081	-0.006	0.047	-6.5
Hammond's Flycatcher	41	70	70	0.0	18.9	23	26	48	84.6	38.1 **	48	0.371	0.686	0.314	0.236	84.6
Dusky Flycatcher	52	246	163	-33.7	7.5 ***	27	42	34	-19.0	26.6	55	0.171	0.209	0.038	0.071	22.2
Western Flycatcher	69	157	166	5.7	12.8	39	67	48	-28.4	14.2 *	73	0.427	0.289	-0.138	0.119	-32.2
Cassin's Vireo	35	64	60	-6.3	15.2	21	27	21	-22.2	29.4	41	0.422	0.350	-0.072	0.174	-17.0
Warbling Vireo	84	406	399	-1.7	10.5	32	43	42	-2.3	32.6	86	0.106	0.105	0.001	0.036	-0.6
Black-capped Chickadee	42	142	133	-6.3	8.6	43	194	203	4.6	16.2	46	1.366	1.526	0.160	0.395	11.7
Mountain Chickadee	31	86	60	-30.2	9.0 ***	31	68	48	-29.4	19.4	40	0.791	0.800	0.009	0.261	1.2
Chestnut-backed Chick.	37	93	76	-18.3	20.2	36	134	100	-25.4	20.8	45	1.441	1.316	-0.125	0.570	-8.7
Bushtit	18	61	64	4.9	38.2	20	56	91	62.5	31.3	22	0.918	1.422	0.504	0.473	54.9
Red-breasted Nuthatch	40	56	40	-28.6	13.7 *	30	40	51	27.5	31.0	47	0.714	1.275	0.561	0.394	78.5
Brown Creeper	35	41	61	48.8	28.1 **	36	47	72	53.2	41.7	48	1.146	1.180	0.034	0.460	3.0
Bewick's Wren	16	51	45	-11.8	18.0	24	90	124	37.8	32.0	25	1.765	2.756	0.991	0.673	56.1
House Wren	29	182	119	-34.6	8.4 **	30	220	157	-28.6	11.1	33	1.209	1.319	0.111	0.574	9.1
Winter Wren	28	67	65	-3.0	17.4	29	71	51	-28.2	22.0	35	1.060	0.785	-0.275	0.335	-26.0
Golden-crowned Kinglet	32	78	75	-3.8	17.2	31	319	142	-55.5	13.8 *	37	4.090	1.893	-2.196	1.054 **	-53.7
Ruby-crowned Kinglet	18	70	58	-17.1	14.5	15	40	37	-7.5	25.1	21	0.571	0.638	0.067	0.512	11.6
Veery	10	52	56	7.7	13.3	4	2	7	250.0	422.3	10	0.039	0.125	0.087	0.069	225.0
Swainson's Thrush	77	678	696	2.7	5.8	47	98	178	81.6	36.1 **	77	0.145	0.256	0.111	0.071	76.9
Hermit Thrush	26	52	46	-11.5	18.6	30	35	24	-31.4	20.6	38	0.673	0.522	-0.151	0.227	-22.5
American Robin	97	415	430	3.6	8.4	59	132	141	6.8	22.2	97	0.318	0.328	0.010	0.075	3.1
Wrentit	11	54	42	-22.2	11.0	12	55	40	-27.3	15.9	13	1.019	0.952	-0.066	0.329	-6.5
Gray Catbird	20	198	250	26.3	12.2 **	11	69	67	-2.9	32.2	20	0.349	0.268	-0.080	0.121	-23.1
Cedar Waxwing	38	281	206	-26.7	11.0 *	6	16	12	-25.0	30.7	38	0.057	0.058	0.001	0.045	2.3
Orange-crowned Warbler	37	138	81	-41.3	8.1 ***	35	117	68	-41.9	16.7 **	42	0.848	0.840	-0.008	0.310	-1.0
Nashville Warbler	20	60	75	25.0	43.7	24	100	77	-23.0	31.1	27	1.667	1.027	-0.640	0.560	-38.4
Yellow Warbler	65	595	618	3.9	8.1	48	321	286	-10.9	19.1	69	0.540	0.463	-0.077	0.125	-14.2
Yellow-rumped Warbler	56	276	269	-2.5	10.7	38	288	196	-31.9	10.3 ***	58	1.044	0.729	-0.315	0.480	-30.2
Townsend's Warbler	17	77	76	-1.3	21.1	18	47	30	-36.2	28.7	22	0.610	0.395	-0.216	0.223	-35.3
Hermit Warbler	22	89	95	6.7	18.8	19	89	71	-20.2	17.2	23	1.000	0.747	-0.253	0.363	-25.3

TABLE 3. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2005	2006	%chg.	SE[b]	n[c]	2005	2006	%chg.	SE[d]	n[e]	2005	2006	change	SE[f]	%chg.
MacGillivray's Warbler	82	620	605	-2.4	6.2	67	321	277	-13.7	9.6	87	0.518	0.458	-0.060	0.077	-11.6
Common Yellowthroat	26	178	153	-14.0	11.7	17	86	118	37.2	52.0	28	0.483	0.771	0.288	0.364	59.6
Wilson's Warbler	67	349	333	-4.6	10.3	55	146	110	-24.7	10.7 **	72	0.418	0.330	-0.088	0.095	-21.0
Yellow-breasted Chat	18	89	90	1.1	18.3	8	28	31	10.7	22.5	18	0.315	0.344	0.030	0.182	9.5
Western Tanager	69	283	209	-26.1	22.7	31	55	63	14.5	34.7	73	0.194	0.301	0.107	0.109	55.1
Spotted Towhee	39	117	131	12.0	11.7	36	123	126	2.4	14.1	46	1.051	0.962	-0.089	0.269	-8.5
Chipping Sparrow	40	153	158	3.3	10.9	23	95	83	-12.6	40.1	44	0.621	0.525	-0.096	0.320	-15.4
Brewer's Sparrow	9	5	29	480.0	353.7	7	8	33	312.5	321.9	10	1.600	1.138	-0.462	1.540	-28.9
Fox Sparrow	19	49	49	0.0	19.7	12	10	18	80.0	89.9	23	0.204	0.367	0.163	0.159	80.0
Song Sparrow	84	671	681	1.5	6.3	86	690	685	-0.7	8.6	90	1.028	1.006	-0.022	0.138	-2.2
Lincoln's Sparrow	31	236	184	-22.0	9.1 **	30	120	108	-10.0	25.8	37	0.509	0.587	0.078	0.169	15.4
White-crowned Sparrow	15	46	62	34.8	29.5	11	46	47	2.2	10.1	17	1.000	0.758	-0.242	0.588	-24.2
Dark-eyed Junco	62	418	496	18.7	9.4 **	61	455	499	9.7	19.5	68	1.089	1.006	-0.083	0.276	-7.6
Black-headed Grosbeak	71	288	264	-8.3	10.1	38	87	107	23.0	30.8	75	0.302	0.405	0.103	0.144	34.2
Lazuli Bunting	47	108	155	43.5	23.5 **	24	36	60	66.7	37.3 *	51	0.333	0.387	0.054	0.133	16.1
Red-winged Blackbird	18	88	83	-5.7	17.8	8	18	7	-61.1	25.1	18	0.205	0.084	-0.120	0.074	-58.8
Brown-headed Cowbird	45	73	94	28.8	19.8	17	10	16	60.0	84.6	49	0.137	0.170	0.033	0.082	24.3
Bullock's Oriole	26	90	104	15.6	21.8	20	25	48	92.0	47.3 **	28	0.278	0.462	0.184	0.148	66.2
Purple Finch	36	247	215	-13.0	17.4	24	109	68	-37.6	12.9 *	39	0.441	0.316	-0.125	0.169	-28.3
Cassin's Finch	24	40	52	30.0	41.9	8	11	8	-27.3	55.0	25	0.275	0.154	-0.121	0.134	-44.1
House Finch	10	18	32	77.8	109.5	13	44	26	-40.9	35.9	14	2.444	0.813	-1.632	0.717 **	-66.8
Pine Siskin	38	209	58	-72.2	10.6 **	14	24	23	-4.2	63.1	39	0.115	0.397	0.282	0.177	245.3
Lesser Goldfinch	13	63	51	-19.0	19.1	10	54	34	-37.0	12.9 **	13	0.857	0.667	-0.191	0.382	-22.2
American Goldfinch	29	219	203	-7.3	9.0	6	9	19	111.1	57.9	29	0.041	0.094	0.053	0.064	127.8
Evening Grosbeak	16	25	54	116.0	86.3	2	0	5	++++		16	0.000	0.093	0.093	0.073	++++
All species pooled	**107**	**10573**	**10195**	**-3.6**	**2.5**	**107**	**5804**	**5429**	**-6.5**	**5.5**	**107**	**0.549**	**0.532**	**-0.016**	**0.057**	**-3.0**
	Number decreasing: 30/59 (51%)					Number decreasing: 31/59 (53%)					Number decreasing: 30/59 (51%)					
SOUTHWEST MAPS REGION																
Nuttall's Woodpecker	19	29	49	69.0	39.1 **	15	45	28	-37.8	20.9	19	1.552	0.571	-0.980	0.435 **	-63.2
Western Flycatcher	19	53	86	62.3	50.9	16	20	24	20.0	38.6	21	0.377	0.279	-0.098	0.186	-26.0
Black Phoebe	24	52	34	-34.6	13.5 **	20	61	40	-34.4	17.1	27	1.173	1.177	0.003	0.449	0.3
Ash-throated Flycatcher	27	100	87	-13.0	19.2	12	26	24	-7.7	19.6	27	0.260	0.276	0.016	0.166	6.1
Bell's Vireo	6	77	36	-53.2	8.8 ***	6	42	10	-76.2	16.6 ***	7	0.546	0.278	-0.268	0.258	-49.1
Warbling Vireo	19	59	35	-40.7	14.8 **	12	14	14	0.0	70.8	20	0.237	0.400	0.163	0.240	68.6

TABLE 3. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2005	2006	%chg.	SE[b]	n[c]	2005	2006	%chg.	SE[d]	n[e]	2005	2006	change	SE[f]	%chg.
Chestnut-backed Chick.	9	17	18	5.9	25.7	9	48	47	-2.1	24.1	9	2.824	2.611	-0.212	1.294	-7.5
Oak Titmouse	11	26	34	30.8	29.2	12	51	27	-47.1	10.8 ***	12	1.962	0.794	-1.167	0.482 **	-59.5
Bushtit	29	56	102	82.1	50.9 **	22	84	83	-1.2	28.9	30	1.500	0.814	-0.686	0.341 **	-45.8
Bewick's Wren	33	162	189	16.7	17.5	32	388	247	-36.3	7.1 ***	35	2.395	1.307	-1.088	0.366 ***	-45.4
House Wren	18	154	121	-21.4	9.9 *	17	157	72	-54.1	8.7 ***	20	1.020	0.595	-0.424	0.236 *	-41.6
Swainson's Thrush	12	177	112	-36.7	12.4 *	9	21	56	166.7	53.8 **	12	0.119	0.500	0.381	0.105 ***	321.4
American Robin	20	48	66	37.5	28.3	7	17	7	-58.8	38.2	21	0.354	0.106	-0.248	0.269	-70.1
Wrentit	15	52	58	11.5	16.6	16	113	61	-46.0	8.6 ***	16	2.173	1.052	-1.121	0.451 **	-51.6
Orange-crowned Warbler	16	62	42	-32.3	13.4 *	12	44	7	-84.1	4.5 ***	17	0.710	0.167	-0.543	0.184 ***	-76.5
Lucy's Warbler	9	99	112	13.1	19.9	8	59	12	-79.7	9.3 ***	9	0.596	0.107	-0.489	0.207 **	-82.0
Yellow Warbler	18	81	87	7.4	20.1	9	42	30	-28.6	35.6	18	0.519	0.345	-0.174	0.224	-33.5
Common Yellowthroat	22	130	141	8.5	21.2	15	79	44	-44.3	18.6	23	0.608	0.312	-0.296	0.226	-48.6
Wilson's Warbler	12	165	105	-36.4	17.8	9	100	103	3.0	26.4	12	0.606	0.981	0.375	0.205 *	61.9
Yellow-breasted Chat	18	174	174	0.0	7.4	8	43	16	-62.8	8.2 ***	18	0.247	0.092	-0.155	0.088 *	-62.8
Summer Tanager	10	74	75	1.4	22.1	6	8	3	-62.5	15.1 ***	10	0.108	0.040	-0.068	0.063	-63.0
Western Tanager	10	130	31	-76.2	23.7 **	2	3	0	-100.0	0.0	10	0.023	0.000	-0.023	0.025	-100.0
Spotted Towhee	25	131	118	-9.9	10.5	20	57	38	-33.3	14.5 *	26	0.435	0.322	-0.113	0.152	-26.0
Abert's Towhee	4	15	25	66.7	71.0	5	55	8	-85.5	4.7 **	5	3.667	0.320	-3.347	1.862	-91.3
Song Sparrow	31	228	330	44.7	19.3 **	28	435	280	-35.6	9.3 **	32	1.908	0.849	-1.059	0.472 **	-55.5
Black-headed Grosbeak	29	89	91	2.2	20.3	11	36	14	-61.1	19.6 **	30	0.405	0.154	-0.251	0.164	-62.0
Blue Grosbeak	10	141	76	-46.1	7.8 ***	2	3	0	-100.0	0.0	10	0.021	0.000	-0.021	0.018	-100.0
Varied Bunting	4	60	22	-63.3	16.8 **	0	0	0			4	0.000	0.000	0.000		
Brown-headed Cowbird	23	41	70	70.7	36.8 **	2	1	1	0.0	200.0	23	0.024	0.014	-0.010	0.029	-41.4
Bullock's Oriole	19	85	47	-44.7	16.1	10	61	19	-68.9	20.3 ***	21	0.718	0.404	-0.313	0.495	-43.7
House Finch	23	117	144	23.1	24.4	16	66	48	-27.3	26.7	23	0.564	0.333	-0.231	0.299	-40.9
Lesser Goldfinch	19	99	76	-23.2	34.3	9	34	7	-79.4	12.4 **	19	0.343	0.092	-0.251	0.104 **	-73.2
All species pooled	**39**	**3596**	**3568**	**-0.8**	**6.8**	**39**	**2543**	**1533**	**-39.7**	**5.7 *** **	**39**	**0.707**	**0.430**	**-0.278**	**0.110 ** **	**-39.2**
	Number decreasing: 14/32 (44%)					Number decreasing: 26/32 (81%)***					Number decreasing: 26/32 (81%)***					
NORTH-CENTRAL MAPS REGION																
Downy Woodpecker	13	24	24	0.0	41.1	16	30	44	46.7	32.6 *	17	1.250	1.833	0.583	0.647	46.7
Traill's Flycatcher	17	65	38	-41.5	12.5 *	3	3	7	133.3	134.7	18	0.046	0.184	0.138	0.099	299.1
Least Flycatcher	6	43	43	0.0	25.5	4	2	8	300.0	200.0	7	0.047	0.186	0.140	0.056 **	300.0
Black-capped Chickadee	14	48	48	0.0	27.2	14	63	71	12.7	17.6	16	1.313	1.479	0.167	0.651	12.7
House Wren	13	103	124	20.4	18.3	12	82	66	-19.5	25.9	14	0.796	0.532	-0.264	0.263	-33.1

TABLE 3. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2005	2006	%chg.	SE[b]	n[c]	2005	2006	%chg.	SE[d]	n[e]	2005	2006	change	SE[f]	%chg.
American Robin	15	82	88	7.3	13.6	11	68	55	-19.1	42.3	16	0.829	0.625	-0.204	0.461	-24.6
Gray Catbird	17	238	312	31.1	11.4 ***	15	120	134	11.7	19.3	17	0.504	0.430	-0.075	0.171	-14.8
Nashville Warbler	2	4	10	150.0	75.0	1	32	41	28.1		2	8.000	4.100	-3.900	4.083	-48.8
Yellow Warbler	14	148	161	8.8	7.7	10	44	105	138.6	56.6 *	16	0.297	0.652	0.355	0.214	119.4
American Redstart	7	35	44	25.7	20.0	4	5	22	340.0	91.0	7	0.143	0.500	0.357	0.087 ***	250.0
Common Yellowthroat	21	162	174	7.4	17.9	15	58	47	-19.0	25.5	21	0.358	0.270	-0.088	0.182	-24.6
Field Sparrow	10	49	52	6.1	32.6	5	12	7	-41.7	33.8	10	0.245	0.135	-0.110	0.127	-45.0
Grasshopper Sparrow	9	136	223	64.0	18.3 ***	9	55	51	-7.3	34.4	9	0.404	0.229	-0.176	0.129	-43.4
Song Sparrow	17	101	126	24.8	16.6	15	97	89	-8.2	17.7	18	0.960	0.706	-0.254	0.328	-26.5
Northern Cardinal	12	36	69	91.7	34.5 ***	11	11	30	172.7	109.0	12	0.306	0.435	0.129	0.156	42.3
Rose-breasted Grosbeak	10	43	37	-14.0	26.3	8	9	10	11.1	38.7	10	0.209	0.270	0.061	0.149	29.1
Indigo Bunting	14	54	54	0.0	18.8	3	3	1	-66.7	33.3	14	0.056	0.019	-0.037	0.032	-66.7
Dickcissel	10	61	142	132.8	60.9 *	3	0	9	++++		10	0.000	0.063	0.063	0.022 **	++++
Bobolink	11	150	110	-26.7	14.4 *	8	8	63	687.5	613.8	11	0.053	0.573	0.519	0.139 ***	973.9
Red-winged Blackbird	18	124	92	-25.8	14.4 *	10	22	10	-54.5	33.4	19	0.177	0.109	-0.069	0.100	-38.7
Western Meadowlark	9	29	41	41.4	39.2	7	5	24	380.0	395.1	9	0.172	0.585	0.413	0.247	239.5
Brown-headed Cowbird	19	110	76	-30.9	13.9 *	13	18	10	-44.4	18.4 *	20	0.164	0.132	-0.032	0.062	-19.6
American Goldfinch	22	177	164	-7.3	13.8	0	0	0			22	0.000	0.000	0.000		
All species pooled	27	2537	2821	11.2	5.6 **	26	940	1130	20.2	13.3 *	27	0.371	0.401	0.030	0.066	8.1
	Number increasing: 13/23 (57%)					Number increasing: 13/23 (57%)					Number increasing: 12/23 (52%)					
SOUTH-CENTRAL MAPS REGION																
Common Ground-Dove	3	42	38	-9.5	54.9	3	5	23	360.0	372.0	3	0.119	0.605	0.486	0.266	408.4
Downy Woodpecker	25	36	51	41.7	30.6 *	19	35	18	-48.6	13.6 **	28	0.972	0.353	-0.619	0.262 **	-63.7
Acadian Flycatcher	27	199	210	5.5	11.3	18	22	17	-22.7	22.5	28	0.111	0.081	-0.030	0.037	-26.8
White-eyed Vireo	43	596	598	0.3	5.4	40	225	207	-8.0	12.1	43	0.378	0.346	-0.031	0.065	-8.3
Red-eyed Vireo	29	107	93	-13.1	14.2	9	6	8	33.3	96.1	29	0.056	0.086	0.030	0.045	53.4
Carolina Chickadee	38	61	87	42.6	29.7 *	37	73	49	-32.9	16.4	43	1.197	0.563	-0.634	0.306 **	-52.9
Tufted Titmouse	30	92	76	-17.4	14.9	33	106	83	-21.7	13.9	37	1.152	1.092	-0.060	0.275	-5.2
Black-crested Titmouse	16	30	27	-10.0	18.2	10	23	17	-26.1	21.1	17	0.767	0.630	-0.137	0.438	-17.9
Carolina Wren	43	436	302	-30.7	5.8 ***	42	321	239	-25.5	9.1 **	44	0.736	0.791	0.055	0.124	7.5
Bewick's Wren	13	54	40	-25.9	19.4	13	40	13	-67.5	11.1 ***	14	0.741	0.325	-0.416	0.271	-56.1
Blue-gray Gnatcatcher	26	47	52	10.6	29.5	12	11	20	81.8	84.4	27	0.234	0.385	0.151	0.129	64.3
Blue-winged Warbler	6	47	40	-14.9	27.4	5	10	8	-20.0	32.6	6	0.213	0.200	-0.013	0.132	-6.0
Black-and-white Warbler	21	24	40	66.7	47.2 **	12	17	13	-23.5	33.7	22	0.708	0.325	-0.383	0.336	-54.1

TABLE 3. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2005	2006	%chg.	SE[b]	n[c]	2005	2006	%chg.	SE[d]	n[e]	2005	2006	change	SE[f]	%chg.
American Redstart	9	41	52	26.8	25.9	4	3	9	200.0	210.8	9	0.073	0.173	0.100	0.087	136.5
Prothonotary Warbler	20	214	176	-17.8	10.8	16	111	67	-39.6	16.3 *	20	0.519	0.381	-0.138	0.148	-26.6
Swainson's Warbler	15	66	55	-16.7	14.1	10	12	8	-33.3	30.1	15	0.182	0.146	-0.036	0.088	-20.0
Kentucky Warbler	26	202	173	-14.4	12.1	22	107	73	-31.8	15.1	26	0.530	0.422	-0.108	0.125	-20.3
Common Yellowthroat	16	112	70	-37.5	10.9 **	10	41	23	-43.9	13.0 ***	18	0.366	0.329	-0.038	0.155	-10.2
Hooded Warbler	18	203	181	-10.8	6.2	11	34	28	-17.6	36.1	18	0.168	0.155	-0.013	0.075	-7.6
Yellow-breasted Chat	24	360	280	-22.2	5.0 **	18	115	95	-17.4	9.5 *	25	0.319	0.339	0.020	0.090	6.2
Summer Tanager	36	82	78	-4.9	14.8	12	6	12	100.0	77.9 *	37	0.073	0.154	0.081	0.051	110.3
Field Sparrow	14	78	65	-16.7	13.3	8	12	7	-41.7	21.9	16	0.154	0.108	-0.046	0.072	-30.0
Northern Cardinal	52	585	420	-28.2	5.8 ***	43	261	234	-10.3	12.8	52	0.446	0.557	0.111	0.099	24.9
Indigo Bunting	32	341	287	-15.8	8.2 *	21	27	39	44.4	56.3	32	0.079	0.136	0.057	0.040	71.6
Painted Bunting	34	371	336	-9.4	14.0	24	89	66	-25.8	28.5	34	0.240	0.196	-0.044	0.063	-18.1
All species pooled	**53**	**5150**	**4412**	**-14.3**	**3.3 *****	**53**	**1862**	**1539**	**-17.3**	**5.7 ****	**53**	**0.362**	**0.349**	**-0.013**	**0.036**	**-3.5**
	Number decreasing: 18/25 (72%)**					Number decreasing: 19/25 (76%)***					Number decreasing: 16/25 (64%)					
NORTHEAST MAPS REGION																
Downy Woodpecker	47	62	72	16.1	23.5	44	75	91	21.3	19.5	56	1.210	1.264	0.054	0.374	4.5
Traill's Flycatcher	15	64	63	-1.6	20.0	7	6	7	16.7	93.3	16	0.094	0.111	0.017	0.076	18.5
Eastern Phoebe	21	34	24	-29.4	24.0	21	27	48	77.8	47.3 *	29	0.794	2.000	1.206	0.586 **	151.9
Red-eyed Vireo	54	145	179	23.4	15.3 *	8	9	5	-44.4	41.8	54	0.062	0.028	-0.034	0.032	-55.0
Blue Jay	35	33	40	21.2	33.7	9	5	10	100.0	130.8	36	0.152	0.250	0.099	0.148	65.0
Black-capped Chickadee	55	187	161	-13.9	11.8	48	183	144	-21.3	9.5 *	57	0.979	0.894	-0.084	0.266	-8.6
Tufted Titmouse	39	38	79	107.9	39.9 ***	33	55	107	94.5	45.2 ***	44	1.447	1.354	-0.093	0.406	-6.4
Carolina Wren	23	45	75	66.7	32.6 **	21	55	70	27.3	31.1	27	1.222	0.933	-0.289	0.340	-23.6
House Wren	16	49	60	22.4	25.6	16	39	49	25.6	67.3	22	0.796	0.817	0.021	0.418	2.6
Veery	38	179	195	8.9	9.3	22	53	24	-54.7	17.0 **	38	0.296	0.123	-0.173	0.066 ***	-58.4
Swainson's Thrush	9	49	56	14.3	21.4	6	14	25	78.6	37.8 *	10	0.286	0.446	0.161	0.144	56.3
Hermit Thrush	22	49	48	-2.0	24.7	17	16	19	18.8	47.0	26	0.327	0.396	0.069	0.172	21.2
Wood Thrush	41	134	185	38.1	17.6 **	30	55	86	56.4	48.0	46	0.410	0.465	0.054	0.146	13.3
American Robin	48	184	182	-1.1	8.9	39	78	97	24.4	26.5	49	0.424	0.533	0.109	0.155	25.7
Gray Catbird	47	633	712	12.5	5.5 **	38	218	370	69.7	21.6 ***	49	0.344	0.520	0.175	0.105 *	50.9
Cedar Waxwing	23	82	87	6.1	20.2	3	3	3	0.0	57.7	23	0.037	0.035	-0.002	0.023	-5.7
Yellow Warbler	21	109	109	0.0	14.9	10	36	38	5.6	18.5	23	0.330	0.349	0.018	0.128	5.6
Chestnut-sided Warbler	23	74	73	-1.4	18.5	15	26	31	19.2	40.8	28	0.351	0.425	0.073	0.164	20.9
Magnolia Warbler	18	75	69	-8.0	14.2	11	25	31	24.0	43.8	18	0.333	0.449	0.116	0.176	34.8

TABLE 3. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2005	2006	%chg.	SE[b]	n[c]	2005	2006	%chg.	SE[d]	n[e]	2005	2006	change	SE[f]	%chg.
Black-thrtd. Blue Warbler	11	29	32	10.3	24.8	9	13	39	200.0	142.7	12	0.448	1.219	0.771	0.471	171.9
Black-thrtd. Green Warb.	21	38	57	50.0	21.7 **	9	4	19	375.0	412.8	21	0.105	0.333	0.228	0.168	216.7
Black-and-white Warbler	32	49	47	-4.1	18.1	16	4	29	625.0	412.5	34	0.082	0.617	0.535	0.216 **	655.9
American Redstart	32	91	106	16.5	17.4	17	36	38	5.6	24.1	34	0.396	0.359	-0.037	0.143	-9.4
Worm-eating Warbler	16	34	50	47.1	19.0 ***	8	24	30	25.0	22.0	17	0.706	0.600	-0.106	0.307	-15.0
Ovenbird	54	179	203	13.4	12.2	38	72	100	38.9	30.3	56	0.402	0.493	0.090	0.117	22.5
Louisiana Waterthrush	18	45	48	6.7	32.6	14	39	39	0.0	23.2	21	0.867	0.813	-0.054	0.353	-6.3
Common Yellowthroat	51	255	239	-6.3	10.7	28	94	73	-22.3	19.5	52	0.369	0.305	-0.063	0.090	-17.1
Scarlet Tanager	25	48	26	-45.8	13.8 **	4	10	1	-90.0	13.8 ***	25	0.208	0.039	-0.170	0.143	-81.5
Eastern Towhee	23	28	35	25.0	28.3	12	10	15	50.0	63.5	24	0.357	0.429	0.071	0.207	20.0
Chipping Sparrow	20	21	41	95.2	69.9 *	8	4	17	325.0	350.9	21	0.191	0.415	0.224	0.243	117.7
Song Sparrow	30	184	201	9.2	10.6	30	250	200	-20.0	17.7	35	1.359	0.995	-0.364	0.278	-26.8
White-throated Sparrow	12	47	50	6.4	23.3	10	9	18	100.0	90.7	14	0.192	0.360	0.169	0.120	88.0
Dark-eyed Junco	9	27	23	-14.8	21.5	9	29	31	6.9	56.0	11	1.074	1.348	0.274	0.751	25.5
Northern Cardinal	43	140	141	0.7	12.9	27	42	43	2.4	22.5	44	0.300	0.305	0.005	0.084	1.7
Indigo Bunting	27	51	57	11.8	18.1	8	17	3	-82.4	9.6 ***	27	0.333	0.053	-0.281	0.098 ***	-84.2
Red-winged Blackbird	13	46	28	-39.1	13.5 *	4	7	0	-100.0	0.0	14	0.152	0.000	-0.152	0.077 *	-100.0
American Goldfinch	36	166	215	29.5	16.3 **	1	1	0	-100.0		36	0.006	0.000	-0.006	0.005	-100.0
All species pooled	**67**	**4301**	**4735**	**10.1**	**3.3 *****	**66**	**1887**	**2221**	**17.7**	**9.2 ****	**67**	**0.439**	**0.469**	**0.030**	**0.049**	**6.9**
	Number increasing: 24/37 (65%)**					Number increasing: 26/37 (70%)**					Number increasing: 22/37 (59%)					
SOUTHEAST MAPS REGION																
Downy Woodpecker	40	53	49	-7.5	22.9	34	52	64	23.1	19.0	49	0.981	1.306	0.325	0.406	33.1
Acadian Flycatcher	39	161	228	41.6	21.5 **	19	12	32	166.7	123.2	41	0.074	0.140	0.066	0.045	88.3
Eastern Phoebe	12	12	14	16.7	39.1	11	40	20	-50.0	24.6 *	16	3.333	1.429	-1.905	1.928	-57.1
White-eyed Vireo	35	171	164	-4.1	14.6	21	31	62	100.0	68.5	39	0.181	0.378	0.197	0.078 **	108.5
Red-eyed Vireo	46	175	189	8.0	15.0	10	12	10	-16.7	44.7	46	0.069	0.053	-0.016	0.042	-22.8
Carolina Chickadee	42	57	87	52.6	34.1 *	35	58	76	31.0	29.6	47	1.018	0.874	-0.144	0.347	-14.2
Tufted Titmouse	44	66	93	40.9	25.0 *	41	60	94	56.7	39.2 *	48	0.909	1.011	0.102	0.261	11.2
Carolina Wren	55	231	274	18.6	9.9 **	49	178	229	28.7	17.2 *	57	0.771	0.836	0.065	0.178	8.5
Wood Thrush	42	285	289	1.4	9.7	33	65	90	38.5	23.6 *	45	0.228	0.311	0.083	0.061	36.5
American Robin	15	50	50	0.0	21.3	13	23	40	73.9	63.1	19	0.460	0.800	0.340	0.480	73.9
Gray Catbird	30	171	127	-25.7	10.5 **	13	75	89	18.7	20.8	32	0.439	0.701	0.262	0.319	59.8
Prairie Warbler	13	63	88	39.7	23.9	10	24	15	-37.5	17.7	16	0.381	0.171	-0.211	0.077 **	-55.3
Prothonotary Warbler	13	39	25	-35.9	12.9	8	37	9	-75.7	6.7 *	17	0.949	0.360	-0.589	0.449	-62.1

TABLE 3. Continued.

	ADULTS					YOUNG					REPRODUCTIVE INDEX					
Species	n[a]	2005	2006	%chg.	SE[b]	n[c]	2005	2006	%chg.	SE[d]	n[e]	2005	2006	change	SE[f]	%chg.
Worm-eating Warbler	22	65	62	-4.6	18.8	18	26	28	7.7	36.2	24	0.400	0.452	0.052	0.177	12.9
Ovenbird	38	113	128	13.3	16.7	30	57	69	21.1	23.7	43	0.504	0.539	0.035	0.144	6.9
Louisiana Waterthrush	26	56	63	12.5	16.4	22	50	55	10.0	18.3	30	0.893	0.873	-0.020	0.243	-2.2
Kentucky Warbler	39	234	253	8.1	6.6	33	78	120	53.8	32.4 *	41	0.333	0.474	0.141	0.109	42.3
Common Yellowthroat	46	232	228	-1.7	11.1	31	74	76	2.7	16.3	46	0.319	0.333	0.014	0.100	4.5
Hooded Warbler	30	149	151	1.3	10.8	21	28	50	78.6	34.5 **	32	0.188	0.331	0.143	0.051 ***	76.2
Yellow-breasted Chat	24	117	159	35.9	11.4 ***	14	15	25	66.7	49.0 *	24	0.128	0.157	0.029	0.055	22.6
Eastern Towhee	36	59	49	-16.9	14.6	19	9	24	166.7	95.1 **	38	0.153	0.490	0.337	0.173 *	221.1
Field Sparrow	18	67	59	-11.9	17.4	6	19	50	163.2	50.2 **	20	0.284	0.848	0.564	0.689	198.8
Song Sparrow	4	20	13	-35.0	20.4	4	30	33	10.0	30.9	5	1.500	2.539	1.039	1.724	69.2
Northern Cardinal	56	349	364	4.3	9.8	42	91	115	26.4	19.8	56	0.261	0.316	0.055	0.062	21.2
Indigo Bunting	52	313	262	-16.3	7.5 *	13	35	26	-25.7	21.6	52	0.112	0.099	-0.013	0.060	-11.3
Red-winged Blackbird	5	18	30	66.7	115.5	1	5	22	340.0		5	0.278	0.733	0.456	0.383	164.0
American Goldfinch	21	91	109	19.8	17.6	1	0	1	++++		21	0.000	0.009	0.009	0.010	++++
All species pooled	**58**	**4024**	**4204**	**4.5**	**3.0**	**58**	**1349**	**1743**	**29.2**	**6.6 *****	**58**	**0.335**	**0.415**	**0.079**	**0.053**	**23.7**
	Number increasing: 16/27 (59%)					Number increasing: 22/27 (81%)***					Number increasing: 20/27 (74%)***					
ALASKA AND BOREAL CANADA MAPS REGIONS																
Swainson's Thrush	6	35	40	14.3	23.3	6	21	13	-38.1	19.2	6	0.600	0.325	-0.275	0.293	-45.8
Tennessee Warbler	5	14	12	-14.3	36.6	3	69	3	-95.7	3.2 **	5	4.929	0.250	-4.679	4.179	-94.9
American Redstart	6	58	58	0.0	10.7	4	15	10	-33.3	37.2	6	0.259	0.172	-0.086	0.167	-33.3
Ovenbird	5	39	37	-5.1	12.4	4	26	15	-42.3	11.7 *	5	0.667	0.405	-0.261	0.407	-39.2
Canada Warbler	5	32	19	-40.6	23.6	4	31	11	-64.5	15.3 **	5	0.969	0.579	-0.390	0.443	-40.2
White-throated Sparrow	6	31	33	6.5	35.5	6	25	27	8.0	9.1	6	0.807	0.818	0.012	0.406	1.5
All species pooled	**6**	**358**	**355**	**-0.8**	**5.5**	**6**	**258**	**155**	**-39.9**	**20.9**	**6**	**0.721**	**0.437**	**-0.284**	**0.249**	**-39.4**
	Number decreasing: 3/6 (50%)					Number decreasing: 5/6 (83%)					Number decreasing: 5/6 (83%)					

[a] Number of stations at which at least one individual adult bird of the species was captured in either year.
[b] Standard error of the percent change in the number of adult birds captured.
[c] Number of stations at which at least one individual young bird of the species was captured in either year.
[d] Standard error of the percent change in the number of young birds captured.
[e] Number of stations at which at least one individual aged bird of the species was captured in either year.
[f] Standard error of the change in the reproductive index.
* $0.05 \leq P < 0.10$; ** $0.01 \leq P < 0.05$; *** $P < 0.01$

recorded in the 15-yr MAPS data set (Table 3). Regional changes in productivity for all species pooled between 2005 and 2006 were opposite the changes in productivity between 2004 and 2005 for four of the seven regions, but were in the same direction for three regions. The substantial and generally significant decreases in productivity between 2004 and 2005 in the Northeast and Southeast regions were followed by significant and highly significant increases between 2005 and 2006 in the number of young birds of all species pooled in these two regions (17.7% and 29.2% respectively). In addition, the proportions of species with increases in number of young in these two regions (70% and 81%, respectively) were also significant and highly significant, respectively. Non-significant increases between 2005 and 2006 in the reproductive index of all species pooled also occurred in these two regions, while the proportion of species that showed increases in reproductive index (74%) was significant in the Southeast Region. A highly significant decrease in the number of young of all species pooled (-39.7%) and a significant decrease in reproductive index (-39.2%) occurred in the Southwest Region between 2005 and 2006, following nearly significant increases in productivity there between 2004 and 2005. The proportions of species with decreasing number of young and reproductive index between 2005 and 2006 in the Southwest (both 81%) were highly significant. Non-significant decreases in productivity between 2005 and 2006 also occurred in the Alaska/Boreal Canada Region, following non-significant increases in productivity there between 2004 and 2005. Changes in productivity of all species pooled between 2005 and 2006 were in the same direction as those between 2004 and 2005 for the Northwest and South-central regions, where decreases occurred, and for the North-central Region, where increases occurred. All of these changes in reproductive index were non-significant, but the decrease in the number of young in the South-central region (-17.3%) and proportion of decreasing species there (76%) were both significant, while the increase in number of young in the North-central region (20.2%) was nearly significant. Summing over the three regions where productivity increased (North-central, Northeast and Southeast), 14 species had significant or nearly significant increases in number of young, compared to seven species with significant or nearly significant decreases; and 10 species had significant or nearly significant increases in reproductive index, compared to four species with significant or nearly significant decreases. Similarly, summing over the four regions where productivity decreased (Northwest, Southwest, South-central, and Alaska/Boreal Canada), 31 species had significant or nearly significant decreases in number of young, compared to only six species with significant or nearly significant increases; and 15 species had significant or nearly significant decreases in reproductive index, compared to only two species with significant or nearly significant increases.

Program-wide, the number of young for all species pooled decreased by a nearly significant -6.1% while the reproductive index for all species pooled decreased by a non- significant -5.3% from 0.480 in 2005 to 0.454 in 2006 (Table 3). The program-wide proportions of species with decreasing number of young (50%) and decreasing reproductive index (52%) were each non-significant. Program-wide, 21 species had significant or nearly significant decreases in number of young, and 11 species had significant or nearly significant increases. Similarly, nine species had significant or nearly significant decreases in reproductive index, and six had significant or nearly significant increases.

4. *Fifteen-year (1992-2006) program-wide trends* — Chained indices of adult population size (Fig. 3a) and productivity (Fig. 3b) for all species pooled at the program-wide scale showed a highly significant decreasing trend in adult population size of -1.77% yr^{-1}, and a widely fluctuating temporal pattern in reproductive index with a slight and non-significant decreasing tendency of -0.25% yr-1. Interestingly, all five decreases in productivity were followed by decreases in adult population size the next year, but only three of the eight increases in productivity were followed by increases in adult population size the next year. Nevertheless, seven of the nine significant or nearly significant changes in productivity were followed the next year by changes of adult population size of the same sign (P = 0.070; binomial test), while only one of four non-significant changes in productivity was followed by a change of adult population size of the same sign.

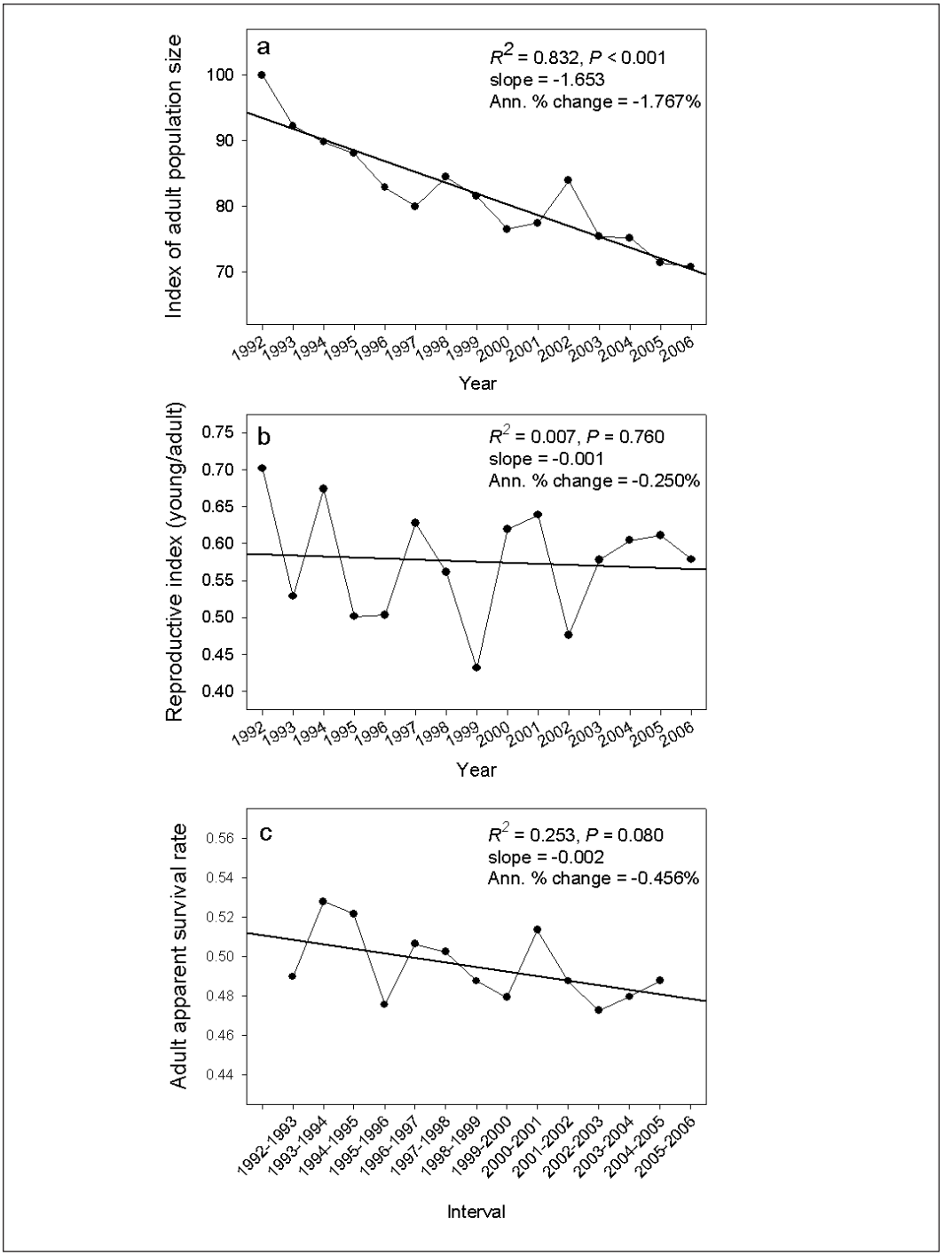

FIGURE 3. Program-wide 15-yr (1992-2006) trends for all species pooled for (a) adult population size and (b) productivity (reproductive index: young/adult) from chain indices of constant-effort year-to-year changes derived from the analysis of > 849,000 captures of > 662,000 aged individuals; and (c) the program-wide 13-yr trend for all species pooled for adult annual apparent survival rate from the fully time-dependent CJS mark-recapture model applied to > 406,000 capture histories of individual adult birds.

SURVIVAL-RATE ESTIMATES

Regional and program-wide maximum-likelihood estimates of time-constant annual adult apparent survival rates, recapture probabilities, and proportions of residents among the newly captured adults that were not recaptured seven or more days later during their first year of capture are presented in Table 4 for species that met survivorship selection criteria (see Methods - Data Analysis), along with the total number of individual adult birds captured and the total number of captures and returns of those individuals. These estimates were derived from 15 years (1992-2006) of mark-recapture data pooled over all stations in each region (or program-wide) that were operated for four or more consecutive years during this period. Data were pooled from 174 stations in the Northwest, 98 in the Southwest, 58 in the North-central, 84 in the South- central, 119 in the Northeast, 89 in the Southeast, and 31 in the Alaska/Boreal Canada Region (a total of 653 stations program-wide), for an average of 93 stations per region (Table 5). The regional increases for the 15-yr period (1992-2006) over the 12-yr period (1992-2003) in the number of stations contributing data to survivorship analyses ranged from 0.0% in the Alaska/Boreal Canada Region to 30.8% and 31.8% in the Northeast and North-central regions, respectively, and averaged 17.7%, which was very near the program-wide increase of 18.7%.

A total of 192 species fulfilled selection criteria for survivorship analyses program-wide, with 85 species fulfilling these criteria in the Northwest, 91 in the Southwest, 62 in the North-central, 63 in the South-central, 76 in the Northeast, 47 in the Southeast, and 34 in the Alaska/Boreal Canada Region, for an average of 65 species per region (Tables 4 and 5). Increases in the number of species per region that fulfilled selection criteria for survivorship analyses ranged from 0.0% in the Alaska/Boreal Canada Region to 14.8% in the North-central Region and averaged 4.9%; the program-wide change was also an increase of 4.9%.

The mean number of individual adult birds captured per station per species during the 15 years was lowest for the Northeast (22.3) and Southeast (24.4), higher for the Southwest (36.7) and South-central (37.0), higher still for the Northwest (39.6) and North-central (41.9) regions; it was highest for the Alaska/Boreal Canada Region (53.4; Table 4). Altogether, the 653 stations included in these survivorship analyses were operated for an average of 8.24 years each (87 stations for four, 133 for five, 57 for six, 43 for seven, 45 for eight, 57 for nine, 59 for 10, 34 for 11, 21 for 12, 48 for 13, 23 for 14, and 46 for 15 years) and produced an average capture rate of 4.18 adult individuals per station per species yr^{-1}.

As in past years, the average total number of adult captures per individual per species (for species that met survivorship selection criteria) was remarkably constant over the seven regions, ranging from 1.33±0.21 in the South-central Region to 1.54±0.25 in the Alaska/Boreal Canada Region, and averaging 1.37±0.25 overall. Similarly, the average total number of returns per individual per species also remained remarkably constant over the seven regions, ranging from 0.132±0.072 in the South-central Region to 0.157±0.074 in the Alaska/Boreal Canada Region, and averaging 0.135±0.078 overall.

The precision of the estimates of annual adult survival rate from 653 stations in the 15-yr period (1992-2006) increased over that obtained from 550 stations in the 12-yr period (1992-2003; Table 5). The mean coefficient of variation in survival probability, CV(φ), for all species in each region ranged from 13.5% in the Northwest to 21.3% in the Southwest and averaged 17.7±2.9% over all regions; the mean program-wide CV(φ) was 13.8%. These figures compare to a range from 15.3% in the Northwest to 23.7% in the South-central, an average of 19.5±2.9% over all regions, and 15.0% program-wide for 1992-2003 data. This represents a 9% average improvement going from 12 to 15 years (Table 5), and can be compared to a 6% improvement going from 10 to 12 years, 8% from 7 to 10 years, and 28% from 5 to 7 years. Another measure of the increased precision provided by 15, rather than 12, years is the mean number of species over the seven regions having CV(φ) < 30%, which increased by 10% from 51 species with 12 years to 56 species with 15 years. Similarly, the mean number of species per region having CV(φ) < 20% increased by 13% from 40 to 46 species; and the mean number having CV(φ) < 10% increased by 19% from 21 to 25 species (Table 5). The analogous program-wide increases in the numbers of species were 5%, 8%, and 14%. The mean

TABLE 4. Program-wide and regional time-constant estimates of annual adult apparent survival probability, recapture probability, and proportion of residents from modified Cormack-Jolly-Seber mark-recapture analyses[a] (using transient models[b]), and selected and equivalent time-dependent models from 15 years (1992-2006) of MAPS data.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
PROGRAM-WIDE																				
Common Ground-Dove	12	577	645	18	0.385	0.099	25.8	0.000	0.061	0.046	76.0	0.000	0.987	0.728	73.7	0.000	...			
Yellow-billed Cuckoo	110	711	765	20	0.480	0.088	18.3	0.029	0.211	0.089	42.0	0.184	0.148	0.068	45.8	0.002	...			
Belted Kingfisher *†	12	35	51	6	0.275	0.157	57.3	0.000	0.468	0.340	72.7	0.000	1.000	0.939	93.9	0.000	...			
Acorn Woodpecker	12	81	96	9	0.439	0.165	37.7	0.000	0.768	0.206	26.9	0.000	0.229	0.138	60.1	0.000	...			
Gila Woodpecker	5	30	47	9	0.694	0.139	20.1	0.000	0.830	0.150	18.1	0.000	0.147	0.105	71.1	0.000	...			
Golden-fronted Woodpecker†	7	171	213	11	0.343	0.122	35.6	0.005	0.153	0.115	75.3	0.001	1.000	0.746	74.6	0.000	...			
Red-bellied Woodpecker	122	561	645	49	0.444	0.060	13.5	0.007	0.160	0.058	36.2	0.018	0.812	0.313	38.6	0.002	...			
Williamson's Sapsucker	14	210	274	19	0.473	0.085	18.1	0.002	0.197	0.082	41.8	0.598	0.507	0.226	44.5	0.000	.t.	...		
Yellow-bellied Sapsucker	19	200	277	26	0.412	0.081	19.6	0.029	0.263	0.098	37.3	0.011	0.809	0.330	40.8	0.001	...			
Red-naped Sapsucker	40	826	1469	212	0.482	0.027	5.6	0.007	0.523	0.042	8.0	0.018	0.522	0.063	12.0	0.002	...			
Red-breasted Sapsucker	54	1139	1875	229	0.445	0.026	5.9	0.000	0.457	0.041	8.9	0.018	0.577	0.068	11.8	0.001	...			
Ladder-backed Woodpecker	26	192	255	39	0.536	0.069	12.8	0.000	0.371	0.086	23.2	0.001	0.566	0.164	29.0	0.000	...			
Nuttall's Woodpecker	30	425	664	101	0.580	0.038	6.6	0.002	0.363	0.048	13.3	0.001	0.526	0.091	17.2	0.004	...			
Downy Woodpecker	322	3266	4190	423	0.516	0.020	3.8	0.000	0.330	0.024	7.4	0.000	0.400	0.036	9.0	0.000	...			
Hairy Woodpecker	189	950	1191	155	0.650	0.030	4.5	0.018	0.196	0.027	13.9	0.007	0.538	0.083	15.4	0.018	...			
White-headed Woodpecker *†	9	56	59	2	0.591	0.303	51.3	0.000	0.035	0.155	447.5	0.000	1.000	4.528	452.8	0.000	...			
Northern Flicker	200	894	1032	60	0.445	0.053	12.0	0.000	0.206	0.055	26.8	0.003	0.448	0.129	28.8	0.002	...			
Pileated Woodpecker	27	44	50	5	0.946	0.120	12.7	0.000	0.063	0.055	87.5	0.000	0.380	0.346	91.0	0.000	...			
Olive-sided Flycatcher	19	128	170	20	0.671	0.075	11.1	0.000	0.421	0.102	24.2	0.000	0.124	0.055	44.3	0.000	...			
Western Wood-Pewee	105	2490	3387	403	0.517	0.020	3.9	0.042	0.365	0.026	7.2	0.253	0.449	0.040	9.0	0.876	..t	.tt		
Eastern Wood-Pewee	138	1085	1351	111	0.519	0.038	7.4	0.000	0.288	0.044	15.4	0.001	0.362	0.065	18.0	0.000	...			
Yellow-bellied Flycatcher*	4	106	129	2	0.824	0.264	32.1	0.000	0.032	0.044	137.7	0.000	0.149	0.206	138.5	0.000	...			
Acadian Flycatcher	93	3918	5672	717	0.486	0.015	3.1	0.004	0.542	0.023	4.2	0.007	0.362	0.024	6.6	0.030	...			
Traill's Flycatcher	105	4676	6700	623	0.475	0.016	3.3	0.000	0.499	0.024	4.9	0.000	0.274	0.020	7.2	0.001	...			
Least Flycatcher	35	1785	2414	200	0.450	0.028	6.3	0.020	0.356	0.038	10.8	0.020	0.366	0.048	13.1	0.001	...			
Hammond's Flycatcher	61	1572	2273	273	0.467	0.024	5.1	0.207	0.385	0.034	8.7	0.075	0.507	0.056	11.0	0.000	...			
Gray Flycatcher *†	4	119	125	2	0.365	0.298	81.7	0.000	0.033	0.123	377.1	0.000	1.000	3.758	375.8	0.000	...			
Dusky Flycatcher	56	3284	4917	485	0.493	0.018	3.6	0.999	0.421	0.025	6.0	0.030	0.307	0.025	8.3	0.004	t..			
Western Flycatcher	89	4006	5037	384	0.490	0.020	4.1	0.486	0.332	0.026	7.8	0.090	0.294	0.028	9.5	0.098	...	t..		
Black Phoebe	34	397	492	45	0.531	0.062	11.7	0.007	0.360	0.078	21.7	0.018	0.297	0.081	27.1	0.001	...			
Eastern Phoebe	63	521	666	41	0.407	0.062	15.1	0.237	0.479	0.101	21.2	0.091	0.220	0.064	28.9	0.109	...			

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Vermilion Flycatcher†	6	114	135	11	0.439	0.124	28.3	0.000	0.162	0.125	77.1	0.000	1.000	0.814	81.4	0.000	...			
Dusky-capped Flycatcher *†	4	36	46	2	0.979	0.286	29.2	0.000	0.014	0.028	195.6	0.000	1.000	1.790	179.0	0.000	...			
Ash-throated Flycatcher	65	1538	1795	155	0.602	0.033	5.5	0.001	0.222	0.033	14.7	0.005	0.382	0.063	16.6	0.732	..t	...		
Great Crested Flycatcher	136	878	991	77	0.633	0.042	6.7	0.253	0.167	0.037	22.2	0.057	0.368	0.089	24.3	0.008	...	t..		
Brown-crested Flycatcher	9	369	464	53	0.533	0.060	11.2	0.000	0.351	0.076	21.6	0.001	0.484	0.132	27.2	0.119	...			
Eastern Kingbird	49	353	404	23	0.505	0.089	17.7	0.231	0.324	0.108	33.4	0.003	0.225	0.092	40.9	0.140	...	t..		
White-eyed Vireo	105	4592	8131	1058	0.501	0.012	2.4	0.503	0.514	0.018	3.6	0.658	0.436	0.024	5.5	0.005	tt.	...	.t.	
Bell's Vireo	21	819	1279	171	0.529	0.030	5.7	0.005	0.447	0.042	9.5	0.003	0.443	0.059	13.4	0.003	...			
Yellow-throated Vireo	24	79	95	11	0.595	0.134	22.6	0.000	0.241	0.143	59.4	0.000	0.512	0.360	70.3	0.000	...			
Plumbeous Vireo	11	115	153	21	0.540	0.087	16.2	0.001	0.343	0.108	31.6	0.001	0.463	0.181	39.0	0.000	...			
Cassin's Vireo	35	774	910	52	0.547	0.054	9.9	0.001	0.133	0.039	29.6	0.001	0.470	0.145	30.9	0.000	...			
Blue-headed Vireo	22	183	222	14	0.441	0.104	23.5	0.000	0.199	0.105	53.0	0.001	0.517	0.288	55.6	0.000	...			
Hutton's Vireo	27	199	276	27	0.579	0.074	12.8	0.007	0.242	0.075	30.9	0.007	0.466	0.164	35.3	0.004	...			
Warbling Vireo	155	7822	10957	1074	0.506	0.012	2.4	0.040	0.362	0.016	4.4	0.499	0.354	0.020	5.5	0.792	..t	.tt	.t.	
Red-eyed Vireo	218	6836	8884	985	0.558	0.012	2.2	0.996	0.262	0.014	5.2	0.925	0.490	0.030	6.0	0.029	tt.			
Gray Jay†	23	116	165	36	0.586	0.061	10.4	0.047	0.264	0.070	26.4	0.001	1.000	0.301	30.1	0.000	...			
Steller's Jay	75	471	559	58	0.687	0.047	6.8	0.000	0.180	0.042	23.1	0.018	0.390	0.100	25.5	0.002	...			
Blue Jay	199	1324	1454	86	0.607	0.041	6.8	0.004	0.113	0.029	26.0	0.010	0.441	0.120	27.3	0.118	...			
Western Scrub-Jay	43	245	281	26	0.564	0.079	13.9	0.001	0.244	0.085	35.0	0.000	0.380	0.151	39.8	0.377	...	..t		
Mexican Jay*	4	39	47	3	0.359	0.212	59.1	0.000	0.298	0.311	104.3	0.000	0.468	0.538	115.1	0.000	...			
Tree Swallow	61	931	1192	76	0.447	0.045	10.0	0.000	0.214	0.048	22.3	0.000	0.524	0.126	24.0	0.000	...			
Violet-green Swallow	14	245	299	19	0.449	0.089	19.7	0.005	0.246	0.104	42.0	0.363	0.383	0.176	46.0	0.011	...	.t.		
Northern Rough-winged Swallow	22	163	183	12	0.341	0.126	36.8	0.000	0.548	0.225	41.1	0.000	0.309	0.186	60.3	0.000	...			
Barn Swallow	21	477	566	39	0.483	0.060	12.5	0.268	0.177	0.058	32.5	0.442	0.508	0.174	34.3	0.022	.t.	...	t..	
Carolina Chickadee	157	2146	2523	189	0.487	0.030	6.1	0.001	0.203	0.030	14.9	0.001	0.522	0.084	16.1	0.000	...			
Black-capped Chickadee	209	5236	7381	829	0.455	0.014	3.1	0.047	0.378	0.020	5.2	0.001	0.556	0.036	6.4	0.011	...			
Mountain Chickadee	61	1803	2284	212	0.456	0.028	6.1	0.008	0.285	0.034	12.0	0.019	0.514	0.069	13.5	0.002	...			
Chestnut-backed Chickadee	60	1749	2295	232	0.419	0.027	6.4	0.001	0.377	0.039	10.4	0.007	0.503	0.063	12.5	0.621	..t	...		
Boreal Chickadee	12	148	219	30	0.435	0.070	16.1	0.029	0.367	0.103	28.1	0.018	0.772	0.261	33.9	0.001	...			
Bridled Titmouse	7	54	72	10	0.556	0.128	23.0	0.000	0.243	0.134	54.9	0.000	0.806	0.492	61.0	0.000	...			
Oak Titmouse	23	375	568	76	0.582	0.044	7.5	0.000	0.352	0.054	15.2	0.000	0.400	0.082	20.6	0.000	...			
Juniper Titmouse	5	59	110	21	0.553	0.083	15.0	0.000	0.530	0.122	23.0	0.000	0.589	0.223	37.8	0.000	...			
Tufted Titmouse	195	3225	4356	531	0.452	0.017	3.9	0.981	0.390	0.025	6.5	0.091	0.572	0.046	8.1	0.003	t..			
Black-crested Titmouse	21	378	497	57	0.479	0.053	11.1	0.000	0.192	0.053	27.4	0.000	0.994	0.289	29.1	0.000	...			

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Verdin†	7	89	109	6	0.406	0.167	41.2	0.000	0.119	0.125	104.8	0.000	1.000	1.045	104.5	0.000	...			
Bushtit	70	2569	3057	158	0.331	0.032	9.6	0.970	0.215	0.040	18.7	0.019	0.681	0.132	19.4	0.036	t..			
Red-breasted Nuthatch	102	929	1034	40	0.336	0.065	19.4	0.000	0.122	0.061	50.4	0.000	0.778	0.398	51.2	0.000	...			
White-breasted Nuthatch	128	655	796	59	0.492	0.053	10.7	0.002	0.264	0.060	22.9	0.000	0.390	0.101	25.9	0.001	...			
Brown Creeper	77	1036	1295	81	0.347	0.044	12.8	0.002	0.232	0.056	24.3	0.007	0.718	0.182	25.3	0.000	...			
Carolina Wren	164	5068	8418	958	0.379	0.012	3.2	1.000	0.631	0.023	3.6	0.007	0.476	0.028	5.8	0.002	t..			
Bewick's Wren	115	3436	5709	720	0.432	0.015	3.4	0.119	0.546	0.024	4.5	0.001	0.529	0.035	6.6	0.010	...			
House Wren	146	5550	8142	587	0.355	0.016	4.4	0.018	0.411	0.027	6.5	0.018	0.460	0.036	7.7	0.000	...			
Winter Wren	52	1311	2120	176	0.364	0.027	7.4	0.047	0.530	0.052	9.7	0.017	0.359	0.050	14.1	0.007	...			
Golden-crowned Kinglet	73	1427	1778	24	0.114	0.055	48.2	0.028	0.282	0.165	58.4	0.002	0.411	0.175	42.7	0.009	...			
Ruby-crowned Kinglet	39	1365	1705	65	0.319	0.047	14.8	0.624	0.245	0.062	25.5	0.142	0.422	0.108	25.7	0.016	t..	...		
Arctic Warbler	2	259	481	52	0.323	0.050	15.5	0.001	0.632	0.103	16.3	0.000	0.648	0.163	25.2	0.000	...			
Blue-gray Gnatcatcher	114	980	1080	30	0.399	0.075	18.8	0.001	0.135	0.063	46.7	0.360	0.384	0.181	47.2	0.050	...	.t.		
Eastern Bluebird	51	334	448	23	0.387	0.079	20.5	0.009	0.292	0.105	36.0	0.181	0.339	0.135	39.7	0.002	...			
Western Bluebird	17	184	248	16	0.360	0.093	26.0	0.000	0.396	0.154	38.9	0.001	0.328	0.154	46.9	0.003	...			
Veery	78	3346	6518	1292	0.589	0.011	1.9	0.007	0.572	0.016	2.7	0.004	0.498	0.023	4.7	0.000	...			
Gray-cheeked Thrush	6	253	539	74	0.441	0.044	10.0	0.000	0.706	0.072	10.1	0.000	0.527	0.108	20.4	0.000	...			
Bicknell's Thrush	1	28	45	10	0.608	0.122	20.1	0.000	0.322	0.149	46.3	0.000	0.840	0.479	57.0	0.000	...			
Swainson's Thrush	133	15147	32752	5494	0.589	0.005	0.9	0.000	0.618	0.008	1.2	0.000	0.362	0.009	2.5	1.000	..t			
Hermit Thrush	93	2893	5032	711	0.473	0.015	3.1	0.148	0.590	0.023	3.9	0.123	0.455	0.030	6.6	0.225	...	..t		
Wood Thrush	160	7040	11700	1155	0.419	0.011	2.6	0.999	0.510	0.019	3.7	0.970	0.411	0.022	5.3	0.000	tt.			
American Robin	364	12980	16653	1577	0.491	0.010	2.1	1.000	0.265	0.012	4.4	0.001	0.535	0.027	5.0	0.000	t..			
Varied Thrush	41	596	772	59	0.406	0.049	12.0	0.307	0.388	0.076	19.7	0.186	0.367	0.089	24.4	0.000	...	t..	.t.	
Wrentit	52	2800	5565	896	0.570	0.013	2.2	0.999	0.537	0.019	3.5	0.716	0.400	0.024	6.1	0.318	tt.	t.t		
Gray Catbird	167	16370	26192	3385	0.507	0.007	1.4	0.018	0.455	0.010	2.2	0.004	0.459	0.014	3.0	0.029	...			
Northern Mockingbird	39	612	740	22	0.340	0.081	23.9	0.006	0.181	0.085	46.8	0.015	0.378	0.175	46.2	0.013	...			
Brown Thrasher	74	907	1159	115	0.552	0.036	6.5	0.000	0.234	0.037	16.0	0.004	0.485	0.088	18.0	0.000	...			
Long-billed Thrasher	4	220	296	44	0.550	0.069	12.6	0.001	0.429	0.088	20.5	0.018	0.541	0.149	27.5	0.000	...			
California Thrasher	15	156	205	25	0.608	0.082	13.4	0.004	0.174	0.070	40.3	0.000	0.750	0.320	42.6	0.000	...			
European Starling	38	382	409	15	0.399	0.115	28.8	0.002	0.214	0.139	64.7	0.002	0.373	0.267	71.6	0.000	...			
Cedar Waxwing	115	5473	5999	32	0.437	0.074	17.0	0.000	0.032	0.015	45.8	0.004	0.237	0.101	42.3	0.000	...			
Blue-winged Warbler	41	1447	2111	247	0.529	0.025	4.8	0.000	0.372	0.033	8.8	0.000	0.421	0.048	11.4	0.000	...			
Golden-winged Warbler	4	43	59	8	0.664	0.127	19.2	0.000	0.222	0.124	55.7	0.000	0.540	0.344	63.7	0.000	...			
Orange-crowned Warbler	84	5266	7277	630	0.418	0.015	3.7	0.602	0.445	0.025	5.6	0.366	0.361	0.026	7.3	0.003	t..	.t.		

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Nashville Warbler	39	1553	1870	81	0.320	0.042	13.0	0.091	0.367	0.072	19.6	0.413	0.291	0.064	22.0	0.098	...	.t.		
Virginia's Warbler	14	770	940	66	0.414	0.050	12.2	0.003	0.341	0.071	20.8	0.377	0.365	0.089	24.4	0.000	...	.t.		
Lucy's Warbler	13	803	970	78	0.525	0.048	9.2	0.003	0.350	0.060	17.2	0.001	0.289	0.060	20.7	0.498	...	..t		
Northern Parula	55	587	667	40	0.455	0.064	14.1	0.000	0.267	0.078	29.1	0.001	0.326	0.106	32.7	0.001	...			
Yellow Warbler	184	15468	24826	3300	0.540	0.007	1.3	0.000	0.462	0.010	2.1	0.002	0.402	0.012	3.0	0.048	...			
Chestnut-sided Warbler	27	1258	2187	262	0.454	0.025	5.4	0.011	0.512	0.039	7.5	0.002	0.523	0.057	10.9	0.003	...			
Magnolia Warbler	21	836	1332	132	0.395	0.033	8.4	0.989	0.684	0.059	8.7	0.006	0.310	0.049	15.8	0.000	t..			
Black-throated Blue Warbler	13	213	303	36	0.511	0.071	13.9	0.000	0.467	0.099	21.2	0.000	0.387	0.114	29.4	0.001	...			
Yellow-rumped Warbler	114	6332	7786	588	0.439	0.017	3.8	0.001	0.269	0.020	7.6	0.004	0.467	0.039	8.5	0.001	...			
Black-throated Gray Warbler	24	212	242	7	0.406	0.151	37.2	0.001	0.064	0.071	109.6	0.001	0.851	0.900	105.8	0.000	...			
Black-throated Green Warbler	31	621	909	97	0.388	0.040	10.2	0.000	0.548	0.070	12.9	0.002	0.467	0.086	18.4	0.076	...			
Townsend's Warbler	30	1464	1830	134	0.420	0.035	8.3	0.000	0.244	0.041	16.8	0.000	0.558	0.103	18.4	0.002	...			
Hermit Warbler	34	1545	1703	61	0.649	0.047	7.3	0.002	0.076	0.022	29.3	0.000	0.316	0.094	29.8	0.000	...			
Blackburnian Warbler	7	69	83	6	0.511	0.166	32.6	0.000	0.110	0.114	103.5	0.000	0.884	0.919	104.0	0.000	...			
Pine Warbler	44	308	358	16	0.285	0.096	33.6	0.000	0.399	0.187	46.8	0.001	0.364	0.198	54.3	0.000	...			
Prairie Warbler	33	930	1305	143	0.500	0.035	6.9	0.039	0.331	0.042	12.8	0.175	0.499	0.077	15.4	0.002	...			
Blackpoll Warbler	10	233	350	30	0.316	0.063	20.0	0.004	0.690	0.136	19.8	0.000	0.348	0.117	33.6	0.005	...			
Black-and-white Warbler	98	1612	2076	198	0.505	0.028	5.6	0.186	0.315	0.036	11.3	0.524	0.420	0.056	13.4	0.136	.t.	...	t..	
American Redstart	83	4713	6847	722	0.492	0.015	3.0	0.183	0.385	0.020	5.2	0.314	0.423	0.028	6.7	0.398	...	..t	.t.	.tt
Prothonotary Warbler	30	1144	1528	135	0.471	0.036	7.6	0.017	0.296	0.044	14.8	0.046	0.544	0.092	16.9	0.017	...			
Worm-eating Warbler	38	1163	1634	185	0.554	0.029	5.3	0.001	0.399	0.039	9.7	0.003	0.345	0.045	13.0	0.001	...			
Swainson's Warbler	10	220	394	44	0.505	0.064	12.7	0.002	0.418	0.085	20.3	0.617	0.511	0.137	26.8	0.007	.t.	...		
Ovenbird	151	5663	8162	983	0.536	0.012	2.3	0.509	0.430	0.017	4.0	0.309	0.361	0.020	5.6	0.069	t..	.t.		
Northern Waterthrush	29	748	1148	133	0.500	0.034	6.8	0.022	0.563	0.052	9.3	0.263	0.313	0.048	15.3	0.001	...	.t.		
Louisiana Waterthrush	46	908	1524	185	0.513	0.029	5.7	0.000	0.578	0.044	7.7	0.011	0.328	0.043	13.0	0.002	...			
Kentucky Warbler	73	2787	4890	744	0.530	0.014	2.7	0.001	0.563	0.021	3.8	0.000	0.416	0.027	6.4	0.001	...			
Mourning Warbler	9	345	586	79	0.463	0.045	9.7	0.004	0.489	0.069	14.2	0.003	0.575	0.113	19.7	0.002	...			
MacGillivray's Warbler	104	9259	18168	2332	0.490	0.008	1.7	0.379	0.596	0.013	2.1	0.002	0.387	0.015	3.7	0.622	..t	t..		
Common Yellowthroat	256	14713	24806	2797	0.476	0.007	1.5	0.258	0.498	0.011	2.3	0.008	0.402	0.014	3.4	0.035	...	t..		
Hooded Warbler	58	1883	3158	350	0.456	0.020	4.5	0.047	0.519	0.033	6.4	0.002	0.405	0.039	9.5	0.006	...			
Wilson's Warbler	93	12587	19216	1615	0.428	0.009	2.2	0.031	0.510	0.016	3.1	0.967	0.281	0.013	4.6	1.000	.tt			
Canada Warbler	13	498	765	83	0.456	0.044	9.7	0.075	0.505	0.069	13.7	0.001	0.377	0.074	19.6	0.027	...			
Red-faced Warbler *†	3	54	57	2	0.372	0.301	80.9	0.000	0.064	0.235	364.0	0.000	1.000	3.771	377.1	0.000	...			
Yellow-breasted Chat	97	5375	9017	1234	0.502	0.011	2.2	0.979	0.462	0.016	3.5	0.013	0.499	0.025	5.0	0.008	t..			

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Summer Tanager	91	1360	1880	260	0.569	0.027	4.7	0.425	0.376	0.032	8.6	0.059	0.469	0.052	11.0	0.095	...	t..		
Scarlet Tanager	116	905	1031	57	0.524	0.052	9.9	0.001	0.123	0.039	31.7	0.001	0.535	0.177	33.0	0.018	...			
Western Tanager	98	3118	3422	180	0.514	0.031	6.1	0.016	0.116	0.024	20.4	0.117	0.569	0.121	21.2	0.002	...			
Olive Sparrow	4	269	517	88	0.542	0.043	8.0	0.001	0.697	0.061	8.8	0.003	0.467	0.086	18.4	0.007	...			
Green-tailed Towhee	18	506	753	106	0.592	0.038	6.4	0.045	0.320	0.045	13.9	0.045	0.474	0.081	17.1	0.001	...			
Spotted Towhee	118	4525	6739	946	0.498	0.013	2.6	0.042	0.428	0.019	4.3	0.114	0.536	0.031	5.7	0.002	...			
Eastern Towhee	141	1441	2062	260	0.471	0.025	5.3	0.000	0.387	0.035	9.0	0.001	0.580	0.066	11.3	0.000	...			
Canyon Towhee†	6	92	122	11	0.626	0.140	22.3	0.000	0.111	0.074	66.3	0.000	1.000	0.666	66.6	0.000	...			
California Towhee	38	889	1266	200	0.555	0.029	5.1	0.001	0.362	0.036	10.0	0.001	0.588	0.074	12.5	0.500	...	..t		
Abert's Towhee	6	171	232	21	0.462	0.092	19.8	0.000	0.297	0.113	38.2	0.000	0.563	0.247	43.9	0.000	...			
Bachman's Sparrow	8	90	152	14	0.443	0.118	26.7	0.000	0.508	0.178	35.0	0.000	0.420	0.202	48.1	0.000	...			
Rufous-crowned Sparrow	22	339	509	61	0.488	0.052	10.6	0.119	0.375	0.070	18.6	0.000	0.539	0.125	23.1	0.000	...			
American Tree Sparrow	7	203	338	35	0.457	0.062	13.7	0.000	0.552	0.103	18.7	0.000	0.335	0.103	30.6	0.000	...			
Chipping Sparrow	112	2421	3012	208	0.429	0.028	6.6	0.046	0.249	0.033	13.4	0.017	0.513	0.074	14.5	0.011	...			
Clay-colored Sparrow	11	587	720	35	0.378	0.067	17.6	0.022	0.425	0.111	26.2	0.263	0.254	0.082	32.3	0.001	...	.t.		
Field Sparrow	88	2932	4217	475	0.421	0.018	4.3	0.048	0.366	0.026	7.2	0.012	0.654	0.056	8.6	0.000	...			
Vesper Sparrow	7	83	103	13	0.694	0.094	13.5	0.002	0.252	0.101	39.9	0.002	0.277	0.135	48.6	0.000	...			
Lark Sparrow	21	520	566	25	0.397	0.080	20.2	0.000	0.305	0.115	37.6	0.001	0.252	0.110	43.5	0.001	...			
Black-throated Sparrow	12	226	250	10	0.606	0.126	20.9	0.000	0.187	0.108	57.7	0.016	0.182	0.116	64.0	0.010	...			
Sage Sparrow *†	2	99	104	3	0.426	0.228	53.5	0.000	0.045	0.112	252.0	0.000	1.000	2.530	253.0	0.000	...			
Savannah Sparrow	17	675	932	137	0.516	0.034	6.7	0.154	0.357	0.045	12.6	0.154	0.571	0.089	15.6	0.000	...			
Grasshopper Sparrow	10	620	859	68	0.395	0.051	12.9	0.033	0.414	0.079	19.1	0.954	0.448	0.101	22.5	0.000	.t.			
Fox Sparrow	45	1368	2354	297	0.501	0.022	4.4	0.486	0.514	0.034	6.6	0.056	0.399	0.041	10.3	0.589	..t	t.t	...	t..
Song Sparrow	267	18568	35119	4612	0.480	0.006	1.2	0.193	0.531	0.009	1.7	0.131	0.488	0.013	2.6	0.002	...			
Lincoln's Sparrow	56	3537	8364	1031	0.434	0.012	2.7	0.182	0.623	0.020	3.2	0.881	0.563	0.032	5.6	0.001	.t.			
Swamp Sparrow	17	530	952	105	0.426	0.037	8.6	0.938	0.678	0.063	9.3	0.006	0.332	0.060	18.0	0.062	t..			
White-throated Sparrow	28	1434	2380	207	0.353	0.025	7.2	0.011	0.516	0.048	9.4	0.029	0.504	0.064	12.7	0.017	...			
White-crowned Sparrow	36	1666	2873	371	0.459	0.020	4.3	0.002	0.472	0.031	6.6	0.377	0.574	0.053	9.2	0.000	...	.t.		
Golden-crowned Sparrow	5	281	539	76	0.494	0.042	8.5	0.000	0.529	0.066	12.5	0.007	0.521	0.106	20.4	0.000	...			
Dark-eyed Junco	142	9455	15941	2030	0.443	0.009	1.9	0.032	0.494	0.014	2.8	0.998	0.538	0.021	3.9	0.000	.t.			
Northern Cardinal	246	10430	15493	2294	0.537	0.008	1.6	0.881	0.394	0.011	2.8	0.011	0.542	0.020	3.7	0.002	t..			
Pyrrhuloxia*	2	149	155	4	0.701	0.203	29.0	0.000	0.267	0.189	70.7	0.000	0.039	0.036	90.4	0.000	...			
Rose-breasted Grosbeak	64	1102	1328	96	0.475	0.042	8.9	0.007	0.244	0.047	19.3	0.623	0.452	0.098	21.7	0.003	.t.	...		
Black-headed Grosbeak	141	6351	8223	887	0.551	0.013	2.4	0.715	0.279	0.015	5.4	0.022	0.448	0.028	6.3	0.001	t..	...		

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Blue Grosbeak	40	822	1001	89	0.566	0.049	8.7	0.499	0.290	0.051	17.7	0.001	0.368	0.076	20.5	0.001	...	t..		
Lazuli Bunting	55	2532	3157	214	0.495	0.026	5.3	0.001	0.274	0.031	11.1	0.017	0.295	0.038	12.9	0.047	...			
Indigo Bunting	161	6555	9279	1052	0.467	0.012	2.6	0.817	0.398	0.018	4.4	0.003	0.489	0.027	5.6	0.001	t..			
Varied Bunting	4	163	210	23	0.514	0.113	21.9	0.000	0.302	0.114	37.8	0.000	0.605	0.259	42.8	0.000	...			
Painted Bunting	36	2496	3450	441	0.544	0.020	3.6	0.076	0.485	0.027	5.6	0.012	0.319	0.027	8.3	0.016	...			
Dickcissel	17	1087	1213	41	0.465	0.064	13.9	0.001	0.194	0.063	32.3	0.002	0.276	0.094	34.3	0.002	...			
Bobolink	5	329	371	15	0.724	0.162	22.3	0.000	0.145	0.075	51.6	0.000	0.299	0.161	53.6	0.000	...			
Red-winged Blackbird	114	3698	4135	240	0.616	0.026	4.3	0.032	0.142	0.020	13.8	0.944	0.351	0.051	14.6	0.021	.t.			
Eastern Meadowlark	12	59	69	5	0.589	0.167	28.3	0.000	0.349	0.213	61.1	0.000	0.195	0.157	80.3	0.000	...			
Brewer's Blackbird *†	18	165	171	3	0.484	0.261	54.0	0.000	0.026	0.105	402.2	0.000	1.000	4.062	406.2	0.000	...			
Common Grackle	68	1394	1446	28	0.450	0.077	17.1	0.001	0.075	0.052	69.5	0.001	0.377	0.269	71.3	0.011	...			
Bronzed Cowbird	5	91	111	10	0.432	0.134	31.0	0.000	0.329	0.192	58.4	0.000	0.549	0.393	71.5	0.000	...			
Brown-headed Cowbird	298	3656	5113	614	0.476	0.016	3.4	0.001	0.423	0.024	5.6	0.002	0.479	0.035	7.3	0.001	...			
Orchard Oriole	27	520	633	52	0.515	0.058	11.3	0.029	0.291	0.067	23.0	0.001	0.389	0.104	26.8	0.011	...			
Hooded Oriole *†	3	40	49	4	0.590	0.232	39.3	0.000	0.118	0.126	107.2	0.000	1.000	1.069	106.9	0.000	...			
Bullock's Oriole	66	2175	2745	211	0.477	0.028	5.9	0.001	0.308	0.035	11.3	0.007	0.367	0.048	13.2	0.000	...			
Baltimore Oriole	68	1072	1322	107	0.508	0.039	7.6	0.002	0.319	0.049	15.3	0.047	0.325	0.060	18.4	0.001	...			
Pine Grosbeak	11	143	170	12	0.398	0.117	29.5	0.000	0.252	0.160	63.3	0.002	0.598	0.431	72.1	0.000	...			
Purple Finch	61	5062	6347	573	0.486	0.017	3.5	0.028	0.284	0.020	7.1	0.047	0.443	0.036	8.2	0.001	...			
Cassin's Finch	21	723	774	20	0.495	0.087	17.6	0.002	0.078	0.047	60.4	0.043	0.386	0.234	60.7	0.010	...			
House Finch	80	2260	2381	54	0.496	0.058	11.7	0.001	0.059	0.029	50.1	0.003	0.525	0.266	50.6	0.000	...			
Common Redpoll	14	1631	2035	18	0.369	0.090	24.5	0.000	0.027	0.019	67.8	0.000	0.780	0.489	62.8	0.000	...			
Pine Siskin	56	3205	3442	30	0.382	0.075	19.6	0.018	0.024	0.018	75.0	0.004	0.683	0.497	72.8	0.000	...			
Lesser Goldfinch	52	2130	2296	62	0.366	0.052	14.3	0.001	0.107	0.042	38.9	0.000	0.547	0.213	39.0	0.076	...			
American Goldfinch	207	11566	13919	953	0.426	0.013	3.1	0.155	0.255	0.016	6.2	0.094	0.466	0.031	6.7	0.057	...			
Mean (192 species)	63	2119	3168	348	0.488	0.064	13.8	0.116	0.334	0.067	35.9	0.093	0.492	0.257	39.9	0.055				
Mean (169 better-estimated sp.)[m]	70	2385	3573	394	0.489	0.048	10.0	0.132	0.352	0.056	21.1	0.106	0.456	0.116	24.9	0.062				
NORTHWEST MAPS REGION																				
Williamson's Sapsucker	9	100	136	11	0.499	0.111	22.3	0.000	0.186	0.102	54.8	0.045	0.583	0.341	58.4	0.000	...			
Red-naped Sapsucker	36	663	1137	138	0.424	0.033	7.9	0.003	0.546	0.056	10.3	0.000	0.496	0.075	15.2	0.001	...			
Red-breasted Sapsucker	52	1109	1836	224	0.440	0.027	6.0	0.000	0.461	0.041	9.0	0.011	0.585	0.070	11.9	0.001	...			
Downy Woodpecker	57	577	740	75	0.443	0.048	10.8	0.544	0.326	0.063	19.3	0.123	0.539	0.120	22.3	0.006	t..	...		

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Hairy Woodpecker	66	381	475	67	0.603	0.048	7.9	0.067	0.230	0.049	21.2	0.009	0.593	0.142	23.9	0.110	...			
White-headed Woodpecker *†	7	49	52	2	0.601	0.310	51.6	0.000	0.036	0.156	430.7	0.000	1.000	4.348	434.8	0.000	...			
Northern Flicker	75	341	385	17	0.339	0.103	30.5	0.000	0.140	0.101	72.1	0.000	0.805	0.591	73.5	0.000	...			
Olive-sided Flycatcher†	13	59	74	5	0.680	0.146	21.4	0.000	0.048	0.051	106.2	0.000	1.000	1.054	105.4	0.000	...			
Western Wood-Pewee	78	1879	2537	305	0.529	0.024	4.4	0.044	0.380	0.030	8.0	0.156	0.404	0.041	10.2	0.258	...			
Traill's Flycatcher	38	1900	2832	319	0.510	0.022	4.4	0.009	0.487	0.033	6.7	0.001	0.310	0.031	10.0	0.495	...	..t		
Least Flycatcher	3	77	98	6	0.436	0.188	43.0	0.000	0.297	0.216	72.5	0.000	0.427	0.343	80.3	0.000	...			
Hammond's Flycatcher	60	1564	2265	273	0.467	0.024	5.1	0.207	0.385	0.034	8.7	0.075	0.509	0.056	11.0	0.000	...			
Dusky Flycatcher	49	3080	4677	469	0.494	0.018	3.6	0.999	0.418	0.025	6.1	0.011	0.318	0.027	8.4	0.004	t..			
Western Flycatcher	60	2385	3131	286	0.493	0.023	4.7	0.012	0.341	0.030	8.9	0.012	0.357	0.039	10.9	0.004	...			
Black Phoebe	4	89	122	12	0.706	0.105	14.8	0.000	0.284	0.107	37.8	0.009	0.221	0.111	50.4	0.001	...			
Eastern Kingbird	10	110	121	6	0.466	0.183	39.3	0.000	0.373	0.235	63.1	0.000	0.175	0.138	78.8	0.000	...			
Cassin's Vireo	35	774	910	52	0.547	0.054	9.9	0.001	0.133	0.039	29.6	0.001	0.470	0.145	30.9	0.000	...			
Hutton's Vireo	14	71	99	11	0.659	0.114	17.3	0.000	0.343	0.137	40.0	0.000	0.292	0.151	51.8	0.000	...			
Warbling Vireo	106	5694	8343	908	0.508	0.013	2.5	0.024	0.361	0.017	4.7	0.122	0.417	0.025	6.0	0.876	..t			
Red-eyed Vireo	9	199	309	33	0.557	0.068	12.1	0.028	0.247	0.070	28.2	0.046	0.579	0.185	32.0	0.000	...			
Gray Jay	11	62	86	20	0.664	0.077	11.6	0.002	0.227	0.080	35.4	0.003	0.766	0.304	39.7	0.000	...			
Steller's Jay	66	326	358	27	0.681	0.073	10.7	0.000	0.161	0.061	38.2	0.000	0.316	0.132	41.9	0.000	...			
Western Scrub-Jay	10	54	63	6	0.608	0.144	23.6	0.000	0.215	0.149	69.2	0.000	0.356	0.277	77.7	0.000	...			
Tree Swallow	24	532	732	57	0.467	0.052	11.1	0.000	0.232	0.056	24.2	0.001	0.614	0.162	26.3	0.002	...			
Violet-green Swallow	9	123	138	6	0.346	0.169	48.9	0.000	0.211	0.212	100.5	0.000	0.499	0.521	104.5	0.000	...			
Northern Rough-winged Swallow	13	119	134	8	0.389	0.157	40.5	0.000	0.427	0.244	57.0	0.000	0.310	0.230	74.2	0.000	...			
Barn Swallow	7	380	463	37	0.502	0.061	12.2	0.185	0.182	0.059	32.3	0.306	0.547	0.188	34.4	0.006	...	.t.	t..	
Black-capped Chickadee	58	1530	2282	305	0.463	0.024	5.1	0.004	0.429	0.034	8.0	0.051	0.615	0.063	10.3	0.002	...			
Mountain Chickadee	51	1486	1870	175	0.470	0.031	6.5	0.007	0.285	0.037	13.1	0.076	0.487	0.072	14.8	0.001	...			
Chestnut-backed Chickadee	51	1301	1540	109	0.326	0.039	12.0	0.000	0.208	0.050	24.0	0.004	0.935	0.236	25.2	0.003	...			
Bushtit†	18	403	482	21	0.335	0.095	28.3	0.002	0.132	0.082	61.8	0.069	1.000	0.599	59.9	0.001	...			
Red-breasted Nuthatch	75	793	887	37	0.356	0.068	19.1	0.000	0.124	0.063	50.3	0.000	0.750	0.385	51.3	0.000	...			
White-breasted Nuthatch	10	43	65	12	0.578	0.135	23.4	0.000	0.857	0.136	15.8	0.000	0.266	0.130	48.8	0.000	...			
Brown Creeper	56	763	973	73	0.376	0.047	12.6	0.000	0.248	0.060	24.3	0.003	0.727	0.189	26.0	0.000	...			
Bewick's Wren	27	519	880	114	0.446	0.038	8.6	0.001	0.520	0.061	11.7	0.003	0.553	0.092	16.6	0.000	...			
House Wren	40	1464	2219	162	0.353	0.031	8.8	0.448	0.381	0.050	13.1	0.272	0.548	0.081	14.8	0.008	t..	...	.t.	
Winter Wren	39	1248	2047	175	0.364	0.027	7.4	0.074	0.540	0.052	9.6	0.027	0.368	0.052	14.1	0.011	...			
Golden-crowned Kinglet*	59	1278	1582	20	0.084	0.050	59.2	0.003	0.392	0.260	66.2	0.002	0.374	0.173	46.2	0.004	...			

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Ruby-crowned Kinglet	24	1136	1445	61	0.341	0.049	14.5	0.691	0.250	0.063	25.4	0.257	0.418	0.109	26.0	0.002	t..	.t.		
Veery	8	273	614	126	0.665	0.035	5.3	0.000	0.580	0.048	8.2	0.000	0.428	0.068	16.0	0.001	...			
Swainson's Thrush	93	10644	24739	4549	0.595	0.006	1.0	0.001	0.626	0.008	1.3	0.000	0.423	0.011	2.7	0.029	...			
Hermit Thrush	36	1041	1607	194	0.443	0.028	6.3	0.002	0.539	0.045	8.4	0.377	0.407	0.052	12.8	0.002	...	.t.		
American Robin	152	6817	9110	1022	0.518	0.013	2.4	1.000	0.263	0.014	5.3	0.003	0.609	0.037	6.0	0.007	t..			
Varied Thrush	31	481	636	54	0.425	0.051	11.9	0.506	0.399	0.078	19.7	0.307	0.356	0.089	25.1	0.001	t..	.t.	...	
Wrentit	21	728	1732	306	0.563	0.022	3.8	0.276	0.580	0.032	5.6	0.387	0.477	0.051	10.8	0.840	..t	.tt	t..	t.t
Gray Catbird	18	1466	2294	297	0.529	0.025	4.7	0.194	0.386	0.032	8.2	0.008	0.534	0.055	10.2	0.815	..t			
European Starling	13	233	253	12	0.426	0.142	33.2	0.000	0.331	0.191	57.6	0.000	0.293	0.207	70.5	0.000	...			
Cedar Waxwing	40	2673	3069	28	0.389	0.080	20.5	0.003	0.052	0.025	47.3	0.007	0.318	0.137	43.1	0.003	...			
Orange-crowned Warbler	40	1923	2680	269	0.441	0.024	5.5	0.068	0.432	0.037	8.6	0.112	0.405	0.045	11.2	0.006	...			
Nashville Warbler	20	979	1187	62	0.325	0.048	14.7	0.002	0.425	0.088	20.8	0.002	0.292	0.072	24.6	0.004	...			
Virginia's Warbler	2	329	374	25	0.412	0.086	21.0	0.011	0.168	0.084	49.7	0.592	0.724	0.375	51.8	0.001	.t.	...		
Yellow Warbler	79	8477	14268	2011	0.564	0.009	1.6	0.124	0.476	0.012	2.6	0.210	0.393	0.015	3.9	0.214	...	.t.	..t	
Yellow-rumped Warbler	70	4695	5663	408	0.456	0.020	4.4	0.007	0.227	0.022	9.7	0.018	0.488	0.051	10.5	0.001	...			
Black-throated Gray Warbler	20	175	200	5	0.425	0.176	41.6	0.001	0.076	0.087	113.5	0.000	0.563	0.614	109.1	0.000	...			
Townsend's Warbler	26	1305	1631	126	0.435	0.036	8.4	0.001	0.240	0.042	17.3	0.001	0.567	0.107	18.9	0.004	...			
Hermit Warbler	34	1545	1703	61	0.649	0.047	7.3	0.002	0.076	0.022	29.3	0.000	0.316	0.094	29.8	0.000	...			
American Redstart	10	609	1040	131	0.488	0.035	7.1	0.004	0.561	0.054	9.6	0.995	0.408	0.063	15.3	0.001	.t.			
Northern Waterthrush	9	278	428	49	0.542	0.056	10.3	0.100	0.427	0.078	18.2	0.164	0.344	0.087	25.4	0.003	...			
MacGillivray's Warbler	96	9042	17910	2321	0.491	0.008	1.7	0.622	0.598	0.013	2.1	0.001	0.394	0.015	3.8	0.378	t..	..t		
Common Yellowthroat	35	2556	4810	612	0.496	0.016	3.1	0.002	0.554	0.024	4.4	0.001	0.387	0.028	7.3	0.011	...			
Wilson's Warbler	62	5329	8742	916	0.446	0.013	2.8	0.785	0.525	0.021	3.9	0.999	0.368	0.022	6.0	0.176	tt.			
Yellow-breasted Chat	21	1374	2499	357	0.508	0.020	4.0	0.980	0.501	0.031	6.1	0.007	0.452	0.043	9.6	0.024	t..			
Western Tanager	85	2592	2835	146	0.495	0.036	7.2	0.006	0.107	0.026	24.5	0.047	0.653	0.165	25.3	0.001	...			
Green-tailed Towhee	13	419	654	102	0.615	0.039	6.3	0.018	0.322	0.045	13.9	0.029	0.502	0.086	17.2	0.000	...			
Spotted Towhee	61	1888	2799	368	0.488	0.021	4.3	0.725	0.428	0.030	7.0	0.204	0.489	0.045	9.2	0.078	t..	...	tt.	
Chipping Sparrow	44	1390	1718	117	0.457	0.038	8.3	0.017	0.236	0.041	17.5	0.028	0.459	0.087	19.0	0.046	...			
Vesper Sparrow	4	66	83	11	0.697	0.104	14.9	0.000	0.256	0.111	43.4	0.001	0.287	0.151	52.6	0.000	...			
Savannah Sparrow	5	461	659	117	0.534	0.038	7.1	0.114	0.325	0.047	14.3	0.042	0.734	0.125	17.1	0.000	...			
Fox Sparrow	30	873	1550	194	0.498	0.028	5.6	0.813	0.485	0.042	8.6	0.167	0.429	0.055	12.8	0.027	t..			
Song Sparrow	126	9800	20119	2718	0.473	0.007	1.6	0.977	0.571	0.012	2.1	0.715	0.504	0.017	3.5	0.000	tt.	t..		
Lincoln's Sparrow	39	3047	7305	955	0.438	0.012	2.8	0.124	0.624	0.021	3.3	0.974	0.607	0.035	5.8	0.016	.t.			
White-crowned Sparrow	20	952	1708	243	0.478	0.025	5.2	0.001	0.518	0.039	7.5	0.119	0.549	0.061	11.2	0.000	...			

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h] φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	Recapture probability[j] p	SE(p)	CV(p)	$w(p_i)$[i]	Proportion of residents[k] τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	Models selected[l] 1	2	3	4
Dark-eyed Junco	98	7798	13290	1775	0.460	0.009	2.0	0.264	0.491	0.014	2.9	0.900	0.528	0.022	4.2	0.000	.t.			
Black-headed Grosbeak	89	3521	4631	527	0.571	0.017	3.1	0.011	0.249	0.018	7.2	0.007	0.517	0.043	8.2	0.001	...			
Lazuli Bunting	32	1842	2332	173	0.523	0.029	5.6	0.001	0.253	0.032	12.5	0.004	0.330	0.047	14.2	0.047	...			
Red-winged Blackbird	32	1505	1716	129	0.679	0.036	5.3	0.008	0.140	0.026	18.2	0.266	0.385	0.074	19.2	0.005	...	.t.		
Brown-headed Cowbird	88	1326	1972	264	0.452	0.025	5.5	0.007	0.480	0.039	8.0	0.018	0.534	0.058	10.9	0.000	...			
Bullock's Oriole	33	1223	1582	144	0.486	0.034	7.1	0.004	0.348	0.045	12.9	0.011	0.403	0.063	15.6	0.000	...			
Pine Grosbeak *†	5	69	76	4	0.384	0.202	52.6	0.000	0.106	0.173	163.1	0.000	1.000	1.676	167.6	0.000	...			
Purple Finch	39	3590	4453	385	0.471	0.021	4.4	0.009	0.293	0.026	8.8	0.182	0.429	0.043	10.1	0.002	...			
Cassin's Finch	19	607	647	15	0.550	0.100	18.1	0.002	0.083	0.051	61.5	0.041	0.256	0.159	62.2	0.011	...			
House Finch†	12	522	569	18	0.523	0.097	18.5	0.004	0.039	0.039	98.8	0.060	1.000	0.985	98.5	0.002	...			
Pine Siskin	49	3082	3314	30	0.383	0.075	19.6	0.011	0.024	0.018	74.8	0.002	0.685	0.498	72.7	0.007	...			
Lesser Goldfinch†	9	498	529	10	0.401	0.141	35.1	0.000	0.036	0.051	140.2	0.000	1.000	1.376	137.6	0.001	...			
American Goldfinch	31	2598	3431	322	0.475	0.023	4.8	0.057	0.322	0.029	8.9	0.970	0.452	0.047	10.5	0.003	.t.			
Mean (85 species)	39	1733	2749	322	0.486	0.061	13.5	0.132	0.327	0.064	34.5	0.126	0.508	0.239	37.7	0.054				
Mean (71 better-estimated sp.)[m]	43	2018	3225	383	0.500	0.043	8.6	0.158	0.355	0.047	18.8	0.148	0.476	0.105	22.1	0.064				
SOUTHWEST MAPS REGION																				
Common Ground-Dove *†	3	92	105	2	0.374	0.303	81.2	0.000	0.042	0.093	222.2	0.000	1.000	2.070	207.0	0.000	...			
Acorn Woodpecker	10	70	85	9	0.439	0.165	37.7	0.000	0.767	0.207	27.0	0.000	0.263	0.158	59.9	0.000	...			
Gila Woodpecker	5	30	47	9	0.694	0.139	20.1	0.000	0.830	0.150	18.1	0.000	0.147	0.105	71.1	0.000	...			
Williamson's Sapsucker	5	110	138	8	0.435	0.132	30.3	0.000	0.217	0.140	64.4	0.000	0.433	0.298	68.8	0.000	...			
Red-naped Sapsucker	4	163	332	74	0.584	0.044	7.6	0.004	0.522	0.063	12.1	0.029	0.675	0.129	19.1	0.000	...			
Ladder-backed Woodpecker†	12	76	102	14	0.407	0.121	29.8	0.000	0.361	0.175	48.4	0.000	1.000	0.569	56.9	0.000	...			
Nuttall's Woodpecker	30	425	664	101	0.580	0.038	6.6	0.002	0.363	0.048	13.3	0.001	0.526	0.091	17.2	0.004	...			
Downy Woodpecker	31	433	647	83	0.636	0.041	6.4	0.002	0.326	0.048	14.6	0.004	0.339	0.065	19.3	0.002	...			
Hairy Woodpecker	13	104	152	22	0.713	0.070	9.8	0.000	0.224	0.068	30.2	0.001	0.388	0.146	37.6	0.000	...			
Northern Flicker	29	211	252	24	0.529	0.083	15.7	0.004	0.265	0.092	34.9	0.011	0.430	0.175	40.8	0.007	...			
Olive-sided Flycatcher	3	62	89	15	0.772	0.088	11.3	0.000	0.703	0.118	16.7	0.000	0.049	0.035	71.1	0.000	...			
Western Wood-Pewee	23	421	553	55	0.517	0.052	10.1	0.005	0.242	0.056	23.3	0.725	0.575	0.148	25.8	0.003	.t.	...		
Traill's Flycatcher	4	56	68	6	0.426	0.163	38.2	0.000	0.385	0.247	64.3	0.000	0.416	0.326	78.5	0.000	...			
Gray Flycatcher *†	3	67	73	2	0.387	0.314	81.1	0.000	0.054	0.155	287.4	0.000	1.000	2.836	283.6	0.000	...			
Dusky Flycatcher	7	204	240	16	0.461	0.106	23.0	0.001	0.513	0.160	31.2	0.010	0.164	0.074	45.3	0.000	...			
Western Flycatcher	29	1621	1906	98	0.484	0.041	8.4	0.046	0.303	0.049	16.3	0.869	0.208	0.040	19.3	0.024	.t.			

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Black Phoebe	30	308	370	33	0.451	0.073	16.2	0.003	0.420	0.108	25.6	0.002	0.331	0.108	32.5	0.000	...			
Vermilion Flycatcher†	4	67	80	8	0.537	0.150	27.8	0.000	0.145	0.130	89.3	0.000	1.000	0.947	94.7	0.000	...			
Dusky-capped Flycatcher *†	4	36	46	2	0.979	0.286	29.2	0.000	0.014	0.028	195.6	0.000	1.000	1.790	179.0	0.000	...			
Ash-throated Flycatcher	59	1448	1700	150	0.607	0.034	5.5	0.001	0.217	0.033	15.0	0.003	0.397	0.067	16.8	0.731	..t	...		
Brown-crested Flycatcher	5	71	86	8	0.630	0.165	26.1	0.000	0.787	0.186	23.7	0.000	0.107	0.068	63.4	0.000	...			
Bell's Vireo	9	298	485	61	0.478	0.054	11.4	0.003	0.592	0.084	14.2	0.001	0.410	0.093	22.6	0.000	...			
Plumbeous Vireo	8	73	109	20	0.511	0.089	17.4	0.001	0.406	0.123	30.3	0.000	0.703	0.273	38.7	0.000	...			
Hutton's Vireo	13	128	177	16	0.548	0.098	17.8	0.003	0.195	0.085	43.8	0.020	0.611	0.290	47.5	0.001	...			
Warbling Vireo	22	1794	2226	143	0.515	0.033	6.5	0.002	0.374	0.044	11.8	0.269	0.191	0.029	15.3	0.999	..t	.tt		
Steller's Jay	9	145	201	31	0.688	0.062	8.9	0.001	0.195	0.057	29.1	0.076	0.602	0.196	32.5	0.002	...			
Western Scrub-Jay	30	167	189	15	0.540	0.108	20.0	0.001	0.181	0.101	55.7	0.000	0.485	0.291	60.0	0.045	...			
Mexican Jay*	4	39	47	3	0.359	0.212	59.1	0.000	0.298	0.311	104.3	0.000	0.468	0.538	115.1	0.000	...			
Tree Swallow	13	120	143	7	0.560	0.137	24.5	0.001	0.210	0.130	62.0	0.000	0.191	0.135	70.9	0.001	...			
Violet-green Swallow	5	122	161	13	0.482	0.102	21.1	0.001	0.256	0.118	46.2	0.667	0.398	0.209	52.6	0.000	.t.	...		
Black-capped Chickadee	6	109	179	21	0.403	0.084	20.8	0.000	0.514	0.144	28.0	0.000	0.668	0.260	38.9	0.000	...			
Mountain Chickadee	10	317	414	37	0.397	0.063	15.9	0.307	0.287	0.086	30.0	0.506	0.653	0.218	33.3	0.002	.t.	t..	...	
Chestnut-backed Chickadee	9	448	755	123	0.503	0.036	7.1	0.090	0.481	0.053	11.0	0.664	0.548	0.086	15.7	0.003	.t.	...		
Bridled Titmouse	7	54	72	10	0.556	0.128	23.0	0.000	0.243	0.134	54.9	0.000	0.806	0.492	61.0	0.000	...			
Oak Titmouse	22	363	554	75	0.555	0.044	8.0	0.000	0.393	0.058	14.9	0.000	0.400	0.083	20.8	0.001	...			
Juniper Titmouse	5	59	110	21	0.553	0.083	15.0	0.000	0.530	0.122	23.0	0.000	0.589	0.223	37.8	0.000	...			
Verdin *†	5	59	75	3	0.319	0.237	74.1	0.000	0.137	0.204	148.6	0.000	1.000	1.408	140.8	0.000	...			
Bushtit	52	2166	2575	137	0.332	0.034	10.2	0.921	0.231	0.045	19.5	0.341	0.642	0.131	20.4	0.107	t..	tt.		
White-breasted Nuthatch	23	179	230	22	0.438	0.087	19.8	0.019	0.303	0.115	38.0	0.004	0.578	0.252	43.6	0.011	...			
Brown Creeper*	7	209	252	6	0.174	0.135	77.4	0.004	0.164	0.201	122.9	0.001	0.927	0.998	107.7	0.000	...			
Bewick's Wren	66	2227	3792	475	0.441	0.018	4.1	0.942	0.538	0.030	5.5	0.002	0.540	0.044	8.1	0.128	t..			
House Wren	39	1813	2654	204	0.358	0.026	7.4	0.000	0.433	0.046	10.6	0.000	0.474	0.062	13.0	0.000	...			
Golden-crowned Kinglet*	4	52	76	4	0.285	0.187	65.5	0.000	0.263	0.281	106.7	0.000	0.834	0.918	110.1	0.000	...			
Blue-gray Gnatcatcher	13	134	162	5	0.361	0.176	48.7	0.000	0.178	0.187	105.2	0.000	0.411	0.441	107.3	0.000	...			
Western Bluebird	12	142	194	12	0.375	0.113	30.0	0.002	0.272	0.141	51.7	0.000	0.508	0.281	55.2	0.000	...			
Swainson's Thrush	12	3243	5936	638	0.594	0.016	2.6	0.494	0.568	0.022	3.9	0.018	0.176	0.013	7.6	1.000	..t	t.t		
Hermit Thrush	8	585	928	150	0.499	0.033	6.5	0.073	0.412	0.046	11.2	0.045	0.722	0.104	14.3	0.000	...			
American Robin	35	1036	1325	136	0.479	0.035	7.2	0.380	0.249	0.040	15.9	0.233	0.654	0.115	17.6	0.378	t..	..t	.t.	
Wrentit	31	2072	3833	590	0.574	0.016	2.7	0.995	0.516	0.023	4.4	0.739	0.378	0.028	7.4	0.112	tt.			
California Thrasher	15	156	205	25	0.608	0.082	13.4	0.004	0.174	0.070	40.3	0.000	0.750	0.320	42.6	0.000	...			

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Orange-crowned Warbler	26	1942	2449	168	0.414	0.031	7.5	0.072	0.371	0.046	12.4	0.006	0.333	0.050	15.0	0.044	...			
Virginia's Warbler	12	441	566	41	0.415	0.062	15.0	0.002	0.452	0.099	21.9	0.011	0.276	0.080	29.0	0.001	...			
Lucy's Warbler	13	803	970	78	0.525	0.048	9.2	0.003	0.350	0.060	17.2	0.001	0.289	0.060	20.7	0.498	...	..t		
Yellow Warbler	24	1267	1715	165	0.523	0.030	5.8	0.967	0.396	0.041	10.4	0.000	0.308	0.043	14.0	0.032	t..			
Yellow-rumped Warbler	6	388	448	24	0.350	0.082	23.3	0.432	0.134	0.078	58.5	0.176	0.965	0.575	59.6	0.072	t..	...	.t.	
Black-throated Gray Warbler *†	4	37	42	2	0.379	0.284	75.1	0.000	0.089	0.187	209.6	0.000	1.000	2.062	206.2	0.000	...			
MacGillivray's Warbler	8	217	258	11	0.340	0.114	33.5	0.002	0.325	0.177	54.6	0.025	0.271	0.161	59.3	0.000	...			
Common Yellowthroat	38	3250	5227	552	0.497	0.016	3.3	1.000	0.416	0.024	5.7	0.007	0.419	0.032	7.6	0.003	t..			
Wilson's Warbler	15	4337	5714	349	0.478	0.021	4.4	0.011	0.423	0.030	7.2	0.943	0.174	0.017	9.8	1.000	.tt			
Red-faced Warbler *†	3	54	57	2	0.372	0.301	80.9	0.000	0.064	0.235	364.0	0.000	1.000	3.771	377.1	0.000	...			
Yellow-breasted Chat	23	1473	2551	359	0.519	0.021	4.1	0.061	0.447	0.030	6.7	0.061	0.540	0.050	9.2	0.006	...			
Summer Tanager	12	385	688	142	0.635	0.036	5.7	0.047	0.437	0.044	10.1	0.001	0.636	0.087	13.7	0.000	...			
Western Tanager	11	519	580	34	0.578	0.066	11.4	0.011	0.143	0.053	37.1	0.011	0.381	0.150	39.3	0.000	...			
Spotted Towhee	56	2624	3924	578	0.504	0.017	3.4	0.007	0.430	0.024	5.5	0.047	0.569	0.042	7.3	0.017	...			
Canyon Towhee†	5	80	110	11	0.653	0.144	22.1	0.000	0.123	0.077	63.1	0.000	1.000	0.623	62.3	0.000	...			
California Towhee	37	872	1240	192	0.549	0.029	5.3	0.001	0.357	0.037	10.3	0.001	0.596	0.076	12.8	0.500	...	..t		
Abert's Towhee	6	171	232	21	0.462	0.092	19.8	0.000	0.297	0.113	38.2	0.000	0.563	0.247	43.9	0.000	...			
Rufous-crowned Sparrow	15	221	321	36	0.506	0.067	13.2	0.001	0.346	0.086	24.9	0.000	0.490	0.148	30.3	0.000	...			
Chipping Sparrow†	8	231	260	12	0.460	0.123	26.7	0.001	0.079	0.075	95.9	0.000	1.000	0.971	97.1	0.001	...			
Lark Sparrow	9	290	319	17	0.369	0.097	26.4	0.000	0.476	0.170	35.8	0.000	0.219	0.106	48.6	0.000	...			
Black-throated Sparrow	11	176	192	6	0.648	0.153	23.6	0.000	0.141	0.105	74.8	0.000	0.152	0.122	80.4	0.001	...			
Sage Sparrow *†	2	99	104	3	0.426	0.228	53.5	0.000	0.045	0.112	252.0	0.000	1.000	2.530	253.0	0.000	...			
Fox Sparrow	2	84	140	19	0.531	0.082	15.5	0.000	0.548	0.128	23.4	0.000	0.327	0.144	44.0	0.000	...			
Song Sparrow	44	4350	7648	1150	0.545	0.012	2.1	0.047	0.461	0.016	3.6	0.942	0.501	0.026	5.1	0.004	.t.			
Lincoln's Sparrow	2	110	380	35	0.437	0.057	13.0	0.000	0.876	0.080	9.1	0.000	0.176	0.101	57.3	0.000	...			
White-crowned Sparrow	3	65	86	9	0.673	0.105	15.6	0.000	0.187	0.096	51.4	0.000	0.385	0.231	60.1	0.000	...			
Dark-eyed Junco	10	536	815	81	0.340	0.042	12.3	0.000	0.494	0.080	16.2	0.999	0.688	0.143	20.9	0.000	.t.			
Northern Cardinal	5	107	166	28	0.470	0.089	19.0	0.000	0.597	0.130	21.7	0.000	0.722	0.232	32.2	0.000	...			
Black-headed Grosbeak	51	2739	3462	349	0.520	0.021	4.1	0.046	0.334	0.027	8.1	0.460	0.367	0.036	9.9	0.049	...	.t.		
Blue Grosbeak	26	709	874	84	0.599	0.052	8.6	0.119	0.295	0.052	17.6	0.001	0.351	0.072	20.6	0.001	...			
Lazuli Bunting	22	680	815	41	0.368	0.058	15.8	0.002	0.414	0.099	23.9	0.011	0.218	0.065	29.8	0.001	...			
Varied Bunting	4	163	210	23	0.514	0.113	21.9	0.000	0.302	0.114	37.8	0.000	0.605	0.259	42.8	0.000	...			
Red-winged Blackbird†	18	446	488	22	0.689	0.092	13.4	0.003	0.030	0.024	79.5	0.022	1.000	0.781	78.1	0.002	...			
Brown-headed Cowbird	47	614	941	135	0.520	0.034	6.6	0.003	0.458	0.049	10.7	0.004	0.485	0.073	15.0	0.000	...			

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Hooded Oriole *†	3	40	49	4	0.590	0.232	39.3	0.000	0.118	0.126	107.2	0.000	1.000	1.069	106.9	0.000	...			
Bullock's Oriole	30	828	1016	60	0.392	0.052	13.3	0.071	0.351	0.076	21.7	0.070	0.315	0.079	25.1	0.001	...			
Purple Finch	10	1306	1686	171	0.533	0.030	5.6	0.165	0.264	0.033	12.6	0.731	0.464	0.067	14.5	0.009	.t.			
Cassin's Finch *†	2	116	127	5	0.318	0.170	53.6	0.000	0.101	0.159	157.1	0.000	1.000	1.601	160.1	0.000	...			
House Finch	49	1524	1586	33	0.510	0.077	15.2	0.184	0.080	0.046	56.9	0.303	0.343	0.200	58.4	0.015	...	.t.	t..	
Lesser Goldfinch	42	1620	1755	52	0.363	0.056	15.4	0.001	0.135	0.052	38.6	0.000	0.476	0.187	39.3	0.182	...			
American Goldfinch	21	1177	1308	61	0.499	0.052	10.5	0.001	0.155	0.044	28.1	0.003	0.368	0.109	29.5	0.001	...			
Mean (91 species)	17	676	959	98	0.496	0.095	21.3	0.083	0.328	0.097	51.2	0.111	0.536	0.398	57.3	0.066				
Mean (68 better-estimated sp.)[m]	21	867	1240	129	0.516	0.062	12.3	0.111	0.376	0.075	24.1	0.147	0.444	0.134	31.6	0.088				
NORTH-CENTRAL MAPS REGION																				
Red-bellied Woodpecker	16	84	107	13	0.467	0.121	25.8	0.000	0.260	0.137	52.6	0.000	0.895	0.537	60.0	0.000	...			
Downy Woodpecker	34	452	583	58	0.393	0.054	13.7	0.000	0.278	0.073	26.1	0.000	0.851	0.248	29.2	0.000	...			
Hairy Woodpecker	18	91	107	13	0.552	0.114	20.6	0.001	0.322	0.137	42.5	0.000	0.399	0.210	52.7	0.000	...			
Northern Flicker	22	109	134	7	0.364	0.143	39.3	0.000	0.341	0.214	62.8	0.000	0.290	0.209	71.9	0.000	...			
Western Wood-Pewee†	2	106	187	31	0.453	0.072	16.0	0.018	0.396	0.106	26.7	0.371	1.000	0.327	32.7	0.000	...	.t.		
Eastern Wood-Pewee	20	263	328	19	0.442	0.093	20.9	0.001	0.273	0.110	40.5	0.018	0.353	0.162	45.8	0.000	...			
Traill's Flycatcher	16	868	1297	122	0.461	0.036	7.7	0.142	0.507	0.056	11.0	0.141	0.321	0.052	16.2	0.086	...			
Least Flycatcher	15	1359	1924	187	0.456	0.029	6.4	0.045	0.368	0.040	10.9	0.117	0.421	0.056	13.4	0.001	...			
Great Crested Flycatcher	24	147	175	25	0.766	0.068	8.8	0.000	0.231	0.069	30.0	0.001	0.325	0.114	35.1	0.000	...			
Eastern Kingbird *†	13	104	116	5	0.486	0.210	43.1	0.000	0.069	0.118	170.1	0.000	1.000	1.763	176.3	0.000	...			
Warbling Vireo	11	172	194	11	0.502	0.123	24.6	0.000	0.146	0.102	69.7	0.066	0.493	0.362	73.5	0.001	...			
Red-eyed Vireo	29	813	1063	100	0.530	0.038	7.2	0.001	0.378	0.052	13.7	0.076	0.316	0.057	17.9	0.002	...			
Blue Jay†	31	295	328	21	0.593	0.082	13.8	0.003	0.058	0.043	73.3	0.004	1.000	0.747	74.7	0.000	...			
Tree Swallow *†	10	101	108	4	0.490	0.211	43.1	0.000	0.050	0.119	236.9	0.000	1.000	2.432	243.2	0.000	...			
Black-capped Chickadee	39	1100	1465	144	0.402	0.033	8.3	0.000	0.457	0.054	11.9	0.002	0.455	0.070	15.5	0.002	...			
Tufted Titmouse	14	224	310	48	0.507	0.057	11.2	0.002	0.427	0.081	18.9	0.001	0.513	0.131	25.5	0.002	...			
White-breasted Nuthatch	22	129	150	8	0.526	0.138	26.2	0.000	0.116	0.087	75.5	0.000	0.547	0.424	77.5	0.000	...			
Carolina Wren	7	100	159	17	0.327	0.082	25.0	0.072	0.668	0.177	26.5	0.006	0.426	0.192	45.1	0.000	...			
House Wren	28	1497	2221	155	0.343	0.030	8.7	0.174	0.406	0.052	12.7	0.009	0.468	0.070	15.0	0.040	...			
Eastern Bluebird	11	83	99	6	0.423	0.161	38.1	0.000	0.351	0.224	63.9	0.000	0.244	0.186	76.4	0.000	...			
Veery	14	529	925	174	0.604	0.031	5.1	0.001	0.556	0.042	7.5	0.002	0.481	0.060	12.4	0.001	...			
Wood Thrush	17	470	752	78	0.396	0.044	11.0	0.000	0.393	0.068	17.3	0.000	0.741	0.154	20.8	0.000	...			

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
American Robin	37	1331	1631	100	0.414	0.040	9.7	0.004	0.390	0.060	15.3	0.029	0.274	0.052	18.9	0.004	...			
Gray Catbird	36	3940	6411	772	0.500	0.014	2.9	0.007	0.485	0.021	4.4	0.029	0.402	0.026	6.4	0.003	...			
Brown Thrasher	11	153	201	27	0.668	0.071	10.6	0.000	0.160	0.056	34.8	0.000	0.727	0.271	37.4	0.007	...			
European Starling *†	4	45	49	2	0.534	0.247	46.2	0.000	0.048	0.108	223.5	0.000	1.000	2.241	224.1	0.000	...			
Cedar Waxwing *†	21	785	841	2	0.673	0.262	38.9	0.000	0.002	0.006	351.0	0.000	1.000	3.427	342.7	0.000	...			
Blue-winged Warbler	6	205	363	43	0.619	0.058	9.4	0.000	0.342	0.069	20.1	0.003	0.351	0.095	27.1	0.003	...			
Golden-winged Warbler	2	35	48	7	0.651	0.139	21.4	0.000	0.290	0.157	54.2	0.000	0.477	0.314	65.9	0.000	...			
Nashville Warbler	4	235	268	9	0.389	0.127	32.7	0.001	0.338	0.191	56.7	0.000	0.186	0.123	66.0	0.001	...			
Yellow Warbler	22	2129	3365	459	0.542	0.019	3.4	0.001	0.396	0.025	6.2	0.000	0.494	0.040	8.2	0.003	...			
Chestnut-sided Warbler	5	462	823	107	0.424	0.038	9.0	0.620	0.584	0.064	11.0	0.004	0.640	0.108	16.8	0.001	t..	...		
Yellow-rumped Warbler *†	1	37	45	2	0.372	0.272	73.3	0.000	0.103	0.243	237.5	0.000	1.000	2.453	245.3	0.000	...			
Black-and-white Warbler	7	144	183	20	0.493	0.087	17.7	0.001	0.517	0.134	25.9	0.001	0.257	0.102	39.8	0.000	...			
American Redstart	15	847	1196	88	0.449	0.041	9.1	0.001	0.334	0.055	16.5	0.029	0.378	0.075	19.8	0.011	...			
Ovenbird	13	557	728	71	0.547	0.047	8.6	0.018	0.387	0.062	16.0	0.338	0.296	0.063	21.2	0.768	..t	.tt	...	
Northern Waterthrush	3	75	101	11	0.336	0.123	36.7	0.000	0.540	0.231	42.9	0.000	0.644	0.392	60.9	0.000	...			
Kentucky Warbler	4	119	223	47	0.568	0.059	10.4	0.000	0.595	0.082	13.8	0.000	0.604	0.143	23.6	0.001	...			
Mourning Warbler	3	169	312	52	0.505	0.059	11.6	0.003	0.627	0.086	13.7	0.003	0.547	0.128	23.3	0.000	...			
Common Yellowthroat	35	2535	4333	455	0.451	0.019	4.1	0.013	0.492	0.029	6.0	0.025	0.460	0.038	8.4	0.821	..t			
Scarlet Tanager	15	90	103	6	0.447	0.170	38.0	0.000	0.418	0.250	59.7	0.000	0.207	0.163	78.4	0.000	...			
Eastern Towhee	15	104	150	16	0.395	0.097	24.5	0.001	0.459	0.162	35.3	0.002	0.531	0.242	45.6	0.000	...			
Chipping Sparrow†	12	244	298	17	0.338	0.097	28.8	0.001	0.170	0.110	64.7	0.002	1.000	0.665	66.5	0.000	...			
Clay-colored Sparrow	9	577	710	35	0.378	0.067	17.6	0.022	0.425	0.111	26.2	0.263	0.255	0.082	32.3	0.001	...	.t.		
Field Sparrow	15	936	1376	155	0.406	0.032	7.8	0.628	0.370	0.047	12.8	0.002	0.701	0.106	15.1	0.141	t..	...		
Savannah Sparrow*	3	61	71	3	0.470	0.203	43.3	0.000	0.452	0.324	71.7	0.000	0.069	0.080	115.7	0.000	...			
Grasshopper Sparrow	2	348	441	17	0.273	0.098	35.7	0.000	0.482	0.212	43.9	0.000	0.319	0.148	46.6	0.000	...			
Song Sparrow	36	1919	3133	324	0.426	0.021	5.0	0.497	0.500	0.035	7.1	0.497	0.447	0.045	10.0	0.005	t..	.t.		
Lincoln's Sparrow	2	49	91	10	0.426	0.115	26.9	0.000	0.787	0.183	23.3	0.000	0.233	0.146	62.8	0.000	...			
Swamp Sparrow	6	281	534	53	0.439	0.051	11.6	0.000	0.723	0.085	11.8	0.000	0.259	0.069	26.7	0.000	...			
White-throated Sparrow	3	344	683	64	0.374	0.044	11.7	0.013	0.631	0.085	13.5	0.008	0.509	0.117	23.0	0.001	...			
Northern Cardinal	30	970	1303	158	0.477	0.033	6.8	0.002	0.338	0.043	12.7	0.009	0.609	0.092	15.1	0.012	...			
Rose-breasted Grosbeak	26	578	705	55	0.472	0.058	12.4	0.013	0.265	0.066	24.9	0.927	0.475	0.135	28.5	0.017	.t.			
Black-headed Grosbeak	1	91	130	11	0.581	0.119	20.5	0.000	0.250	0.118	47.1	0.000	0.357	0.196	55.1	0.000	...			
Indigo Bunting	27	1190	1599	158	0.477	0.031	6.5	0.980	0.316	0.040	12.7	0.002	0.475	0.071	14.9	0.001	t..			
Bobolink*	2	316	357	14	0.903	0.240	26.5	0.000	0.115	0.066	57.7	0.000	0.265	0.142	53.5	0.000	...			

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Red-winged Blackbird	17	792	849	31	0.544	0.080	14.7	0.002	0.074	0.042	57.5	0.000	0.557	0.329	59.0	0.002	...			
Brown-headed Cowbird	35	534	702	69	0.549	0.050	9.1	0.001	0.375	0.062	16.6	0.001	0.306	0.066	21.6	0.001	...			
Orchard Oriole	3	174	233	28	0.593	0.087	14.7	0.006	0.335	0.094	28.0	0.000	0.413	0.139	33.6	0.000	...			
Bullock's Oriole	1	68	90	7	0.784	0.122	15.6	0.000	0.043	0.034	79.2	0.000	0.863	0.686	79.6	0.000	...			
Baltimore Oriole	20	492	618	66	0.556	0.050	9.0	0.000	0.286	0.057	19.8	0.029	0.419	0.099	23.6	0.001	...			
American Goldfinch	33	2880	3558	265	0.359	0.024	6.8	0.014	0.305	0.036	11.7	0.005	0.578	0.074	12.8	0.991	..t			
Mean (62 species)	15	580	832	82	0.488	0.090	18.9	0.053	0.352	0.098	48.2	0.049	0.518	0.364	54.9	0.047				
Mean (46 better-estimated sp.)[m]	17	715	1044	107	0.494	0.062	12.6	0.071	0.388	0.077	24.9	0.058	0.476	0.153	31.1	0.064				
SOUTH-CENTRAL MAPS REGION																				
Common Ground-Dove	8	483	538	16	0.392	0.105	26.8	0.000	0.074	0.056	75.8	0.000	0.831	0.615	74.0	0.000	...			
Yellow-billed Cuckoo	57	566	614	18	0.497	0.092	18.5	0.020	0.188	0.086	45.8	0.051	0.181	0.089	49.4	0.001	...			
Golden-fronted Woodpecker†	7	171	213	11	0.343	0.122	35.6	0.005	0.153	0.115	75.3	0.001	1.000	0.746	74.6	0.000	...			
Red-bellied Woodpecker	25	166	185	11	0.433	0.127	29.4	0.011	0.108	0.105	96.8	0.023	0.987	0.995	100.8	0.004	...			
Ladder-backed Woodpecker	14	116	153	25	0.598	0.081	13.5	0.000	0.380	0.100	26.2	0.000	0.415	0.144	34.6	0.000	...			
Downy Woodpecker	41	487	592	59	0.551	0.052	9.4	0.017	0.241	0.055	22.9	0.047	0.485	0.125	25.9	0.001	...			
Eastern Wood-Pewee	21	227	256	15	0.603	0.112	18.5	0.005	0.288	0.120	41.9	0.001	0.212	0.108	51.0	0.003	...			
Acadian Flycatcher	19	1254	1834	238	0.494	0.027	5.4	0.000	0.566	0.040	7.2	0.000	0.349	0.040	11.4	0.007	...			
Ash-throated Flycatcher*	5	70	73	3	0.547	0.286	52.3	0.000	0.473	0.345	72.9	0.000	0.084	0.090	106.9	0.000	...			
Great Crested Flycatcher	26	210	243	20	0.525	0.090	17.1	0.017	0.200	0.092	46.2	0.074	0.503	0.258	51.2	0.006	...			
Brown-crested Flycatcher	4	298	378	45	0.511	0.063	12.3	0.000	0.275	0.077	28.2	0.007	0.689	0.229	33.2	0.007	...			
Eastern Kingbird*	11	76	82	2	0.681	0.225	33.0	0.000	0.238	0.240	101.1	0.000	0.048	0.061	128.4	0.000	...			
White-eyed Vireo	38	2813	4887	646	0.530	0.016	3.0	0.039	0.504	0.023	4.5	0.096	0.411	0.029	7.0	0.077	...			
Bell's Vireo	12	521	794	110	0.542	0.036	6.6	0.017	0.395	0.049	12.4	0.960	0.464	0.077	16.7	0.001	.t.			
Red-eyed Vireo	26	591	699	70	0.517	0.049	9.5	0.003	0.211	0.051	24.3	0.007	0.637	0.170	26.7	0.002	...			
Carolina Chickadee	53	977	1116	62	0.457	0.052	11.4	0.002	0.117	0.039	33.8	0.011	0.759	0.262	34.5	0.000	...			
Black-capped Chickadee	7	138	168	12	0.397	0.110	27.7	0.008	0.254	0.143	56.5	0.001	0.522	0.325	62.3	0.003	...			
Tufted Titmouse	36	866	1120	126	0.434	0.037	8.6	0.113	0.289	0.048	16.8	0.041	0.794	0.150	18.8	0.015	...			
Black-crested Titmouse	21	378	497	57	0.479	0.053	11.1	0.000	0.192	0.053	27.4	0.000	0.994	0.289	29.1	0.000	...			
Carolina Wren	48	2033	3510	451	0.406	0.018	4.4	0.603	0.621	0.032	5.2	0.004	0.507	0.043	8.4	0.030	t..	...		
Bewick's Wren	22	690	1037	131	0.390	0.034	8.6	0.316	0.606	0.061	10.0	0.444	0.482	0.075	15.6	0.155	...	tt.		
House Wren	5	168	213	18	0.345	0.089	25.8	0.000	0.579	0.172	29.7	0.000	0.353	0.155	43.9	0.000	...			
Blue-gray Gnatcatcher	35	445	483	13	0.549	0.110	20.0	0.011	0.079	0.058	73.3	0.021	0.370	0.273	73.9	0.001	...			

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Eastern Bluebird *†	14	87	114	2	0.378	0.289	76.6	0.000	0.045	0.090	201.2	0.000	1.000	1.867	186.7	0.000	...			
Wood Thrush	8	214	314	25	0.314	0.080	25.3	0.000	0.306	0.124	40.4	0.000	0.950	0.398	41.8	0.000	...			
Gray Catbird	8	822	1217	169	0.541	0.030	5.5	0.091	0.480	0.043	8.9	0.902	0.366	0.049	13.3	0.251	.t.	.tt		
Northern Mockingbird	19	400	500	20	0.367	0.084	22.9	0.007	0.200	0.092	45.7	0.024	0.406	0.190	46.7	0.008	...			
Brown Thrasher	17	335	418	32	0.366	0.069	18.8	0.001	0.562	0.126	22.4	0.004	0.298	0.099	33.1	0.000	...			
Long-billed Thrasher	4	220	296	44	0.550	0.069	12.6	0.001	0.429	0.088	20.5	0.018	0.541	0.149	27.5	0.000	...			
Blue-winged Warbler	5	442	665	94	0.552	0.043	7.8	0.000	0.412	0.056	13.5	0.000	0.446	0.080	18.0	0.001	...			
Northern Parula†	14	110	121	7	0.649	0.148	22.9	0.000	0.047	0.063	132.6	0.000	1.000	1.337	133.7	0.000	...			
Yellow Warbler	3	109	157	28	0.487	0.076	15.5	0.000	0.380	0.106	27.8	0.002	0.763	0.268	35.2	0.000	...			
Prairie Warbler	4	258	362	47	0.588	0.064	10.8	0.003	0.235	0.059	25.1	0.002	0.672	0.189	28.1	0.001	...			
Black-and-white Warbler	16	294	330	16	0.584	0.099	16.9	0.000	0.228	0.098	43.2	0.001	0.196	0.096	48.8	0.019	...			
American Redstart	1	109	140	19	0.640	0.091	14.2	0.000	0.288	0.100	34.5	0.000	0.458	0.189	41.3	0.000	...			
Prothonotary Warbler	13	708	969	80	0.484	0.049	10.1	0.022	0.285	0.056	19.5	0.003	0.540	0.118	21.8	0.262	...	..t		
Worm-eating Warbler	2	89	115	11	0.551	0.117	21.3	0.000	0.591	0.172	29.1	0.000	0.132	0.075	56.5	0.000	...			
Swainson's Warbler	3	123	238	29	0.436	0.078	17.9	0.001	0.522	0.123	23.6	0.010	0.639	0.209	32.7	0.000	...			
Ovenbird	6	134	185	21	0.566	0.086	15.2	0.000	0.401	0.112	27.9	0.000	0.307	0.119	38.9	0.000	...			
Louisiana Waterthrush	6	109	167	19	0.448	0.092	20.6	0.002	0.521	0.147	28.2	0.037	0.423	0.173	40.9	0.000	...			
Kentucky Warbler	23	980	1557	227	0.591	0.026	4.4	0.000	0.480	0.036	7.4	0.000	0.326	0.038	11.7	0.007	...			
Common Yellowthroat	19	659	1036	118	0.461	0.036	7.9	0.001	0.484	0.056	11.6	0.076	0.417	0.069	16.5	0.002	...			
Hooded Warbler	7	307	451	36	0.442	0.068	15.4	0.000	0.291	0.083	28.4	0.000	0.584	0.184	31.5	0.000	...			
Yellow-breasted Chat	13	1472	2384	346	0.538	0.022	4.1	0.006	0.431	0.030	6.9	0.813	0.521	0.049	9.3	0.006	.t.			
Summer Tanager	32	569	700	78	0.507	0.050	9.9	0.003	0.286	0.057	20.0	0.018	0.571	0.133	23.3	0.003	...			
Olive Sparrow	4	269	517	88	0.542	0.043	8.0	0.001	0.697	0.061	8.8	0.003	0.467	0.086	18.4	0.007	...			
Eastern Towhee	16	123	150	12	0.499	0.123	24.7	0.000	0.142	0.101	71.3	0.002	0.963	0.708	73.5	0.000	...			
Rufous-crowned Sparrow	7	118	188	25	0.460	0.082	17.7	0.029	0.423	0.118	27.8	0.000	0.639	0.229	35.8	0.000	...			
Field Sparrow	33	1399	2019	236	0.460	0.025	5.5	0.023	0.345	0.035	10.0	0.193	0.624	0.075	12.0	0.004	...			
Lark Sparrow†	8	170	183	6	0.454	0.169	37.3	0.000	0.051	0.085	168.0	0.000	1.000	1.689	168.9	0.000	...			
Black-throated Sparrow*	1	50	58	4	0.551	0.245	44.4	0.000	0.320	0.269	83.9	0.000	0.247	0.264	106.9	0.000	...			
Grasshopper Sparrow	6	269	414	51	0.421	0.056	13.3	0.003	0.433	0.087	20.1	0.950	0.579	0.147	25.4	0.000	.t.			
Northern Cardinal	65	4434	6572	980	0.534	0.013	2.4	1.000	0.393	0.017	4.3	0.500	0.548	0.031	5.6	0.000	t..	tt.		
Pyrrhuloxia*	2	149	155	4	0.701	0.203	29.0	0.000	0.267	0.189	70.7	0.000	0.039	0.036	90.4	0.000	...			
Blue Grosbeak *†	7	72	81	3	0.290	0.214	73.9	0.000	0.136	0.223	163.7	0.000	1.000	1.618	161.8	0.000	...			
Indigo Bunting	33	2640	3903	479	0.458	0.019	4.1	0.049	0.452	0.028	6.2	0.000	0.520	0.043	8.2	0.592	..t	...		
Painted Bunting	34	2406	3317	417	0.534	0.020	3.8	0.309	0.492	0.028	5.8	0.078	0.321	0.027	8.6	0.254	...	t..	..t	

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Dickcissel	15	775	873	36	0.496	0.065	13.1	0.001	0.219	0.068	31.1	0.002	0.246	0.085	34.6	0.001	...			
Eastern Meadowlark	11	58	68	5	0.589	0.167	28.3	0.000	0.349	0.213	61.1	0.000	0.199	0.160	80.3	0.000	...			
Bronzed Cowbird	3	80	99	10	0.447	0.138	30.8	0.000	0.353	0.197	55.9	0.000	0.573	0.404	70.6	0.000	...			
Brown-headed Cowbird	45	742	979	111	0.459	0.038	8.4	0.003	0.285	0.048	16.9	0.048	0.718	0.139	19.4	0.007	...			
Orchard Oriole	18	276	321	17	0.385	0.096	25.0	0.022	0.278	0.134	48.2	0.002	0.417	0.223	53.4	0.151	...			
American Goldfinch	21	610	717	45	0.364	0.058	16.0	0.029	0.224	0.074	33.0	0.018	0.620	0.219	35.3	0.002	...			
Mean (63 species)	18	586	837	98	0.491	0.088	18.6	0.044	0.330	0.096	41.9	0.087	0.529	0.280	48.0	0.030				
Mean (53 better-estimated sp.)[m]	20	677	973	115	0.488	0.066	13.9	0.053	0.353	0.080	28.6	0.104	0.516	0.179	33.9	0.036				
NORTHEAST MAPS REGION																				
Red-bellied Woodpecker†	23	92	106	10	0.547	0.130	23.7	0.000	0.108	0.099	91.3	0.000	1.000	0.947	94.7	0.000	...			
Yellow-bellied Sapsucker	15	170	234	23	0.393	0.086	21.8	0.004	0.287	0.113	39.4	0.004	0.833	0.365	43.8	0.000	...			
Downy Woodpecker	82	748	958	92	0.449	0.043	9.5	0.001	0.478	0.065	13.7	0.000	0.325	0.061	18.9	0.002	...			
Hairy Woodpecker	46	218	274	33	0.731	0.059	8.1	0.000	0.146	0.046	31.4	0.000	0.514	0.172	33.4	0.001	...			
Northern Flicker	44	163	187	12	0.470	0.120	25.6	0.000	0.147	0.103	70.3	0.000	0.654	0.479	73.2	0.001	...			
Eastern Wood-Pewee	48	266	337	28	0.510	0.072	14.2	0.000	0.235	0.077	32.6	0.119	0.449	0.162	36.2	0.001	...			
Yellow-bellied Flycatcher*	3	44	58	2	0.839	0.207	24.7	0.000	0.078	0.093	119.2	0.000	0.193	0.259	133.9	0.000	...			
Acadian Flycatcher	14	191	244	15	0.557	0.097	17.5	0.000	0.339	0.119	35.2	0.006	0.162	0.077	47.4	0.000	...			
Traill's Flycatcher	31	1138	1542	121	0.456	0.036	7.9	0.000	0.512	0.057	11.1	0.003	0.222	0.037	16.5	0.003	...			
Least Flycatcher	15	293	328	5	0.444	0.178	40.0	0.000	0.100	0.109	109.4	0.000	0.240	0.260	108.5	0.001	...			
Eastern Phoebe	38	374	499	37	0.462	0.066	14.3	0.047	0.499	0.102	20.4	0.011	0.212	0.063	29.8	0.001	...			
Great Crested Flycatcher	42	217	237	14	0.620	0.098	15.8	0.002	0.134	0.077	57.4	0.006	0.348	0.209	60.0	0.006	...			
Eastern Kingbird	13	60	82	10	0.502	0.134	26.6	0.000	0.518	0.192	37.1	0.000	0.360	0.201	55.7	0.000	...			
White-eyed Vireo	15	406	664	90	0.474	0.041	8.6	0.002	0.421	0.060	14.2	0.003	0.596	0.111	18.6	0.007	...			
Yellow-throated Vireo	5	44	56	9	0.629	0.172	27.4	0.000	0.398	0.195	49.1	0.000	0.436	0.293	67.3	0.000	...			
Blue-headed Vireo	22	183	222	14	0.441	0.104	23.5	0.000	0.199	0.105	53.0	0.001	0.517	0.288	55.6	0.000	...			
Warbling Vireo	12	123	152	10	0.348	0.118	33.8	0.000	0.506	0.222	43.9	0.001	0.298	0.177	59.4	0.000	...			
Red-eyed Vireo	84	2310	3016	308	0.544	0.022	4.1	0.057	0.247	0.024	9.8	0.690	0.531	0.059	11.0	0.000	.t.	...		
Blue Jay	76	478	524	28	0.694	0.071	10.3	0.000	0.179	0.058	32.2	0.004	0.170	0.062	36.4	0.376	...	..t		
Carolina Chickadee	22	267	311	28	0.488	0.081	16.6	0.001	0.234	0.093	39.5	0.007	0.542	0.244	45.1	0.002	...			
Black-capped Chickadee	87	2090	2873	303	0.488	0.023	4.7	0.985	0.302	0.028	9.4	0.004	0.565	0.061	10.8	0.000	t..			
Tufted Titmouse	63	735	963	94	0.383	0.041	10.8	0.029	0.332	0.062	18.6	0.011	0.725	0.154	21.2	0.000	...			
White-breasted Nuthatch	37	201	244	16	0.562	0.098	17.5	0.001	0.116	0.068	58.8	0.009	0.684	0.411	60.0	0.002	...			

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Carolina Wren	30	689	974	77	0.336	0.042	12.4	0.029	0.566	0.084	14.9	0.002	0.359	0.075	21.0	0.000	...			
House Wren	30	526	721	42	0.397	0.059	14.9	0.002	0.428	0.095	22.3	0.018	0.234	0.068	29.1	0.001	...			
Eastern Bluebird	15	115	181	13	0.417	0.104	24.9	0.002	0.304	0.137	45.2	0.001	0.464	0.240	51.8	0.000	...			
Veery	56	2544	4979	992	0.577	0.013	2.2	0.029	0.573	0.018	3.1	0.017	0.512	0.027	5.4	0.001	...			
Bicknell's Thrush	1	28	45	10	0.608	0.122	20.1	0.000	0.322	0.149	46.3	0.000	0.840	0.479	57.0	0.000	...			
Swainson's Thrush	10	258	471	88	0.613	0.049	8.0	0.029	0.615	0.063	10.2	0.002	0.533	0.090	17.0	0.004	...			
Hermit Thrush	38	597	1079	172	0.471	0.030	6.4	0.076	0.637	0.048	7.5	0.846	0.517	0.068	13.3	0.158	.t.			
Wood Thrush	70	2824	4273	363	0.412	0.020	4.8	0.160	0.438	0.032	7.3	0.064	0.378	0.036	9.6	0.100	...			
American Robin	90	2641	3288	258	0.450	0.026	5.7	0.005	0.270	0.031	11.5	0.012	0.499	0.064	12.9	0.007	...			
Gray Catbird	81	8894	14453	1980	0.513	0.009	1.8	0.051	0.452	0.013	2.8	0.950	0.497	0.019	3.9	0.005	.t.			
Brown Thrasher	17	159	217	25	0.532	0.081	15.2	0.000	0.233	0.082	35.3	0.000	0.673	0.262	39.0	0.004	...			
Blue-winged Warbler	21	488	621	54	0.425	0.056	13.1	0.001	0.416	0.085	20.4	0.004	0.388	0.100	25.8	0.119	...			
Nashville Warbler	14	328	401	10	0.286	0.122	42.5	0.017	0.149	0.121	81.3	0.086	0.547	0.422	77.0	0.000	...			
Northern Parula	10	170	212	16	0.412	0.095	23.1	0.003	0.480	0.161	33.5	0.076	0.226	0.104	46.0	0.002	...			
Yellow Warbler	44	2235	3374	465	0.502	0.019	3.7	0.000	0.486	0.027	5.6	0.000	0.431	0.035	8.1	0.998	..t			
Chestnut-sided Warbler	22	796	1364	155	0.475	0.032	6.7	0.004	0.470	0.048	10.2	0.001	0.457	0.066	14.3	0.001	...			
Magnolia Warbler	16	691	1095	114	0.416	0.037	8.9	0.978	0.653	0.063	9.7	0.015	0.327	0.055	16.8	0.000	t..			
Black-throated Blue Warbler	12	203	291	36	0.517	0.072	13.8	0.000	0.470	0.099	21.0	0.000	0.395	0.116	29.3	0.000	...			
Yellow-rumped Warbler	19	440	629	71	0.459	0.046	10.1	0.004	0.432	0.070	16.3	0.004	0.443	0.095	21.4	0.002	...			
Black-throated Green Warbler	27	580	862	96	0.392	0.040	10.3	0.001	0.566	0.071	12.5	0.022	0.477	0.088	18.3	0.263	...	..t		
Blackburnian Warbler	7	69	83	6	0.511	0.166	32.6	0.000	0.110	0.114	103.5	0.000	0.884	0.919	104.0	0.000	...			
Pine Warbler	11	117	153	11	0.211	0.098	46.5	0.000	0.595	0.283	47.5	0.000	0.680	0.431	63.3	0.000	...			
Blackpoll Warbler	3	105	154	13	0.363	0.103	28.4	0.000	0.569	0.197	34.6	0.000	0.288	0.153	53.0	0.000	...			
Black-and-white Warbler	51	875	1198	135	0.495	0.034	6.9	0.052	0.328	0.044	13.5	0.958	0.525	0.085	16.2	0.173	.t.			
American Redstart	48	2620	3707	382	0.490	0.020	4.0	0.012	0.363	0.027	7.4	0.001	0.424	0.040	9.3	0.998	..t			
Worm-eating Warbler	16	633	874	84	0.540	0.043	8.0	0.000	0.311	0.052	16.8	0.004	0.403	0.082	20.3	0.003	...			
Ovenbird	79	2742	3938	505	0.558	0.017	3.1	0.004	0.418	0.024	5.6	0.005	0.364	0.028	7.8	0.617	..t	...		
Northern Waterthrush	7	118	156	14	0.463	0.103	22.2	0.000	0.508	0.163	32.2	0.000	0.259	0.125	48.1	0.000	...			
Louisiana Waterthrush	15	309	518	48	0.498	0.055	11.1	0.000	0.587	0.087	14.9	0.000	0.213	0.059	27.9	0.007	...			
Kentucky Warbler	5	78	113	16	0.565	0.097	17.1	0.000	0.489	0.136	27.8	0.000	0.282	0.125	44.3	0.000	...			
Mourning Warbler	3	83	132	8	0.583	0.134	23.0	0.000	0.099	0.067	67.8	0.000	0.839	0.578	68.9	0.000	...			
Common Yellowthroat	79	3730	6008	757	0.496	0.015	3.0	0.002	0.510	0.022	4.3	0.001	0.400	0.026	6.4	0.001	...			
Hooded Warbler	15	653	1094	127	0.414	0.034	8.2	0.070	0.661	0.059	8.9	0.002	0.382	0.060	15.8	0.070	...			
Canada Warbler	9	174	228	15	0.452	0.104	23.0	0.003	0.384	0.147	38.3	0.009	0.270	0.130	48.0	0.002	...			

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Yellow-breasted Chat	6	245	345	42	0.430	0.058	13.5	0.000	0.406	0.090	22.2	0.000	0.537	0.151	28.1	0.000	...			
Scarlet Tanager	56	465	528	25	0.523	0.079	15.2	0.001	0.075	0.044	58.7	0.011	0.781	0.464	59.3	0.002	...			
Eastern Towhee	55	787	1142	147	0.474	0.033	6.9	0.000	0.376	0.045	12.1	0.000	0.606	0.091	15.0	0.000	...			
Chipping Sparrow	34	395	527	45	0.394	0.058	14.8	0.000	0.367	0.090	24.6	0.000	0.530	0.154	29.0	0.000	...			
Field Sparrow	21	285	370	27	0.164	0.054	32.6	0.246	0.758	0.196	25.8	0.016	0.647	0.258	39.9	0.001	...			
Song Sparrow	57	2269	3866	386	0.386	0.020	5.1	0.737	0.567	0.036	6.3	0.292	0.479	0.044	9.2	0.298	t..	.tt		
Swamp Sparrow	11	249	418	52	0.413	0.052	12.7	1.000	0.630	0.092	14.6	0.000	0.421	0.105	24.9	0.000	t..			
White-throated Sparrow	21	772	1205	105	0.290	0.034	11.8	0.039	0.628	0.078	12.4	0.005	0.538	0.097	18.1	0.174	...			
Dark-eyed Junco	19	467	694	61	0.379	0.049	12.8	0.000	0.419	0.080	19.2	0.007	0.524	0.124	23.7	0.007	...			
Northern Cardinal	64	1540	2223	342	0.582	0.022	3.8	0.768	0.387	0.028	7.1	0.182	0.486	0.046	9.4	0.005	t..			
Rose-breasted Grosbeak	34	498	591	38	0.468	0.063	13.5	0.000	0.232	0.071	30.8	0.029	0.404	0.138	34.1	0.000	...			
Indigo Bunting	42	823	1133	112	0.409	0.037	9.1	0.177	0.514	0.063	12.2	0.041	0.373	0.064	17.2	0.001	...			
Red-winged Blackbird	31	805	916	54	0.513	0.055	10.7	0.257	0.297	0.067	22.5	0.691	0.237	0.063	26.5	0.000	.t.	t..		
Common Grackle	33	528	555	15	0.441	0.107	24.4	0.002	0.143	0.099	69.3	0.000	0.297	0.215	72.4	0.142	...			
Brown-headed Cowbird	45	257	303	23	0.326	0.085	26.2	0.001	0.420	0.156	37.1	0.000	0.487	0.227	46.6	0.004	...			
Orchard Oriole*	2	41	47	4	0.488	0.208	42.6	0.000	0.218	0.214	98.5	0.000	0.570	0.608	106.7	0.000	...			
Baltimore Oriole	37	466	579	37	0.435	0.065	14.9	0.017	0.373	0.095	25.5	0.047	0.274	0.086	31.5	0.007	...			
Purple Finch	11	159	201	17	0.294	0.094	32.1	0.828	0.327	0.172	52.5	0.062	0.824	0.493	59.8	0.009	t..			
American Goldfinch	72	3260	3717	184	0.397	0.030	7.6	0.033	0.176	0.030	17.2	0.134	0.537	0.096	17.9	0.305	...	..t		
Mean (76 species)	32	824	1202	134	0.470	0.071	15.8	0.089	0.378	0.090	31.7	0.072	0.468	0.185	37.6	0.064				
Mean (66 better-estimated sp.)[m]	35	926	1355	153	0.478	0.061	12.9	0.086	0.390	0.079	24.7	0.081	0.449	0.140	30.5	0.074				
SOUTHEAST MAPS REGION																				
Red-bellied Woodpecker	58	219	247	15	0.391	0.104	26.6	0.000	0.236	0.131	55.6	0.008	0.492	0.299	60.6	0.001	...			
Downy Woodpecker	75	560	661	56	0.585	0.052	9.0	0.000	0.306	0.061	19.9	0.000	0.256	0.063	24.5	0.007	...			
Hairy Woodpecker†	35	134	159	18	0.624	0.087	14.0	0.000	0.099	0.058	59.1	0.000	1.000	0.616	61.6	0.000	...			
Eastern Wood-Pewee	49	329	430	49	0.538	0.058	10.9	0.000	0.339	0.071	21.0	0.001	0.412	0.108	26.1	0.000	...			
Acadian Flycatcher	56	2433	3547	460	0.479	0.019	3.9	0.001	0.534	0.029	5.4	0.001	0.391	0.032	8.2	0.047	...			
Great Crested Flycatcher	44	304	336	18	0.595	0.091	15.3	0.000	0.104	0.059	57.1	0.001	0.471	0.279	59.4	0.002	...			
White-eyed Vireo	49	1344	2526	317	0.456	0.021	4.7	0.007	0.569	0.035	6.2	0.002	0.441	0.045	10.1	0.004	...			
Red-eyed Vireo	67	2884	3752	472	0.578	0.017	3.0	0.945	0.259	0.019	7.4	0.789	0.497	0.043	8.6	0.407	tt.	ttt	t..	
Blue Jay	66	435	482	34	0.595	0.065	10.9	0.001	0.113	0.049	43.1	0.007	0.552	0.249	45.1	0.269	...	..t		
Carolina Chickadee	81	898	1092	99	0.511	0.040	7.9	0.000	0.254	0.045	17.8	0.000	0.466	0.094	20.1	0.002	...			

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Tufted Titmouse	82	1400	1963	263	0.475	0.024	5.1	0.997	0.445	0.036	8.2	0.001	0.491	0.054	11.0	0.001	t..			
Carolina Wren	79	2246	3775	413	0.361	0.018	5.0	1.000	0.655	0.035	5.3	0.001	0.496	0.044	8.9	0.002	t..			
House Wren	4	82	114	6	0.453	0.152	33.6	0.000	0.232	0.159	68.5	0.000	0.321	0.249	77.6	0.000	...			
Blue-gray Gnatcatcher*	48	307	334	9	0.192	0.109	56.8	0.000	0.446	0.310	69.6	0.001	0.280	0.216	76.9	0.001	...			
Wood Thrush	65	3532	6361	689	0.432	0.014	3.3	0.073	0.571	0.024	4.3	0.028	0.409	0.028	6.9	0.028	...			
American Robin	21	653	704	25	0.456	0.079	17.4	0.002	0.097	0.056	58.1	0.377	0.561	0.333	59.3	0.001	...	.t.		
Gray Catbird	23	1235	1792	166	0.424	0.029	6.8	0.036	0.452	0.047	10.4	0.260	0.366	0.052	14.1	0.002	...	.t.		
Brown Thrasher	29	260	323	31	0.617	0.067	10.9	0.004	0.166	0.056	33.6	0.029	0.499	0.179	35.9	0.000	...			
Blue-winged Warbler	9	312	462	56	0.516	0.049	9.5	0.001	0.305	0.061	20.2	0.002	0.566	0.137	24.3	0.000	...			
Northern Parula	27	298	325	17	0.373	0.100	26.8	0.000	0.272	0.142	52.1	0.000	0.398	0.237	59.5	0.001	...			
Yellow Warbler	1	71	90	10	0.455	0.131	28.7	0.000	0.218	0.148	68.0	0.000	0.875	0.639	73.1	0.000	...			
Pine Warbler	30	185	199	5	0.425	0.196	46.2	0.000	0.230	0.215	93.3	0.000	0.185	0.194	104.9	0.000	...			
Prairie Warbler	24	641	908	95	0.459	0.042	9.0	0.018	0.392	0.058	14.8	0.018	0.456	0.085	18.7	0.001	...			
Black-and-white Warbler	20	228	280	23	0.554	0.086	15.4	0.000	0.188	0.075	40.1	0.000	0.543	0.237	43.8	0.000	...			
American Redstart	4	65	79	11	0.414	0.146	35.3	0.000	0.472	0.223	47.3	0.000	0.624	0.427	68.5	0.000	...			
Prothonotary Warbler	15	415	535	54	0.455	0.054	11.9	0.003	0.321	0.073	22.7	0.000	0.546	0.147	27.0	0.001	...			
Worm-eating Warbler	20	441	645	90	0.572	0.043	7.5	0.002	0.464	0.058	12.4	0.001	0.356	0.065	18.2	0.011	...			
Swainson's Warbler	7	97	156	15	0.595	0.106	17.7	0.002	0.308	0.114	37.1	0.001	0.377	0.176	46.6	0.000	...			
Ovenbird	50	2041	3053	368	0.507	0.020	3.9	0.028	0.459	0.029	6.4	0.073	0.386	0.036	9.2	0.017	...			
Louisiana Waterthrush	24	480	815	112	0.533	0.038	7.2	0.002	0.579	0.056	9.7	0.004	0.361	0.059	16.4	0.029	...			
Kentucky Warbler	41	1610	2997	454	0.494	0.019	3.7	0.000	0.616	0.028	4.6	0.004	0.467	0.038	8.2	0.003	...			
Common Yellowthroat	48	1958	3334	300	0.407	0.021	5.2	0.374	0.546	0.038	6.9	0.019	0.338	0.036	10.7	0.009	...	t..		
Hooded Warbler	36	923	1613	187	0.491	0.028	5.7	0.003	0.492	0.043	8.7	0.001	0.401	0.053	13.1	0.000	...			
Yellow-breasted Chat	31	792	1216	130	0.382	0.033	8.6	0.970	0.513	0.059	11.5	0.030	0.509	0.081	15.9	0.000	t..			
Summer Tanager	43	374	455	37	0.465	0.070	15.0	0.178	0.240	0.079	33.1	0.006	0.570	0.210	36.8	0.024	...			
Scarlet Tanager	44	346	396	26	0.542	0.075	13.8	0.000	0.133	0.059	44.5	0.000	0.534	0.249	46.7	0.000	...			
Eastern Towhee	55	427	620	85	0.475	0.044	9.3	0.000	0.443	0.065	14.6	0.007	0.543	0.105	19.4	0.000	...			
Bachman's Sparrow	6	79	140	13	0.470	0.126	26.8	0.000	0.490	0.179	36.6	0.000	0.425	0.213	50.0	0.000	...			
Chipping Sparrow*	8	75	85	4	0.600	0.215	35.8	0.000	0.181	0.171	94.5	0.000	0.260	0.275	105.7	0.000	...			
Field Sparrow	19	312	452	57	0.358	0.051	14.3	0.000	0.490	0.093	19.0	0.377	0.707	0.175	24.7	0.002	...	.t.		
Song Sparrow	3	228	350	33	0.348	0.061	17.5	0.245	0.540	0.122	22.5	0.090	0.394	0.127	32.2	0.001	...	t..		
Northern Cardinal	82	3379	5229	786	0.536	0.014	2.6	0.000	0.403	0.019	4.7	0.002	0.553	0.034	6.2	0.000	...			
Indigo Bunting	58	1891	2628	301	0.492	0.023	4.6	0.022	0.342	0.030	8.7	0.017	0.520	0.055	10.6	0.001	...			
Painted Bunting	2	90	133	24	0.688	0.078	11.4	0.000	0.390	0.096	24.7	0.000	0.329	0.116	35.3	0.000	...			

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Common Grackle†	19	688	711	12	0.236	0.115	48.9	0.001	0.057	0.112	195.7	0.001	1.000	1.998	199.8	0.000	...			
Brown-headed Cowbird	38	183	216	12	0.366	0.112	30.5	0.006	0.436	0.194	44.5	0.021	0.335	0.188	56.3	0.000	...			
American Goldfinch	29	1041	1188	76	0.488	0.046	9.4	0.002	0.147	0.039	26.6	0.000	0.572	0.160	27.9	0.003	...			
Mean (47 species)	37	828	1232	139	0.478	0.068	15.5	0.105	0.352	0.084	33.5	0.046	0.479	0.203	38.8	0.019				
Mean (39 better-estimated sp.)[m]	39	954	1436	166	0.491	0.053	10.9	0.126	0.369	0.065	23.2	0.055	0.475	0.138	27.5	0.022				
ALASKA AND BOREAL CANADA MAPS REGIONS																				
Western Wood-Pewee	2	84	110	12	0.429	0.122	28.4	0.000	0.667	0.188	28.2	0.000	0.323	0.165	51.1	0.000	...			
Traill's Flycatcher	15	597	840	53	0.375	0.049	13.0	0.000	0.542	0.092	17.0	0.000	0.234	0.059	25.4	0.000	...			
Gray Jay†	11	53	78	16	0.515	0.096	18.6	0.000	0.408	0.135	33.1	0.000	1.000	0.424	42.4	0.000	...			
Tree Swallow *†	1	77	91	6	0.212	0.142	67.0	0.000	0.327	0.334	102.0	0.000	1.000	1.145	114.5	0.000	...			
Black-capped Chickadee	12	269	414	44	0.400	0.055	13.8	0.063	0.395	0.088	22.3	0.170	0.713	0.196	27.5	0.005	...			
Boreal Chickadee	10	133	200	29	0.427	0.071	16.5	0.003	0.354	0.104	29.3	0.005	0.903	0.315	34.9	0.000	...			
Arctic Warbler	2	259	481	52	0.323	0.050	15.5	0.001	0.632	0.103	16.3	0.000	0.648	0.163	25.2	0.000	...			
Gray-cheeked Thrush	6	253	539	74	0.441	0.044	10.0	0.000	0.706	0.072	10.1	0.000	0.527	0.108	20.4	0.000	...			
Swainson's Thrush	17	926	1526	219	0.452	0.027	5.9	0.006	0.611	0.043	7.0	0.017	0.484	0.057	11.7	0.029	...			
Hermit Thrush	10	648	1391	191	0.485	0.028	5.7	0.119	0.777	0.040	5.1	0.001	0.342	0.047	13.8	0.001	...			
American Robin†	16	395	472	29	0.296	0.070	23.7	0.002	0.196	0.097	49.5	0.000	1.000	0.520	52.0	0.000	...			
Varied Thrush *†	10	115	136	5	0.211	0.157	74.5	0.000	0.210	0.296	140.9	0.000	1.000	1.479	147.9	0.000	...			
Orange-crowned Warbler	16	1377	2123	193	0.391	0.026	6.7	0.003	0.534	0.047	8.8	0.007	0.374	0.049	13.1	0.000	...			
Yellow Warbler	11	1180	1857	162	0.409	0.029	7.1	0.011	0.505	0.050	9.9	0.001	0.383	0.054	14.2	0.001	...			
Yellow-rumped Warbler	18	772	1001	83	0.372	0.042	11.4	0.000	0.428	0.072	16.9	0.001	0.450	0.096	21.4	0.001	...			
Townsend's Warbler*	4	159	199	8	0.196	0.111	56.5	0.000	0.432	0.308	71.3	0.000	0.492	0.385	78.2	0.000	...			
Blackpoll Warbler	6	121	188	17	0.292	0.083	28.4	0.000	0.810	0.166	20.5	0.000	0.404	0.178	44.0	0.000	...			
American Redstart	4	460	679	89	0.534	0.043	8.1	0.048	0.337	0.053	15.8	0.952	0.561	0.108	19.3	0.000	.t.			
Ovenbird	3	189	258	18	0.373	0.101	27.0	0.000	0.530	0.172	32.5	0.000	0.329	0.145	44.0	0.000	...			
Northern Waterthrush	10	277	463	59	0.507	0.052	10.2	0.000	0.714	0.074	10.4	0.000	0.280	0.065	23.3	0.000	...			
Mourning Warbler	3	93	142	19	0.386	0.090	23.3	0.000	0.520	0.157	30.3	0.000	0.628	0.260	41.4	0.000	...			
Wilson's Warbler	15	2919	4758	350	0.343	0.018	5.3	0.013	0.598	0.038	6.3	0.699	0.297	0.030	10.1	0.198	.t.			
Canada Warbler	3	243	435	60	0.462	0.052	11.3	0.000	0.493	0.080	16.3	0.000	0.574	0.130	22.7	0.001	...			
American Tree Sparrow	7	203	338	35	0.457	0.062	13.7	0.000	0.552	0.103	18.7	0.000	0.335	0.103	30.6	0.000	...			
Chipping Sparrow	5	68	100	9	0.306	0.119	39.1	0.000	0.401	0.228	56.8	0.000	0.769	0.505	65.6	0.000	...			
Savannah Sparrow	6	130	166	12	0.294	0.111	37.6	0.000	0.738	0.218	29.5	0.000	0.340	0.188	55.3	0.000	...			

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_i)$[i]	p	SE(p)	CV(p)	$w(p_i)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_i)$[i]	1	2	3	4
Fox Sparrow	13	411	664	84	0.507	0.042	8.2	0.007	0.576	0.064	11.1	0.004	0.352	0.068	19.3	0.119	...			
Lincoln's Sparrow	12	323	579	30	0.396	0.064	16.1	0.000	0.320	0.091	28.3	0.000	0.383	0.133	34.7	0.000	...			
White-throated Sparrow	4	318	492	38	0.472	0.064	13.5	0.029	0.252	0.067	26.5	0.001	0.491	0.148	30.2	0.001	...			
White-crowned Sparrow	13	649	1079	119	0.405	0.034	8.3	0.010	0.425	0.055	13.0	0.118	0.679	0.113	16.6	0.000	...			
Golden-crowned Sparrow	5	281	539	76	0.494	0.042	8.5	0.000	0.529	0.066	12.5	0.007	0.521	0.106	20.4	0.000	...			
Dark-eyed Junco	15	654	1142	113	0.301	0.032	10.6	0.000	0.634	0.072	11.3	0.000	0.694	0.118	17.0	0.000	...			
Pine Grosbeak	6	74	94	8	0.455	0.150	33.0	0.000	0.400	0.219	54.8	0.000	0.414	0.300	72.4	0.000	...			
Common Redpoll	14	1631	2035	18	0.369	0.090	24.5	0.000	0.027	0.019	67.8	0.000	0.780	0.489	62.8	0.000	...			
Mean (34 species)	9	481	753	69	0.391	0.070	20.6	0.009	0.488	0.118	30.3	0.058	0.550	0.249	38.9	0.010				
Mean (26 better-estimated sp.)[m]	9	587	934	86	0.415	0.054	13.5	0.012	0.518	0.084	18.9	0.076	0.488	0.135	26.7	0.014				

[a] Using the computer program TMSURVIV (Hines et al. 2003), a modification of SURVIV (White 1983) to accommodate transient models.

[b] These models, developed by Pradel et. al (1997), modified by Nott and DeSante (2002), and fully formulated by Hines et al. (2003), include both between- and within-year information on transients and permit the estimation of three parameters: apparent survival probability (φ), recapture probability (p), and proportion of residents among those newly-banded adults that were not recaptured at least seven days later during their first year of capture (τ). In the fully time-constant model, each of these three parameters is constrained to be constant over all years.

[c] Species included are those for which (a) an average of at least 2.5 individual adult birds were captured per year over the 15 years, 1992-2006 (38 year-unique records), (b) at least two returns were recorded during the 15 years from all stations pooled, and (c) survival and recapture probabilities were neither 1.000 nor 0.000. Data for any given species were only included from stations where the species was a usual breeder and summer resident (i.e., attempted to breed during more than half of the years that the station was operated).

[d] Number of super-stations that were operated for a least four consecutive years during the 15-yr period, 1992-2006, at which (a) at least one adult individual of the species was captured and (b) the species was a usual breeder. A super-station includes all stations within one km of each other.

[e] Total number of individual adult birds captured during the 15 years, 1992-2006, at stations where the species was a usual breeder; thus the number of capture histories upon which the estimates of survival probability, recapture probability, and proportion of residents were based.

[f] Total number of captures of adults of the species during the 15 years, 1992-2006, at stations where the species was a usual breeder

[g] Total number of returns during the 15 years, 1992-2006, at stations where the species was a usual breeder. A return is defined as the first capture of an individual adult birds in any year other than the year during which it was initially banded.

[h] Defined as the probability of an adult bird surviving to and returning in a particular year (breeding season) to the area where it was present in the previous year (breeding season). The estimated probability (φ), standard error of the estimate (SE(φ)), and coefficient of variation (CV(φ)=100*SE(φ)/φ) are presented.

[i] The amount of support for time-dependence for each of the three parameters is provided by summing the w_i for all models in which time dependence of the parameter of interest occurred (w_i; Burnham and Anderson 1998). w_i={exp(-ΔQAIC$_c$/2)}/Σ{exp(-ΔQAIC$_c$/2)} where QAIC$_c$ is the Akaike Information Criterion for model i, modified for small sample sizes and overdispersion of data, and ΔQAIC$_c$ is the difference between the QAIC$_c$ of model i and the model with the lowest QAIC$_c$. Values of $w_i > 0.50$ indicate strong support for time dependence in the parameter, while $0.5>w_i>0.25$ suggest some support for time dependence in the parameter. Despite substantial support for time-dependence in one or more parameters, all parameter estimates presented in this table are for the time-constant model.

TABLE 4. Continued.

Species[c]	No. stn.[d]	No. indv.[e]	No. capt.[f]	No. btwn. year recap.[g]	Survival probability[h]				Recapture probability[j]				Proportion of residents[k]				Models selected[l]			
					φ	SE(φ)	CV(φ)	$w(\varphi_t)$[i]	p	SE(p)	CV(p)	$w(p_t)$[i]	τ	SE(τ)	CV(τ)	$w(\tau_t)$[i]	1	2	3	4

[j] Defined as the conditional probability of recapturing an adult bird at least once in a particular year (breeding season), given that it did survive and return to the area where it was present in the previous year (breeding season). The estimated probability (p), standard error of the estimate (SE(p)), and coefficient of variation (CV(p)) are presented.

[k] The estimated proportion of residents among those newly-banded adults that were not recaptured seven or more days later during their first year of capture. The estimated proportion (τ), standard error of the estimate (SE(τ)), and coefficient of variation (CV(τ)) are presented.

[l] Models involving time dependence were selected according to modified Akaike's Information Criterion ($QAIC_C$), with the selected model (Model 1) being the one with the lowest $QAIC_C$. All equivalent models (models with a $QAIC_C$ within 2.0 units of the selected model) are shown and listed in order (Models 2-4) of increasing $QAIC_C$. Despite time-dependence in one or more parameters (e.g., φ_t) being selected for a number of species, all parameter estimates presented in this summary are for the time-constant model. Models are designated as follows: ...=$\varphi p \tau$; t..=$\varphi_t p \tau$; .t.=$\varphi p_t \tau$; ..t=$\varphi p \tau_t$; tt.=$\varphi_t p_t \tau$; t.t=$\varphi_t p \tau_t$; .tt=$\varphi p_t \tau_t$; ttt=$\varphi_t p_t \tau_t$, where φ is the survival probability, p is the recapture probability, and τ is the proportion of residents among those newly-captured adults that were not recaptured seven or more days later during their first year of capture.

[m] Better-estimated species are those for which CV(φ) < 30.0% and φ is not qualified by the use of * or †.

* The estimate for survival probability should be viewed with caution because it is based on fewer than five between-year recaptures or the estimate is very imprecise (SE(φ) ≥ 0.200 or CV(φ) ≥ 50.0%)

† The estimate for survival probability, recapture probability, or both may be biased low because the estimate for τ was 1.00.

TABLE 5. Comparison of numbers of stations contributing data to survivorship analyses, numbers of species for which survivorship could be estimated, and precision of the survivorship estimates using data from 12 years, 1992-2003, and 15 years, 1992-2006.

	No. stations		No. species		Mean CV(φ)		Number (proportion) of species with CV(φ)<30%		CV(φ)<20%		CV(φ)<10%	
Region	12-YR	15-YR	12-YR	15-YR	12-YR	15-YR	12-YR	15-YR	12-YR	15-YR	12-YR	15-YR
PROGRAM-WIDE	550	653	183	192	15.0%	13.8%	162 (0.885)	174 (0.906)	140 (0.761)	151 (0.786)	86 (0.467)	98 (0.510)
NORTHWEST	151	174	80	85	15.3%	13.5%	70 (0.875)	74 (0.871)	61 (0.753)	67 (0.788)	42 (0.519)	48 (0.565)
SOUTHWEST	83	98	86	91	23.7%	21.3%	64 (0.744)	74 (0.813)	50 (0.581)	57 (0.626)	25 (0.291)	30 (0.330)
NORTH-CENTRAL	44	58	54	62	20.4%	18.9%	43 (0.796)	50 (0.806)	33 (0.611)	38 (0.613)	15 (0.278)	22 (0.355)
SOUTH-CENTRAL	71	84	62	63	20.6%	18.6%	53 (0.855)	55 (0.873)	36 (0.581)	41 (0.651)	17 (0.274)	20 (0.317)
NORTHEAST	91	119	75	76	18.3%	15.8%	62 (0.827)	68 (0.895)	48 (0.640)	52 (0.684)	20 (0.267)	26 (0.342)
SOUTHEAST	79	89	45	47	16.8%	15.5%	36 (0.800)	40 (0.851)	31 (0.689)	36 (0.766)	16 (0.356)	22 (0.468)
ALASKA/BOREAL CANADA	31	31	34	34	21.4%	20.6%	27 (0.794)	28 (0.824)	22 (0.647)	22 (0.647)	9 (0.265)	9 (0.265)
Mean of regions	79	93	62	65	19.5%	17.7%	51 (0.814)	56 (0.849)	40 (0.643)	45 (0.683)	21 (0.321)	25 (0.386)

proportions of species over the seven regions having CV(φ) < 30%, < 20%, and < 10% also increased with 15 years (by 4%, 6%, and 20%, respectively; Table 5). The analogous program-wide increases in the proportions of species were 2%, 3%, and 9%.

Mean regional survival probabilities for all species in each region (Table 4) ranged from 0.391 (Alaska/Boreal Canada) to 0.496 (Southwest) and averaged 0.471±0.036 for the seven regions; the mean program-wide survival probability was 0.488. Mean regional recapture probabilities ranged from 0.327 (Northwest) and 0.328 (Southwest) to 0.488 (Alaska/Boreal Canada) and averaged 0.365±0.057; the mean program-wide recapture probability was 0.334. Mean regional proportions of residents among newly-captured adults ranged from 0.468 (Northeast) to 0.550 (Alaska/Boreal Canada) and averaged 0.513±0.030; the mean program-wide proportion of residents was 0.492.

As in previous years, mean regional survival and recapture probabilities increased and mean regional proportions of residents decreased when consideration was limited in each region to species for which survival was "better estimated" (see Methods). This pattern held for each of the three parameters in each of the seven regions and program-wide except for mean survival in the South-central Region which was slightly higher for all species (0.491) than for better-estimated species (0.488). When consideration was limited to the better-estimated species, mean regional survival probabilities ranged from 0.415 (Alaska/Boreal Canada) to 0.516 (Southwest) and averaged 0.483±0.032 for the seven regions; the mean program-wide survival probability for better-estimated species was 0.489. Mean regional recapture probabilities ranged from 0.353 (South-central) to 0.518 (Alaska/Boreal Canada) and averaged 0.393±0.057; the mean program-wide recapture probability for better-estimated species was 0.352. Mean regional proportions of residents among newly-captured adults ranged from 0.444 (Southwest) to 0.516 (South-central) and averaged 0.475±0.024; the mean program-wide proportion of residents for better-estimated species was 0.456.

Again, as in previous years, mean regional survival rates for all species were higher in the three southern regions (Southwest: 0.496±0.095; South-central: 0.491±0.088; Southeast: 0.478±0.068) than in the three northern regions (Northwest: 0.486±0.061; North-central: 0.488±0.090; Northeast: 0.470±0.071), respectively, and were lowest in the far northern Alaska/Boreal Canada region (0.391±0.070). In addition, except for unexpectedly high mean survival in the North-central Region, mean regional survival rates for all species tended to be higher in the two western regions, lower in the two central regions, and lowest in the two eastern regions. In contrast, mean regional recapture probabilities for all species tended to show the opposite pattern with respect to both latitude and longitude, being generally lower in the three more southerly than the three more northerly regions and highest in Alaska/Boreal Canada; and higher in the two eastern regions, lower in the two central regions, and lowest in the two western regions. Mean regional proportions of residents among newly captured adults for all species showed a geographic pattern quite similar to that for survival rate (i.e., generally higher in more southerly and westerly regions), except that the highest mean proportion of residents occurred in the Alaska/Boreal Canada Region.

In general, mean regional survival probabilities from the 15-yr data set were lower than those from the 12-yr data set, both for all species (by an average of -0.004) and for better-estimated species (by an average of -0.006). The only exceptions to this pattern were the Northwest for all species (15-yr higher than 12-yr by +0.002) and, especially, the North-central Region (15-yr higher than 12-yr by +0.024 for all species and by +0.015 for better-estimated species). To control for potential differences in the species being compared, we ran matched-pairs *t*-tests between survival estimates from the 15- and 12-yr data sets for those species-region and species-program wide combinations for which survival for the species was estimated with CV(φ) < 30% for both sets of data. We found that regional survival estimates were lower for the 15- than the 12-yr data set for six of the seven regions (all but North-central; $P = 0.055$, binomial test), significantly so (by 0.013) for the Southwest ($t = 2.21$, $n = 63$, $P = 0.031$), and that the mean difference in regional survival estimates for the two time periods was a decrease of -0.006. We also found that survival estimates tended to be lower by -0.003 for 15 than for 12 years of data for the 160 species-program wide combinations,

but this difference was not significant.

For each species in each region, we also modeled all possible combinations of time dependence in the three parameters, φ, p, τ. The selected model (lowest $QAIC_c$) and up to four equivalent models ($QAIC_c$ within 2.0 $QAIC_c$ units of the selected model) are presented for each species in each region (Table 4). We detected time-dependence in at least one parameter (by having a time-dependent model that was at least an equivalent model) for 97 (21.2%) of the 458 species-region combinations and for 54 (28.1%) of the 192 species program-wide (Table 6). We found that time-dependence in at least one parameter was the selected model ($QAIC_c$ at least 2.0 $QAIC_c$ units lower than the $QAIC_c$ of the fully time-independent model) for 74 (16.2%) of the 458 species-region combinations and for 35 (18.2%) of the 192 species program-wide. Time dependence in survival rate was detected for 47 (10.3%) of the 458 species-region combinations and for 29 (15.1%) of the 192 species program-wide, and was found to be the selected model for 35 (7.6%) of the species-region combinations and for 18 (9.4%) of the 192 species program-wide (Table 6). In general, compared to the 12-yr data set in either survival or any parameter, proportions of species in the 15-yr data set for which time dependence was detected were slightly *lower*, but proportions of species for which time dependence was the selected model were somewhat *higher* (Table 6 in this report versus Table 5 in DeSante and Kaschube 2007).

Finally, we examined all nine combinations of time-constant, time-dependent, and linear trend models for program-wide survival (φ) and recapture (p) probabilities for all species pooled. The selected model, which had nearly 100% of the $QAIC_c$ weight (w_i), was the one whereby both survival and recapture probabilities varied with time (Fig. 3c; note that survival probability from 2005-2006 and recapture probability in 2006 are confounded in the fully time-dependent model, so only 13 survival estimates were available over the 15-yr period). Although we found virtually no statistical support for linear compared to the more general time-varying models, the estimated slope for the best linear trend model was significantly negative (Beta = -0.016, $P < 0.05$), with an annual decline in survival of -0.19%. A negative trend ($P = 0.080$) was also supported by a regression fit to annual survival estimates derived from the best time-varying model, indicating an annual decline in survival of -0.46%. Of further interest was that 9 of 12 ($P = 0.054$; binomial test) annual changes in survival rate (Fig.3c) were associated with annual changes in productivity of the same sign (Fig. 3b). Despite this nearly significant proportion of annual changes in adult survival and productivity being in the same direction, the positive correlation between annual survival from years t to t+1 and reproductive index in year t+1 was not significant (Fig. 4; $r = +0.31$, $P = 0.30$).

DISCUSSION

A mean of 448 MAPS stations were operated during the four years 2003-2006, a decrease of 8.9% from the mean of 492 stations operated during the preceding four years 1999-2002, while mean year-to-year continuity of station operation decreased from 91.3% during 1999-2002 to 84.4% during 2003-2006. The 13.3% decrease in total stations between the high of 505 stations in 2002 and 438 stations in 2006 was comprised of a 21.5% decrease (158 to 124) in IBP-operated stations and a 9.5% decrease (347 to 314) in independently operated stations. These decreases, which have apparently been caused by the difficulty of securing funding for the continued operation of long-term monitoring stations, are troubling, and strategies to address this problem need to be developed. Hopefully, on-going efforts to implement plans for Coordinated Bird Monitoring will help alleviate this problem. Although coverage of North America north of Mexico during 2003 through 2006 continued to be widespread, there still were gaps, most notably in the Great Plains, Great Basin, southwest deserts, Alaska, and most of Canada.

PATTERNS OF POPULATION SIZE AND PRODUCTIVITY

Changes in adult population size between 2003 and 2004 for all species pooled and for many individual species were relatively small and mixed across the continent with non-significant decreases at the program-wide scale and in the two eastern and two central regions, non-significant increases in the two western regions, and a significant decrease in the Alaska/Boreal

TABLE 6. Number (proportion) of species in each region for which time-dependence in survival rate, φ_t, or time-dependence in any parameter, φ_t, ρ_t, or τ_t was detected using modified Cormack-Jolly-Seber mark-recapture analyses from 15 years (1992-2006) of MAPS data.

	Number (proportion) of species								
Model	Program-wide	Northwest	Southwest	North-central	South-central	Northeast	Southeast	Ak/Bor.Can.	All regions
φ_t selected[a]	18 (0.094)	12 (0.141)	7 (0.077)	4 (0.065)	2 (0.032)	6 (0.079)	4 (0.085)	0 (0.000)	35 (0.076)
φ_t equivalent[b]	11 (0.057)	2 (0.024)	3 (0.033)	0 (0.000)	2 (0.032)	1 (0.013)	2 (0.043)	0 (0.000)	12 (0.026)
φ_t detected[c]	29 (0.151)	14 (0.165)	10 (0.110)	4 (0.065)	4 (0.063)	7 (0.092)	6 (0.128)	0 (0.000)	47 (0.103)
φ_t time-independent[d]	163 (0.849)	71 (0.835)	81 (0.890)	58 (0.935)	59 (0.937)	69 (0.908)	41 (0.872)	34 (1.000)	411 (0.897)
Total	192	85	91	62	63	76	47	34	458
φ_t, ρ_t, or τ_t selected[e]	35 (0.182)	20 (0.235)	19 (0.209)	8 (0.129)	7 (0.111)	14 (0.184)	4 (0.085)	2 (0.059)	74 (0.162)
φ_t, ρ_t, or τ_t equivalent[e]	19 (0.099)	5 (0.059)	4 (0.044)	2 (0.032)	3 (0.048)	3 (0.039)	6 (0.128)	0 (0.000)	23 (0.050)
φ_t, ρ_t, or τ_t detected[e]	54 (0.281)	25 (0.294)	23 (0.253)	10 (0.161)	10 (0.159)	17 (0.224)	10 (0.213)	2 (0.059)	97 (0.212)
φ, ρ, and τ each time-independent[e]	128 (0.719)	60 (0.706)	68 (0.747)	52 (0.839)	53 (0.841)	59 (0.776)	37 (0.787)	32 (0.941)	361 (0.788)
Total	192	85	91	62	63	76	47	34	458

[a] One or more models with time-dependent survival had $QAIC_C$ more than 2.0 units lower than all models with time-independent survival.

[b] One or more models with time-dependent survival had $QAIC_C$ within 2.0 units of the time-independent survival model with the lowest $QAIC_C$.

[c] All models that fulfilled either of the above two conditions.

[d] All time-dependent survival models had $QAIC_C$ more than 2.0 units higher than the model with the lowest $QAIC_C$.

[e] Same as corresponding criteria above but applied to any parameter, φ_t, ρ_t, or τ_t.

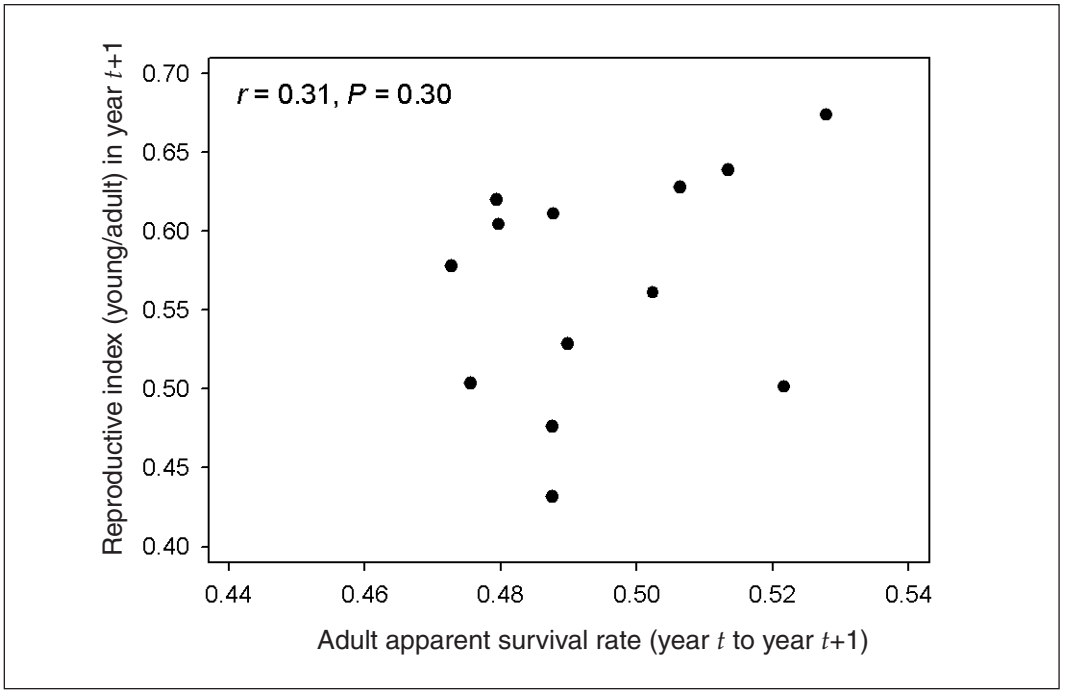

FIGURE 4. Scatterplot of the correlation between program-wide productivity in year t+1 and annual adult apparent survival rate from year t to year t+1 for all species pooled.

Canada Region. Changes in productivity between 2003 and 2004 for all species pooled and for many individual species were also generally rather small and mixed across the continent, but showed a different pattern, with substantial and significant increases in the two eastern regions, a non-significant increase program-wide and in the Northwest, and non-significant decreases in the remaining four regions.

Significant but relatively modest decreases in adult population size between 2004 and 2005 were recorded for all species pooled and for many individual species at the program-wide scale and in the Northwest and South-central regions, but were likely not driven by the small and non-significant changes in productivity in those areas the year before, because two of those three productivity changes were increases. Changes in adult population size between 2004 and 2005 for all species pooled in the remaining five regions were small, non-significant, and mixed, with increases in the two eastern regions (following significant increases in productivity the year before) and in the Alaska/Boreal Canada Region, and decreases in the Southwest and North-central regions (following small and non-significant decreases in productivity the year before). Regional changes in productivity between 2004 and 2005 were again mixed across the continent and were opposite in sign to the changes between 2003 and 2004 for all but the South-central region, where productivity declined non-significantly for the third consecutive year. The substantial decrease in productivity in the Southeast was highly significant while the decrease in the Northeast and increases in the Southwest and North-central regions were nearly significant. Program-wide, productivity showed a slight, non-significant increase.

Regional changes in adult population size between 2005 and 2006 were in the same direction as those between 2004 and 2005 for all but the North-central and Alaska/Boreal Canada regions, but generally tended to be more positive (or less negative) so that the program-wide decrease was very slight and non-significant. This makes four consecutive annual program-wide declines in adult population size for all species pooled, two of which (2002-2003 and 2004-2005)

have been significant. Regional changes in productivity between 2005 and 2006 were again mixed across the continent and were opposite in sign to the changes between 2004 and 2005 for four of the seven regions and at the program-wide scale. The changes in productivity between 2005 and 2006 were more negative (or less positive) than those between 2004 and 2005 program-wide and for all but the two eastern regions, where increases in 2006 contrasted with decreases during 2005. The only significant change in productivity between 2005 and 2006, however, was in the Southwest where a significant 39.2% decrease in 2006 contrasted with a nearly significant increase of 43.9% in 2005.

A general out-of phase pattern of changes in productivity and adult population size has been noted before in the MAPS dataset (e.g., DeSante and Kaschube 2006, DeSante and Kaschube 2007). At the program-wide scale, for example, 8 of 10 annual changes in productivity during 1992 to 2003 were followed by changes in adult population size of the same sign ($P = 0.055$, binomial test). This pattern tended to be less evident during the period 2004 to 2006, and only persisted strongly in the South-central Region, where 11 of 13 annual changes in productivity during 1992 to 2006 were followed by changes in adult population size of the same sign ($P = 0.011$, binomial test). Analogous 15-yr results for the other regions are: Northwest, 9 of 13 ($P = 0.133$); Northeast, Southeast, Alaska/Boreal Canada, and program-wide, each 8 of 13 ($P = 0.291$); and Southwest and North-central, both 7 of 13 ($P = 0.538$). We believe that the weakening in this pattern was caused, at least in part, by the fact that annual changes in both productivity and adult population size during those latter three years were relatively small. Indeed, for all species pooled, only four of the 21 regional annual changes in productivity and six of the 21 changes in adult population size recorded during those three years were significant. These results illustrate that while there is a tendency for changes in productivity to be followed the next year by changes in adult population size of the same sign, other factors in addition to productivity, presumably survival of both young and adults, also play important roles in driving annual changes in adult population size.

Finally, we note from 15 years of data that the directions of annual changes in both adult population size and productivity tended to be the same for the Northwest and Southwest regions (10 of 14 for each parameter, $P = 0.090$) and for the Northeast and Southeast regions (12 of 14 for adult population size, $P = 0.007$, and 8 of 14 for productivity), but not for the North-central and South-central regions (7 of 14 for adult population size and 4 of 14 for productivity). Instead, the direction of annual changes in both parameters for the North-central Region tended to be more similar to those in the Northeast and Southeast regions (11 of 14 for adult population size for each region, $P = 0.028$), while the direction of annual changes in both parameters for the South-central Region tended to be more similar to the Northwest (10 of 14 for adult population size, $P = 0.090$) and Southwest regions. We also note that the direction of annual changes in adult population size and productivity in the Alaska/Boreal Canada Region did not closely match those in any of the other three northern regions. In general, the similarities in directions of annual changes between regions were greater for changes in adult population size than productivity. These results suggest that annual environmental factors (presumably weather) that affect landbird populations differ substantially between the western, eastern, and far northern parts of the continent, and that those in the north-central portion are more similar to those in the East, while those in the south-central portion are more similar to those in the West.

SURVIVAL-RATE ESTIMATES

Increasing the number of years of data from 12 to 15 provided the following increases: (1) the mean number of stations per region operated for at least four consecutive years (the minimum number of years necessary to be included in survivorship analyses using a transient model) increased by an average of 17.7% (79 to 93 stations); (2) the mean number of years per region over which stations were operated increased by 7.0% (7.70 to 8.24 years); and (3) the mean number of species per region that met selection criteria for survivorship analyses increased by an average of 4.9% (62 to 65 species). In contrast, however, mean adult captures per individual per species per region in the 15-yr data set (1.37) remained virtually the same as in the 12-yr data set (1.38), as did mean

returns per individual adult per species per region (0.135 in each data set). The increase in the length of the study and in the number of stations available for survivorship analyses (thus producing an increase in the total number of capture histories and the average number of years over which they were captured) resulted in a continued increase in the precision of the time-constant parameter estimates obtained from the mark-recapture analyses. Indeed, compared to the 12-yr data set, the mean number of species per region in the 15-yr data set with CV(φ) < 30%, < 20%, and < 10% increased by 10% (from 51 to 56 species), 13% (from 40 to 46 species), and 19% (from 21 to 25 species), respectively. These results suggest that the precision of time-constant estimates of survival might continue to increase throughout the life of the program.

Again, as in previous years, a pattern of survivorship was detected in which mean regional annual adult survival probabilities tended to be lower at more northerly regions. This may be a result of the longer migration routes of more northerly nesting migratory species and the more severe winter weather faced by more northerly nesting permanent residents. Mean regional annual adult survival probabilities also tended to be lower in each of the seven regions for the 15-yr than for the 12-yr data set, thus continuing the pattern noted in previous reports in which mean regional survival rates tended to be lower for 12-yr than 10-yr, 10-yr than 7-yr, and 7-yr than 5-yr data sets. The resulting conclusion that survival rates tend to be decreasing was confirmed, at least for all species pooled at the program-wide scale, by modeling survival both as year-dependent and as a linear function of year.

PROGRAM-WIDE, ALL-SPECIES-POOLED TRENDS IN POPULATION SIZE AND VITAL RATES

Chain indices of adult population size for all species pooled at the program-wide scale (Fig. 3a) have shown a severe and highly significant decline of -1.77% yr^{-1} over the 15 years 1992-2006, resulting in a total decrease in population size of 22%. It is important to note that vital rates (productivity and survival) do not need to be declining to result in a population decline. All that is needed is for productivity to be too low to balance mortality (or, stated alternatively, for survival to be too low to maintain a stable population in the face of a given productivity rate). Program-wide results for all species pooled, however, suggest that adult survival actually declined by -0.46% yr^{-1} over the 15 years (Fig. 3c) and that productivity also tended to decline by -0.25% yr^{-1} (Fig. 3b). These decreasing vital rates may well increase the difficulty of reversing population declines in these species, and suggest an urgent need to prioritize efforts to reverse the decreases in survival rates.

It is also interesting that annual changes in survival rate (measured from breeding season to breeding season) between pairs of years (t-1 to t) and (t to t+1) tended to have the same sign as annual changes in productivity between year t and t+1, despite the fact that the positive correlation between survival from years t to t+1 and productivity in year t+1 was not significant. It seems likely that variations in annual survival may be driven by weather and habitat conditions on the wintering grounds (especially in late winter when food resources may be at a minimum), even in those situations for migratory species in which most mortality occurs during migration (Sillett and Holmes 2002). If so, then the tendency for annual changes in survival to have the same sign as the subsequent annual changes in productivity suggests that the same factors that drive annual variation in survival might also drive some of the annual variation in productivity, and that these factors may act during the non-breeding season. This is consistent with analyses of MAPS data that showed that annual variations in productivity of Nearctic-Neotropical migratory species breeding in the Pacific Northwest are driven by late-winter/early-spring weather conditions on their wintering grounds (Nott et al. 2002). These considerations further reinforce the pressing need to understand the effects of winter habitat, weather, and climate on the vital rates of landbirds, especially those wintering in the Neotropics.

We point out that the results presented in Figs. 3a and 3b derive from the analysis of > 849,000 captures of > 662,000 aged individuals, while the results presented in Fig. 3c derive from the modeling of > 406,000 individual adult capture histories. We hasten to add, however, that these results are based on pooling data from all species over all regions and, thus, likely obscure the

many important spatial and life-history-related patterns in vital rates that are suggested in the species- and region-specific results (Tables 1-4). These patterns presumably arise in response to such factors as body mass, migration strategy, nest location, and foraging behavior. Moreover the vital rates of these many different species are likely to be affected differently by various weather and habitat conditions, which in turn vary greatly over the different regions of the continent, within each of which the pool of species itself tends to differ. Considering all these sources of heterogeneity when data from all these species are pooled over the entire continent, it is remarkable that such a consistent pattern of results emerges.

RECENT RESULTS AND CURRENT DIRECTIONS RELATED TO RESEARCH AND MANAGEMENT GOALS OF MAPS

One of the major goals of MAPS is to determine the proximate demographic cause(s) of population trends, i.e., to determine whether population trends are driven by processes affecting productivity or by processes affecting survival. In our previous MAPS report (DeSante and Kaschube 2007) we described work by Saracco et al. (2008) on Yellow Warblers that showed that spatial variation in MAPS population trends in this species could largely be explained by spatial variation in adult and first-year survival, rather than by spatial variation in productivity. This inference was further supported for this species by a spatial comparison of BBS estimates of population trends for 15 BBS Physiographic Strata and MAPS productivity indices and survival-rate estimates.

Saracco and DeSante (2008) recently expanded this work and examined the importance of productivity, recruitment, and adult apparent survival in driving spatial variation at the scale of Bird Conservation Regions in 12-yr (1992-2003) MAPS population trends for 28 species of Nearctic-Neotropical migratory landbirds. They assessed MAPS population trends (*lambda*) and adult survival and recruitment rates using reverse-time and "transient" Cormack-Jolly-Seber mark-recapture models, and indexed productivity by the ratio of young to adult birds in MAPS constant-effort data. They found that productivity had strong effects on recruitment and *lambda* for only 9 species, while recruitment had strong effects on *lambda* for 25 species, thereby implicating first-year survival as the driver for at least 16 species. They also found that adult survival had a strong effect on *lambda* for 10 species. Species for which first-year survival was important in explaining spatial variation in trends tended to have declining populations, those for which adult survival was important tended to have stable populations, and those for which productivity was important tended to have stable or increasing populations. These results suggest that: (1) enhancing survival (especially of first-year birds) will be important for slowing declines and stabilizing populations, (2) enhancing productivity may be necessary to recover populations whose declines have been arrested, and (3) identifying relationships between vital rates and winter habitat and weather will likely be critical for migratory bird conservation.

We have also begun to model responses of these vital rates to weather and habitat characteristics in order to make inferences regarding ultimate causes of population trends and to inform management actions and strategies for reversing declines and maintaining stable or increasing populations (Nott et al. 2003, 2005). Our initial work in this regard suggests that recent population trends in some species appear to be driven by systematic changes in weather likely caused by climate change, and that the changes in weather that are driving these population trends may be acting variously on the breeding grounds, wintering grounds, or molt-migration grounds of particular species. These results have important implications, not only for the development of management and conservation efforts to reverse landbird population declines, but also for efforts to devise adaptation and mitigation strategies for climate change.

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APPENDIX. Summary of 39 MAPS stations newly established in 2004, 41 stations newly established in 2005, 37 stations newly established in 2006, and one station established prior to 2004 but not previously summarized in a MAPS annual report. Only stations for which data has been received from the operator are included.

Stn. no.	Station name	Operator	Sponsor	Prov./ State	Nearest town	10′ block	Elev. (m)	Habitat(s)	First Year
I. Stations established before 2004									
NORTHEAST REGION									
15680	Tuckernuck Island	R.Veit	Private	MA	Madaket	411-0701	10	?	99
II. Stations established in 2004									
NORTHWEST REGION									
11241	Cape Creek	D.DeSante	USFS-Region 6	OR	Florence	440-1240	271	thinned doug. fir stand on coastal hill	04
11242	Rose Amazon	D.Farrar	USDOD - USACOE=Army Corps	OR	Eugene	440-1231	98	oak woodlnd/riparian/wet upland prairie	04
11243	Pine Creek	K.Healy	USFWS	ID	Pinehurst	473-1161	745	willow-aspen riparian corridor	04
11244	Springston	K.Healy	USFWS	ID	Harrison	472-1164	652	deciduous-mixed wetland	04
11245	Pyramid Lake, Jasper	M.Wesbrook	Private - Friends of Jasper	AB	Jasper	525-1180	1000	wetland-meadow complex/aspen stand	04
11249	South Okanagan WMA	W.Easton	Canadian Wildlife Service	BC	Osoyoos	490-1193	280	riparian woodland	04
11250	Vaseux West	W.Easton	Canadian Wildlife Service	BC	Okanagan Falls	491-1193	363	riparian woodland	04
11251	Vaseux East	W.Easton	Canadian Wildlife Service	BC	Okanagan Falls	491-1193	330	riparian woodland and meadow	04
11252	Venner Meadows	W.Easton	Canadian Wildlife Service	BC	Okanagan Falls	491-1192	1423	high elevation rip. shrub/wet meadow	04
11253	Park Rill	W.Easton	Canadian Wildlife Service	BC	Okanagan Falls	491-1193	640	rip. woodl/grazed grassl/shrubsteppe	04
SOUTHWEST REGION									
12343	Plot E3	T.Martin	USNBS	AZ	Happy Jack	342-1111	2212	conifer dominated snow melt drainage	04
12344	Plot E4	T.Martin	USNBS	AZ	Happy Jack	342-1111	2212	conifer dominated snow melt drainage	04
12346	Barka Slough	P.Nieto	USAF - Vandenberg Air Force B	CA	Lompoc	344-1202	84	willow riparian	04
12355	Nacimiento River NG	J.Griffiths	USDOD - California Army Nat.G	CA	Bradley	354-1204	164	cottonwood- willow ripiarian corridor	04
12356	Salinas River NG	J.Griffiths	USDOD - California Army Nat.G	CA	Bradley	355-1204	150	cottonwood- willow riparian corridor	04
12357	Lost Lake Island	J.Wood	USBOR - US Bureau of Reclamation	CA	Fresno	365-1194	91	mixed-willow-cottonwood riparian	04
12358	Willow Unit	J.Wood	USBOR - US Bureau of Reclamation	CA	Fresno	365-1194	128	valley oak-black willow riparian	04
12359	Nakagawa	A.Pfeffer	CALFED	CA	Lodi	380-1211	15	cottonwood-willow rip/borders agri.	04
12360	Woodbridge Regional Park	A.Pfeffer	CALFED	CA	Woodbridge	380-1211	9	cottonwd-willow-boxelder rip in suburb	04
12381	Portal AZ Desert Scrubl.	T.Hays	Private	AZ	Portal	315-1090	1386	mixed desert scrubland	04
NORTH-CENTRAL REGION									
13374	Whitford Farm	L.Johnson	Private	WI	Harrisville	435-0892	260	deciduous woods/oldfield/wetland	04
SOUTH-CENTRAL REGION									
14509	Dropzone	D.DeSante	USDoD	TX	Bastrop	301-0971	155	mixed grassland/post oak woodland	04
14510	Shelterwood 1	N.Higginbotham	LA Dept. of Wildlife and Fisheries	LA	Krotz Springs	303-0914	9	bottomland hardwoods	04
14511	Shelterwood 2	N.Higginbotham	LA Dept. of Wildlife and Fisheries	LA	Krotz Springs	302-0914	8	bottomland hardwoods	04
14512	Norfork Chapin Point	C.Rideout	USDOD - USACOE=Army Corps	AR	Mountain Home	362-0921	200	upland hardwood/pine stand mix	04
14516	West Cache Creek	J.Kelly	USDOD - Fort Sill	OK	Lawton	343-0983	340	riparian woodland/mixed grass prairie	04
14519	Arroyo Unit	M.Conway	Private	TX	Rio Honda	261-0973	5	mixed thorn scrub w/temporary wetland	04
14525	Atchafalaya NWR	E.Baka	LA Dept. of Wildlife and Fisheries	LA	Krotz Springs	?	?	bottomland hardwood forest	04
NORTHEAST REGION									
15662	Alliance Middle School LL	A.Eibel	Private - GE Foundation	OH	Alliance	405-0810	371	mixed decid. hardwood for./grassland	04
15664	North Parcel - Tamarack	L.Doss	Marvelwood School	CT	Kent	414-0732	366	upland transitional hardwd/pine swamp	04

APPENDIX. Continued.

Stn. no.	Station name	Operator	Sponsor	Prov./ State	Nearest town	10′ block	Elev. (m)	Habitat(s)	First Year
15667	Keene State WMA	J.Atwood	Private	NH	Keene	425-0721	148	fragmented rip. corr/ag fields/suburbia	04
15669	Ruthven Park	R.Ludkin	Private	ON	Cayuga	425-0795	190	mixed wood plain	04
15672	Black Branch, Nulhegan B.	J.Chace	Villanova University/USFWS	VT	Bloomfield	444-0714	354	mixed conifer forest	04
SOUTHEAST REGION									
16712	Area 03	D.DeSante	USDoD-Legacy	IN	Nebraska	390-0852	235	riparian corridor in deciduous forest	04
16713	Cowley Cemetery	D.DeSante	USDoD-Legacy	KY	Radcliff	375-0855	163	oldfield complex/riparian cor./upl.fores	04
16715	Dennison Ferry	B.Moore	USNPS - Mammoth Cave NP	KY	Mammoth Cave	371-0860	142	temperate deciduous riparian corridor	04
16716	Long Branch	M.Whitehead	Private - Friends of the Reedy River	SC	Greenville	345-0822	306	young riparian habitat - restored 03	04
16719	Clifton Farm	C.Buck	Private	VA	Warrenton	384-0774	623	mixed deciduous for./rip. cor./meadow	04
16720	Eno River State Park	B.Strong	NC Division of Parks & Rec.	NC	Hillsborough	360-0790	143	mixed hardwoods; riparian corridor	04
III. Stations established in 2005									
NORTHWEST REGION									
11263	Mosquito Creek	D.DeSante	USFS-Region 6	OR	McKenzie Bridge	440-1220	1381	regenerating clearcut	05
11264	Little Rattlesnake	D.DeSante	USFS-Region 6	WA	Rimrock	464-1210	1280	montane meadow	05
11265	Skull Creek	D.DeSante	USFS-Region 6	WA	Silverton	480-1212	552	managed coniferous forest	05
11266	Deer Creek	D.DeSante	USFS-Region 6	OR	Bly	422-1204	1724	willow riparian meadow	05
11267	Whit's Lake Road	K.Duffy	Private	MT	West Yellowstone	444-1110	2045	aspen woodlands	05
11300	QUIC	J.Alexander	?	OR		?	?	?	05
SOUTHWEST REGION									
12361	Valenzuela Tract	M.Hunnicutt	USFWS - Buenos Aires NWR	AZ	Arivaca	313-1112	1103	cottonwd-willow-mesq.-hackberry rip.	05
12364	Kern River Preserve	A.Sutton	S.Sierra Research Station	CA	Weldon	354-1181	805	cottonwood/willow rip. corr./restoration	05
12365	Barbour	M.Truan	Calfed/Lower Putah Creek	CA	Winters	383-1215	45	Cottonwd, willow, walnut riparian cor.	05
12366	Fremont Weir	M.Truan	CA Dept of Water Resources	CA	Knights Landing	384-1213	10	Cottonwood, oak, sycamore rip. woodl	05
12367	Los Rios Farms	M.Truan	Calfed/Lower Putah Creek	CA	Davis	383-1213	16	Cottonwood, willow riparian corridor	05
12368	Russell Ranch	M.Truan	Calfed/Lower Putah Creek	CA	Davis	383-1215	18	Cottonwd, elderbrry, willow rip. corrid.	05
12369	Sutter Bypass	M.Truan	CA Dept of Water Resources	CA	Knights Landing	384-1213	10	Cottonwood, oak riparian woodland	05
12370	Havasu NWR - South Dike	J.Kahl, Jr.	USBR	AZ	Topock	344-1142	146	cottonwood/salt cedar riparian corridor	05
12376	Rancho Jamul - burned	M.Madden-Smith	CA Dept of Fish and Game	CA	Jamul	323-1165	250	burned disturbed coastal sage scrub/wetl	05
12377	Rancho Jamul - unburned	M.Madden-Smith	CA Dept of Fish and Game	CA	Jamul	324-1165	250	disturbed coastal sage scrub/wetland	05
12378	Santa Ysabel Ranch - burn	M.Madden-Smith	CA Dept of Fish and Game	CA	?	?	?	?	05
12379	Santa Ysabel Ranch - unb	M.Madden-Smith	CA Dept of Fish and Game	CA	?	?	?	?	05
NORTH-CENTRAL REGION									
13389	Craven	S.Davis	Canadian Wildlife Service	SK	Craven	504-1045	500	aspen-ash-willow riparian corridor	05
13393	Mormon Island Field Two	F.Chavez-Ramirez	Private - Platte Riv. Whooping Crane	NE	Doniphan	404-0982	579	managed mixed grass prairie	05
13394	Mormon Pasture Twelve	F.Chavez-Ramirez	Private - Platte Riv. Whooping Crane	NE	Doniphan	404-0982	579	managed mixed grass prairie	05
13395	Wild Rose Middle Pasture	F.Chavez-Ramirez	Private - Platte Riv. Whooping Crane	NE	Alda	404-0982	579	managed mixed grass prairie	05
SOUTH-CENTRAL REGION									
14496	Big Thicket National Pr.	D.Roemer	USNPS - Big Thicket Natio	TX	Kountze	302-0942	33	mixed pine/hardwood with clearcut	05
14520	Group Select 1	E.Baka	LA Dept. of Wildlife and Fisheries	LA	Krotz Springs	302-0914	8	bottomland hardwoods	05

APPENDIX. Continued.

Stn. no.	Station name	Operator	Sponsor	Prov./ State	Nearest town	10′ block	Elev. (m)	Habitat(s)	First Year
14521	Group Select 2	E.Baka	LA Dept. of Wildlife and Fisheries	LA	Krotz Springs	302-0914	8	bottomland hardwoods	05
14522	Natural Area 1	E.Baka	LA Dept. of Wildlife and Fisheries	LA	Krotz Springs	302-0914	8	bottomland hardwoods	05
14523	Natural Area 2	E.Baka	LA Dept. of Wildlife and Fisheries	LA	Krotz Springs	302-0914	6	bottomland hardwoods	05
14524	LA10	J.Johnson	USDoD-Army	LA	Leesville	310-0931	92	longleaf&loblolly/hardw&honeysuckle	05
14526	Windmill #1	M.Janis	Texas Parks and Wildlife	TX	Paducah	340-1002	553	mequite woodland	05
14528	TEWO	D.Twedt	USGS/USFWS	LA	?	?	?	?	05
14529	Two Bayou Creek WMA	C.Rideout	AR Game & Fish Commission	AR	Camden	333-0924	25	bottomland hardwood with mixed pines	05
NORTHEAST REGION									
15665	Lick Run	D.DeSante	USDoD-Navy	WV	Sugar Grove	383-0791	625	riparian corridor/coniferous forest	05
15666	Flesh Run	D.DeSante	USDoD-Navy	WV	Sugar Grove	382-0791	718	virginia pine forest on steep slope	05
15671	Montana Forest Station	T.Greg	Private	NJ	New Village	404-0750	195	mixed woodland with field edges	05
SOUTHEAST REGION									
16717	Area 46	D.DeSante	USDoD-Legacy	IN	New Marion	385-0852	273	walnut forest surrounded by grassland	05
16718	Ordinance Lake	D.DeSante	USDoD-Legacy	KY	Muldraugh	375-0855	213	?	05
16722	Seven Islands WR	C.Muise	TN Orn. Society, Knoxville	TN	Seven Islands	355-0834	266	managed native grassld/scrub-shrub/rip	05
16723	Greenburry Point N. Sev.	A.Sprenger	Private	MD	Annapolis	385-0762	5	maturing oldfield	05
16724	Forked Oaks	J.Dodson	NCSU CNR Dept of Forestry	NC	Rougemont	361-0785	128	mixed pine/hardwood for.in rip. corr.	05
16726	Walls of Jerico	Y.Wang	Alabama A&M University	AL	Scottsboro	345-0860	215	deciduous bottomland hardwood	05
16728	Honey Island Swamp	D.Henry	LA Dept. of Wildlife and Fisheries	LA	Pearl River	302-0894	4	bottomland hardwood forest	05
IV. Stations established in 2006									
NORTHWEST REGION									
11268	Teton Village Ski Area	D.Wachob	Conservation Research Center	WY	Teton Village	433-1104	1935	ski run frag. mixed aspen & conifer	06
11269	Beavertail Hill State Prk	K.Smucker	MT's Nat. Res. Damage Program	MT	Clinton	464-1133	1102	mixed cottonwd with ponderosa pine rip	06
11301	3 Creek Ranch	R.Smith	Private	WY	Jackson	432-1105	1850	cottonwood-spruce riparian	06
SOUTHWEST REGION									
12371	MBSP - Powell II	J.Isaacs	California State Parks	CA	Los Osos	351-1204	21	coastal scrub/sycamore-willow rip. corr.	06
12372	Imperial NWR	N.Bartok	State - University of Arizona	AZ	Martinez Lake	325-1142	52	managed and native riparian woodlands	06
12373	Cabrillo National Mon.	S.Kaiser	Private	CA	San Diego	324-1171	65	California coastal chaparral/sage scrub	06
NORTH-CENTRAL REGION									
13392	Rum River Central Park	J.Port	Bethel University, Anoka County	MN	Andover	451-0932	270	mixed deciduous and riparian corridor	06
13396	Eagle Bluffs	A.Forbes	Audubon Missouri	MO	Columbia	384-0922	174	cottonwood-willow riparian forest	06
13397	Beavertail Creek	F.Cuthbert	University of Michigan Bio. Stn.	MI	Pellston	453-0843	221	aspen-conifer woods adjacent to lake	06
13398	Central Maple River	F.Cuthbert	University of Michigan Bio. Stn.	MI	Pellston	453-0844	215	aspen-conifer woods adjacent to river	06
13399	Gate's Bog	F.Cuthbert	University of Michigan Bio. Stn.	MI	Pellston	453-0844	225	aspen-hardwd for. adj. to leather lf bog	06
13400	North Maple River	F.Cuthbert	University of Michigan Bio. Stn.	MI	Pellston	453-0844	217	aspen-conifer woods adjacent to river	06
13401	South Maple River	F.Cuthbert	University of Michigan Bio. Stn.	MI	Pellston	453-0844	211	trembling aspen forsest adj to river	06
13402	Burn Plots	F.Cuthbert	University of Michigan Bio. Stn.	MI	Pellston	453-0844	236	aspen/red oak/red pine adj. to burn plot	06
SOUTH-CENTRAL REGION									
14530	Grandview WMA	C.Rideout	AR Game & Fish Commission	AR	Columbus	?	80	blackland prairie/riparian woodland	06
NORTHEAST REGION									

APPENDIX. Continued.

Stn. no.	Station name	Operator	Sponsor	Prov./ State	Nearest town	10′ block	Elev. (m)	Habitat(s)	First Year
15674	California Hill	S.Dehn	Private	NY	Eddyville	421-0784	503	mixed deciduous with meadow/ scrub	06
15675	West Humber River Valley	D.Derbyshire	Toronto & Region Conservation	ON	Brampton	434-0794	179	suburban mixed woodland/meadow/rip.	06
15676	Stream	D.Speicher	PARC sponsors	PA	Skytop	411-0751	521	eastern deciduous forest/riparian zone	06
15681	Junco Nest	D.Junkin	Private	NY	Java Center	423-0781	554	mixed woodland - rural	06
SOUTHEAST REGION									
16727	Wehle ForeverWild Nat. Pr	E.Soehren	ADCNR, State Lands Division	AL	Midway	320-0852	104	hardwood bottoms adj to pine sandhills	06
16731	Congaree Swamp	B.Hulslander	State/Private	SC		?	?	?	06
ALASKA AND BOREAL CANADA									
17733	East Umiat Mountain	D.DeSante	USFWS - Region 7	AK	Umiat	692-1515	79	willow/alder riparian	06
17734	West Umiat Mountain	D.DeSante	USFWS - Region 7	AK	Umiat	692-1520	79	willow riparian with gravel pits	06
17735	River Road	D.DeSante	USFWS - Region 7	AK	Umiat	692-1520	81	willow/alder riparian with grassy fields	06
17736	South Bank	D.DeSante	USFWS - Region 7	AK	Umiat	692-1520	84	willow riparian w herb./forbe fields	06
17737	West of Landing Field	D.DeSante	USFWS - Region 7	AK	Umiat	691-1521	114	willow riparian	06
17738	Nome River A	D.DeSante	USFWS - Region 7	AK	Nome	643-1651	30	willow riparian shrublnd/grassy opening	06
17739	Nome River B	D.DeSante	USFWS - Region 7	AK	Nome	643-1651	30	willow riparian shrbland/grassy opening	06
17740	Penny River	D.DeSante	USFWS - Region 7	AK	Nome	643-1654	30	willow riparian shrubland/tundra border	06
17741	Snake River	D.DeSante	USFWS - Region 7	AK	Nome	643-1652	30	willow riparian shrbland/grassy opening	06
17742	Solomon River	D.DeSante	USFWS - Region 7	AK	Nome	643-1643	33	willow rip.shrubland/riverine gravel bar	06
17743	Snake Lake	D.DeSante	USFWS - Region 7	AK	Dillingham	591-1584	105	spruce-birch forest w alder/tundra	06
17744	Dead Woodpecker Valley	D.DeSante	USFWS - Region 7	AK	Dillingham	591-1583	55	spruce-birch for. w narrow tundra strip	06
17745	Hill 364	D.DeSante	USFWS - Region 7	AK	Dillingham	591-1584	74	open spruce-birch forest w willow/bog	06
17746	Moose Paddle Creek	D.DeSante	USFWS - Region 7	AK	Dillingham	591-1584	47	open spruce-birch for. w willow/rip.	06
17747	Two Meadows View	D.DeSante	USFWS - Region 7	AK	Dillingham	590-1583	98	spruce-birch forest/tundra meadows	06
17748	Boneyard	D.DeSante	USFWS - Region 7	AK	Nome	643-1652	17	disturbed willow/ponds/several dirt road	06
18807	Lomond	R.Thompson	Parks Canada	NL	Wiltondale	492-0574	60	mature balsam fir forest/alder riparian	06
18808	Wiltondale	R.Thompson	Parks Canada	NL	Wiltondale	492-0573	20	mature balsam fir forest	06

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THE 2005 AND 2006 NORTH AMERICAN BREEDING BIRD CENSUS WITH ADDITIONS FOR 2003 AND 2004

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Abstract. The Breeding Bird Census (BBC) is the longest, continuously-run bird monitoring program in North America. Here we publish BBC reports for 2005 and 2006, with an additional nine reports from 2003 and 2004 that were not included in the previous publication (Gardali and Lowe 2007) due to late submission. Breeding Bird Censuses were conducted at 21 sites in 2005 and 20 in 2006.

EL CENSO DE AVES REPRODUCTORAS DE NORTEAMERICA DE 2005 Y 2006, CON DATOS ADICIONALES DE 2003 Y 2004

Resumen. El Censo de Aves Reproductoras (BBC) es el programa de monitoreo de aves contínuo más longevo de Norteamérica. Publicamos los informes del BBC para 2005 y 2006, con nueve informes adicionales de 2003 y 2004 que no se incluyeron en la anterior publicación (Gardali y Lowe 2007) por retrasos en su elaboración. Se llevaron a cabo conteos del BBC en 21 sitios en 2005, y 20 en 2006.

INTRODUCTION

The Breeding Bird Census (BBC) is the breeding season component of the Resident Bird Counts (RBC), which also include the Winter Bird Population Study. The BBC uses the spot- or territory-mapping method to estimate densities of breeding birds. More information on methods, history, and uses of BBC data can be found in Lowe (2006).

A total of 41 BBC reports were submitted for 2005 and 2006, similar to 2003 and 2004 (47 reports) but down considerably from 2001 and 2002 (68 reports). The length of effort among censuses ranges from new to 47 yr with the majority being > 30 yr.

Two reports from 2003 and 2004 are also included herein as they were received too late for publication in *Bird Populations* 8.

Please contact Tom Gardali (tgardali@prbo.org) for BBC instructions and data forms. To understand layout of the reports, see Gardali and Lowe (2006).

THE 2003 AND 2004 BREEDING BIRD CENSUS

Here, for years 2003 and 2004, we add an additional two reports (Table 1), which were submitted too late for inclusion in volume 8 of *Bird Populations*. These two reports are from

California and they raise the total reports for 2001 and 2002 to 22 and 25, respectively.

THE 2005 AND 2006 BREEDING BIRD CENSUS

A total of 41 Breeding Bird Census reports are included, 21 in 2005 and 20 in 2006 (Tables 2 and 3). The counts come from 7 U.S. states, 1 Canadian province, and the District of Columbia. Similar to 2003 and 2004, California, Connecticut, and Ontario each had the most counts; 7 in 2005 and 8 in 2006 in California, 5 in 2005 and 5 in 2006 in Connecticut, and 3 in 2005 and 3 in 2006 in Ontario. Included here is one plot (2006, report #10) being published for the first time.

LITERATURE CITED

GARDALI, T., AND J. D. LOWE. 2006. Reviving resident bird counts: the 2001 and 2002 Breeding Bird Census. Bird Populations 7: 90-95.

GARDALI, T., AND J. D. LOWE. 2007. The 2003 and 2004 North American Breeding Bird Census with additions for 2001 and 2002. Bird Populations 8:116-120.

LOWE, J. D. 2006. An annotated bibliography of Breeding Bird Census publications. Bird Populations 7:128-135.

TABLE 1. Summary of Breeding Bird Census reports from 2003 and 2004 for sites not included in Gardali and Lowe (2007).

Habitat (Year)	State/ Prov.	Author(s)	Plot Size (ha)	Terr. per 40 ha	Num. spp.	Hrs. Obs.	Yrs. Study
Non-forested Wetlands (2003)							
22. Desert Riparian-Freshwater Marsh	CA	E. A. Cardiff	15.4	356	30	26.0	26
Non-forested Wetlands (2004)							
25. Desert Riparian-Freshwater Marsh	CA	E. A. Cardiff	15.4	332	29	24.5	27

TABLE 2. Summary of Breeding Bird Census reports from 2005.

Habitat	State/ Prov.	Author(s)	Plot Size (ha)	Terr. per 40 ha	Num. spp.	Hrs. Obs.	Yrs. Study
Broadleaf Forests							
1. Mixed Hardwood Poletimber	CT	D. Rosgen	8.5	586	51	19.0	39
2. Second-Growth Hardwood Forest	CT	D. Rosgen	10.1	269	38	15.0	39
3. Mixed Upland Broadleaf Forest	DC	M.E. D'Imperio	14.2	321	28	35.0	47
4. Red Oak-Ironwood Savannah	ON	B. Gendreau	12.0	457	30	34.5	7
5. Red Oak-Sugar Maple Savannah	ON	B. Gendreau	10.5	623	31	36.7	6
6. Oak-Maple-Poplar Hollow	PA	L. Ingram	11.3	71	9	17.7	13
7. Virgin Hardwood Swamp Forest	SC	M. Dawson	8.9	393	19	11.4	14
8. Mature Maple-Beech-Birch Forest	TN	H. Wilson et al.	10.2	216	9	21.2	13
Needleleaf Forests							
9. Tamarack Slough	ON	C. Friis	8.8	627	34	26.4	9
Broadleaf/Needleleaf Forests							
10. Climax Hemlock-White Pine Forest with Transition Hardwoods	CT	D. Rosgen	10.5	371	36	20.0	39
11. Young Mixed Hardwood-Conifer Stand	CT	D. Rosgen	8.5	306	38	12.0	28
12. Riparian Woodland	ID	S.R. Robinson	8.9	200	20	14.0	9
Mixed Habitats							
13. Riparian Scrub Basin	CA	M. Aimar	12.7	526	25	22.1	2
14. Streamside Riparian Woodland I	CA	T. Reeser	17.8	213	21	26.5	2
15. Streamside Riparian Woodland II	CA	S. Hoffman	12.3	429	32	19.1	2
16. Forest Wetland and Bordering Cliff and Talus	NY	L. Bowdery et al.	22.3	105	30	27.2	3
Non-forested Wetlands							
17. Desert Riparian-Freshwater Marsh	CA	E.A. Cardiff	15.4	358	35	28.0	28
18. Shrubby Swamp & Sedge Hummocks	CT	D. Rosgen	8.1	1032	48	26.0	39
Shrublands							
19. Coastal Scrub	CA	S. Jennings	8.1	311	19	201.6	31
20. Disturbed Coastal Scrub A	CA	C. Snow, S. Jennings	4.7	357	28	149.0	31
21. Disturbed Coastal Scrub B	CA	K. Neijstrom, S. Jennings	8.1	356	22	211.3	31

TABLE 3. Summary of Breeding Bird Census reports from 2006.

Habitat	State/ Prov.	Author(s)	Plot Size (ha)	Terr. per 40 ha	Num. spp.	Hrs. Obs.	Yrs. Study
Broadleaf Forests							
1. Mixed Hardwood Poletimber	CT	D. Rosgen	8.5	621	50	19.0	40
2. Second-Growth Hardwood Forest	CT	D. Rosgen	10.1	277	39	14.5	40
3. Hardwood Swamp Forest	SC	M.R. Dawson	8.1	375	19	13.7	14
4. Mature Maple-Beech-Birch Forest	TN	L.M. Lewis	10.2	161	8	13.3	14
Broadleaf/Needleleaf Forests							
5. Climax Hemlock-White Pine Forest with Transition Hardwoods	CT	D. Rosgen	10.5	381	42	21.0	40
6. Young Mixed Hardwood-Conifer Stand	CT	D. Rosgen	8.5	322	35	11.0	29
7. Riparian Woodland	ID	S.R. Robinson	8.9	227	20	11.8	10
8. Mixed Upland Forest	NY	L. Bowdery et al.	42.3	171	43	33.1	8
8. Intergrading Dune-Swale Savannah	ON	C-A. Wegenschimmel	11.0	135	11	49.7	9
Mixed Habitats							
10. Riparian Scrub	CA	J. Coumoutso	14.6	205	19	16.8	New
11. Riparian Scrub Basin	CA	M. Aimar	12.7	485	28	20.2	3
12. Streamside Riparian Woodland I	CA	T. Reeser	17.8	352	24	38.8	3
13. Streamside Riparian Woodland III	CA	S. Hoffman	12.3	493	31	27.0	3
14. Field, Ridge, Shrubby Trees, and Woods	ON	M.F.G. Clark	5.8	641	16	12.1	11
15. Sedge-Tamarack Dune Pond	ON	M. Boyd	10.0	420	25	39.5	5
Non-forested Wetlands							
16. Desert Riparian-Freshwater Marsh	CA	E.A. Cardiff	15.4	436	31	25.5	29
17. Shrubby Swamp and Sedge Hummocks	CT	D. Rosgen	8.1	1007	52	27.0	40
Shrublands							
18. Coastal Scrub	CA	J. Musina et al.	8.1	212	21	236.4	32
19. Disturbed Coastal Scrub A	CA	E. Porzig, S. Jennings	4.7	277	31	143.5	32
20. Disturbed Coastal Scrub B	CA	S. Jennings	8.1	259	24	203.9	32

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BREEDING BIRD CENSUS: 2003

22. DESERT RIPARIAN–FRESHWATER MARSH
DESIERTO RIVEREÑO–PANTANO

EUGENE A. CARDIFF
San Bernardino County Museum
2024 Orange Tree Lane
Redlands CA 92374

Location: California; San Bernardino Co.; Morongo Valley; Big Morongo Wildlife Reserve; 34°3'N, 116°35'W; Morongo Valley Quadrangle, USGS. **Continuity:** Established 1977; 26 yr. **Size:** 15.4 ha. **Description of Plot:** See *J. Field Ornithol.* 62 (Suppl.):76 (1991), 64 (Suppl.):92–93 (1993), and 65 (Suppl.):106–107 (1994). **Weather:** Mean start temp., 11.4°C (range 3–20°C). **Coverage:** 26.0 h; 8 visits (8 sunrise); 17, 29 April; 6, 15, 22, 29 May; 4, 13 June; 2003. **Census:** Bewick's Wren, 15.0 (39; 3N,7FL); House Finch, 12.0 (31; 5N); Spotted Towhee, 11.0 (29); House Wren, 9.0 (23; 4N); Common Yellowthroat, 9.0 (2FL); Lesser Goldfinch, 9.0; Song Sparrow, 7.0 (18); Mourning Dove, 6.0 (16); Western Scrub-Jay, 5.0 (13; 4FL); Verdin, 5.0 (1N); Brown-headed Cowbird, 5.0; Yellow-breasted Chat, 4.0 (10; 2FL); Summer Tanager, 4.0; Anna's Hummingbird, 3.0 (8); Nuttall's Woodpecker, 3.0 (2N,1FL); Brown-crested Flycatcher, 3.0 (1N); Bushtit, 3.0 (1N); Phainopepla, 3.0; Yellow Warbler, 3.0; California Towhee, 3.0; Gambel's Quail, 2.0; Virginia Rail, 2.0; Costa's Hummingbird, 2.0 (2N); Ash-throated Flycatcher, 2.0 (1N); Hooded Oriole, 2.0 (2N,3FL); Cooper's Hawk, 1.0 (1N,1FL); Black Phoebe, 1.0 (1N,2FL); California Thrasher, 1.0 (1N,3FL); European Starling, 1.0 (1N); Blue Grosbeak, 1.0. **Total:** 30 species; 137.0 territories (356/40 ha). **Visitors:** Green Heron, Red-tailed Hawk, Greater Roadrunner, Black-chinned Hummingbird, Ladder-backed Woodpecker, Vermilion Flycatcher, Bell's Vireo, Hutton's Vireo, American Crow, Black-headed Grosbeak, Bullock's Oriole, Lawrence's Goldfinch. **Remarks:** This year's 30 species on 137 territories was higher than last year's 29 species on 107 territories. Nineteen species were up and four were down compared to last year. This year was wetter than last year and there was more evidence that pairs fledged young. A Bell's Vireo was singing on territory, but it left early. **Other Observers:** Dori Myers, Alice Ashbaugh, and Dee Zeller. **Acknowledgments:** San Bernardino County Museum, San Bernardino Valley Audubon Society, and Bureau of Land Management.

Bird Populations 9:175

BREEDING BIRD CENSUS: 2004

25. DESERT RIPARIAN–FRESHWATER MARSH
DESIERTO RIVEREÑO–PANTANO

EUGENE A. CARDIFF
San Bernardino County Museum
2024 Orange Tree Lane
Redlands CA 92374

Location: California; San Bernardino Co.; Morongo Valley; Big Morongo Wildlife Reserve; 34°3'N, 116°35'W; Morongo Valley Quadrangle, USGS. **Continuity:** Established 1977; 27 yr. **Size:** 15.4 ha. **Description of Plot:** See *J. Field Ornithol.* 62 (Suppl.):76 (1991), 64 (Suppl.):92–93 (1993), and 65 (Suppl.):106–107 (1994). **Weather:** Mean start temp., 11.5°C (range 5–19°C). **Coverage:** 24.5 h; 8 visits (8 sunrise); 14, 20, 29 April; 6, 13, 19, 27 May; 10 June; 2004. **Census:** Bewick's Wren, 14.0 (36; 2N,7FL); House Wren, 11.0 (29; 2N,2FL); Common Yellowthroat, 9.0 (23; 1N,1FL); House Finch, 9.0 (1N,6FL); Spotted Towhee, 8.0 (21; 7FL); Song Sparrow, 8.0; Lesser Goldfinch, 8.0 (1N,4FL); Virginia Rail, 5.0 (13); Western Scrub-Jay, 5.0 (1FL); Verdin, 5.0 (3N,3FL); Yellow-breasted Chat, 5.0; Brown-headed Cowbird, 5.0; Anna's Hummingbird, 4.0 (10; 2N); Yellow Warbler, 4.0; Mourning Dove, 3.0 (8); Nuttall's Woodpecker, 3.0 (1N); Brown-crested Flycatcher, 3.0 (1N); Bushtit, 3.0 (1N,6FL); Summer Tanager, 3.0; Black Phoebe, 2.0 (2N,6FL); Phainopepla, 2.0; California Towhee, 2.0 (3FL); Hooded Oriole, 2.0 (1N,1FL); Gambel's Quail, 1.0 (1FL); Ash-throated Flycatcher, 1.0; California Thrasher, 1.0 (2FL); Blue Grosbeak, 1.0; Cooper's Hawk, 0.5 (1N,4FL); Black-throated Sparrow, 0.5 (1N,2FL). **Total:** 29 species; 128.0 territories (332/40 ha). **Visitors:** White-winged Dove, Greater Roadrunner, Black-chinned Hummingbird, Costa's Hummingbird, Ladder-backed Woodpecker, Vermilion Flycatcher, Cassin's Kingbird, Bell's Vireo, Oak Titmouse, European Starling, Lucy's Warbler, Black-headed Grosbeak, Bullock's Oriole, Lawrence's Goldfinch. **Remarks:** Drought conditions are still occurring in the region, slowing recovery from the particularly severe drought of 2002. **Other Observers:** Dori Myers, Alice Ashbaugh, and Dee Zeller. **Acknowledgments:** San Bernardino County Museum, San Bernardino Valley Audubon Society, and Bureau of Land Management.

Bird Populations 9:176-186

BREEDING BIRD CENSUS: 2005

1. MIXED HARDWOOD POLETIMBER
BOSQUE MIXTO MADERERO

DAVID ROSGEN
White Memorial Conservation Center
P.O. Box 368
Litchfield CT 06759

Site Number: CT1265009. **Location:** Connecticut; Litchfield Co.; Litchfield; White Memorial Foundation–Wheeler Hill; 41°42'N, 73°13'W; Litchfield Quadrangle, USGS. **Continuity:** Established 1965; 39 yr. **Size:** 8.5 ha. **Description of Plot:** See *Aud. Field Notes* 19:609–610 (1965), *J. Field Ornithol.* 64(Suppl.):36 (1993), and *Bird Populations* 8:125 (2007). Succession is continuing. **Weather:** Mean start temp., 19.6°C (range 9–26°C). May's mean temperature was 11.3°C, which is far below average. Mean temperatures in June (20.3°C) and July (21.7°C) were about average. Only two days during this period saw temperatures exceed 32.2°C, while nighttime lows in May dipped below 0°C six times. Rain fell on 17 d in May totaling 11.9 cm (slightly above normal), and in June on 11 d totaling 7.7 cm. This is about 3 cm below normal. During July, rain on 15 d totaled 15.0 cm (2 cm above average). Source: White Memorial's own weather station. **Coverage:** 19.0 h; 10 visits (0 sunrise, 5 sunset); 3, 10, 17, 29 May; 7, 18, 30 June; 12, 21, 28 July; 2005. **Census:** Red-eyed Vireo, 13.5 (64; 1N,12FL); Ovenbird, 13.0 (61; 1N,10FL); Veery, 12.5 (59; 1N,8FL); Gray Catbird, 11.5 (54; 1N,20FL); American Redstart, 11.0 (52; 1N,15FL); Eastern Towhee, 7.0 (33; 12FL); Wood Thrush, 5.0 (24; 6FL); Common Yellowthroat, 4.5 (21; 5FL); Chestnut-sided Warbler, 4.0 (19; 1N,3FL); Black-capped Chickadee, 3.0 (14; 1N,10FL); Tufted Titmouse, 3.0 (12FL); American Robin, 3.0 (1N,7FL); Yellow Warbler, 3.0 (1N,6FL); Northern Cardinal, 3.0 (2N,9FL); Black-and-white Warbler, 2.5 (2FL); Scarlet Tanager, 2.5 (2FL); American Crow, 2.0 (2N,8FL); Baltimore Oriole, 2.0 (1N,3FL); American Goldfinch, 2.0 (3FL); Mourning Dove, 1.5 (2FL); Downy Woodpecker, 1.5 (1N,3FL); Blue Jay, 1.5 (3FL); White-breasted Nuthatch, 1.5 (5FL); Wild Turkey, 1.0 (4FL); Eastern Wood-Pewee, 1.0; Blue-gray Gnatcatcher, 1.0; Song Sparrow, 1.0 (1N,4FL); Rose-breasted Grosbeak, 1.0; Red-bellied Woodpecker, 0.5; Yellow-bellied Sapsucker, 0.5 (1N,3FL); Hairy Woodpecker, 0.5; Northern Flicker, 0.5; Eastern Phoebe, 0.5 (1N); House Wren, 0.5 (1N,6FL); European Starling, 0.5 (1N,6FL); Cedar Waxwing, 0.5 (3FL); Chipping Sparrow, 0.5 (4FL); Brown-headed Cowbird, 0.5; House Finch, 0.5 (3FL); Broad-winged Hawk, +; Red-tailed Hawk, +; Barred Owl, +; Ruby-throated Hummingbird, +; Great Crested Flycatcher, +; Warbling Vireo, +; Fish Crow, + (2FL); Carolina Wren, +; Hermit Thrush, +; Blue-winged Warbler, +; Magnolia Warbler, +; Purple Finch, +. **Total:** 51 species; 124.5 territories (586/40 ha). **Visitors:** Black-billed Cuckoo, Yellow-throated Vireo. **Remarks:** The number of breeding species increased to a record-high 51 this year topping the previous high of 50 recorded in 2002 and 2003. Last year, 47 species were documented on plot. The 10-yr average is 43 species. Seven species were found this year that weren't last year (Broad-winged Hawk, Yellow-bellied Sapsucker, Hairy Woodpecker, Ruby-throated Hummingbird, Fish Crow, European Starling, and Chipping Sparrow). Species found last year but not documented this year were Eastern Kingbird, Black-throated Green Warbler, and Golden-crowned Kinglet. The total number of territories this year decreased to 124.5 from last year's 138.0, but remains above the 10-yr average of 109 territories. Red-eyed Vireo declined by 3.0 territories but remained the most abundant species. Ovenbird moved up to the number two spot with an unchanged population from last year, while Veery dropped to number three due to a decrease of 1.0 territory. Gray Catbird remained the fourth most abundant species even though it declined by 0.5 territories. American Redstart increased by 2.0 territories. **Other Observers:** John Eykelhoff, John Grabowski, Marie Kennedy, and Olaf Soltau.

2. SECOND-GROWTH HARDWOOD FOREST
BOSQUE SECUNDARIO DE MADERAS DURAS

DAVID ROSGEN
White Memorial Conservation Center
P.O. Box 368
Litchfield CT 06759

Site Number: CT2765006. **Location:** Connecticut; Litchfield Co.; Morris; White Memorial Foundation–Van Winkle Road; 41°42'N, 73°12'W; Litchfield Quadrangle, USGS. **Continuity:** Established

1965; 39 yr. **Size:** 10.1 ha. **Description of Plot:** See *Aud. Field Notes* 19:590–591 (1965), *J. Field Ornithol.* 64(Suppl.):37–38 (1993), and *Bird Populations* 8:126 (2007). **Weather:** Mean start temp., 21.2°C (range 13–27°C). May's mean temperature 11.3°C was far below average. Mean temperatures in June (20.3°C) and July (21.7°C) were about average. Only two days had temperatures exceed 32.2°C, while nighttime lows went below 0°C six times in May. Rain fell on 17 d in May totaling 11.9 cm (slightly above normal), 11 d in June totaling 7.7 cm (about 3 cm below normal), and 15 d in July totaling 15.0 cm (about 2 cm above normal). Source: White Memorial's own weather station. **Coverage:** 15.0 h; 10 visits (0 sunrise, 8 sunset); 10, 21 May; 2, 9, 17, 28 June; 5, 14, 25, 31 July; 2005. **Census:** Ovenbird, 12.0 (48; 1N,7FL); Veery, 11.0 (44; 8FL); Red-eyed Vireo, 10.5 (42; 4FL); Scarlet Tanager, 3.5 (14; 4FL); Wood Thrush, 3.0 (12; 2FL); American Robin, 2.5 (2N,7FL); Yellow-bellied Sapsucker, 2.0; Eastern Wood-Pewee, 2.0 (2FL); Tufted Titmouse, 2.0 (4FL); Gray Catbird, 2.0 (1N,6FL); Black-and-white Warbler, 1.5; American Redstart, 1.5 (3FL); Wild Turkey, 1.0 (3FL); Red-bellied Woodpecker, 1.0; Downy Woodpecker, 1.0 (1N,5FL); Hairy Woodpecker, 1.0; American Crow, 1.0 (3FL); Black-capped Chickadee, 1.0 (4FL); White-breasted Nuthatch, 1.0 (1N,4FL); Common Yellowthroat, 1.0; Chipping Sparrow, 1.0 (3FL); American Goldfinch, 1.0; Red-tailed Hawk, 0.5; Pileated Woodpecker, 0.5; Eastern Phoebe, 0.5; Blue Jay, 0.5; Blue-gray Gnatcatcher, 0.5; Hermit Thrush, 0.5; Song Sparrow, 0.5 (3FL); Northern Cardinal, 0.5; Baltimore Oriole, 0.5 (1N); Mourning Dove, +; Great Crested Flycatcher, +; Brown Creeper, +; Cedar Waxwing, +; Chestnut-sided Warbler, +; Eastern Towhee, +; Brown-headed Cowbird, +. **Total:** 38 species; 68.0 territories (269/40 ha). **Visitors:** Barred Owl, Northern Flicker, Black-throated Green Warbler, Rose-breasted Grosbeak. **Remarks:** The number of species breeding in the plot dropped to 38 this year; four less than average and four less than last year. Species not detected this year included Broad-winged Hawk, Eastern Kingbird, Yellow-throated Vireo, Pine Warbler, and Louisiana Waterthrush. Species found this year but not last year included Pileated Woodpecker, Brown Creeper, Hermit Thrush, and Song Sparrow. The number of territories continued to decline from 99.5 in 2003, 77.5 in 2004, and only 68.0 this year. The plot average is 97.0 territories. Two possible contributing factors in this years decline and the decline overall were the cold, wet weather in May (which may have caused many early nest failures and reduced the availability of insects as prey items) and nearby road reconstruction along the southern end of the plot. Red-eyed Vireo was replaced by Ovenbird as the most abundant species in the plot; Veery remained the second most abundant. **Other Observers:** Candace Kalmick, Marie Kennedy, and Ed Yescott. **Acknowledgments:** Marie Kennedy was very helpful in compiling this report.

3. MIXED UPLAND BROADLEAF FOREST

BOSQUE MIXTO DE HOJA ANCHA DE ALTURAS

MARY E. D'IMPERIO
4000 Cathedral Ave. NW, #106B
Washington DC 20016

Site Number: DC1060009. **Location:** District of Columbia; Washington; Glover-Archbold Park; 38°55'N, 77°5'W; Washington West Quadrangle, USGS. **Continuity:** Established 1959; 47 yr. **Size:** 14.2 ha. **Description of Plot:** See *Aud. Field Notes* 14:502–503 (1960). Two areas adjacent to the plot are slated for some degree of development. It has not yet happened, but it is imminent. **Weather:** Mean start temp., 11.9°C (range 4–27°C). Eleven days were clear, five were partly cloudy, and three were cloudy. **Coverage:** 35.0 h; 19 visits (17 sunrise); 6, 12, 16(2), 19, 21, 24, 29 April; 1, 5, 8, 12, 15, 17(2), 22, 26, 28 May; 21 July; 2005. **Census:** Northern Cardinal, 13.0 (37; 1FL); Red-bellied Woodpecker, 12.0 (34); Carolina Wren, 12.0; Red-eyed Vireo, 9.0 (25); Gray Catbird, 9.0; Veery, 6.0 (17); Tufted Titmouse, 5.0 (14); Downy Woodpecker, 4.0 (11; 2FL); Northern Flicker, 4.0; Acadian Flycatcher, 4.0; Song Sparrow, 3.5 (10); American Crow, 3.0 (8); White-breasted Nuthatch, 3.0; House Wren, 3.0; Eastern Towhee, 3.0; Common Grackle, 2.5; Mourning Dove, 2.0; Eastern Wood-Pewee, 2.0; Blue-gray Gnatcatcher, 2.0; Wood Thrush, 2.0; House Finch, 2.0; House Sparrow, 2.0 (1N); Chimney Swift, 1.0; Hairy Woodpecker, 1.0; Blue Jay, 1.0; Carolina Chickadee, 1.0; American Robin, 1.0; European Starling, 1.0. **Total:** 28 species; 114.0 territories (321/40 ha). **Visitors:** Canada Goose, Green Heron, Turkey Vulture, Red-shouldered Hawk, Broad-winged Hawk, Yellow-billed Cuckoo, Ruby-throated Hummingbird, Pileated Woodpecker, Great Crested Flycatcher, White-eyed Vireo, Yellow-throated Vireo, Fish Crow, Northern Mockingbird, Brown Thrasher, Northern Parula, Black-and-white Warbler, American Redstart, Ovenbird, Louisiana Waterthrush, Common Yellowthroat, Scarlet Tanager, Indigo Bunting, Brown-headed Cowbird, Baltimore Oriole, American Goldfinch. **Remarks:** Species richness was higher, with more territories (114.0 vs. 94.0) and more individual birds seen on average compared to 2004. Tufted Titmouse numbers appear to be recovering, as are Carolina Chickadee and crow numbers to a lesser extent, after the recent crash in population. The Red-shouldered Hawks are still nesting further north, near the community gardens. Diversity among avian visitors was higher compared to 2004. **Other Observers:** Neal Fitzpatrick.

4. RED OAK–IRONWOOD SAVANNAH
SAVANA DE ROBLE ROJO–PALO DE HIERRO

BENOIT GENDREAU
Bird Studies Canada
P.O. Box 160
Port Rowan ON N0E 1M0

Location: Ontario; Municipality of Haldimand-Norfolk; Port Rowan; Long Point Company-Courtright Ridge; 42°34'N, 80°17'W; Big Rice Bay Quadrangle, DEMR. **Continuity:** Established 1979; 7 yr. **Size:** 12.0 ha. **Description of Plot:** See *Am. Birds* 34:65 (1980), *J. Field Ornithol.* 63(Suppl.):56–57 (1992) and 64(Suppl):52–53 (1993). **Weather:** Mean start temp., 15.8°C (range 10–26°C). Wind brought down 15 trees. **Coverage:** 34.5 h; 10 visits (9 sunrise, 1 sunset); 2, 5, 7, 8, 9, 11, 13, 16, 18, 20 June; 2005. **Census:** Yellow Warbler, 18.0 (60; 1N); Red-winged Blackbird, 14.5 (48; 1N); House Wren, 12.5 (42; 2N); Song Sparrow, 10.5 (35; 2FL); Eastern Wood-Pewee, 10.0 (33); Common Yellowthroat, 9.0 (30); Warbling Vireo, 5.0 (17); Red-eyed Vireo, 5.0; American Robin, 5.0 (6FL); Gray Catbird, 5.0; Tree Swallow, 4.5 (15; 3N); Eastern Kingbird, 4.0 (13); Baltimore Oriole, 4.0; Mourning Dove, 3.0 (10); Downy Woodpecker, 3.0; European Starling, 3.0 (1N); Brown-headed Cowbird, 3.0; Great Crested Flycatcher, 2.5; American Woodcock, 2.0; Black-capped Chickadee, 2.0; Indigo Bunting, 2.0; Common Grackle, 2.0; Northern Flicker, 1.0 (1N); Willow Flycatcher, 1.0; Blue Jay, 1.0; Blue-gray Gnatcatcher, 1.0; American Redstart, 1.0; Northern Cardinal, 1.0; American Goldfinch, 1.0; Red-bellied Woodpecker, 0.5. **Total:** 30 species; 137.0 territories (457/40 ha). **Visitors:** Canada Goose, Wood Duck, Yellow-billed Cuckoo, Ruby-throated Hummingbird, Red-headed Woodpecker, American Crow, Marsh Wren, Cedar Waxwing, Scarlet Tanager, Swamp Sparrow, Orchard Oriole, House Finch. **Remarks:** This study is part of a long-term project designed to monitor the response of vegetation and breeding bird communities to a reduction in deer browsing at Long Point, Lake Erie. **Other Observer:** Christian Friis. **Acknowledgments:** I thank Jon McCracken and Christian Friis for project supervision, Jane Bowles and Michael Bradstreet for measuring vegetation parameters, Stu Mackenzie for field assistance, and the Canadian Wildlife Service for financial support.

5. RED OAK–SUGAR MAPLE SAVANNAH
SAVANA DE ROBLE ROJO–ARCE DULCE

BENOIT GENDREAU
Bird Studies Canada
P.O. Box 160
Port Rowan ON N0E 1M0

Location: Ontario; Municipality of Haldimand-Norfolk; Port Rowan; Long Point National Wildlife Area; 16.7 km from Long Point Lighthouse; 42°33'40"N, 80°15'W; Big Rice Bay Quadrangle, DEMR. **Continuity:** Established 1979; 6 yr. **Size:** 10.5 ha. **Description of plot:** See *Am. Birds* 34:51 (1980), *J. Field Ornithol.* 63(Suppl.):58–59 (1992) and 66(Suppl.):51–52 (1995). **Weather:** Mean start temp. 17.8°C (range 12–28°C). **Coverage:** 36.7 h; 10 visits (9 sunrise, 1 sunset); 1, 4, 6, 7, 10, 11, 14, 17, 19, 21 June; 2005. **Census:** House Wren, 18.5 (70; 1N); Yellow Warbler, 16.5 (63); Red-winged Blackbird, 12.0 (46; 3N,2FL); Eastern Wood-Pewee, 11.5 (44; 1N); Song Sparrow, 10.5 (40; 2FL); Baltimore Oriole, 8.5 (32; 1N); Gray Catbird, 8.0 (30); Common Yellowthroat, 7.5 (29); Tree Swallow, 7.0 (27; 2N); Warbling Vireo, 6.5 (25); Eastern Kingbird, 6.0 (23); Mourning Dove, 5.0 (19); Field Sparrow, 5.0; Brown-headed Cowbird, 5.0; Downy Woodpecker, 4.0 (15); Great Crested Flycatcher, 3.0 (11); Blue Jay, 3.0; Black-capped Chickadee, 3.0; American Robin, 3.0; Indigo Bunting, 3.0; Common Grackle, 3.0; Red-bellied Woodpecker, 2.0; European Starling, 2.0; Eastern Towhee, 2.0; Northern Cardinal, 2.0; Northern Flicker, 1.5; American Woodcock, 1.0; Yellow-billed Cuckoo, 1.0; Chimney Swift, 1.0; Blue-gray Gnatcatcher, 1.0; Wilson's Snipe, 0.5. **Total:** 31 species, 163.5 territories (623/40 ha). **Visitors:** Wood Duck, Ruby-throated Hummingbird, Red-headed Woodpecker, Red-eyed Vireo, White-breasted Nuthatch, Cedar Waxwing, Black-throated Green Warbler, Ovenbird, Orchard Oriole, American Goldfinch. **Remarks:** This study is part of a long-term project designed to monitor the response of vegetation and breeding bird communities to a reduction in deer browsing at Long Point, Lake Erie. **Other Observer:** Christian Friis. **Acknowledgments:** I thank Jon McCracken and Christian Friis for project supervision, Jane Bowles and Michael Bradstreet for measuring vegetation parameters, Stu Mackenzie for field assistance, and the Canadian Wildlife Service for financial support.

6. OAK–MAPLE–POPLAR HOLLOW
BOSQUE DE ROBLE–ARCE–ALAMO HUECO

LINDA INGRAM
Nolde Forest Environmental Education Center
2910 New Holland Road
Reading PA 19607-9448

Site Number: PA1093123. **Location:** Pennsylvania; Berks Co.; Reading; Nolde Forest, Buck Hollow; 40°16'57"N, 75°57'30"W; Reading Quadrangle, USGS. **Continuity:** Established 1993; 13 yr. **Size:** 11.3 ha. **Description of Plot:** See *J. Field Ornithol.* 65(Suppl.):61 (1994). **Weather:** Mean start temp., 12.0°C (range 4–24°C). Precipitation was significantly below normal for May 2005. Normal May temperatures: mean 16.07°C, minimum 11.1°C, maximum 22.2°C. **Coverage:** 17.7 h; 10 visits (8 sunrise, 2 sunset); 26

April; 2, 8, 9, 11, 15, 18, 22, 23 May; 3 June; 2005. **Census:** Wood Thrush, 5.0 (18); Ovenbird, 5.0; Veery, 2.5; Northern Cardinal, 2.5; Red-bellied Woodpecker, 1.0; Pileated Woodpecker, 1.0; Blue Jay, 1.0; American Crow, 1.0; Tufted Titmouse, 1.0. **Total:** 9 species; 20.0 territories (71/40 ha). **Visitors:** Mourning Dove, Downy Woodpecker, Northern Flicker, Eastern Wood-Pewee, Great Crested Flycatcher, White-breasted Nuthatch, American Robin, Gray Catbird, Scarlet Tanager, Chipping Sparrow, Rose-breasted Grosbeak, American Goldfinch. **Other Observers:** Lynn Scheirer, Patricia Mangas, Phyllis Reynolds, David Reynolds, Keith Lutz, and Kevin Lutz.

7. VIRGIN HARDWOOD SWAMP FOREST
BOSQUE PANTANOSO VIRGEN DE MADERAS DURAS

MICHAEL DAWSON
Francis Beidler Forest
336 Sanctuary Road
Harleyville SC 29448

Location: South Carolina; Berkeley Co.; Harleyville; Francis Beidler Forest Sanctuary; 33°13'N, 80°20'W; Pringletown Quadrangle, USGS. **Continuity:** Established 1979; 14 yr. **Size:** 8.9 ha. **Description of Plot:** See *Am. Birds* 34:50 (1980) and *J. Field Ornithol.* 65(Suppl.):64 (1994). The plot is continuing to recover from the damage caused by hurricane Hugo in 1989. Scrubby areas have thinned greatly as saplings have increased in height and shaded the forest floor. **Weather:** Mean start temp., 14.6°C (range 2–18°C). April was a fairly wet month. May was drier than average. Temperatures were cooler than normal. **Coverage:** 11.4 h; 9 visits (9 sunrise, 0 sunset); 17, 30 April; 1, 10, 13, 14, 22, 27, 28 May; 2005. **Census:** Blue-gray Gnatcatcher, 26.0 (117); Red-eyed Vireo, 8.5 (38); Tufted Titmouse, 7.5 (34); Northern Cardinal, 7.0 (31); Red-bellied Woodpecker, 4.5 (20); Carolina Wren, 4.5; Northern Parula, 4.5; Acadian Flycatcher, 4.0 (18); White-eyed Vireo, 4.0; Prothonotary Warbler, 4.0; Yellow-billed Cuckoo, 2.0; Pileated Woodpecker, 2.0; Great Crested Flycatcher, 2.0; Hooded Warbler, 2.0; Downy Woodpecker, 1.0; Carolina Chickadee, 1.0; White-breasted Nuthatch, 1.0; Yellow-throated Warbler, 1.0; Swainson's Warbler, 1.0. **Total:** 19 species; 87.5 territories (393/40 ha). **Visitors:** White Ibis, Red-shouldered Hawk, Barred Owl, Chimney Swift, Red-headed Woodpecker, Yellow-throated Vireo, Blue Jay, American Crow, Wood Thrush, Gray Catbird, Black-throated Blue Warbler, Kentucky Warbler, Common Yellowthroat, Summer Tanager, Brown-headed Cowbird. **Other Observer:** Norman Brunswig.

8. MATURE MAPLE–BEECH–BIRCH FOREST
BOSQUE MADURO DE ARCE–HAYA–ABEDUL

HAYDEN WILSON, DAVID VOGT & LAURA M. LEWIS*
**Cherokee National Forest*
2800 N. Ocoee Street
Cleveland TN 37312

Site Number: TN2392102. **Location:** Tennessee; Monroe Co.; Whigg Ridge, Cherokee National Forest; 35°19'36"N, 84°2'30"W; Big Junction Quadrangle, USGS. **Continuity:** Established 1992; 13 yr. **Size:** 10.2 ha. **Description of Plot:** See *J. Field Ornithol.* 64(Suppl.):57–58 (1993) and 66(Suppl.):63 (1995). **Weather:** Mean start temp., 17.6°C (range 2–30°C). The visits on 20 June and 21 June followed heavy rains; stream noise was considerable. **Coverage:** 21.2 h; 10 visits (5 sunrise, 5 sunset); 24, 25 May; 4, 5, 8, 9, 20, 21, 24, 25 June; 2005. **Census:** Veery, 16.0 (63; 2N); Blue-headed Vireo, 11.0 (43; 1FL); Ovenbird, 10.0 (39); Dark-eyed Junco, 8.5 (33; 5FL); Blackburnian Warbler, 3.5 (14); Black-throated Blue Warbler, 3.0 (12; 1N,1FL); Carolina Chickadee, 1.0; Tufted Titmouse, 1.0; Rose-breasted Grosbeak, 1.0. **Total:** 9 species; 55.0 territories (216/40 ha). **Visitors:** Ruffed Grouse, Hairy Woodpecker, Blue Jay, White-breasted Nuthatch, Winter Wren, American Robin, Cedar Waxwing, Chestnut-sided Warbler. **Remarks:** Flyovers: Chimney Swift. **Acknowledgments:** Logistical and financial support provided by the USDA Forest Service, Cherokee National Forest.

9. TAMARACK SLOUGH
PANTANO DE LARICE AMERICANO

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Location: Ontario; Municipality of Haldimand-Norfolk; Port Rowan; Long Point National Wildlife Area; 42°33'N, 80°5'W; Gravelly Bay Quadrangle, DEMR. **Continuity:** Established 1973; 9 yr. **Size:** 8.8 ha. **Description of Plot:** See *Am. Birds* 28:1017–1018 (1974), *J. Field Ornithol.* 63(Suppl):68–69 (1992) and 64(Suppl):66–67 (1993). **Weather:** Mean start temp., 21.0°C (range 15–25°C). **Coverage:** 26.4 h; 8 visits (6 sunrise, 2 sunset); 5, 7, 8, 21, 24, 26, 28, 29 June; 2005. **Census:** Yellow Warbler, 35.0 (159;1N); Red-winged Blackbird, 17.0 (77; 1N,2FL); House Wren, 9.0 (41); Gray Catbird, 7.0 (32); Common Yellowthroat, 6.0 (27); Eastern Towhee, 4.0 (18); Chipping Sparrow, 4.0 (2FL); Common Grackle, 4.0 (1FL); Song Sparrow, 3.5 (16); Baltimore Oriole, 3.5 (2N,1FL); Eastern Kingbird, 3.0 (14); Tree Swallow, 3.0; Black-capped Chickadee, 3.0; Brown Thrasher, 3.0 (1N); Brown-headed Cowbird, 3.0; American Woodcock, 2.0; Mourning Dove, 2.0;

Yellow-billed Cuckoo, 2.0; Whip-poor-will, 2.0; Eastern Wood-Pewee, 2.0; Least Flycatcher, 2.0 (1N); Carolina Wren, 2.0; Blue-gray Gnatcatcher, 2.0; American Robin, 2.0; Cedar Waxwing, 2.0; Swamp Sparrow, 2.0; Virginia Rail, 1.0; Great Crested Flycatcher, 1.0; White-eyed Vireo, 1.0; Blue Jay, 1.0; Marsh Wren, 1.0; Chestnut-sided Warbler, 1.0; Field Sparrow, 1.0; American Goldfinch, 1.0. **Total:** 34 species; 138.0 territories; (627/40 ha) **Visitors:** Wood Duck, Pied-billed Grebe, American Bittern, Great Blue Heron, Green Heron, Wilson's Snipe, Black-billed Cuckoo, Belted Kingfisher, Willow Flycatcher, Warbling Vireo, Red-eyed Vireo, American Crow, Eastern Bluebird, European Starling, American Redstart, Ovenbird, Scarlet Tanager, Northern Cardinal, Indigo Bunting, House Finch. **Remarks:** This study is part of a long-term project designed to monitor the response of vegetation and breeding bird communities to a reduction in deer browsing at Long Point, Lake Erie. **Other Observer:** Silke Laucht. **Acknowledgments:** I thank Jon McCracken for project supervision, Jane Bowles and Michael Bradstreet for measuring vegetation parameters, Stu Mackenzie for field assistance, and the Canadian Wildlife Service for financial support.

10. CLIMAX HEMLOCK–WHITE PINE FOREST WITH TRANSITION HARDWOODS

BOSQUE CLIMAX DE PICEA–PINO BLANCO EN TRANSICION A MADERAS DURAS

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Site Number: CT2765008. **Location:** Connecticut; Litchfield Co.; Litchfield; White Memorial Foundation–Catlin Woods; 41°43'N, 73°12'W; Litchfield Quadrangle, USGS. **Continuity:** Established 1965; 39 yr. **Size:** 10.5 ha. **Description of Plot:** See *Aud. Field Notes* 19:594–595 (1965), *J. Field Ornithol.* 67(Suppl.):60 (1996), and *Bird Populations* 8:129–130 (2007). Succession is continuing in the blow-down areas at a rapid pace. **Weather:** Mean start temp., 20.1°C (range 13–28°C). May's mean temperature was 11.3°C (far below average). Mean temperatures in June (20.3°C) and July (21.7°C) were about average. Only two days during this period saw temperatures exceed 32.2°C, while nighttime lows in May dipped below 0°C six times. Rain fell on 17 d in May totaling 11.9 cm (slightly above average), 11 d in June totaling 7.7 cm (about 3 cm below normal), and 15 d in July totaling 15.0 cm (about 2 cm above average). Source: White Memorial's own weather station. **Coverage:** 20.0 h; 12 visits (1 sunrise, 7 sunset); 5, 13, 20, 27 May; 3, 11, 19 June; 1, 11, 20, 26, 31 July; 2005. Maximum number of observers/visit: 3. **Census:** Ovenbird, 15.0 (57; 19FL); Veery, 14.0 (53; 1N,20FL); Black-throated Green Warbler, 11.5 (44; 1N,17FL); Red-eyed Vireo, 10.0 (38; 10FL); Blackburnian Warbler, 7.5 (29; 2FL); Hermit Thrush, 6.0 (23; 1N,14FL); Wood Thrush, 4.0 (15; 4FL); Scarlet Tanager, 3.5 (13; 4FL); Black-capped Chickadee, 3.0 (11; 18FL); Eastern Wood-Pewee, 2.5 (3FL); Great Crested Flycatcher, 2.0; Pine Warbler, 2.0; Mourning Dove, 1.5 (2FL); Blue-headed Vireo, 1.5 (2FL); American Robin, 1.5 (2N,6FL); Yellow-bellied Sapsucker, 1.0; Pileated Woodpecker, 1.0 (2FL); Blue Jay, 1.0 (3FL); Tufted Titmouse, 1.0 (9FL); Winter Wren, 1.0; Yellow-rumped Warbler, 1.0 (1N,3FL); Black-and-white Warbler, 1.0 (2FL); Downy Woodpecker, 0.5; Hairy Woodpecker, 0.5; American Crow, 0.5 (1N,3FL); White-breasted Nuthatch, 0.5; Brown Creeper, 0.5; Gray Catbird, 0.5; Northern Cardinal, 0.5 (2FL); Brown-headed Cowbird, 0.5; Purple Finch, 0.5; American Goldfinch, 0.5; Wild Turkey, +; Eastern Phoebe, +; Red-breasted Nuthatch, +; Magnolia Warbler, +. **Total:** 36 species; 97.5 territories (371/40 ha). **Visitors:** Great Horned Owl, Barred Owl, Canada Warbler. **Remarks:** The number of breeding species dropped to 36 this year; seven fewer than last year and seven fewer than the 10-yr average of 43 species. All of the species that were lost this year were marginal users of the plot, sticking to edges and blow downs. Hence, vegetation succession may have reached a point to render these habitats unsuitable for these species. The only species found this year but missed last year were Eastern Phoebe, Winter Wren, and Magnolia Warbler. No new species were found this year. The number of territories crashed to 97.5 this year from last years 123.5, and the 10-yr average of 124. Since Black-throated Green Warbler declined by 4.5 territories and Blackburnian Warbler declined by 4.5 territories, some of the problem may have been a shortage of caterpillars brought on by May's terrible weather. Ovenbird was the most abundant species this year, followed by Veery. **Other Observers:** John Eykelhoff, Lukas Hyder, Marie Kennedy, Russ Naylor, Bob Stanowski, and Pamela Velez.

11. YOUNG MIXED HARDWOOD–CONIFER STAND

BOSQUE JOVEN–MIXTO DE MADERAS DURAS/RODAL DE CONIFEROS

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Site Number: CT2778262. **Location:** Connecticut; Litchfield Co.; Morris; White Memorial Foundation–Pitch Road; 41°42'N, 73°10'W; Litchfield Quadrangle, USGS. **Continuity:** Established 1978; 28 yr. **Size:** 8.5 ha. **Description of Plot:** See *Am. Birds*

33:72 (1979). The habitat around the perimeter of the plot continues to be destroyed, or at least degraded, by off-road vehicles. Illegal dumping and partying are also occurring frequently. **Weather:** Mean start temp., 21.1°C (range 13–27°C). May's mean temperature was 11.3°C (far below average). Mean temperatures in June (20.3°C) and July (21.7°C) were about average. Only two days during this period saw temperatures exceed 32.2°C, while nighttime lows in May dipped below 0°C six times. Rain fell on 17 d in May totaling 11.9 cm (slightly above average), 11 d in June totaling 7.7 cm (about 3 cm below normal), and 15 d in July totaling 15.0 cm (about 2 cm above average). Source: White Memorial's own weather station. **Coverage:** 12.0 h; 8 visits (1 sunrise, 7 sunset); 26 May; 3, 12, 24 June; 5, 16, 23, 29 July; 2005. **Census:** Veery, 11.5 (54; 4FL); Ovenbird, 11.0 (52; 1N,6FL); Red-eyed Vireo, 8.0 (38; 2FL); Scarlet Tanager, 3.5 (16; 2FL); Yellow-bellied Sapsucker, 3.0 (14); Eastern Wood-Pewee, 3.0 (2FL); Wood Thrush, 3.0; American Robin, 2.5 (4FL); Hermit Thrush, 2.0; Black-capped Chickadee, 1.5 (4FL); Tufted Titmouse, 1.5 (4FL); Gray Catbird, 1.5 (2FL); American Redstart, 1.5 (2FL); Downy Woodpecker, 1.0; Blue Jay, 1.0 (2FL); American Crow, 1.0 (2FL); Black-throated Blue Warbler, 1.0; Black-and-white Warbler, 1.0; Louisiana Waterthrush, 1.0; Northern Cardinal, 1.0 (2FL); American Goldfinch, 1.0; Wild Turkey, 0.5; White-breasted Nuthatch, 0.5; Black-throated Green Warbler, 0.5; Common Yellowthroat, 0.5; Eastern Towhee, 0.5; Rose-breasted Grosbeak, 0.5; Brown-headed Cowbird, 0.5; Red-bellied Woodpecker, +; Hairy Woodpecker, +; Northern Flicker, +; Pileated Woodpecker, +; Great Crested Flycatcher, +; Blue-gray Gnatcatcher, +; Cedar Waxwing, +; Blackburnian Warbler, +; Chipping Sparrow, +; Baltimore Oriole, +. **Total:** 38 species; 65.0 territories (306/40 ha). **Visitors:** Red-tailed Hawk, Chestnut-sided Warbler, Pine Warbler, Canada Warbler, Song Sparrow, Dark-eyed Junco, Purple Finch. **Remarks:** It was another terrible year for birds attempting to breed in this plot. Frequent harassment from off-road vehicles and partiers was the primary problem. Cold, wet weather in May was a secondary problem. Consequently, the number of breeding species recorded dropped to 38 from last years 40 and the 10-yr average of 44 species. The only species found on territory here this year but not last year were Hairy and Pileated woodpeckers. The number of territories found this year declined to 65.0, which is the second lowest ever found in this plot. The lowest was 42.5 in 1979. The 10-yr average is 88 territories, declining for the second year. Species declining the most this year were Red-eyed Vireo and Wood Thrush (each –2.0 territories). A total of 13 species exhibited decreases in numbers this year, and three were lost entirely. Species that increased in number this year included Veery (+1.0; now the most abundant bird), Eastern Wood-Pewee (+1.5), and Yellow-bellied Sapsucker (+0.5). **Other Observers:** Lukas Hyder, Russ Naylor, and Ed Yescott. **Acknowledgments:** Marie Kennedy was very helpful in compiling this year's Breeding Bird Census data.

12. RIPARIAN WOODLAND
ARBOLADO RIVEREÑO

SCOTT R. ROBINSON
Bureau of Land Management
3815 N. Schreiber Way
Coeur d'Alene ID 83815

Location: Idaho; Kootenai Co.; Coeur d'Alene; Blackwell Island; 47°41'N, 116°48'W; Coeur d'Alene Quadrangle, USGS. **Continuity:** Established 1997; 9 yr. **Size:** 8.9 ha. **Description of Plot:** See 1997 BBC report (unpublished) and *Bird Populations* 7:106 (2006) and 7:123 (2006). This is the third year post construction of the day-use recreation site. **Weather:** Mean start temp., 10.7°C (range 5–19°C). No flooding this year. This year's mosquito hatch between 16 and 22 June was the same time period as last year. **Coverage:** 14.0 h; 10 visits (10 sunrise); 3, 11, 18, 25, 31 May; 8, 16, 22, 29 June; 6 July; 2005. **Census:** American Robin, 6.5 (29); Yellow Warbler, 6.0 (27); Tree Swallow, 4.0 (18); Gray Catbird, 3.0 (13); Song Sparrow, 3.0; Mallard, 2.0; Ring-necked Pheasant, 2.0; Spotted Sandpiper, 2.0; Black-capped Chickadee, 2.0; Cedar Waxwing, 2.0; Red-winged Blackbird, 2.0; Brown-headed Cowbird, 2.0; Mourning Dove, 1.0; Calliope Hummingbird, 1.0; Downy Woodpecker, 1.0; Northern Flicker, 1.0; Violet-green Swallow, 1.0; European Starling, 1.0; Chipping Sparrow, 1.0; Black-headed Grosbeak, 1.0. **Total:** 20 species; 44.5 territories (200/40 ha). **Visitors:** Canada Goose, Wood Duck, Gadwall, Common Merganser, California Quail, Double-crested Cormorant, Great Blue Heron, Osprey, Bald Eagle, Red-tailed Hawk, Killdeer, Ring-billed Gull, Red-naped Sapsucker, Western Wood-Pewee, American Crow, Common Raven, Pygmy Nuthatch, Nashville Warbler, Yellow-rumped Warbler, Common Yellowthroat, Bullock's Oriole, House Finch, American Goldfinch.

13. RIPARIAN SCRUB BASIN
CUENCA CON MATORRAL RIBEREÑO

MELODY AIMAR
Santa Ana Watershed Association
25864-K Business Center Drive
Redlands CA 92374

Location: California; Riverside Co.; Riverside; Mockingbird Canyon; 33°53'33"N, 117°24'47"W; Riverside West Quadrangle, USGS. **Continuity:** Established 2004; 2 yr. **Size:** 12.7 ha. **Description of Plot:** See *Bird Populations* 8:142–143 (2007). **Weather:**

Mean start temp., 16.7°C (range 12–21°C). Temperatures were mild, as is typical for southern California's Mediterranean climate. There was no precipitation during, or within 24 h of, survey visits. **Coverage:** 22.1 h; 8 visits (0 sunrise, 0 sunset); 2, 10 March; 4, 13, 21 April; 24 May; 2, 30 June; 2005. Maximum number of observers/visit: 3. **Census:** California Towhee, 22.5 (71; 2N,1FL); Song Sparrow, 22.0 (69; 5FL); Bewick's Wren, 15.5 (49; 1N,3FL); Spotted Towhee, 15.5; Anna's Hummingbird, 11.5 (36); California Quail, 11.0 (35; 1N); Lesser Goldfinch, 10.5 (33); Common Yellowthroat, 10.0 (31; 2FL); House Finch, 8.5 (27); Black-headed Grosbeak, 6.5 (20); Bushtit, 5.0 (16; 1N); Black Phoebe, 4.0 (13; 1N); California Thrasher, 4.0; Yellow Warbler, 4.0; Mourning Dove, 3.0 (9); Hooded Oriole, 2.5; Nuttall's Woodpecker, 2.0; Northern Flicker, 2.0; House Wren, 2.0 (1N); Red-tailed Hawk, 1.0 (1N); Killdeer, 1.0 (1N,3FL); Western Scrub-Jay, 1.0; Barn Swallow, 1.0 (1N); Cooper's Hawk, 0.5; Yellow-breasted Chat, 0.5. **Total:** 25 species; 167.0 territories (526/40 ha). **Visitors:** Black-chinned Hummingbird, Ash-throated Flycatcher, Western Kingbird, Least Bell's Vireo, California Gnatcatcher, Northern Mockingbird. **Remarks:** California Towhees and Song Sparrows were the most abundant breeders . The species observed are common and locally abundant with the exception of Yellow Warbler and Yellow-breasted Chat, both of which are of "special concern" in California as defined by the California Department of Fish and Game. Yellow Warbler did not occur on the plot in 2004. The lack of Brown-headed Cowbirds can be explained by a major trapping effort throughout the watershed, including a nearby location. **Acknowledgements:** Special thanks to Gage Canal for site access.

14. STREAMSIDE RIPARIAN WOODLAND I

BOSQUE RIBEREÑO I

TERRY REESER
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Location: California; Orange Co.; Yorba Linda; Featherly Regional Park; 33°52'24"N, 117°42'23"W; Black Star Canyon and Prado Dam Quadrangles, USGS. **Continuity:** Established 2004; 2 yr. **Size:** 17.8 ha. **Description of Plot:** See *Bird Populations* 8:143–144 (2007). High river flows caused by winter and spring rains and by emergency water releases from Prado Dam changed the river route at the upstream end of the plot and scoured the understory and some trees from roughly 30% of the plot. Adjustments made to the plot because of the river realignment accounted for an increase in size of 1.4 hectares. **Weather:** Mean start temp., 23.0°C (range 17–38°C). Temperatures were mild, as typical for southern California's Mediterranean climate. Source: National Weather Service. **Coverage:** 26.5 h; 6 visits (0 sunrise, 0 sunset); 3, 17 March; 29 April; 1, 2 June; 21 July; 2005. **Census:** Song Sparrow, 16.5 (37); Common Yellowthroat, 11.0 (25); Bewick's Wren, 10.0 (22); House Wren, 10.0 (2N,3FL); Yellow Warbler, 7.5 (17; 1N); Anna's Hummingbird, 5.0 (11); Nuttall's Woodpecker, 5.0; Least Bell's Vireo, 5.0 (3N,3FL); Spotted Towhee, 5.0; Black Phoebe, 4.0 (9); Wrentit, 3.0 (7); California Towhee, 3.0; Mallard, 2.0 (12FL); Bushtit, 2.0 (1N,1FL); Wood Duck, 1.0 (7FL); Downy Woodpecker, 1.0; Ash-throated Flycatcher, 1.0 (1N); Western Scrub-Jay, 1.0; Tree Swallow, 1.0 (1N); Red-shouldered Hawk, 0.5; Black-headed Grosbeak, 0.5. **Total:** 21 species; 95.0 territories (213/40 ha). **Visitors:** California Quail, Cooper's Hawk, Red-tailed Hawk, Mourning Dove, Greater Roadrunner, White-throated Swift, Black-chinned Hummingbird, Say's Phoebe, American Crow, Northern Rough-winged Swallow, Oak Titmouse, California Thrasher, Yellow-breasted Chat, Blue Grosbeak, Hooded Oriole, Bullock's Oriole, House Finch, Lesser Goldfinch, American Goldfinch. **Remarks:** The breeding bird community includes riparian, coastal sage, and chaparral species. The endangered Least Bell's Vireo and two species on California's "special concern" list (defined by California Department of Fish and Game), Yellow Warbler and Yellow-breasted Chat (visitor), bred on the plot along with other species of local concern such as Downy Woodpecker. Two pairs of Red-shouldered Hawks probably used the plot. Accurate counts were slightly hindered because I could only survey one side of the river. The high river flows and the resulting loss of vegetation may have been a factor in lowering the overall observations from 28 species and 228.5 territories for 2004 to 21 species and 95.0 territories for 2005. Nest monitoring for the Least Bell's Vireo and winter bird surveys take place on the plot. **Acknowledgements:** I thank Harbors, Beaches, and Parks Resources and Development Department, County of Orange, for site access and its continuing logistical support.

15. STREAMSIDE RIPARIAN WOODLAND III

BOSQUE RIBEREÑO III

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Location: California; Riverside Co.; Redlands; San Timoteo Canyon; 33°59'5"N, 117°7'45"W; Sunnymead Quadrangle, USGS. **Continuity:** Established 2004; 2 yr. **Size:** 12.3 ha. **Description of Plot:** See *Bird Populations* 8:144–145 (2007). Approximately 0.7 ha was not included from the original plot that was

surveyed in 2004. The area is located on a low-lying terrace on the north side of the creek and is comprised of sparse vegetation not characteristic of streamside riparian woodland. This plot has been undergoing passive restoration for four years after the removal of invasive *Arundo donax* from approximately 50% of the plot. **Weather:** Mean start temp., 18.3˚C (range 12–26˚C). Temperatures were mildly warm, as typical for southern California's Mediterranean climate. Source: data were obtained by using a Kestrel weather meter. **Coverage:** 19.1 h; 8 visits (1 sunrise, 0 sunset); 8, 30 March; 29 April; 19, 27 May; 14, 30 June; 8 July; 2005. Maximum number of observers/visit: 3. **Census:** Bewick's Wren, 19.0 (62); House Wren, 16.5 (54); Song Sparrow, 16.5; Northern Rough-winged Swallow, 12.0 (39); Spotted Towhee, 8.5 (28); California Towhee, 6.0 (20); Lesser Goldfinch, 5.0 (16); Black Phoebe, 4.5 (15); Nuttall's Woodpecker, 4.0 (13); Least Bell's Vireo, 4.0 (4N,4FL); House Finch, 3.5 (11); Mourning Dove, 3.0 (10); Barn Owl, 3.0; Common Yellowthroat, 3.0; American Goldfinch, 3.0; Oak Titmouse, 2.5; Black-chinned Hummingbird, 2.0; Bushtit, 2.0; Yellow-breasted Chat, 2.0; Downy Woodpecker, 1.5; Ash-throated Flycatcher, 1.5; Red-shouldered Hawk, 1.0; Anna's Hummingbird, 1.0; Northern Flicker, 1.0; Common Raven, 1.0; Western Bluebird, 1.0; European Starling, 1.0; Brown-headed Cowbird, 1.0; Cooper's Hawk, 0.5; Western Kingbird, 0.5; Blue Grosbeak, 0.5; Bullock's Oriole, 0.5. **Total:** 32 species; 132.0 territories (429/40 ha). **Visitors:** Mallard, Great Blue Heron, Red-tailed Hawk, Killdeer, Greater Roadrunner, American Crow, Barn Swallow, California Thrasher, Yellow Warbler, Red-winged Blackbird. **Remarks:** Thirty-two species bred on this plot. Four nests of the endangered Least Bell's Vireo were found, but all failed. Two vireo nests were parasitized by Brown-headed Cowbirds. Four vireo fledglings were detected. Cowbird trapping took place just off of the plot. Other breeding species that have exhibited declines and are of state or local concern include Downy Woodpecker and Yellow-breasted Chat. Raptor use on and near the plot and the presence of cavity nesters continues. These data represent minimum numbers given that territories were determined based on 4–6 registrations. Winter bird surveys are also conducted on this plot. **Other Observers:** Dick Zembal, Bonnie Nash, and Melody Aimar. **Acknowledgements:** Special thanks to the U.S. Army Corps of Engineers for providing funding for the surveys.

16. FOREST WETLAND AND BORDERING CLIFF AND TALUS

ANEGADO FORESTADO Y FARALLONES Y TALUDES QUE LO BORDEAN

LYNN BOWDERY, ALLAN BOWDERY, TOM SARRO, LIN FAGAN & RUTH ELWELL
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Daniel Smiley Research Center
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Location: New York; Ulster Co.; Rochester; Sleepy Hollow; 41°46'N, 74°11'W; Mohonk Lake Quadrangle, USGS. **Continuity:** Established 1995; 3 yr. **Size:** 22.3 ha. **Description of Plot:** See *J. Field Ornithol.* 67(Suppl.):71–72 (1996). **Weather:** Mean start temp., 16.5°C (range 10–24°C). It started out foggy on the 5/27, 6/2, and 6/16 visits; it cleared on 5/27 and 6/2, but it turned to rain on 6/16. May average temperature was 13°C (1.6°C below the 105-yr average). June average temperature was 23°C (6.8°C above the 105-yr average). Precipitation in May totalled 5.36 cm (5.41 cm below the 105-yr average), and in June 7.16 cm (2.87 cm below the 105-yr average). Source: Mohonk Lake Weather Station. **Coverage:** 27.2 h; 13 visits (11 sunrise, 1 sunset); 17, 25, 27, 31 May; 2, 5, 9, 13, 16, 20, 23, 27 June; 5 July; 2005. Maximum number of observers/visit: 5. **Census:** Black-and-white Warbler, 6.0 (11); Worm-eating Warbler, 4.5 (8); Ovenbird, 4.5; Black-throated Blue Warbler, 4.0 (7); Indigo Bunting, 3.5 (6); Eastern Wood-Pewee, 3.0 (5); Eastern Phoebe, 3.0; Red-eyed Vireo, 3.0; Black-throated Green Warbler, 3.0; Great Crested Flycatcher, 2.0; Blue Jay, 2.0 (1FL); Black-capped Chickadee, 2.0; Scarlet Tanager, 2.0; Eastern Towhee, 2.0; Louisiana Waterthrush, 1.5; Chipping Sparrow, 1.5; Mourning Dove, 1.0; Hairy Woodpecker, 1.0 (1FL); Tufted Titmouse, 1.0; White-breasted Nuthatch, 1.0; Winter Wren, 1.0; Hermit Thrush, 1.0; Wood Thrush, 1.0; Yellow-rumped Warbler, 1.0; Prairie Warbler, 1.0; Yellow-billed Cuckoo, 0.5; Pileated Woodpecker, 0.5; Yellow-throated Vireo, 0.5; American Redstart, 0.5; Common Raven, +. **Total:** 30 species; 58.5 territories (105/40 ha). **Visitors:** Peregrine Falcon, Black-billed Cuckoo, Ruby-throated Hummingbird, Red-bellied Woodpecker, Downy Woodpecker, Acadian Flycatcher, American Crow, American Robin, Cedar Waxwing, Chestnut-sided Warbler, Magnolia Warbler, Blackburnian Warbler, Common Yellowthroat, Swamp Sparrow, Northern Cardinal, Rose-breasted Grosbeak, Brown-headed Cowbird, Baltimore Oriole, American Goldfinch. **Remarks:** The gypsy moth caterpillar population was lower in 2005 than it was in 2000. The trail through

the study area has remained closed. The naturally regrowing vegetation added to the fallen branches from the November 2002 ice storm (which severely damaged the trees at this elevation) made the path challenging to pass along in places. Bear tracks and scat were observed. An all-black morph gray squirrel was seen on several occasions. **Other Observers:** Bea Conover, Jaime Deppen, John Thompson, and Jane Vecchione. **Acknowledgments:** Thanks to the Mohonk Preserve, Inc., including Paul Huth, Director of the Daniel Smiley Research Center of the Mohonk Preserve, for their cooperation.

17. DESERT RIPARIAN–FRESHWATER MARSH
DESIERTO RIVEREÑO–PANTANO

EUGENE A. CARDIFF
San Bernardino County Museum
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Redlands CA 92374

Location: California; San Bernardino Co.; Morongo Valley; Big Morongo Wildlife Reserve; 34°3'N, 116°35'W; Morongo Valley Quadrangle, USGS. **Continuity:** Established 1977; 28 yr. **Size:** 15.4 ha. **Description of Plot:** See *J. Field Ornithol.* 62 (Suppl.):76 (1991), 64 (Suppl.):92–93 (1993), and 65 (Suppl.):106–107 (1994). On 22 June 2005, one-third of the plot burned. The fire also burned a large area of desert scrub and riparian to the south and west of the plot. The fire occurred after this year's survey, so it did not affect reported results. **Weather:** Mean start temp., 11.8°C (range 7–15°C). The plot received 21 cm of rain this year, which is a record. **Coverage:** 28.0 h; 8 visits (8 sunrise); 21 April; 3, 5, 12, 19, 26 May; 1, 9 June; 2005. **Census:** Bewick's Wren, 14.0 (36; 6FL); Spotted Towhee, 14.0; House Wren, 10.0 (26; 1N); Common Yellowthroat, 10.0 (1FL); Song Sparrow, 10.0 (1FL); House Finch, 8.0 (21; 2N,4FL); Lesser Goldfinch, 8.0 (2N,7FL); Verdin, 6.0 (16; 4N,5FL); Yellow-breasted Chat, 5.0 (13; 1N); Bushtit, 4.0 (10; 5FL); Summer Tanager, 4.0; Brown-headed Cowbird, 4.0; Anna's Hummingbird, 3.0 (8; 2N); Costa's Hummingbird, 3.0 (2N,2FL); Nuttall's Woodpecker, 3.0 (2N,1FL); Brown-crested Flycatcher, 3.0 (1N); Virginia Rail, 2.0; Mourning Dove, 2.0; Black Phoebe, 2.0 (2N,5FL); Ash-throated Flycatcher, 2.0 (1N); Bell's Vireo, 2.0 (1N); Western Scrub-Jay, 2.0; California Thrasher, 2.0 (2FL); Phainopepla, 2.0 (1N); California Towhee, 2.0; Hooded Oriole, 2.0 (2N,2FL); Gambel's Quail, 1.0; Cooper's Hawk, 1.0 (1N,2FL); Long-eared Owl, 1.0 (2FL); Western Bluebird, 1.0 (1N); European Starling, 1.0; Lucy's Warbler, 1.0; Yellow Warbler, 1.0; Black-throated Sparrow, 1.0 (1N,3FL); Lawrence's Goldfinch, 1.0 (1N). **Total:** 35 species; 138.0 territories (358/40 ha). **Visitors:** Red-tailed Hawk, Black-chinned Hummingbird, Ladder-backed Woodpecker, Vermilion Flycatcher, Cassin's Kingbird, Western Kingbird, Mountain Chickadee, Black-headed Grosbeak, Bullock's Oriole. **Remarks:** Numbers of breeding birds were higher than recent years as a result of the record rainfall. **Other Observers:** Dori Myers, Alice Ashbaugh, and Dee Zeller. **Acknowledgments:** San Bernardino County Museum, San Bernardino Valley Audubon Society, and Bureau of Land Management.

18. SHRUBBY SWAMP AND SEDGE HUMMOCKS
PANTANO ARBUSTIVO–MOGOTE

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Location: Connecticut; Litchfield Co.; Litchfield; White Memorial Foundation–North Shore Marsh; 41°43'N, 73°13'W; Litchfield Quadrangle, USGS. **Continuity:** Established 1965; 39 yr. **Size:** 8.1 ha. **Description of Plot:** See *Aud. Field Notes* 19:625–627 (1965) and *Bird Populations* 7:125–126 (2006). Succession is continuing; red maple trees, up to 15 cm DBH, now cover almost half of the plot. **Weather:** Mean start temp was 19.6°C (range 9–29°C). May's mean temperature was 11.3°C (far below average). Mean temperatures in June (20.3°C) and July (21.7°C) were about average. Only two days during this period saw temperatures exceed 32.2°C, while nighttime lows in May dipped below 0°C six times. Rain fell on 17 d in May totaling 11.9 cm (slightly above average), 11 d in June totaling 7.7 cm (about 3 cm below normal), and 15 d in July totaling 15.0 cm (about 2 cm above average). Source: White Memorial's own weather station. **Coverage:** 26.0 h; 12 visits (1 sunrise, 3 sunset); 2, 9, 16, 27 May; 6, 13, 20, 28 June; 9, 20, 25, 31 July; 2005. Maximum number of observers/visit: 3. **Census: Swamp** Sparrow, 34.5 (170; 2N,76FL); Red-winged Blackbird, 33.5 (165; 3N,68FL); Yellow Warbler, 26.5 (131; 7N,48FL); Common Yellowthroat, 21.0 (104; 32FL); Gray Catbird, 20.5 (101; 4N,47FL); Song Sparrow, 8.5 (42; 2N,18FL); Common Grackle, 6.5 (32; 1N,17FL); American Goldfinch, 6.0 (30; 1N,10FL); Tree Swallow, 4.0 (20; 3N,17FL); Veery, 4.0 (10FL); Eastern Kingbird, 3.0 (15; 2N,8FL); Black-capped Chickadee, 3.0 (2N,21FL); Baltimore Oriole, 3.0 (1N,6FL); Warbling Vireo, 2.5 (2N,4FL); Cedar Waxwing, 2.5 (1N,6FL); American Redstart, 2.5 (1N,9FL); Tufted Titmouse, 2.0 (10FL); American Robin, 2.0 (1N,6FL); Northern Cardinal, 2.0 (5FL); Mourning Dove, 1.5; Alder Flycatcher, 1.5 (3FL); Least Flycatcher, 1.5; Great Crested Flycatcher, 1.5 (2FL); Blue-gray Gnatcatcher, 1.5 (2FL); Black-and-white Warbler, 1.5 (3FL); Red-bellied Woodpecker, 1.0; Yellow-bellied Sapsucker, 1.0 (2FL); Willow Flycatcher, 1.0 (2FL); White-breasted Nuthatch, 1.0 (5FL); Brown-headed Cowbird, 1.0 (1FL); Canada

Goose, 0.5 (3FL); Mute Swan, 0.5; Mallard, 0.5 (5FL); Great Blue Heron, 0.5; Spotted Sandpiper, 0.5; Downy Woodpecker, 0.5 (1N,3FL); Hairy Woodpecker, 0.5 (2FL); Northern Flicker, 0.5; Pileated Woodpecker, 0.5; Eastern Wood-Pewee, 0.5 (2FL); Yellow-throated Vireo, 0.5; Red-eyed Vireo, 0.5; Chestnut-sided Warbler, 0.5; Northern Waterthrush, 0.5; Rose-breasted Grosbeak, 0.5; American Woodcock, +; Yellow-billed Cuckoo, +; Purple Finch, +. **Total:** 48 species; 209.0 territories (1032/40 ha). **Visitors:** Wood Duck, Ruby-throated Hummingbird, Marsh Wren. **Remarks:** Flooding may have caused nest failures in May, but conditions during the remainder of the season were conducive to high breeding success. The number of breeding species rebounded to 48 (the same number as in 2003). This is five more than were found last year and is well above the 10-yr average of 39 species. Species found this year but not last year included American Woodcock, Yellow-bellied Sapsucker, Pileated Woodpecker, Chestnut-sided Warbler, and Rose-breasted Grosbeak. No species found last year were missed this year. The number of territories this year decreased slightly to 209.0 from 215.5 last year and is well above the 10-year average of 181. Swamp Sparrow remained the most abundant species, and Red-winged Blackbird remained in second place even though they each declined by 0.5 territory. Yellow Warbler remained in third place even though it declined by 3.5 territories. Common Yellowthroat remained in fourth place even though it declined by 2.0 territories. Fifth-place Gray Catbird increased by 2.0 territories. **Other Observers:** John Eykelhoff, Marie Kennedy, and Pamela Velez. **Acknowledgments:** Marie Kennedy provided indispensable help with compiling and computerizing these data.

19. COASTAL SCRUB
MATORRAL COSTANERO

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Petaluma CA 94954

Location: California; Marin Co.; Bolinas; Palomarin Field Station; 37°55'N, 122°45'W; Bolinas Quadrangle, USGS. **Continuity:** Established 1971; 31 yr. **Size:** 8.1 ha. **Description of Plot:** See *Am. Birds* 25:1003–1004 (1971). Succession from coastal scrub to Douglas-fir (*Pseudotsuga menziesii*) forest continues across the plot. **Weather:** Mean start temp., 12.7°C (range 8–18°C). The yearly rain total (1 July 2004–30 June 2005) was 957.4 mm. The 1976–2008 average is 860.7 mm. Rainfall for the study period (1 April–31 July 2005) was 176.5 mm. The 1975–2008 average is 97.2 mm. **Coverage:** 201.6 h; 86 visits (58 sunrise, 0 sunset). 2005. **Census:** Wrentit, 11.0 (54; 14N,23FL); Bewick's Wren, 8.0 (40; 1N,3FL); Spotted Towhee, 7.5 (37; 3N,4FL); Wilson's Warbler, 6.0 (30); Chestnut-backed Chickadee, 4.0 (20); Orange-crowned Warbler, 4.0; Allen's Hummingbird, 3.5 (17); Golden-crowned Kinglet, 3.5; Swainson's Thrush, 3.5; Purple Finch, 3.0 (15); Bushtit, 2.0; White-crowned Sparrow, 2.0 (1N,3FL); Northern Flicker, 1.0; Western Scrub-Jay, 1.0; American Robin, 1.0; Red-tailed Hawk, 0.5; Band-tailed Pigeon, 0.5; Hutton's Vireo, 0.5; Song Sparrow, 0.5. **Total:** 19 species; 63.0 territories (311/40 ha). **Visitors:** None listed. **Remarks:** Number of territories increased 22% from 2004 to 2005. Notable increases were seen in Chestnut-backed Chickadee (1.5 to 4.0 territories) and Golden-crowned Kinglet (0.5 to 3.5 territories). Several species increased from pluses to 1 or 2 full territories. Many species were present in 2004 but not in 2005: California Quail, Mourning Dove, Steller's Jay, Olive-sided Flycatcher, Pacific-slope Flycatcher, Red-breasted Nuthatch, and Dark-eyed Junco. **Other Observer:** Dennis Jongsomjit. **Acknowledgments:** We thank Point Reyes National Seashore for their cooperation. This is PRBO contribution No. 1671.

20. DISTURBED COASTAL SCRUB A
MATORRAL PERTURBADO A

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Location: California; Marin Co.; Bolinas; Palomarin Field Station; 37°55'N, 122°45'W; Bolinas Quadrangle, USGS. **Continuity:** Established 1972; 31 yr. **Size:** 4.7 ha. **Description of Plot:** See *Am. Birds* 26:987–988 (1972). Douglas-fir (*Pseudotsuga menziesii*) on the plot continues to increase in height and density, changing the habitat from coastal scrub to forest. **Weather:** Mean start temp., 12.7°C (range 8–18°C). The yearly rain total (1 July 2004–30 June 2005) was 957.4 mm. The 1976–2008 average is 860.7 mm. Rainfall for the study period (1 April–31 July 2005) was 176.5 mm. The 1975–2008 average is 97.2 mm. **Coverage:** 149.0 h; 52 visits (41 sunrise, 0 sunset). 2005. **Census:** Wilson's Warbler, 5.0 (43); Wrentit, 4.0 (34; 6N,16FL); Spotted Towhee, 3.5 (30; 2N,2FL); Song Sparrow, 3.5 (6N,15FL); Allen's Hummingbird, 3.0 (26); California Quail, 2.5; Bushtit, 2.5; Bewick's Wren, 2.5; American Goldfinch, 2.5; Chestnut-backed Chickadee, 2.0; Swainson's Thrush, 2.0; Orange-crowned Warbler, 2.0; Anna's Hummingbird, 1.5; Purple Finch, 1.5; Mourning Dove, 1.0; Western Scrub-Jay, 1.0; Winter Wren, 1.0; American Robin, 0.5; European Starling, 0.5; Band-tailed Pigeon, +; Northern Flicker, +; Steller's Jay, +; Western Bluebird, +; California Towhee, +; White-crowned Sparrow, +; Dark-eyed Junco, +; Black-headed Grosbeak, +; Brown-headed

Cowbird, +. **Total:** 28 species; 42.0 territories (357/40 ha). **Visitors:** None listed. **Remarks:** Overall territory density increased by 29% from 2004. Species with notable increases from last year include: Wilson's Warbler (2.0 to 5.0 territories), Bewick's Wren (1.0 to 2.5), Orange-crowned Warbler (1.0 to 2.0), Swainson's Thrush (0.5 to 2.0), and Chestnut-backed Chickadee (0.5 to 2.0). No species showed territory density decreases greater than 50%. Winter Wren and European Starling were present in 2005 but not in 2004. This plot is part of a larger study plot, which is surveyed by the same observer. Total hours censusing the plot is typically tallied directly for both the larger area as well as for this plot. This year, however, this was not done; rather, the time spent censusing the entire plot only was recorded along with detailed descriptions of what portion of the total area was covered in a given day. Time spent censusing this plot was determined after the fact by calculating what proportion of the total time was spent in this plot from the area-covered descriptions. **Other Observer:** Dennis Jongsomjit. **Acknowledgments:** We thank Point Reyes National Seashore for their cooperation. This is PRBO contribution No. 1672.

21. DISTURBED COASTAL SCRUB B

MATORRAL PERTURBADO B

KERRY NEIJSTROM & SCOTT JENNINGS
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Location: California; Marin Co.; Bolinas; Palomarin Field Station; 37°55'N, 122°46'W; Bolinas Quadrangle, USGS. **Continuity:** Established 1971; 31 yr. **Size:** 8.1 ha. **Description of Plot:** See *Am. Birds* 25:1002–1003 (1971) and *J. Field Ornithol.* 66(Suppl.):104 (1995). Douglas-fir (*Pseudotsuga menziesii*) trees have continued to grow thicker and taller on the plot. This is especially true in the eastern portion of the plot, where extensive areas are dense forest. **Weather:** Mean start temp., 12.7°C (range 8–18°C). The yearly rain total (1 July 2004–30 June 2005) was 957.4 mm. The 1976–2008 average is 860.7 mm. Rainfall for the study period (1 April–31 July 2005) was 176.5 mm. The 1975–2008 average is 97.2 mm. **Coverage:** 211.3 h; 91 visits (42 sunrise, 0 sunset). 2005. **Census:** American Goldfinch, 9.0 (44; 6N,8FL); Song Sparrow, 8.0 (40; 12N,14FL); Wrentit, 7.5 (37; 9N,18FL); Swainson's Thrush, 7.0 (35); Wilson's Warbler, 7.0; Bewick's Wren, 6.0 (30); Spotted Towhee, 4.5 (22; 6N,2FL); Allen's Hummingbird, 3.5 (17); Anna's Hummingbird, 3.0 (15); Chestnut-backed Chickadee, 3.0; Bushtit, 2.5; Orange-crowned Warbler, 2.5; Purple Finch, 2.5; Winter Wren, 1.5; Mourning Dove, 1.0; Red-tailed Hawk, 0.5; Northern Flicker, 0.5; Western Scrub-Jay, 0.5; American Robin, 0.5; European Starling, 0.5; White-crowned Sparrow, 0.5; Brown-headed Cowbird, 0.5. **Total:** 22 species; 72.0 territories (356/40 ha). **Visitors:** None listed. **Remarks:** Territory density increased 33% from 2004. In general, territory density for most species was constant . Notable increases were seen in Wilson's Warbler (3.5 to 7.0 territories), Swainson's Thrush (4.0 to 7.0), and Bushtit (0.5 to 2.5). Red-tailed Hawk and Winter Wren were present in 2005 but not in 2004, but it is very unlikely that Red-tailed Hawk had a nested on the plot. Steller's Jay, Downy Woodpecker, Golden-crowned Kinglet, and California Towhee were present in 2004 but not in 2005. **Other Observer:** Dennis Jongsomjit. **Acknowledgments:** We thank Point Reyes National Seashore for their cooperation. This is PRBO contribution No. 1673.

Bird Populations 9:187-197

BREEDING BIRD CENSUS: 2006

1. MIXED HARDWOOD POLETIMBER
BOSQUE MIXTO MADERERO

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Site Number: CT1265009. **Location:** Connecticut; Litchfield Co.; Litchfield; White Memorial Foundation–Wheeler Hill; 41°42'N, 73°13'W; Litchfield Quadrangle, USGS. **Continuity:** Established 1965; 40 yr. **Size:** 8.5 ha. **Description of Plot:** See *Aud. Field Notes* 19:609–610 (1965), *J. Field Ornithol.* 64(Suppl.):36 (1993), and *Bird Populations* 8:125 (2007). White-tailed deer are ravaging the native ground cover, and succession is continuing among the tree component of the vegetation. Non-native, invasive species of shrubs (especially Japanese barberry) and vines (Asiatic bittersweet) are becoming increasingly dense. **Weather:** Mean start temp., 18.3°C (range 11–24°C). This year's weather was extremely wet from early May through late August. The wet conditions produced lush, green plant growth that provided excellent cover for nesting birds, plus an abundance of berries and insects for them to eat and feed to their young. Rainfall was well above average in May, June, and July: 17 wet days in May totaling 20.1 cm,20 d in June with total measuring 30.5 cm, and 13 d in July totaling 16.1 cm. May's mean temperature was 13.3°C (below average). Mean temperatures in June (19.3°C) and July (22.4°C) were about average. Source: White Memorial's own weather station. **Coverage:** 19.0 h; 10 visits (1 sunrise, 5 sunset); 5, 16, 23, 30 May; 9, 16, 27 June; 6, 14, 24 July; 2006. **Census:** Red-eyed Vireo, 12.5 (59; 6FL); Veery, 12.0 (56; 12FL); Ovenbird, 11.5 (54; 1N,7FL); Gray Catbird, 11.0 (52; 3N,17FL); Eastern Towhee, 10.5 (49; 2N,17FL); American Redstart, 9.5 (45; 1N,21FL); Common Yellowthroat, 8.0 (38; 10FL); Wood Thrush, 5.0 (24; 2FL); Northern Cardinal, 5.0 (1N,8FL); Black-capped Chickadee, 4.5 (21; 2N,27FL); Chestnut-sided Warbler, 4.5 (4FL); Tufted Titmouse, 4.0 (19; 16FL); American Robin, 3.5 (16; 1N,12FL); Yellow Warbler, 3.5 (2N,8FL); Black-and-white Warbler, 2.5 (5FL); American Goldfinch, 2.5; American Crow, 2.0 (1N,7FL); Scarlet Tanager, 2.0; Baltimore Oriole, 2.0 (1N,3FL); Downy Woodpecker, 1.5 (2FL); Blue Jay, 1.5 (3FL); White-breasted Nuthatch, 1.5 (8FL); Red-bellied Woodpecker, 1.0; Eastern Wood-Pewee, 1.0; House Wren, 1.0 (1N,5FL); Blue-gray Gnatcatcher, 1.0; Song Sparrow, 1.0 (3FL); Rose-breasted Grosbeak, 1.0; Mourning Dove, 0.5; Yellow-bellied Sapsucker, 0.5; Hairy Woodpecker, 0.5; Eastern Phoebe, 0.5 (1N); Great Crested Flycatcher, 0.5; European Starling, 0.5 (1N,4FL); Cedar Waxwing, 0.5; Blue-winged Warbler, 0.5; Red-winged Blackbird, 0.5; Common Grackle, 0.5; House Finch, 0.5 (3FL); Wild Turkey, +; Cooper's Hawk, +; Red-tailed Hawk, +; Barred Owl, +; Northern Flicker, +; Pileated Woodpecker, +; Yellow-throated Vireo, +; Warbling Vireo, +; Fish Crow, +; Brown-headed Cowbird, +; Purple Finch, +. **Total:** 50 species; 132.0 territories (621/40 ha). **Visitors:** Black-billed Cuckoo, Eastern Kingbird. **Remarks:** The number of species breeding in the plot, 50, decreased by 1 from last year. The 10-yr average is 44 species. Cooper's and Red-tailed hawks, Pileated Woodpecker, Yellow-throated Vireo, Red-winged Blackbird, and Common Grackle were all displaying some territoriality this year, but not last year. Species missed this year but found last year included Broad-winged Hawk, Ruby-throated Hummingbird, Carolina Wren, Hermit Thrush, Magnolia Warbler, and Chipping Sparrow. All but Chipping Sparrow (which was 0.5) were pluses last year. The total number of territories found increased to 132.0 from 124.5 last year which is well above the 10-yr average of 112 territories, and is the sixth above-average year in a row. Red-eyed Vireo declined in number again, but only by 1.0 territory, and remained the most abundant species. Veery declined by 0.5 territories, but moved up to second place. Ovenbird dropped to third place, because it declined by 1.5 territories this year. Gray Catbird remained in fourth place, and Eastern Towhee moved into fifth place with an increase of 3.5 territories. Most birds trying to nest on or close to the ground weren't particularly successful due to the resultant flooding. Those that nested in trees or shrubs fared much better. **Other Observers:** John Eykelhoff and Margaret Sellers. **Acknowledgments:** Marie Kennedy helped compile and computerize the data.

BREEDING BIRD CENSUS: 2006

2. SECOND-GROWTH HARDWOOD FOREST
BOSQUE SECUNDARIO DE MADERAS DURAS

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Site Number: CT2765006. **Location:** Connecticut; Litchfield Co.; Morris; White Memorial Foundation–Van Winkle Road; 41°42'N, 73°12'W; Litchfield Quadrangle, USGS. **Continuity:** Established 1965; 40 yr. **Size:** 10.1 ha. **Description of Plot:** See *Aud. Field Notes* 19:590–591 (1965), *J. Field Ornithol.* 64(Suppl.):37–38 (1993), and *Bird Populations* 8:126 (2007). A substantial amount of siltation has occurred in the seasonal steams that pass through the plot. **Weather:** Mean start temp., 18.5°C (range 10–25°C). This year's weather was extremely wet from early May through late August. The wet conditions did produce lush, green plant growth that provided excellent cover for nesting birds, plus an abundance of berries and insects for them to eat and feed to their young. Rainfall was well above average in May, June, and July: 17 d in May with rain totaling 20.1 cm, 20 d in June measuring 30.5 cm, and 13 d in July measuring 16.1 cm. May's mean temperature was 13.3°C (below average). Mean temperatures in June (19.3°C) and July (22.4°C) were about average. Source: White Memorial's own weather station. **Coverage:** 14.5 h; 10 visits (0 sunrise, 9 sunset); 4, 15, 22 May; 1, 11, 20, 29 June; 10, 20, 27 July; 2006. **Census:** Veery, 11.0 (44; 6FL); Ovenbird, 10.0 (40; 20FL); Red-eyed Vireo, 9.5 (38; 6FL); Wood Thrush, 4.0 (16); Eastern Wood-Pewee, 3.0 (12); Scarlet Tanager, 3.0; Yellow-bellied Sapsucker, 2.5 (2N,9FL); American Robin, 2.5 (1N,8FL); Black-capped Chickadee, 2.0 (1N,15FL); Tufted Titmouse, 2.0 (4FL); Gray Catbird, 2.0 (3FL); Downy Woodpecker, 1.5 (1N,3FL); Blue Jay, 1.5 (7FL); White-breasted Nuthatch, 1.5 (1N,9FL); Black-and-white Warbler, 1.5; American Redstart, 1.5 (4FL); Red-bellied Woodpecker, 1.0; Hairy Woodpecker, 1.0 (1N,3FL); American Crow, 1.0; Common Yellowthroat, 1.0; Song Sparrow, 1.0 (4FL); Northern Cardinal, 1.0 (2FL); Red-tailed Hawk, 0.5 (1N); Pileated Woodpecker, 0.5; Eastern Phoebe, 0.5 (3FL); Blue-gray Gnatcatcher, 0.5; Cedar Waxwing, 0.5; Louisiana Waterthrush, 0.5; Rose-breasted Grosbeak, 0.5; Brown-headed Cowbird, 0.5 (1FL); Baltimore Oriole, 0.5; American Goldfinch, 0.5; Wild Turkey, +; Broad-winged Hawk, +; Northern Flicker, +; Great Crested Flycatcher, +; Hermit Thrush, +; Chestnut-sided Warbler, +; Black-throated Green Warbler, +. **Total:** 39 species; 70.0 territories (277/40 ha). **Visitors:** Eastern Kingbird, Yellow-throated Vireo, Brown Creeper, Pine Warbler, Canada Warbler, Eastern Towhee, Chipping Sparrow, Purple Finch. **Remarks:** The number of species breeding in the plot increased slightly to 39 from 38 last year; two less than average. The only species found on territory but not last year was Broad-winged Hawk. Three species that were visitors last year were showing some territoriality this year, while three that were territorial last year were visitors this year. Of the three that moved up this year, two went to pluses, and one went to 0.5 territories. The number of territories found in the plot increased slightly to 70.0, two more than last year, but still far below the 10-yr average of 94.5 territories. Veery moved up to first place in abundance, even though its number of territories remained at 11.0. Ovenbird dropped to second place, because its number of territories declined from 12.0 last year to 10.0 this year. Red-eyed Vireo remained in third place despite a decrease of 1.0 territory. Wood Thrush moved up to fourth place this year with an increase of 1.0 territory over last year. Eastern Wood-Pewee also increased by 1.0 territory this year and moved up to fifth place. Most birds trying to nest on or close to the ground weren't particularly successful due to the resultant flooding. Those that nested in trees or shrubs fared much better. **Other Observers:** John Eykelhoff and Lukas Hyder.

3. HARDWOOD SWAMP FOREST
BOSQUE DE MADERAS DURAS PANTANOSO

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Location: South Carolina; Dorchester Co.; Harleyville; Francis Beidler Forest Sanctuary, Four Holes Swamp; 33°11'N, 80°19'W; Pringletown Quadrangle, USGS. **Continuity:** Established 1979; 14 yr. **Size:** 8.1 ha. **Description of Plot:** See *Am. Birds* 34:50 (1980) and *J. Field Ornithol.* 64 (Suppl.):56 (1993). The plot is still recovering from the effects of hurricane Hugo in 1989. Post-hurricane brushiness is thinning as the understory trees grow up and shade the forest floor. Coarse woody debris is breaking down and rotting away, further opening up the forest floor. The plot vegetation was resurveyed in 1996 (unpublished). **Weather:** Mean start temp., 13.6°C (range 10–19°C). Temperatures and water levels were normal. **Coverage:** 13.7 h; 10 visits (10 sunrise); 20, 26, 28 April; 4, 9, 10, 13, 16, 25, 31 May; 2006. **Census:** Blue-gray Gnatcatcher, 23.5 (116); Red-eyed Vireo, 9.0 (44); Prothonotary Warbler, 7.0 (35); Tufted Titmouse, 6.0 (30); Carolina Wren, 5.5 (27); Acadian Flycatcher, 4.0 (20); Northern Parula, 3.5 (17); Great Crested Flycatcher, 3.0 (15); Yellow-billed Cuckoo, 2.0; Red-bellied Woodpecker, 2.0; Yellow-throated Vireo, 2.0; Hooded Warbler, 2.0; Northern Cardinal, 2.0; Red-shouldered Hawk, 1.0; Pileated Woodpecker, 1.0; Yellow-throated Warbler, 1.0; White-eyed Vireo, 0.5; Black-throated Green Warbler, 0.5; Swainson's

BREEDING BIRD CENSUS: 2006

Warbler, 0.5. **Total:** 19 species; 76.0 territories (375/40 ha). **Visitors:** Wood Duck, Yellow-crowned Night-Heron, Chimney Swift, Downy Woodpecker, American Crow, Fish Crow, White-breasted Nuthatch, Wood Thrush, Black-throated Blue Warbler, Pine Warbler, Ovenbird, Summer Tanager, Brown-headed Cowbird. **Other Observers:** Norman Brunswig, Phillip McKnight.

4. MATURE MAPLE–BEECH–BIRCH FOREST
BOSQUE MADURO DE ARCE–HAYA–ABEDUL

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Cleveland TN 37312

Site Number: TN2392102. **Location:** Tennessee; Monroe Co.; Whigg Ridge, Cherokee National Forest; 35°19'36"N, 84°2'30"W; Big Junction Quadrangle, USGS. **Continuity:** Established 1992; 14 yr. **Size:** 10.2 ha. **Description of Plot:** See *J. Field Ornithol.* 64(Suppl.):57–58 (1993) and 66(Suppl.):63 (1995). Hemlock woolly adelgid infestation has affected many Canada hemlocks in the area; tree mortality is underway. **Weather:** Mean start temp., 18.7°C (range 12–29°C). **Coverage:** 13.3 h; 6 visits (4 sunrise, 2 sunset); 27, 28 May; 1, 30 June; 1, 7 July; 2006. **Census:** Veery, 12.0 (47; 1N); Dark-eyed Junco, 11.5 (45; 1FL); Blue-headed Vireo, 8.5 (33); Ovenbird, 5.0 (20; 1N); Blackburnian Warbler, 3.0 (12); Hairy Woodpecker, 1.0; Downy Woodpecker, +; Tufted Titmouse, +. **Total:** 8 species; 41.0 territories (161/40 ha). **Visitors:** Carolina Chickadee, White-breasted Nuthatch, Gray Catbird, Black-throated Blue Warbler. **Remarks:** Flyovers: Chimney Swift, Cedar Waxwing, and American Goldfinch. Fewer than eight visits were accomplished this year. **Other Observers:** David F. Vogt and Hayden Wilson. **Acknowledgments:** We wish to acknowledge the financial and logistical support of the Cherokee National Forest.

5. CLIMAX HEMLOCK–WHITE PINE FOREST WITH TRANSITION HARDWOODS
BOSQUE CLIMAX DE PICEA–PINO BLANCO EN TRANSICION A MADERAS DURAS

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Site Number: CT2765008. **Location:** Connecticut; Litchfield Co.; Litchfield; White Memorial Foundation–Catlin Woods; 41°43'N, 73°12'W; Litchfield Quadrangle, USGS. **Continuity:** Established 1965; 40 yr. **Size:** 10.5 ha. **Description of Plot:** See *Aud. Field Notes* 19:594–595 (1965), *J. Field Ornithol.* 67(Suppl.):60 (1996), and *Bird Populations* 8:129–130 (2007). Succession is continuing in the blow-down areas. **Weather:** Mean start temp., 20.2°C (range 11–26°C). This year's weather was extremely wet from early May through late August. The wet conditions did produce lush, green plant growth that provided excellent cover for nesting birds, plus an abundance of berries and insects for them to eat and feed to their young. Rainfall was well above average in May, June, and July: 17 wet days in May totaling 20.1 cm, 20 in June totaling 30.5 cm, and 13 in July totaling 16.1 cm. May's mean temperature was 13.3°C (below average). Mean temperatures in June (19.3°C) and July (22.4°C) were about average. Source: White Memorial's own weather station. **Coverage:** 21.0 h; 10 visits (1 sunrise, 7 sunset); 5, 18, 25 May; 6, 11, 17, 28 June; 8, 17, 24 July; 2006. Maximum number of observers/visit, 3. **Census:** Veery, 14.5 (55; 14FL); Ovenbird, 12.5 (48; 1N,24FL); Black-throated Green Warbler, 10.5 (40; 9FL); Red-eyed Vireo, 8.0 (30; 8FL); Hermit Thrush, 6.0 (23; 5FL); Wood Thrush, 5.5 (21; 6FL); Blackburnian Warbler, 4.5 (17); Scarlet Tanager, 4.0 (15; 2FL); Black-capped Chickadee, 3.5 (13; 1N,20FL); Great Crested Flycatcher, 3.0 (11; 3FL); Eastern Wood-Pewee, 2.5; Pine Warbler, 2.5 (2FL); Blue-headed Vireo, 2.0 (2FL); Blue Jay, 2.0 (3FL); Yellow-bellied Sapsucker, 1.5 (2FL); American Robin, 1.5 (1N,6FL); Gray Catbird, 1.5 (2FL); Yellow-rumped Warbler, 1.5 (3FL); Purple Finch, 1.5; Great Horned Owl, 1.0 (3FL); Pileated Woodpecker, 1.0 (2FL); American Crow, 1.0 (3FL); Brown Creeper, 1.0; Black-and-white Warbler, 1.0 (2FL); Northern Cardinal, 1.0 (1N,3FL); Wild Turkey, 0.5 (5FL); Red-tailed Hawk, 0.5 (3FL); Mourning Dove, 0.5; Barred Owl, 0.5; Downy Woodpecker, 0.5; Hairy Woodpecker, 0.5 (3FL); Eastern Phoebe, 0.5 (1N,4FL); Tufted Titmouse, 0.5 (4FL); Red-breasted Nuthatch, 0.5; Northern Waterthrush, 0.5; Brown-headed Cowbird, 0.5; Northern Flicker, +; White-breasted Nuthatch, +; American Redstart, +; Common Yellowthroat, +; Canada Warbler, +; Chipping Sparrow, +. **Total:** 42 species; 100.0 territories (381/40 ha). **Visitors:** Broad-winged Hawk, Cedar Waxwing, Magnolia Warbler, Black-throated Blue Warbler, Baltimore Oriole, American Goldfinch. **Remarks:** The number of species found breeding in the plot rebounded to 42 from 36 last year thus returning to the 10-yr average. The number of territories also increased but was 13 below the 10-yr average. Blackburnian Warbler showed a population declines all over southern New England, so its reduction on this plot may be a result of larger scale issues. It is also possible that there was a scarcity of looper caterpillars again this year. The most abundant species was Veery, which increased by 0.5 territories from last year. The second most abundant species was Ovenbird, which declined by 2.5 territories from last year when it was the most

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abundant species. Black-throated Green Warbler remained in third place even though it declined again, this time by 1.0 territory. Most birds trying to nest on or close to the ground weren't particularly successful due to the resultant flooding. Those that nested in trees or shrubs fared much better. **Other Observers:** John Eykelhoff, Mary Gendron, Caitlin MacGintey, Russ Naylor, Margaret Sellers, and Thomas Sellers.

6. YOUNG MIXED HARDWOOD–CONIFER STAND

BOSQUE JOVEN–MIXTO DE MADERAS DURAS/RODAL DE CONIFEROS

DAVID ROSGEN
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Site Number: CT2778262. **Location:** Connecticut; Litchfield Co.; Morris; White Memorial Foundation–Pitch Road; 41°42'N, 73°10'W; Litchfield Quadrangle, USGS. **Continuity:** Established 1978; 29 yr. **Size:** 8.5 ha. **Description of Plot:** See *Am. Birds* 33:72 (1979). Despite stepped-up law enforcement efforts, off-road vehicles continued to destroy the eastern and northeastern portions of the plot this year. Severe flooding along the streams that pass through the plot and in the swamp in its south-central portion altered the vegetation communities. Otherwise, habitat succession is continuing in the upland portions of the plot. **Weather:** Mean start temp., 19.9°C (range 10–26°C). This year's weather was extremely wet from early May through late August. The wet conditions did produce lush, green plant growth that provided excellent cover for nesting birds, plus an abundance of berries and insects for them to eat and feed to their young. Rainfall was well above average in May, June, and July: 17 wet days in May totaling 20.1 cm, 20 d in June totaling 30.5 cm, and 13 d in July totaling 16.1 cm. May's mean temperature was 13.3°C (below average). Mean temperatures in June (19.3°C) and July (22.4°C) were about average. Source: White Memorial's own weather station. **Coverage:** 11.0 h; 8 visits (1 sunrise, 4 sunset); 25 May; 2, 10, 22, 30 June; 10, 20, 31 July; 2006. **Census:** Veery, 11.5 (54; 6FL); Ovenbird, 9.5 (45; 10FL); Red-eyed Vireo, 7.0 (33; 3FL); Wood Thrush, 4.5 (21; 1N,3FL); American Robin, 4.0 (19; 2N,12FL); Scarlet Tanager, 3.5 (16); Hermit Thrush, 3.0 (14; 2FL); Black-capped Chickadee, 2.5 (1N,14FL); Gray Catbird, 2.5 (1N,3FL); Yellow-bellied Sapsucker, 2.0; American Redstart, 2.0; Eastern Wood-Pewee, 1.5; Tufted Titmouse, 1.5 (9FL); White-breasted Nuthatch, 1.5 (4FL); Black-and-white Warbler, 1.5; Downy Woodpecker, 1.0; Great Crested Flycatcher, 1.0; Blue Jay, 1.0 (3FL); American Crow, 1.0 (3FL); Louisiana Waterthrush, 1.0; Common Yellowthroat, 1.0; Northern Cardinal, 1.0 (2FL); Mourning Dove, 0.5; Great Horned Owl, 0.5 (2FL); Red-bellied Woodpecker, 0.5; Pileated Woodpecker, 0.5; Song Sparrow, 0.5; Rose-breasted Grosbeak, 0.5; American Goldfinch, 0.5; Wild Turkey, +; Hairy Woodpecker, +; Eastern Phoebe, +; Blue-gray Gnatcatcher, +; Cedar Waxwing, +; Blackburnian Warbler, +. **Total:** 35 species; 68.5 territories (322/40 ha). **Visitors:** Broad-winged Hawk, Acadian Flycatcher, Yellow-throated Vireo, Brown Creeper, Black-throated Blue Warbler, Canada Warbler, Baltimore Oriole. **Remarks:** It was another terrible year for birds attempting to breed in this plot due to frequent disturbance by off-road vehicles and the resultant habitat destruction. Frequent floods throughout the breeding season were a secondary problem. Consequently, the number of breeding species recorded dropped to 35, which is the lowest it's been since 1984. Last year, 38 species were found and the 10-yr average is 43 species. Species found on territory this year but not last year were Mourning Dove, Great Horned Owl, Eastern Phoebe, and Song Sparrow. Species missed this year but found last year included Northern Flicker, Black-throated Green Warbler, Eastern Towhee, Chipping Sparrow, and Brown-headed Cowbird. The number of territories found increased slightly to 68.5; 3.5 more than last year, but still far less than the 10-yr average of 84.5 territories. Veery was the most abundant species both this year and last year (11.5 territories each year). Ovenbird was the second most abundant species, even though it declined by 1.5 territories this year. **Other Observers:** Lukas Hyder and Russ Naylor. **Acknowledgments:** Margaret Sellers was very helpful in compiling and computerizing this year's data.

7. RIPARIAN WOODLAND

ARBOLADO RIVEREÑO

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Location: Idaho; Kootenai Co.; Coeur d'Alene; Blackwell Island; 47°41'N, 116°48'W; Coeur d'Alene Quadrangle, USGS. **Continuity:** Established 1997; 10 yr. **Size:** 8.9 ha. **Description of Plot:** See 1997 BBC report (unpublished) and *Bird Populations* 7:106 (2006) and 7:123 (2006). This is the fourth year post construction of the day-use recreation site. **Weather:** Mean start temp., 8.5°C (range 0–16°C). No flooding this year. This year's mosquito hatch occurred between visits 7 and 8. **Coverage:** 11.8 h; 8 visits (8 sunrise); 3, 10, 17, 23, 31 May; 7, 15 June; 6 July; 2006. **Census:** Tree Swallow, 6.0 (27); American Robin, 6.0; Yellow Warbler, 4.0 (18); Red-winged Blackbird, 4.0; Brown-headed Cowbird, 4.0; Spotted Sandpiper, 3.0 (13); Black-capped Chickadee, 3.0; Gray Catbird, 3.0;

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European Starling, 3.0; Song Sparrow, 2.5; Mallard, 2.0; Northern Flicker, 2.0; Wood Duck, 1.0; Ring-necked Pheasant, 1.0; Mourning Dove, 1.0; Downy Woodpecker, 1.0; Violet-green Swallow, 1.0; Cedar Waxwing, 1.0; Yellow-rumped Warbler, 1.0; Bullock's Oriole, 1.0. **Total:** 20 species; 50.5 territories (227/40 ha). **Visitors:** Canada Goose, California Quail, Double-crested Cormorant, Great Blue Heron, Bald Eagle, Killdeer, Ring-billed Gull, Calliope Hummingbird, Red-naped Sapsucker, Western Wood-Pewee, American Crow, Pygmy Nuthatch, Common Yellowthroat, Western Tanager, Spotted Towhee, Chipping Sparrow, Black-headed Grosbeak, Yellow-headed Blackbird, House Finch.

8. MIXED UPLAND FOREST
BOSQUE EN ALTURAS MIXTOS

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Site Number: NY1383002. **Location:** New York; Ulster Co.; New Paltz; Duck Pond Watershed; 41°46'N, 74°9'W; Mohonk Lake Quadrangle, USGS. **Continuity:** Established 1975; 8 yr. **Size:** 42.3 ha. **Description of Plot:** See *Am. Birds* 29:1083 (1975) and 38:69 (1984). The plot (shortest side 335 m, longest 915 m) has a closed canopy dominated by red oak, sugar maple, and eastern hemlock. The stand is 61–100 years of age with a mean canopy height of 17 m (range 12–21 m). The understory is dominated by striped maple, sassafras, and witch-hazel. The ground cover is dominated by low blueberry, mountain laurel, and Virginia creeper. There is one permanent stream with a maximum width of 1.5 m and a maximum depth of 0.5 m, and there are also a few ephemeral streams. There is one pond with a maximum diameter of 61 m and a maximum depth of 2 m. Some of the hemlocks have been killed by woolly adelgids, but many still remain. **Edge:** More than 75% of the plot's perimeter is bordered by the same habitat, and the plot lies within a tract of similar habitat >500 ha in size. **Topography and Elevation:** Minimum elevation 183 m, maximum 274 m. **Weather:** Mean start temp., 13.8°C (range 8–20°C). The average temperature for May was 15°C (0.7°C above normal), and precipitation for May was 12.3 cm (1.7 cm above normal). The average temperature for June was 19.5°C (0.6°C above normal), and precipitation for June was 22.2 cm (12.1 cm above normal). Source: Mohonk Lake Cooperative Weather Station (NOAA). **Coverage:** 33.1 h; 13 visits (12 sunrise, 1 sunset); 11, 17, 22, 24, 29, 31 May; 5, 6, 9, 13, 16, 19, 21 June; 2006. Maximum number of observers/visit: 8. **Census:** Ovenbird, 27.0 (26; 1N,1FL); Red-eyed Vireo, 22.0 (21); Wood Thrush, 19.0 (18; 2FL); Scarlet Tanager, 17.0 (16; 1N); Worm-eating Warbler, 12.0 (11; 1FL); Eastern Wood-Pewee, 11.0 (10); Tufted Titmouse, 6.0 (6; 3FL); Gray Catbird, 6.0; Black-and-white Warbler, 5.0 (5); Common Yellowthroat, 5.0; Song Sparrow, 5.0; Louisiana Waterthrush, 4.5 (4; 2FL); Rose-breasted Grosbeak, 4.5; Red-winged Blackbird, 4.0 (4; 3N,2FL); Baltimore Oriole, 3.0 (3); Blue Jay, 2.5; White-breasted Nuthatch, 2.5 (1FL); Indigo Bunting, 2.5; Yellow-billed Cuckoo, 2.0; Red-bellied Woodpecker, 2.0; Yellow-throated Vireo, 2.0; Black-capped Chickadee, 1.5; Pied-billed Grebe, 1.0 (1FL); Wilson's Snipe, 1.0; Downy Woodpecker, 1.0 (1FL); Hairy Woodpecker, 1.0 (1FL); Acadian Flycatcher, 1.0; Eastern Phoebe, 1.0; Great Crested Flycatcher, 1.0; Blue-winged Warbler, 1.0; Black-throated Blue Warbler, 1.0; American Redstart, 1.0; Eastern Towhee, 1.0; Northern Cardinal, 1.0; Brown-headed Cowbird, 1.0; Wild Turkey, 0.5; Pileated Woodpecker, 0.5; American Crow, 0.5; Chipping Sparrow, 0.5; Barred Owl, +; American Robin, +; Black-throated Green Warbler, +; Field Sparrow, +. **Total:** 43 species; 181.0 territories (171/40 ha). **Visitors:** Canada Goose, Wood Duck, Mallard, Great Blue Heron, Green Heron, Red-tailed Hawk, Mourning Dove, Belted Kingfisher, Blue-headed Vireo, Common Raven, Blue-gray Gnatcatcher, Eastern Bluebird, Veery, Cedar Waxwing, Yellow Warbler, Prairie Warbler, Dark-eyed Junco, Common Grackle, American Goldfinch. **Remarks:** The pond is inhabited by many huge snapping turtles; ducks and geese visit but do not breed. The immature grebe was spotted in an area thick with loosestrife, cattails, and other emergent vegetation. **Other Observers:** Elizabeth Moffett, Bea Conover, Ruth Elwell, John Thompson, Mike Schaeffer, Amanda Mitchell, and Peter Rossi. **Acknowledgments:** Thanks for the cooperation of the Mohonk Preserve and the Mohonk Mountain House.

9. INTERGRADING DUNE–SWALE SAVANNAH
SAVANA CON GRADIENTE DE DUNA A CIENAGA

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Port Rowan ON N0E 1M0

Location: Ontario; Municipality of Haldimand-Norfolk; Port Rowan; Long Point National Wildlife Area; 42°32'45"N, 80°4'0"W; Gravelly Bay Quadrangle, DEMR. **Continuity:** Established 1965; 9 yr. **Size:** 11.0 ha. **Description of Plot:** See *Aud. Field Notes* 19:630 (1965), *J. Field Ornithol.* 63(Suppl.):82–83 (1992), 65(Suppl.):85–86 (1994), and 67(Suppl.):65–66 (1996). **Weather:** Mean start temp., 17.9_C (range 15–20_C). **Coverage:** 49.7 h; 11 visits (9 sunrise, 2 sunset); 6, 9, 11, 13, 14, 15, 17, 18, 20, 21, 22 June; 2006. **Census:** Tree Swallow, 9.5 (35; 8N); Chipping Sparrow, 5.0 (18;

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3N,2FL); House Wren, 4.5 (16; 2N); Field Sparrow, 4.0 (15; 3N,2FL); Eastern Kingbird, 2.5 (1N); Northern Mockingbird, 2.5 (2N,2FL); Brown Thrasher, 2.5 (2N); Mourning Dove, 2.0 (2N); Common Grackle, 2.0 (2N,2FL); Red-winged Blackbird, 1.5 (1N); Gray Catbird, 1.0 (1N). **Total:** 11 species, 37.0 territories (135/40 ha). **Visitors:** Killdeer, Yellow-billed Cuckoo, Black-billed Cuckoo, Whip-poor-will, Northern Flicker, Eastern Phoebe, Warbling Vireo, Red-eyed Vireo, Northern Rough-winged Swallow, Cedar Waxwing, Yellow Warbler, Common Yellowthroat, Song Sparrow, Indigo Bunting, Bobolink, Baltimore Oriole, House Finch, American Goldfinch. **Remarks:** This study is part of a long-term project designed to monitor the response of plant and breeding bird communities to a reduction in deer browsing at Long Point, Lake Erie. **Acknowledgments:** I thank Jon McCracken for project supervision, Jane Bowles and Michael Bradstreet for measuring vegetation parameters, Stuart Mackenzie for field assistance, and the Canadian Wildlife Service for permission to access the National Wildlife Area.

10. RIPARIAN SCRUB
MATORRAL RIBEREÑO

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Location: California; Riverside Co.; Norco; Norco Burn; 33°57'29"N, 117°31'56"W; Corona North Quadrangle, USGS. **Continuity:** New. **Size:** 14.6 ha. **Description of Plot:** The plot is located within the Santa Ana River watershed. This section of the Santa Ana River is perennial, and habitat-altering flows are possible depending on local precipitation. The plot is irregularly shaped with shortest side 89 m and longest side 563 m. After a late summer fire in 2003 that burned close to 200 ha of *Arundo donax* dominated riparian habitat, the Santa Ana Watershed Association began to treat the burned *Arundo*, castor bean, and tamarisk. Prior to the fire, *Arundo* dominated the landscape with small to large fragments of the native riparian woodland plants. In 2003, an additional 75 ha of *Arundo* was removed from the surrounding area and a portion of the plot. Currently, the plot is roughly one-third vegetated in native riparian plants in the early seral stages of growth. Native canopy species include Fremont cottonwood and arroyo willow. Understory species include mulefat, arroyo willow, and Fremont cottonwood. Site disturbances include equestrian and ATV use. **Edge:** Between 26 and 50% of the plot's perimeter is bordered by the same habitat, and the plot lies within a tract of similar habitat 101–500 ha in size. The surrounding land use includes a dairy and golf course to the north and northeast. Open water and riparian habitat border the plot to the south, southwest, and southeast. **Topography and Elevation:** The plot is nearly level with a slope of <5%. Minimum elevation 182 m, maximum 186 m. **Weather:** Mean start temp., 18.3°C (range 15–25°C). Temperatures were mild, as typical for southern California's Mediterranean climate. Source: a Kestrel 3000 was used to measure temperature and wind speed. **Coverage:** 16.8 h; 8 visits (0 sunrise, 0 sunset); 16 March; 3, 19 April; 30 May; 9, 20 June; 3, 14 July; 2006. **Census:** Song Sparrow, 17.0 (47; 2N); House Wren, 7.0 (19); Spotted Towhee, 6.0 (16; 1N); Mourning Dove, 5.0 (14); Anna's Hummingbird, 5.0; Least Bell's Vireo, 5.0 (13N,9FL); Common Yellowthroat, 5.0 (1N); Black-headed Grosbeak, 5.0 (1N); California Thrasher, 3.0 (8); Yellow-breasted Chat, 3.0 (1FL); Brown-headed Cowbird, 3.0; Black-chinned Hummingbird, 2.0; Northern Flicker, 2.0; California Towhee, 2.0; American Goldfinch, 2.0 (2N); Black Phoebe, 1.0; Bushtit, 1.0; White-tailed Kite, 0.5 (2FL); Western Bluebird, 0.5. **Total:** 19 species; 75.0 territories (205/40 ha). **Visitors:** California Quail, Cooper's Hawk, Red-tailed Hawk, American Kestrel, Common Ground-Dove, Nuttall's Woodpecker, Downy Woodpecker, Willow Flycatcher, Ash-throated Flycatcher, Cassin's Kingbird, Western Scrub-Jay, Common Raven, Tree Swallow, Barn Swallow, Bewick's Wren, Orange-crowned Warbler, Yellow Warbler, Lincoln's Sparrow, Blue Grosbeak, House Finch, Lesser Goldfinch. **Remarks:** Song Sparrow was the most abundant breeder due to the presence of a dense understory. House Wren was the second most abundant, inhabiting snags produced by the fire that burned the plot in 2003. A White-tailed Kite nest was located off the plot, but the plot was used for foraging by both adults and two juveniles. Species of concern that bred on the plot include Yellow-breasted Chat. A Brown-headed Cowbird trap was present adjacent to the plot for part of the breeding season. This site continues to be treated for *Arundo* re-growth on a yearly basis. In addition to winter and breeding bird surveys, this site is currently being monitored for the nests of the endangered Least Bell's Vireo.

11. RIPARIAN SCRUB BASIN
CUENCA CON MATORRAL RIBEREÑO

MELODY AIMAR
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Location: California; Riverside Co.; Riverside; Mockingbird Canyon; 33°53'33"N, 117°24'47"W; Riverside West Quadrangle, USGS. **Continuity:** Established 2004; 3 yr. **Size:** 12.7 ha. **Description of Plot:** See *Bird Populations* 8:142–143 (2007). **Weather:**

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Mean start temp., 20.0°C (range 11–25°C). Temperatures were mild, as is typical for southern California's Mediterranean climate. There was no precipitation during, or within 24 hours of, survey visits. **Coverage:** 20.2 h; 8 visits (0 sunrise, 0 sunset); 15, 24 March; 25 April; 4 May; 1, 23 June; 5, 21 July; 2006. **Census:** Song Sparrow, 26.5 (83; 1FL); Bewick's Wren, 22.5 (71); California Towhee, 17.0 (54; 1FL); Spotted Towhee, 11.0 (35); Common Yellowthroat, 10.5 (33; 1FL); California Quail, 9.5 (30; 5FL); Anna's Hummingbird, 9.0 (28); Bushtit, 7.0 (22; 1N); Black-headed Grosbeak, 6.0 (19; 1FL); Mourning Dove, 3.0 (9); Nuttall's Woodpecker, 3.0 (1FL); California Thrasher, 3.0; Phainopepla, 3.0 (3FL); Lesser Goldfinch, 3.0 (1FL); American Goldfinch, 3.0 (2FL); House Wren, 2.5; Western Scrub-Jay, 2.0 (1FL); Yellow Warbler, 2.0; Hooded Oriole, 2.0; California Gnatcatcher, 1.5 (1FL); Red-tailed Hawk, 1.0 (1N,3FL); Black-chinned Hummingbird, 1.0; Northern Flicker, 1.0 (1N); Black Phoebe, 1.0; Wrentit, 1.0; House Finch, 1.0 (9FL); Cooper's Hawk, 0.5; Barn Swallow, 0.5 (1N). **Total:** 28 species; 154.0 territories (485/40 ha). **Visitors:** Downy Woodpecker, Ash-throated Flycatcher, Cassin's Kingbird, Least Bell's Vireo, Northern Mockingbird, Bullock's Oriole. **Remarks:** Song Sparrow was the most abundant breeder with 26.5 territories. The species observed during the census are common with the exception of Yellow Warbler and California Gnatcatcher. The actual California Gnatcatcher nest location was probably just off the plot. The Red-tailed Hawk nest was on the plot, but the territory was larger than the plot. The most common and abundant species on the plot was House Finch. There was only evidence of one breeding territory for this species, however. The lack of Brown-headed Cowbirds on the plot can be explained by a major trapping effort throughout the watershed, including a nearby location. **Acknowledgements:** Special thanks to Gage Canal for site access.

12. STREAMSIDE RIPARIAN WOODLAND I

BOSQUE RIBEREÑO I

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Location: California; Orange Co.; Yorba Linda; Featherly Regional Park; 33°52'24"N, 117°42'23"W; Black Star Canyon and Prado Dam Quadrangles, USGS. **Continuity:** Established 2004; 3 yr. **Size:** 17.8 ha. **Description of Plot:** See *Bird Populations* 8:143–144 (2007) and 2005 report (this volume). **Weather:** Mean start temp., 27.8°C (range 19–32°C). Temperatures were mild, as typical for southern California's Mediterranean climate. Source: National Weather Service. **Coverage:** 38.8 h; 8 visits (0 sunrise, 0 sunset); 15 March; 19 April; 17 May; 21 June; 7, 12, 17, 19 July; 2006. **Census:** Common Yellowthroat, 22.0 (49); Song Sparrow, 22.0; Bewick's Wren, 15.0 (34; 1FL); Yellow Warbler, 14.0 (31); Anna's Hummingbird, 13.0 (29; 1N,1FL); House Wren, 11.0 (3N,2FL); Nuttall's Woodpecker, 10.0 (22); Spotted Towhee, 8.0 (18); Black Phoebe, 6.0 (13); Least Bell's Vireo, 6.0 (3N,6FL); Wrentit, 5.0 (11); Bushtit, 4.0 (9; 1N); Black-headed Grosbeak, 4.0; California Towhee, 3.0 (7); Mallard, 2.0 (2FL); Mourning Dove, 2.0; American Crow, 2.0; California Thrasher, 2.0; Cooper's Hawk, 1.0; Killdeer, 1.0; Downy Woodpecker, 1.0; Ash-throated Flycatcher, 1.0; Yellow-breasted Chat, 1.0; Red-shouldered Hawk, 0.5. **Total:** 24 species; 156.5 territories (352/40 ha). **Visitors:** California Quail, Red-tailed Hawk, American Kestrel, Black-chinned Hummingbird, Belted Kingfisher, Acorn Woodpecker, Northern Flicker, Say's Phoebe, Western Kingbird, Western Scrub-Jay, Common Raven, Tree Swallow, Northern Rough-winged Swallow, Northern Mockingbird, Phainopepla, Blue Grosbeak, Red-winged Blackbird, Hooded Oriole, House Finch, Lesser Goldfinch. **Remarks:** The breeding bird community includes riparian, coastal sage, and chaparral species. The endangered Least Bell's Vireo and two listed as California "species of concern" (as defined by California Department of Fish and Game), Yellow Warbler and Yellow-breasted Chat, bred on the plot along with other species of concern such as Downy Woodpecker. The mature stands of cottonwood and black willow throughout the plot benefit many species observed including Yellow Warbler, Nuttall's Woodpecker, and Downy Woodpecker. Two pairs of Red-shouldered Hawks probably used this plot. The census was hindered because it was only possible to survey one side of the river. Nest monitoring for Least Bell's Vireo and winter bird surveys take place on the plot. **Acknowledgements:** I thank Harbors, Beaches, and Parks Resources and Development Department, County of Orange, for site access and its continuing logistical support.

13. STREAMSIDE RIPARIAN WOODLAND III

BOSQUE RIBEREÑO III

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Location: California; Riverside Co.; Redlands; San Timoteo Canyon; 33°59'5"N, 117°7'45"W; Sunnymead Quadrangle, USGS. **Continuity:** Established 2004; 3 yr. **Size:** 12.3 ha. **Description of Plot:** See *Bird Populations* 8:144–145 (2007) and 2005 report (this volume). **Weather:** Mean start temp., 24.0°C (range 13–33°C). Temperatures were warm, as typical for southern California's Mediterranean climate. Source: the

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Western Regional Climate Center for Beaumont, CA. **Coverage:** 27.0 h; 9 visits (0 sunrise, 0 sunset); 22 March; 12, 24 April; 3, 11, 18, 24 June; 2, 4 July; 2006. **Census:** Song Sparrow, 18.5 (60); Northern Rough-winged Swallow, 14.0 (46); Bewick's Wren, 13.5 (44); House Wren, 13.0 (42); Lesser Goldfinch, 13.0; Spotted Towhee, 11.0 (36); California Towhee, 9.0 (29); Common Yellowthroat, 8.0 (26); American Goldfinch, 7.0 (23); Mourning Dove, 6.0 (20); Anna's Hummingbird, 6.0; Bushtit, 6.0; Black Phoebe, 3.0 (10); Least Bell's Vireo, 3.0 (4N,2FL); Oak Titmouse, 3.0; House Finch, 3.0; Barn Owl, 2.0; Nuttall's Woodpecker, 2.0; Red-shouldered Hawk, 1.0; Black-chinned Hummingbird, 1.0; Downy Woodpecker, 1.0; Ash-throated Flycatcher, 1.0; Common Raven, 1.0; Western Bluebird, 1.0; European Starling, 1.0; Brown-headed Cowbird, 1.0; White-tailed Kite, 0.5; Red-tailed Hawk, 0.5; Orange-crowned Warbler, 0.5; Yellow Warbler, 0.5; Blue Grosbeak, 0.5. **Total:** 31 species; 151.5 territories (493/40 ha). **Visitors:** California Quail, Cooper's Hawk, American Kestrel, Killdeer, Greater Roadrunner, Northern Flicker, Pacific-slope Flycatcher, Western Scrub-Jay, American Crow, Wrentit, Phainopepla, Yellow-breasted Chat, Red-winged Blackbird, Bullock's Oriole. **Remarks:** Thirty-one species bred on this plot that has been undergoing passive restoration for five years after the removal of invasive *Arundo donax* from approximately 50% of the plot. The three male endangered Least Bell's Vireos detected were paired. Other breeding species that have exhibited declines and are of state or local concern include Downy Woodpecker and Yellow Warbler. The White-tailed Kite roosted in the plot and foraged in the grassland just off the plot. Cowbird trapping took place just off of the plot. Winter bird surveys are also conducted on this plot. These data represent minimum numbers given that territories were determined based on 4–6 registrations. **Other Observers:** Linette Lina and Melody Aimar. **Acknowledgements:** Special thanks to the U.S. Army Corps of Engineers for providing funding for the surveys.

14. FIELD, RIDGE, SHRUBBY TREES, AND WOODS

CAMPOS, COLINAS, ARBUSTOS Y BOSQUES

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Location: Ontario; Municipality of Hamilton-Wentworth; Dundas; Dundas Valley Plot #1; 43°15'N, 79°54'W. **Continuity:** Established 1994; 11 yr. **Size:** 5.8 ha. **Description of Plot:** See *J. Field Ornithol.* 60(Suppl.):14 (1989), 66(Suppl.):27–28 (1995), and 67(Suppl.):73–74 (1996). **Weather:** Mean start temp., 24.0°C (range 19–29°C). Average temperatures from May through July were 5.2% above the 30-year norm. Below normal rainfall (–36%) for May and June likely negatively impacted breeding numbers. Overall, rainfall was 9.1% above the norm for the 3-mo study period. Source: Environment Canada. **Coverage:** 12.1 h; 8 visits (0 sunrise, 2 sunset); 3, 24, 31 May; 7, 22, 28 June; 5, 13 July; 2006. **Census:** Yellow Warbler, 30.0 (207); Gray Catbird, 27.0 (186); Northern Cardinal, 7.0 (48); Indigo Bunting, 4.0 (28); Willow Flycatcher, 3.0 (21); American Robin, 3.0; Field Sparrow, 3.0; Song Sparrow, 3.0; American Goldfinch, 3.0; Yellow-billed Cuckoo, 2.0; Black-capped Chickadee, 2.0; Baltimore Oriole, 2.0; Blue Jay, 1.0 (2FL); House Wren, 1.0 (2FL); Wood Thrush, 1.0; Eastern Towhee, 1.0. **Total:** 16 species; 93.0 territories (641/40 ha). **Visitors:** Sharp-shinned Hawk, Cooper's Hawk, Ruby-throated Hummingbird, Downy Woodpecker, Northern Flicker, Great Crested Flycatcher, Red-eyed Vireo, European Starling, Blue-winged Warbler, Chestnut-sided Warbler, American Redstart, Common Yellowthroat, Rose-breasted Grosbeak, Common Grackle, Brown-headed Cowbird. **Remarks:** The near record below normal rainfall (–36%) for May and June, and ongoing vegetative succession (two sizable areas in the once more open south sector now feature dense canopies), may account for the lowest number of territorial males (93) recorded in 16 years. Warblers, seedeaters, and icterids were well below respective 11-yr means (–28%). The three territorial Song Sparrows were nine birds below average. Mimids, flycatchers, and thrushes held their own or exceeded averages with the three Willow Flycatchers making a welcome reappearance after a three-year absence (as did Yellow-billed Cuckoos). The 16 breeding species noted were 2.5 species under the mean.

15. SEDGE–TAMARACK DUNE POND

DUNA DE ESPARGANIO–LARICE AMERICANO

MIKE BOYD
Bird Studies Canada
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Port Rowan ON N0E 1M0

Location: Ontario; Municipality of Haldimand-Norfolk; Port Rowan; Long Point National Wildlife Area; 9.0 km W of Long Point Lighthouse; 42°32'54"N, 80(9'45"W; Little Creek Ridges Quadrangle, DEMR. **Continuity:** Established 1978; 5 yr. **Size:** 10.0 ha. **Description of Plot:** See *Am. Birds* 33:103–104 (1979), *J. Field Ornithol.* 63(Suppl.):93–94 (1992) and 65(Suppl.):103 (1994). **Weather:** Mean start temp., 21.3°C (range 20–23°C). **Coverage:** 39.5 h; 10 visits (8 sunrise, 2 sunset); 6, 8, 13, 15, 17, 18, 20, 22, 23, 28 June; 2006. **Census:** Red-winged Blackbird, 30.0 (120; 11N); Yellow Warbler, 15.5 (62; 1N); Common Yellowthroat, 11.0 (44); Song Sparrow, 9.5 (38); Eastern Kingbird, 5.0 (20; 5N); House Wren, 5.0 (5N); Baltimore Oriole, 3.5 (14; 2N); Chipping Sparrow, 3.0 (12); Mourning Dove, 2.5 (1N); Tree Swallow, 2.5 (1N); Eastern Towhee, 2.0;

BREEDING BIRD CENSUS: 2006

Field Sparrow, 2.0; Swamp Sparrow, 2.0; Eastern Wood-Pewee, 1.5; Red-eyed Vireo, 1.5; American Robin, 1.5; Hooded Merganser, 1.0; Pied-billed Grebe, 1.0; Least Flycatcher, 1.0; Warbling Vireo, 1.0; Black-capped Chickadee, 1.0; Common Grackle, 1.0; Great Crested Flycatcher, 0.5; Northern Rough-winged Swallow, 0.5; Whip-poor-will, +. **Total:** 25 species, 105.0 territories (420/40 ha). **Visitors:** Canada Goose, Mallard, Cooper's Hawk, Killdeer, Yellow-billed Cuckoo, Ruby-throated Hummingbird, Belted Kingfisher, Downy Woodpecker, Hairy Woodpecker, Northern Flicker, Blue Jay, Gray Catbird, Northern Mockingbird, Brown Thrasher, Cedar Waxwing, Orchard Oriole, American Goldfinch. **Remarks:** This study is part of a long-term project designed to monitor the response of plant and breeding bird communities to a reduction in deer browsing at Long Point, Lake Erie. **Other Observers:** Simone Immler and Stuart Mackenzie. **Acknowledgments:** Thanks to Jon McCracken for project supervision, Jane Bowles and Michael Bradstreet for measuring vegetation parameters, Stuart Mackenzie for field assistance, and the Canadian Wildlife Service for permission to access the National Wildlife Area.

16. DESERT RIPARIAN–FRESHWATER MARSH

DESIERTO RIVEREÑO–PANTANO

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Location: California; San Bernardino Co.; Morongo Valley; Big Morongo Wildlife Reserve; 34°3'N, 116°35'W; Morongo Valley Quadrangle, USGS. **Continuity:** Established 1977; 29 yr. **Size:** 15.4 ha. **Description of Plot:** See *J. Field Ornithol.* 62 (Suppl.):76 (1991), 64 (Suppl.):92–93 (1993), and 65 (Suppl.):106–107 (1994). On 22 June 2005, one-third of the plot burned. **Weather:** Mean start temp., 12.8°C (range 5–19°C). **Coverage:** 25.5 h; 8 visits (8 sunrise); 21, 26 April; 2, 10, 16, 23, 30 May; 6 June; 2006. **Census:** Bewick's Wren, 16.0 (42; 2N); Lesser Goldfinch, 16.0 (4N,4FL); House Finch, 14.0 (36; 6N,1FL); Song Sparrow, 12.0 (31); House Wren, 11.0 (29; 1N,1FL); Spotted Towhee, 11.0; Common Yellowthroat, 10.0 (26; 4FL); Verdin, 8.0 (21; 2N); European Starling, 7.0 (18; 7N); Bushtit, 6.0 (16; 3N,9FL); Gambel's Quail, 5.0 (13); Anna's Hummingbird, 5.0 (3N,2FL); Yellow-breasted Chat, 5.0; Brown-headed Cowbird, 5.0; Virginia Rail, 4.0 (10); Summer Tanager, 4.0; Nuttall's Woodpecker, 3.0 (8); Brown-crested Flycatcher, 3.0; Yellow Warbler, 3.0; Lawrence's Goldfinch, 3.0 (2N,3FL); Mourning Dove, 2.0; Black Phoebe, 2.0 (2N); Bell's Vireo, 2.0; California Thrasher, 2.0; California Towhee, 2.0 (2FL); Hooded Oriole, 2.0 (2N); Cooper's Hawk, 1.0 (1N,2FL); Ash-throated Flycatcher, 1.0; Phainopepla, 1.0; Black-throated Sparrow, 1.0 (1N,3FL); Black-headed Grosbeak, 1.0. **Total:** 31 species; 168.0 territories (436/40 ha). **Visitors:** Green Heron, Red-tailed Hawk, American Kestrel, Black-chinned Hummingbird, Ladder-backed Woodpecker, Vermilion Flycatcher, Cassin's Kingbird, Western Kingbird, Mountain Chickadee, Cactus Wren, Bullock's Oriole. **Remarks:** Despite the 2005 fire, breeding birds increased from 138.0 territories to 168.0 this year. This may be due to increased vegetation from both the record 2005 rainfall and annuals sprouting after the burn. **Other Observers:** Dori Myers, Alice Ashbaugh, and Dee Zeller. **Acknowledgments:** San Bernardino County Museum, San Bernardino Valley Audubon Society, and Bureau of Land Management.

17. SHRUBBY SWAMP AND SEDGE HUMMOCKS

PANTANO ARBUSTIVO–MOGOTE

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Location: Connecticut; Litchfield Co.; Litchfield; White Memorial Foundation–North Shore Marsh; 41°43'N, 73°13'W; Litchfield Quadrangle, USGS. **Continuity:** Established 1965; 40 yr. **Size:** 8.1 ha. **Description of Plot:** See *Aud. Field Notes* 19:625–627 (1965) and *Bird Populations* 7:125–126 (2006). Severe flooding events in October 2005 and January, May, and June 2006 killed a few trees, setting back succession, with shrubs also replacing herbaceous vegetation. **Weather:** Mean start temp., 19.6°C (range 8–26°C). This year's weather was extremely wet from early May through late August. The wet conditions did produce lush, green plant growth that provided excellent cover for nesting birds, plus an abundance of berries and insects for them to eat and feed to their young. Rainfall was well above average in May, June, and July: 17 d in May totaling 20.1 cm, 20 d in June totaling 30.5 cm, and 13 d in July totaling 16.1 cm. May's mean temperature was 13.3°C (below average). Mean temperatures in June (19.3°C) and July (22.4°C) were about average. Source: White Memorial's own weather station. **Coverage:** 27.0 h; 12 visits (1 sunrise, 3 sunset); 4, 15, 22, 29 May; 5, 13, 19, 28 June; 6, 13, 20, 27 July; 2006. **Census:** Red-winged Blackbird, 34.0 (168; 2N,76FL); Swamp Sparrow, 32.5 (160; 68FL); Yellow Warbler, 25.5 (126; 6N,47FL); Common Yellowthroat, 22.0 (109; 35FL); Gray Catbird, 18.0 (89; 3N,37FL); Song Sparrow, 7.5 (37; 1N,21FL); Common Grackle, 6.5 (32; 3N,19FL); American Goldfinch, 6.0 (30; 1N,3FL); Veery, 4.5 (22; 15FL); Tree Swallow, 4.0 (20; 4N,21FL); Black-capped Chickadee, 3.5 (17; 1N,13FL); Warbling Vireo, 3.0 (15; 1N,3FL); American Robin, 3.0 (1N,10FL); Baltimore Oriole, 3.0 (1N,4FL); Eastern Kingbird, 2.5 (1N,3FL); Blue-gray

BREEDING BIRD CENSUS: 2006

Gnatcatcher, 2.5 (1N,8FL); Cedar Waxwing, 2.5 (1N,3FL); Mourning Dove, 1.5 (3FL); Willow Flycatcher, 1.5 (3FL); Great Crested Flycatcher, 1.5 (2FL); Tufted Titmouse, 1.5 (9FL); Black-and-white Warbler, 1.5 (8FL); American Redstart, 1.5 (1N,3FL); Yellow-bellied Sapsucker, 1.0; Downy Woodpecker, 1.0 (1N,3FL); Eastern Wood-Pewee, 1.0 (2FL); Alder Flycatcher, 1.0; Least Flycatcher, 1.0; Yellow-throated Vireo, 1.0; Chestnut-sided Warbler, 1.0; Northern Cardinal, 1.0; Mallard, 0.5 (8FL); Great Blue Heron, 0.5; Spotted Sandpiper, 0.5; Hairy Woodpecker, 0.5; Northern Flicker, 0.5 (1N,2FL); Pileated Woodpecker, 0.5; Red-eyed Vireo, 0.5; Blue Jay, 0.5; White-breasted Nuthatch, 0.5 (4FL); Wood Thrush, 0.5; Northern Waterthrush, 0.5 (4FL); Brown-headed Cowbird, 0.5 (1FL); House Finch, 0.5; Canada Goose, +; Osprey, +; American Woodcock, +; Red-bellied Woodpecker, +; House Wren, +; Eastern Bluebird, +; Rose-breasted Grosbeak, +; Purple Finch, +. **Total:** 52 species; 204.0 territories (1007/40 ha). **Visitors:** Mute Swan, Hooded Merganser, Green Heron, Virginia Rail, Ovenbird. **Remarks:** Despite high water levels during spring and summer, breeding birds did very well again this year. The number of breeding species hit a new record high thanks to vegetation succession. The total of 52 species recorded was 12 more than the previous 10-yr average of 40 species. Species showing breeding evidence here this year but not last year included Blue Jay, Eastern Bluebird, House Finch, House Wren, Osprey, and Wood Thrush. The only species that was found last year but not this year was Yellow-billed Cuckoo. Overall, the number of territories decreased slightly to 204.0 from 209.0 last year which is still well above the previous 10-yr average of 185. Red-winged Blackbird was the most abundant species, while Swamp Sparrow was the second most common, a reversal from last year. Yellow Warbler remained the third most abundant species, and Common Yellowthroat was fourth. **Other Observers:** Lorraine Amalavage, John Eykelhoff, Ann Orsillo, Margaret Sellers, and Terry Weaver. **Acknowledgments:** Marie Kennedy helped compile the data and enter them into our computer database.

18. COASTAL SCRUB

MATORRAL COSTANERO

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Petaluma CA 94954

Location: California; Marin Co.; Bolinas; Palomarin Field Station; 37°55'N, 122°45'W; Bolinas Quadrangle, USGS. **Continuity:** Established 1971; 32 yr. **Size:** 8.1 ha. **Description of Plot:** See *Am. Birds* 25:1003–1004 (1971). The habitat composition continues to change from coastal scrub to Douglas-fir (*Pseudotsuga menziesii*) forest. **Weather:** Mean start temp., 12.9°C (range 9–21°C). Bioyear rainfall (1 July 2005–30 June 2006) was 1291.0 mm. The average bioyear rainfall from 1976–2008 is 860.7 mm. The breeding season rainfall (1 April–31 July) was 187.5 mm. The 1975–2008 average breeding season rainfall is 97.2 mm. **Coverage:** 236.4 h; 60 visits (28 sunrise, 0 sunset). 2006. **Census:** Wrentit, 9.5 (47; 11N,18FL); Bewick's Wren, 5.0 (25); Spotted Towhee, 4.5 (22; 1N,3FL); Allen's Hummingbird, 3.5 (17); Purple Finch, 3.0 (15); Orange-crowned Warbler, 2.5; Anna's Hummingbird, 2.0; Bushtit, 2.0; White-crowned Sparrow, 2.0 (2N,4FL); Wilson's Warbler, 1.5 (1N); Western Scrub-Jay, 1.0; Chestnut-backed Chickadee, 1.0; Swainson's Thrush, 1.0; American Robin, 1.0; Red-tailed Hawk, 0.5; Band-tailed Pigeon, 0.5; Mourning Dove, 0.5; Northern Flicker, 0.5; Steller's Jay, 0.5; Song Sparrow, 0.5; Dark-eyed Junco, 0.5. **Total:** 21 species; 43.0 territories (212/40 ha). **Visitors:** None listed. **Remarks:** Territory density decreased 32% from 2005 to 2006. The eight most common species in 2005 declined markedly in 2006; most notable among these was Wilson's Warbler (6.0 to 1.5 territories). Hutton's Vireo and Golden-crowned Kinglet were present in 2005 but not 2006, with the converse true for Mourning Dove, Steller's Jay, and Dark-eyed Junco. **Acknowledgments:** We thank Point Reyes National Seashore for their cooperation. This is PRBO contribution No. 1674.

19. DISTURBED COASTAL SCRUB A

MATORRAL PERTURBADO A

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Location: California; Marin Co.; Bolinas; Palomarin Field Station; 37°55'N, 122°45'W; Bolinas Quadrangle, USGS. **Continuity:** Established 1972; 32 yr. **Size:** 4.7 ha. **Description of Plot:** See *Am. Birds* 26:987–988 (1972). The habitat composition continues to change from coastal scrub to Douglas-fir (*Pseudotsuga menziesii*) forest. This succession began around the 1950s when agriculture ceased on the study site. **Weather:** Mean start temp., 12.9°C (range 9–21°C). Bioyear rainfall (1 July 2005–30 June 2006) was 1291.0 mm. The average bioyear rainfall from 1976–2008 is 860.7 mm. The breeding season rainfall (1 April–31 July) was 187.5 mm. The 1975–2008 average breeding season rainfall is 97.2 mm. **Coverage:** 143.5 h; 62 visits (25 sunrise, 0 sunset). 2006. **Census:** Wrentit, 6.0 (51; 4N,13FL); Song Sparrow, 3.5 (30; 7N,3FL); Bewick's Wren, 2.5; Wilson's Warbler, 2.5; Spotted Towhee, 2.5 (2N,4FL); Anna's Hummingbird, 2.0; Bushtit, 2.0; American Goldfinch, 1.5; Pacific-slope Flycatcher, 1.0; Chestnut-backed Chickadee, 1.0; Swainson's Thrush, 1.0; Orange-crowned Warbler, 1.0; Purple Finch, 1.0;

BREEDING BIRD CENSUS: 2006

California Quail, 0.5; Allen's Hummingbird, 0.5; Downy Woodpecker, 0.5; Northern Flicker, 0.5; Hutton's Vireo, 0.5; Warbling Vireo, 0.5; Western Scrub-Jay, 0.5; American Robin, 0.5; European Starling, 0.5; California Towhee, 0.5; Red-tailed Hawk, +; Band-tailed Pigeon, +; Mourning Dove, +; Steller's Jay, +; Golden-crowned Kinglet, +; Dark-eyed Junco, +; Brown-headed Cowbird, +; House Finch, +. **Total:** 31 species; 32.5 territories (277/40 ha). **Visitors:** None listed. **Remarks:** Territory density decreased by 23% from 2005 to 2006, apparently due to relatively minor decreases among all species; no dramatic decrease was exhibited by any one species. Pacific-slope Flycatcher and Warbling Vireo were present in 2006 but not in 2005, with the converse true for Winter Wren. Western Bluebird and White-crowned Sparrow were present in 2005 with pluses but were not present in 2006. **Acknowledgments:** We thank Point Reyes National Seashore for their cooperation. This is PRBO contribution No. 1675.

20. DISTURBED COASTAL SCRUB B

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Location: California; Marin Co.; Bolinas; Palomarin Field Station; 37°55'N, 122°46'W; Bolinas Quadrangle, USGS. **Continuity:** Established 1971; 32 yr. **Size:** 8.1 ha. **Description of Plot:** See *Am. Birds* 25:1002–1003 (1971) and *J. Field Ornithol.* 66(Suppl.):104 (1995). The habitat composition continues to change from coastal scrub to Douglas-fir (*Pseudotsuga menziesii*) forest. This succession began around the 1950s when agriculture ceased on the study site. **Weather:** Mean start temp., 12.9°C (range 9–21°C). Bioyear rainfall (1 July 2005–30 June 2006) was 1291.0 mm. The average bioyear rainfall from 1976–2008 is 860.7 mm. The breeding season rainfall (1 April–31 July) was 187.5 mm. The 1975–2008 average breeding season rainfall is 97.2 mm. **Coverage:** 203.9 h; 72 visits (30 sunrise, 0 sunset). 2006. **Census:** Song Sparrow, 10.5 (52; 9N,10FL); Wrentit, 10.0 (49; 5N,9FL); Bewick's Wren, 4.0 (20); Wilson's Warbler, 3.5 (17); Orange-crowned Warbler, 3.0 (15); Spotted Towhee, 3.0; American Goldfinch, 3.0 (2N); Allen's Hummingbird, 2.5; Swainson's Thrush, 2.5; Anna's Hummingbird, 2.0; Chestnut-backed Chickadee, 1.5; Bushtit, 1.5; Mourning Dove, 1.0; Purple Finch, 1.0; California Quail, 0.5; Red-tailed Hawk, 0.5; Northern Flicker, 0.5; Olive-sided Flycatcher, 0.5; Western Scrub-Jay, 0.5; American Robin, 0.5; Brown-headed Cowbird, 0.5; California Towhee, +; White-crowned Sparrow, +; Dark-eyed Junco, +. **Total:** 24 species; 52.5 territories (259/40 ha). **Visitors:** None listed. **Remarks:** Territory density decreased 27% from 2005 to 2006. Notable decreases were seen in Wilson's Warbler (7.0 to 3.5 territories), Swainson's Thrush (7.0 to 2.5), and American Goldfinch (9.0 to 3.0). California Quail, Olive-sided Flycatcher, California Towhee, and Dark-eyed Junco were present in 2006 but not in 2005. **Acknowledgments:** We thank Point Reyes National Seashore for their cooperation. This is PRBO contribution No. 1676.

Bird Populations 9:198-199
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BTO News 261:26

THE LATEST TREND INFORMATION ON UK BREEDING BIRDS

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INFORMACION DE ULTIMA HORA SOBRE TENDENCIAS EN AVES REPRODUCTORAS DEL REINO UNIDO

Breeding Birds in the Wider Countryside 2005 was published on the BTO website in November (Visit *www.bto.org/birdtrends*). The latest in this series of annual reports provides a one-stop shop for information on trends in the numbers and breeding performance of widespread UK bird populations. It is a tribute to the hard work of many thousands of volunteer census workers, ringers and nest recorders that we are able to produce such timely and comprehensive information on the status of our bird populations. The website is produced within the BTO/JNCC partnership and includes results from the BTO/JNCC/RSPB Breeding Bird Survey.

IMPROVEMENTS TO THIS YEAR'S REPORT

The 113 individual species pages include current conservation listing status, a summary of population trends and their likely causes, graphs and tables showing trends and changes in population size and breeding performance over the past 36 years and alerts based on 50% and 25% declines. We have added improved navigation to the sections on population changes and productivity trends. A new section on additional information provides links to relevant data from Atlases, BirdFacts, BirdTrack and Garden BirdWatch. We have also added the latest population size estimates. Feral Pigeon has been added to the species coverage.

We are continually working to improve the analyses included in the report. This edition sees improved analytical methods applied to the Constant Effort Sites scheme, for which we are now able to produce smoothed trends with confidence intervals (Fig. 1).

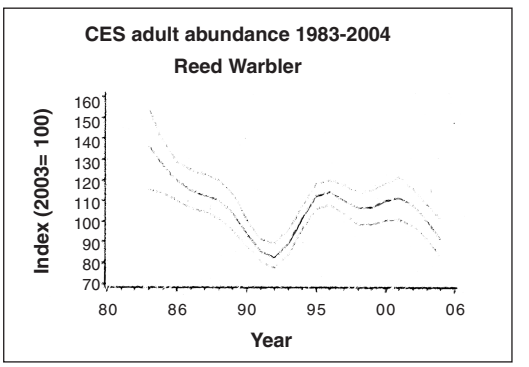

FIGURE 1. CES smoothed trend for Reed Warbler.

KEY FINDINGS

The key findings across all species are summarized on a single page while the discussion and summary tables provide more detailed assessments of trends across species. The key patterns do not vary greatly from year to year because we are looking at smoothed changes from long-term trends. We continue to highlight the ongoing declines of many Red and

Amber listed species, including those associated with farmland and woodland. Yellow Wagtail, Willow Warbler and Cuckoo continue to show declines in excess of 50%, and as such are potential candidates for future Red listing. Although based on limited data, the joint CBC/BBS trend for Tawny Owl now shows a 27% decline over 25 years, making this year's survey particularly timely. The trends are not all gloomy with a few previously declining species showing positive trends over the last 10 years. These include Whitethroat (+41%), Grey Wagtail (+29%) and Song Thrush (+23%).

Stephen Baille and *John Marchant* on behalf of the Wider Countryside Report team

Bird Populations 9:200-201
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BTO News 246:5

THE PAN-EUROPEAN COMMON BIRD MONITORING INITIATIVE

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INICIATIVA PAN-EUROPEA DE MONITOREO DE AVES COMUNES

The Common Birds Census (CBC) and more recently, the BTO/JNCC/RSPB Breeding Bird Survey (BBS) have provided population trends for common breeding birds in the UK since the 1960s. Across Europe, long-term annual bird surveys have also been operating in more than a dozen countries (Fig. 1). In recent years, there has been a surge of activity with new schemes, many based on the design of BBS, starting in countries such as Ireland, Spain, Hungary, Poland and France. In countries such as Romania, there is also considerable interest in initiating new schemes but finding the time and the resources is a real problem.

EUROPEAN-BASED DATA NEED

Those who follow BTO publications regularly, will be well aware of long-term declines in specialist farmland species, such as Corn Bunting and Turtle Dove, and increasing concern about declines in woodland species, such as Willow Tit. But how do these compare with trends in the rest of Europe? Leafing through *European Bird Populations* (BirdLife Conservation Series No 10) reveals that Corn Buntings are declining steeply in Germany, stable in France and Bulgaria, and increasing in Spain. Willow Tit numbers are going down in Austria and Lithuania, stable in Finland and increasing in France. Given the mixed fortunes of individual species, as well as specific trends in individual countries, it would he helpful to develop a system for summarising the status of European bird populations in a way that will convince those in power to influence change. Many of the land management practices that affect birds are increasingly decided at the European level, the Common Agricultural Policy being the most obvious example.

THE MONITORING INITIATIVE

Last September, representatives from 29 countries attended a workshop in Prague to discuss a new Pan-European Common Bird Monitonng (PECBM) initiative. This workshop,

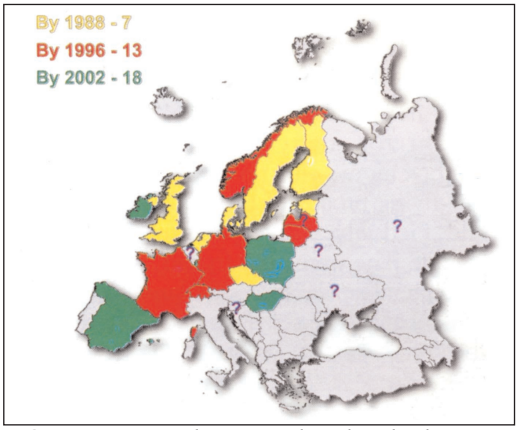

FIGURE 1. National common breeding bird surveys in place.

funded by RSPB, BirdLife International and the European Bird Census Council (EBCC), was organised by the PECBM coordinator Petr Vorisek, and was hosted by the Czech Ornithological Society. The main aims of this project are:

(i) to increase bird survey coverage across Europe through new national schemes and, where needed, develop new 'international' census plots;

(ii) to develop methods of combining data from surveys using different field and analytical methods; and

(iii) to produce European trends for as many species as possible, and combine species trends across Europe to produce Pan European multi-species indicators.

Presentations and discussion focused on details of a common bird monitoring scheme, including organisational structure, analyses and reporting trends. In the end, all countries agreed to produce annual species indices, which would then be combined to produce Pan-European indices based on total numbers of birds, and later combined to produce multi-species indices for farmland and woodland by spring 2003.

THE PILOT WORK

To get some idea how this might work, check a paper by Arco van Strien of Statistics Netherlands, and published in *Bird Study* 2001: Vol 48. This gives the results of some pilot work carried out with data from four countries. Species indices will be combined to produce multi-species indicators, representative of different landscape types (similar to the UK's headline wild bird indicators for farm-land and woodland). It is intended that a semi-popular publication on the *State of Europe's Common Birds* will be produced during the initial phase of this project. This publication and the links developed between participating countries will then be used to seek funding from the EU to further develop this project, including support for new monitoring schemes, international plots, analyses, and web-based facilities.

IMPORTANCE OF EUROPEAN CONSERVATION

It was particularly helpful that delegates from the European Environment Agency participated at the conference, confirming the need for this information in delivering Europe's responsibilities for the conservation of biodiversity. The multi-species indicators should provide a useful presentational tool for summarising a potentially complex array of species trends to decision-makers at a European level. This initiative would also provide data on the status of biodiversity in the accession countries planning to join the EU.

The BTO, along with EBCC, RSPB, BirdLife International and our Dutch counterparts, SOVON, will he playing an important role in these developments to ensure that the valuable data collected for so many years in the UK can he effectively used, in combination with data from our European neighbours, to contribute to bird conservation at a broader geographical scale.

Bird Populations 9:202-208
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BTO News 266:12-14

COMMON BIRD TRENDS 1994-2005

MIKE RAVEN AND DAVID NOBLE
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Mike Raven and *David Noble* report on the results of the BTO/JNCC/RSPB Breeding Bird Survey: 1994–2005.

TENDENCIAS EN AVES COMUNES 1994-2005
Mike Raven y *David Noble* informan sobre los resultados del Censo de Aves Reproductoras del BTO/JNCC/RSBP: 1994-2005.

The BTO/JNCC/RSPB Breeding Bird Survey (BBS) is now the main survey that tracks changes in numbers of widespread terrestrial breeding bird species across the UK. Good information on the status of bird populations is fundamental to their conservation and BBS results are already being used by governments and non-government organisations to set conservation priorities.

The BBS is an annual survey with randomly selected 1-km squares allocated to participants within each BTO Region by volunteer Regional Organisers (ROs). It uses line-transect methods, with each observer visiting their square on two occasions between April and June to count all the birds they see and hear along a 2-km route. Although many parts of the country have reached a near-optimum level of coverage, other areas are still in need of participants. We are particularly keen to increase the number of squares surveyed in Northern Ireland, Scotland and North East England, where increasing the coverage would allow us to monitor regional population changes of more bird species.

SURVEY COVERAGE

This carefully designed yet simple survey attracted more than 2,300 participants in the spring of 2005, who collected information on bird numbers from a record total of 2,879 1-km squares. Record coverage was achieved in all four constituent countries of the UK (England 2,172, Scotland 302, Wales 269 and Northern Ireland 120) and all nine English Government Office Regions. This enabled us to calculate population trends for a greater number of species, with trends produced for England, Scotland, Wales and Northern Ireland and the nine English Government Office Regions as well as for the UK overall.

SPECIES AND HABITAT COVERAGE

A total of 221 species was recorded in 2005 and, of these, 101 species were noted on an average of 40 or more squares each year across the April to June survey period, enabling UK population trends to be calculated. The Wood Pigeon continued to be much the most abundant species on BBS squares in the UK, with 64,011 birds counted and distantly followed by Starling (41,189), Blackbird (33,342) and Rook (33,274). Wood Pigeon was also the most widespread species in the UK, being noted on 2,651 or 93% of surveyed squares but followed very closely by Blackbird (2,649), Chaffinch (also 2,649) and Wren (2,638). At the

other end of the spectrum, two species were recorded for the first time on BBS squares in 2005 (a very late Lapland Bunting seen on the Inner Hebrides on 19th April and three Little Stints in Cheshire on a more typical date in late April). Red Kite (95 squares), Little Egret (44 squares) and Egyptian Goose (20 squares) all continued to increase in occurrence in 2005, while Quail were heard in 21 squares, indicating that more-than-average numbers were present in the UK last year. Several species usually considered as escapes from captivity were also recorded, including the Peacock, which was noted in a remarkable 30 squares. This probably reflects how frequently they are kept in captivity or more interestingly, a possible growing feral population!

POPULATION TRENDS

Table 1 shows the population changes between the last two seasons (2004 and 2005) and for the entire survey period to date (1994 to 2005). Trends are estimated using a log-linear regression model that corrects for differences in coverage among regions. Across the UK, 51 species increased significantly, 22 species declined significantly, and 28 species showed no significant change in numbers between 1994 and 2005. The following are some of the more interesting ups and downs.

GREY PARTRIDGE

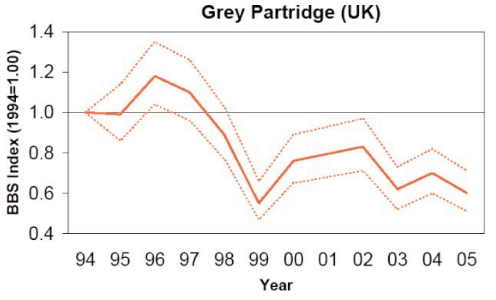
There was no halt to the decline in Grey Partridge, with numbers down by 14% between 2004 and 2005, which means that they are down by 40% over the entire BBS survey period (1994–2005). This species has been declining for several decades (87% since 1978 — as revealed from long-term analyses). Our native Grey Partridge is now a scarce bird across much of the country, being found on only 9% of surveyed BBS sites in 2005, a figure which compares very badly with that for introduced gamebirds such as Red-legged Partridge (22%) and Pheasant (69%).

This decline has largely been caused by the effects of agricultural intensification, more specifically the effects of herbicides on the food plants of young chicks' insect prey. Despite years of research and evidence of recovery on land managed specifically for Grey Partridge, the continuing decline shown by the BBS suggests that efforts to boost the population in the wider countryside have not yet been successful. Perhaps good take-up of options such as conservation headlands and game cover crops in the new Environmental Stewardship scheme will have more success.

GREY WAGTAIL

Numbers of Grey Wagtail increased by an impressive 52% on BBS squares between 2004 and 2005 and are now 75% higher than they were at the start of the survey in 1994. In the past, the UK population has been severely affected by hard winters, such as those in the early 1960s, after which numbers reached a high point during the mid 1970s. This was followed by a steep decline and then a period of relative stability during the late 1980s and 1990s. A new period of increase started in 1998, identified from both BBS and Waterways Bird Survey results.

Grey Wagtails occur at their highest densities along fast-flowing upland streams, with breeding birds favouring watercourses bordered by deciduous woodland, and it is not surprising, therefore, that they are most abundant in



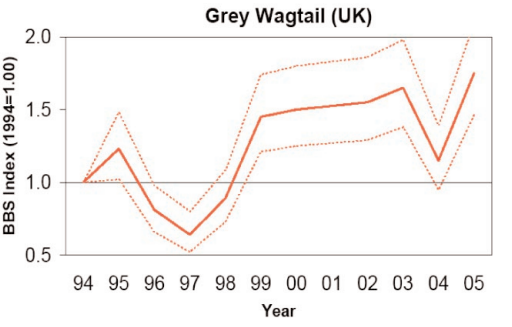


TABLE 1. Population changes of common and widespread species 2004–05 and 1994–2005.

Species	Sample	Change 2004-2005	Change 1994-2005	lcl 1994-2005	ucl 1994-2005
Mute Swan	192	21	26 *	8	45
Greylag Goose	107	31	255 *	183	345
Canada Goose	346	43 *	153 *	123	187
Shelduck	120	134 *	59 *	36	87
Mallard	1013	1	25 *	17	33
Tufted Duck	127	5	38 *	13	68
Red Grouse	102	–11	–15	–32	6
Red-legged Partridge	421	2	55 *	40	72
Grey Partridge	215	–14	–40 *	–49	–29
Pheasant	1370	–4	32 *	25	38
Little Grebe	55	30	56 *	15	113
Great Crested Grebe	59	–24	7	–18	41
(Cormorant)	175	–12	22 *	4	43
(Grey Heron)	535	7	29 *	17	43
Sparrowhawk	288	21	–2	–15	13
Buzzard	582	5	60 *	46	76
Kestrel	545	5	–18 *	–26	–9
Hobby	31	–13	–23	–49	17
Moorhen	538	–2	20 *	9	32
Coot	212	7	79 *	55	107
Oystercatcher	251	–5	–12 *	–21	–3
Golden Plover	52	–6	–8	–31	22
Lapwing	573	–9	–21 *	–27	–14
Snipe	125	–12	36 *	13	62
Curlew	433	–3	–36 *	–41	–31
Redshank	71	–28	–12	–31	12
Common Sandpiper	59	14	–5	–25	19
(Common Tern)	50	–32	–20	–42	11
Feral Pigeon	567	2	7	–3	17
Stock Dove	633	–15	9	–2	20
Wood Pigeon	1967	6	19 *	15	24
Collared Dove	1077	–2	38 *	31	46
Turtle Dove	182	2	–45 *	–54	–34
Cuckoo	711	–9	–29 *	–35	–23
Little Owl	91	–4	–19	–38	6
(Tawny Owl)	79	51	–2	–23	26
Swift	895	1	–21 *	–27	–15
Kingfisher	45	9	–5	–35	38
Green Woodpecker	615	–2	31 *	20	44
Gr Sp Woodpecker	705	11	120 *	101	141
Skylark	1434	–3	–13 *	–17	–10
Sand Martin	102	–25	38 *	11	71
Swallow	1535	6	32 *	26	39
House Martin	786	5	38 *	27	50
Tree Pipit	119	–37 *	–27 *	–40	–10
Meadow Pipit	656	–6	–6 *	–11	–2
Yellow Wagtail	151	–11	–33 *	–43	–20
Grey Wagtail	177	52 *	75 *	46	109
Pied Wagtail	1048	0	21 *	13	29
Dipper	47	8	6	–25	50
Wren	1936	9 *	24 *	20	28
Dunnock	1618	8	22 *	17	28
Robin	1867	4	17 *	13	21
Redstart	133	–9	18	0	40

TABLE 1. (Continued)

Species	Sample	Change 2004-2005	Change 1994-2005	lcl 1994-2005	ucl 1994-2005
Whinchat	72	–28	–36 *	–50	–18
Stonechat	104	28	227 *	153	322
Wheatear	250	–9	–4	–15	9
Blackbird	1952	4	22 *	18	25
Song Thrush	1538	4	18 *	12	24
Mistle Thrush	1014	–4	–7	–14	0
Grasshopper Warbler	62	–4	50 *	11	104
Sedge Warbler	251	–7	10	–3	25
Reed Warbler	95	–3	43 *	19	72
Blackcap	1167	5	61 *	52	71
Garden Warbler	381	–4	–8	–18	3
Lesser Whitethroat	214	–6	–35 *	–44	–23
Whitethroat	1057	–9	27 *	19	35
Wood Warbler	53	–15	–65 *	–74	–54
Chiffchaff	1081	–27 *	30 *	22	38
Willow Warbler	1215	2	1	–4	5
Goldcrest	613	9	71 *	57	85
Spotted Flycatcher	195	21	–26 *	–37	–14
Pied Flycatcher	41	8	–30 *	–48	–5
Long-tailed Tit	701	–7	0	–10	11
Blue Tit	1825	6	24 *	19	28
Great Tit	1689	7	44 *	38	50
Coal Tit	607	24 *	35 *	25	45
Willow Tit	53	–5	–65 *	–75	–51
Marsh Tit	129	8	33 *	8	64
Nuthatch	340	10	71 *	51	93
Treecreeper	283	13	23 *	6	41
Jay	571	–6	–5	–14	5
Magpie	1511	4	3	–1	8
Jackdaw	1298	19 *	40 *	33	49
Rook	1059	–3	–7	–14	1
Carrion Crow	1847	–1	12 *	7	18
Hooded Crow	117	–1	–15	–32	5
Raven	192	7	124 *	87	168
Starling	1527	20 *	–21 *	–26	–16
House Sparrow	1309	4	1	–3	5
Tree Sparrow	137	–15	23 *	1	50
Chaffinch	1953	6	15 *	11	18
Greenfinch	1440	4	43 *	35	50
Goldfinch	1153	6	35 *	26	45
Siskin	112	59 *	–3	–20	17
Linnet	1064	6	–7 *	–14	–1
Lesser Redpoll	125	71 *	40 *	15	71
Bullfinch	484	15	–1	–10	10
Yellowhammer	1022	6	–17 *	–21	–12
Reed Bunting	366	23	30 *	17	43
Corn Bunting	136	–8	–32 *	–43	–19

Population changes of widespread species 2004–05 and 1994–2005. The sample size indicated is the mean number of squares occupied each year over the 11 years (excluding 2001, and squares which were surveyed in only one year). The figures presented are the percentage changes in population levels for the respective time periods: those marked with an asterisk were significantly different at a 5% level. For the 1994–2005 period, the lower and upper 95% confidence limits (lcl, ucl) are given. Species in **bold** are red-listed, and species in *italics* amber-listed in The Population Status of Birds in the UK, Birds of conservation concern: 2002–2007. Trends for species in parenthesis must be treated with caution, because it is considered that the species is either poorly covered by the BBS method, or a high proportion of the counts were made away from breeding sites.

northern and western Britain. Over the past 70 years however, breeding has occurred on an increasingly regular basis in lowland areas, with birds taking a particular liking for rivers containing millstreams and weirs.

HOBBY

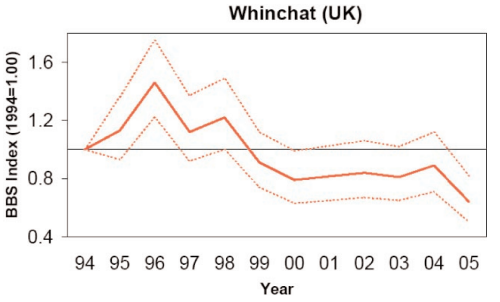
Due to the increase in survey coverage in England over the past four years, we are now able to calculate trends for Hobby for the first time. Although Hobby numbers have shown no significant change on BBS sites since 1994, there is strong evidence to suggest that this species has increased in both numbers and range over the past 50 years. From an estimated British population of less than 100 pairs in the 1950s, numbers have increased to 2,200 pairs by 2000. Results from the two Breeding Bird Atlases have shown a significant spread northwards in England from the 1970s to the 1990s. This is possibly linked to increases in its dragonfly prey and a decreasing dependency on its traditional heathland habitat, which is largely confined to southern England.

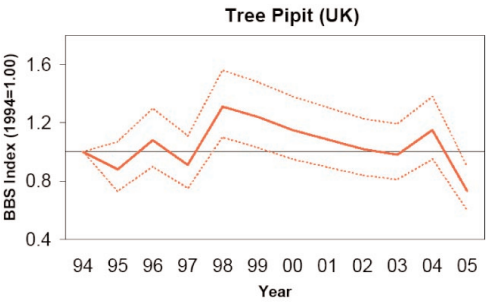
WHINCHAT

On a less positive note, the Whinchat is now recorded on too few squares in England for accurate trends to be calculated, being noted on only 1.2% of squares surveyed in 2005, compared to 2.3% in 1994. This species may be a strong candidate for future inclusion on the red list of Species of Conservation Concern, having largely disappeared as a breeding species from much of lowland Britain. Results from the Breeding Bird Atlases of 1968–72 and 1988–91 highlighted a major contraction in range away from lowland areas, although declines were noted in many southern counties of England as far back as the 1930s. More recently, the Whinchat has declined by 36% on BBS sites since 1994 and this may indicate a fall in numbers on their more traditional upland breeding grounds. The cause of the decline in lowland habitats has been linked to the continued loss of damp marginal land. Similar downward trends have also been reported from a number of northern European countries, including Finland, where a very large population still exists. Work is under way to enable us to improve the monitoring of widespread upland species such as Whinchat using BBS methods.

TREE PIPIT

The increase reported for many of our summer-visitor species between 2003 and 2004 was unfortunately not repeated between 2004 and 2005, with 17 of the 26 species monitored by the BBS declining. Of particular note were the significant declines in Chiffchaff and Tree Pipit, with numbers of the latter species falling by 37% between 2004 and 2005 and by 27% since the start of the survey in 1994. These figures highlight the fact that numbers of our long-distance migrants are prone to large annual variations, driven by factors such as breeding productivity and conditions on their wintering grounds and migration routes. However, this species has recently been moved from the green to the amber list, on the strength of its longer-term population decline in the UK. Tree Pipits occur in greatest abundance in northern England, Scotland and Wales, but Welsh numbers have declined by 29% since 1994, albeit from a rather small sample of survey sites. A contraction in range was noted in central and southeast England between the two atlas periods and anecdotal evidence from the county bird reports suggests that the decline is continuing in

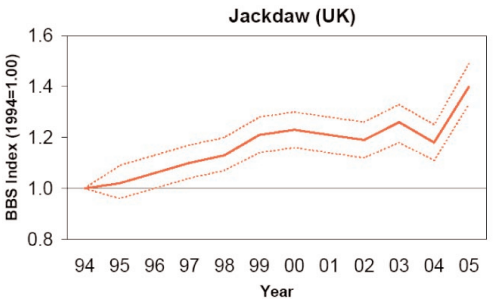




these lowland counties. The causes of this are unclear, but may be linked to changing forest structure, as new plantations mature, and reduced management of lowland woods.

JACKDAW

In common with many of our corvid species, the Jackdaw continues to flourish in the UK, with numbers up by 19% between 2004 and 2005 and up by 40% since 1994. The longer-term trend shows that the population has almost doubled since the 1960s. Regionally, the Jackdaw has increased in Wales and in most English regions, but has remained relatively stable in Scotland and Northern Ireland. As with Magpie, Rook and Carrion Crow, the increase has been associated with improvements in breeding performance and probably reflects the species' generalist feeding habits, which allow the



Jackdaw to exploit a wide range of habitats throughout the year.

BBS-ONLINE UPDATE

2005 was the second year for which BBS observers were able to submit their counts electronically using the BBS-Online application developed and supported by the BTO's Information Systems Unit. Data for 1,146 squares (40% of the total number surveyed) were submitted online in 2005, representing a considerable increase on the 721 squares (29% of the total) in 2004. Electronic submission continues to reduce data checking and entry costs and allows us to provide BBS observers and general visitors to the BTO website with up-to-date results. UK colour maps showing relative abundance for 78 species are now also available on the website (using geostatistical methods to predict abundance at non-surveyed sites). For more information about BBS-Online and results from the scheme please visit www.bto.org/bbs. The latest BBS report can be downloaded from this website.

THE FUTURE

The 2005 fieldwork season was the most successful in the history of the BBS, with more squares being surveyed than in any other year since 1994. This success has been achieved primarily through the hard work carried out by the BTO's network of Regional Organisers who have recruited many new BBS observers across the UK. In addition, many new volunteers continue to be encouraged to participate in the scheme through the BTO's website, and as a result of e-mailing Garden BirdWatch participants and BirdTrack users. This increased coverage is enabling us to monitor the population trends of an increasing number of species. BBS results are increasingly being used by government agencies and nongovernment organisations to set conservation priorities, and BBS results form an important part of the annual report, *The State of the UK's Birds*, which summarises results from a wide range of breeding and wintering bird surveys. Joint CBC/BBS trends are now being used to routinely report on long-term population changes published in the *Breeding Birds in the Wider Countryside: their conservation status 2005* and available on the BTO website (www.bto.org/birdtrends). These joint trends will be used to periodically update the red and amber lists of bird species in *Birds of Conservation Concern* (used to highlight particular species that need special conservation measures).

INCREASING IMPORTANCE

BBS results also form an integral part of the Government's Wild Bird Populations Quality of Life Indicators, which are used to report on progress towards sustainable development. At a wider scale, BBS results are being used to monitor birds at a European level in the Pan-European Common Bird Monitoring initiative and to produce Europewide farmland and woodland multi-species indicators, the former now being used by the European Union.

We are also working to produce trends for species in particular habitats such as woodland and farmland using BBS habitat data. This will enable us to see if species are faring better or worse in certain habitats.

BBS mammal counts are now routinely used to produce population trends for nine species, which are being fed into the Tracking Mammals Partnership (www.trackingmammals.org), which is collating and publishing mammal monitoring results from over 20 different schemes.

ACKNOWLEDGEMENTS

We are extremely grateful to all the ROs, observers and BTO members who took part in the BBS last year. We would also like to thank the farmers and landowners for their support and co-operation in allowing BBS volunteers onto their land. If you would like to take part in the scheme, please contact your local RO or Mike Raven at BTO HQ (e-mail: bbs@bto.org).

The BBS is a partnership between BTO, JNCC and RSPB.

FURTHER READING

Baillie, S R *et al.* (2006) *Breeding Birds in the Wider Countryside: their conservation status 2005.* BTO Research Report 435. BTO, Thetford. (www.bto.org/birdtrends).

Raven, M J & Noble, D G (2006). *The Breeding Bird Survey 2005.* BTO Research Report 439. BTO, Thetford.

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BTO News 267:10-11

WELL-MONITORED WATERWAYS

JOHN MARCHANT
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BTO volunteers continue to monitor the breeding birds of waterways through two separate but interlinked surveys — WBS and WBBS. *John Marchant* discusses recent progress and results.

MONITOREO EFICAZ EN CURSOS FLUVIALES
Los voluntarios del BTO continuan monitorizando las aves reproductoras de los cursos fluviales a través de dos censos separados pero interrelacionados, el WBS y el WBBS. *John Marchant* comenta resultados y avances recientes.

In 2005, the Waterways Bird Survey (WBS) completed 32 seasons of continuous monitoring. Despite WBBS (the Waterways Breeding Bird Survey, equivalent in many ways to the BTO/JNCC/RSPB Breeding Bird Survey (BBS)) providing a competing attraction for volunteers since 1998, support for WBS has stayed strong: an impressive 92 surveys were conducted — an increase over the previous two seasons, although still a little lower than the long-term average (103). We are very grateful to the many loyal observers from previous years, and to the contributors of 10 new sites. For six surveys, 2005 brought up 30 years of WBS mapping, although in each case the stretch had changed hands over the years, and no single observer has yet reached that milestone.

The results over this impressive timespan have contributed valuable data to the UK's monitoring programme for common birds. WBS is a major contributor to the *Breeding Birds of the Wider Countryside* reports on the BTO web site (www.bto.org/birdtrends): especially notable are trends for 14 species for which rivers and canals form the most important breeding habitat, and for which WBS currently provides our most reliable measure of population change. WBS also provides an archive of mapping data, available for research, which now covers 523 sites and some 2,400 km of waterways, distributed throughout the UK.

Major trends detected by WBS include: a collapse of the Yellow Wagtail population beside waterways, measured at a loss of 95% of breeding pairs between 1979 and 2004; an 80% decrease of Little Grebes over the same period; and doubling of the populations of Mallard, Greylag and Canada Geese, Oystercatcher, Whitethroat, and now Goosander. Long-term trends, for species including these, have been given previously in BTO News 253 and 261.

LATEST TRENDS FROM WBS

Of the 92 WBS surveys in 2005, 76 were direct repeats from the previous year. These surveys allow a clear view, detailed in Table 1, of changes since 2004. Changes were mostly numerically small, and just two reached statistical significance — an increase for Pied Wagtail, and

TABLE 1. Estimates of population change 2005, from WBS data.

Species	Territory totals 2004	2005	% change	lcl	ucl	Number of plots
Mute Swan	96	98	+2	–10	+17	49
Canada Goose	171	153	–11	–39	+24	37
Mallard	1884	1861	–1	–8	+6	76
Tufted Duck	56	67	+20	–50	+107	15
Goosander	58	51	–12	–29	+11	20
Moorhen	613	619	+1	–7	+9	64
Coot	255	321	+26	–2	+59	36
Oystercatcher	253	229	–9	–30	+12	24
Lapwing	136	130	–4	–24	+36	32
Curlew	51	46	–10	–29	+17	15
Common Sandpiper	88	85	–3	–21	+10	16
Kingfisher	52	43	–17	–37	+3	37
Sand Martin	1221	1365	+12	–84	+41	18
Grey Wagtail	139	150	+8	–7	+25	44
Pied Wagtail	152	187	+23 *	+10	+40	54
Dipper	73	75	+3	–15	+22	26
Sedge Warbler	395	326	–17 *	–26	-8	38
Reed Warbler	253	253	0	–12	+13	21
Whitethroat	251	259	+3	–12	+24	45
Reed Bunting	240	268	+12	–5	+34	41

Lcl and ucl = 95% lower and upper confidence limits; * = statistically significant change. Species shown as *italics* are Amber-listed, and those shown as **bold** are Red-listed, according to the 2002–07 assessments. Species with fewer than 15 plots contributing paired data are excluded.

a decrease for Sedge Warbler. In both cases, these neatly reversed significant changes recorded between 2003 and 2004, and reflect fluctuation rather than a directional trend.

More subtle changes, not reaching statistical significance in any single year-to-year comparison, may nevertheless be of greater biological importance. The rounded longterm trend data that will shortly be presented in the 'Wider Countryside' report update on the BTO web site show that, through the accumulation of small increases, 2005 provided the highest-ever WBS population index for seven species (Mute Swan, Canada Goose, Tufted Duck, Goosander, Oystercatcher, Reed Warbler and Whitethroat). Possible decreases for Canada Goose and Oystercatcher in 2005 do not affect this longerterm trend. The significance of the Reed Warbler result is unclear, because Constant Effort Sites (CES) ringers, operating in the species' prime habitat of extensive reed beds, have been catching progressively fewer birds. Maybe there has been some loss of habitat quality at some long-established reedbed sites, while Reed Warblers have been making greater use of small or more linear sites. For Whitethroat, it should be remembered that the higher levels recorded by the Common Birds Census (CBC) in the mid 1960s have never been regained, despite the increases over recent decades. Against this, the rounded index for 2005 was the lowest ever for five species (Little Grebe, Lapwing, Common Sandpiper, Sand Martin and Yellow Wagtail). For Little Grebe, breeding season data from CBC and BBS and non-breeding season data from the Wetland Bird Survey (WeBS) suggest that the population nationally has increased, so that a downward trend may in fact be restricted to rivers and canals.

NEWS FROM WBBS

The Waterways Breeding Bird Survey uses a transect method like that of BBS to count breeding birds along linear waterways. Since 1998, the scheme has operated in parallel to WBS. The WBBS sample has two main components — randomly selected stretches, and WBS-linked ones, on which observers conduct both kinds of surveys in parallel. The random

sample has been growing steadily, to 236 in 2005, and the WBBS total reached a new peak of 299 stretches in 2005 — tantalisingly close to the 300 that was our target for that year. We hope now to maintain WBBS at around this level, although funding difficulties for organising this scheme remain – and have temporarily put WBBS reporting into abeyance (but see below).

WBBS surveys are widely distributed in Britain but, sadly, none has been conducted in Northern Ireland since 2003. The random sample has a strong representation in the west of Britain and in the uplands, where there is a high density of watercourses compared, for example, to East Anglia, where just a handful of surveys are conducted. The full sample is about one-tenth that of BBS, but WBBS records many more birds per site. This is because WBBS transects average almost 3.3 km, against the BBS maximum of 2 km, and because WBBS habitat is consistently bird-rich, whereas BBS observers in poor squares may sometimes be struggling to find anything to record.

BBS creates UK indices for species that it records on more than 40 sites per year, and uses a lower threshold of 30 sites for regional indices. Since WBBS sites hold more birds than BBS ones, it might be possible, theoretically, to create equally precise indices from fewer sites. Taking the BBS levels as a guide, however, WBBS had 74 species in 2005 that occurred on more than 40 sites, including 20 waterbirds (see Table 2). Among waterbirds, there are four species — Dipper, Kingfisher, Common Sandpiper and Goosander — where there are more WBBS than BBS sites, and others where WBBS could add a substantial number of birds to a combined monitoring sample. Using a threshold of 30 WBBS sites would bring in three more waterbirds: Shelduck, Redshank and Great Crested Grebe. For some of the more marginal species, it would not be possible to begin population indices as early as 1998, because of smaller WBBS samples in the initial years.

For birds that are largely confined to waterways for breeding, such as Kingfisher, Dipper and Grey Wagtail, the WBBS sample can be taken as representative of the whole British population. For other species it is representative of that section of the population that breeds alongside waterways, in some cases as part of uniquely riparian ecosystems. A WBBS index for any species could therefore be very useful — for example, an index from waterways compared with those from other habitat types covered by BBS could shed light on the way that birds

TABLE 2. WBBS sample sizes for water birds in 2005.

Species	Number of sites	Number of birds	Number of BBS squares
Mallard	269	5782	1414
Pied Wagtail	192	673	1467
Moorhen	173	1221	702
Grey Wagtail	171	544	280
Mute Swan	133	914	272
Reed Bunting	127	629	559
Lapwing	111	801	786
Canada Goose	109	1058	530
Sedge Warbler	107	705	294
Dipper*	93	268	64
Sand Martin	91	1514	143
Coot	90	846	297
Oystercatcher	86	999	343
Kingfisher*	85	127	62
Common Sandpiper*	79	380	56
Curlew	73	315	473
Reed Warbler	66	508	137
Tufted Duck	55	491	161
Goosander*	54	188	36
Greylag Goose	51	658	193

For species marked with an asterisk, there are more WBBS sites than BBS sites.

interact with habitat as their numbers change.

A series of multi-species indicators from WBBS data is already at the planning stage. These could give simple indications of overall trends in bird numbers, in a way that might influence management policies for waterside habitats. It would be ideal to extend the run both of indices and of indicators back to the 1970s, by linking them to the WBS trend data. Whether this will be possible will depend on how well the trends correspond between WBS and WBBS during the overlap period, work on which is still in progress. Comparison of trends so far between the mapping and transect methods has shown mixed results. This is partly because WBS mapping has territories as its counting unit whereas individual birds are the unit for WBBS transects. A similar difficulty has been overcome, however, in linking BBS results to the earlier CBC counts.

MORE SURVEYS, PLEASE

We are hoping that both WBS and WBBS surveys will be operating as usual in 2007, but the final decision of which waterways survey is likely to be continued in the long term will not be taken until later in 2007. The Environment Agency has just agreed to fund analyses of the 2005 and 2006 WBBS data, which will aid in this process and allow the new WBBS trends to be reported. For WBS, you can choose your own stretch of river or canal to cover, provided that it is at least 3 km in length and does not overlap with any existing survey stretches. For WBBS, there are still many plots in the random selection that await an observer, or have fallen vacant. Another way to contribute is by setting up a WBS mapping survey and then also making WBBS transect visits to the same site. Please contact me at the BTO Thetford HQ or e-mail: wbbs@ bto.org for more information.

ACKNOWLEDGEMENTS

Many thanks to all WBS and WBBS volunteers, who have mastered the art of putting riverside walks to best purpose, and to the Environment Agency for their funding for WBBS.

Bird Populations 9:213-216
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BTO News 263:12-13

POOR 2005 BREEDING SEASON INDICATED

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Dawn Balmer and *Mark Grantham* report on changes in the abundance and productivity of common songbirds between 2004 and 2005 on Constant Effort Sites (CES).

BAJO EXITO EN LA TEMPORADA REPRODUCTIVA DE 2005
Dawn Balmer y *Mark Grantham* informan sobre los cambios en abundancia y productividad de aves canoras comunes entre 2004 y 2005 en los Sitios de Esfuerzo Constante (CES).

Following a good breeding season for many species in 2004, CES ringers hoped for another successful summer of mist-netting. As the season progressed, hopes faded but dedicated ringers continued to document the highs and lows of the 2005 breeding season.

MIXED FORTUNES FOR ADULTS

The results we present here come from standardised catches at 104 sites that submitted data for 2005 by early January 2006. As in previous years, the majority of sites were in England (81 sites) with smaller numbers in Scotland (14), Ireland (5) and Wales (4). Table 1 shows the changes on CE sites between 2004 and 2005.

There were statistically significant increases in the number of adults caught between 2004 and 2005 for six species: Wren, Robin, Blackcap, Blue Tit, Great Tit and Chaffinch. All of these species had successful breeding seasons in 2004 (see BTO News 257) and were likely to have had good overwinter survival, aided by relatively mild winter weather. The long-term trend in adult numbers for these species also shows an increase although there are some interesting patterns. Wren and Robin show a strong cyclical pattern of ups and downs, very much related to winter weather conditions. Both Blackcap and Great Tit show a sustained long-term increase in numbers caught. Blue Tit shows a cyclical pattern between the start of CES in 1983 and 2000 and since then numbers have stabilised.

Five species showed a statistically significant decrease in the numbers of adults caught between 2004 and 2005: Sedge Warbler, Reed Warbler, Whitethroat, Chiffchaff and Willow Tit. The longterm trends for Sedge Warbler and Reed Warbler are shown in Figure 1. Reed Warblers declined steadily to a low point in 1991 and then increased to 2000. Since then numbers have tailed off again. Sedge Warbler numbers have fluctuated, but since 1996 have declined steadily. Sedge Warblers winter in West Africa, primarily Senegal, Mali and Ghana and it is known that rainfall in the Sahel is closely related to the adult survival of this species. The exact wintering area of Reed Warblers is hard to determine as there are so few records of ringed birds found in Africa during the winter, although ring recoveries so far suggest Ghana, Senegal, Gambia and Guinea-Bissau are likely

TABLE 1. Changes in captures on CE sites from 2004 to 2005.

Species	Adults n sites 2005	Juveniles n sites 2005	Adult % change vs 2004	Trend 83-04	Productivity % change vs 2004	Productivity % change vs 83-04	Trend 83-04
Wren	99	98	+11 *	↑	–2	+1	↔
Dunnock	98	97	+5	↔	+11	+2	↔
Robin	94	99	+16 *	↑	–10	–2	↓
Blackbird	100	94	+3	↓	–3	+3	↓
Song Thrush	88	81	+4	↓	–11	+26	↓
Cetti's Warbler	8	10	–4	↑	–31	+55	↔
Sedge Warbler	64	62	–23 *	↔	–14	–2	↓
Reed Warbler	53	60	–16 *	↓	–16	+7	↔
Lesser Whitethroat	28	47	–11	↓	+24	–21	↔
Whitethroat	58	57	–32 *	↓	–24 *	+11	↓
Garden Warbler	59	63	+14	↓	–9	+2	↓
Blackcap	95	95	+13 *	↑	–12 *	+8	↔
Chiffchaff	83	89	–28 *	↑	–5	+5	↔
Willow Warbler	78	83	–5	↓	+1	–12	↓
Long-tailed Tit	88	74	–2	↑	–18 *	–1	↔
Willow Tit	8	12	-64 *	↓	+127	–49	↔
Blue Tit	99	97	+23 *	↔	–46 *	+23	↓
Great Tit	97	97	+29 *	↔	–35 *	+27	↓
Treecreeper	38	57	+5	↔	–45 *	+30	↔
Chaffinch	88	74	+28 *	↔	–16 *	+40	↔
Greenfinch	54	44	–6	↑	+37 *	–3	↓
Goldfinch	44	27	0	↔	–17	–28	↔
Linnet	18	17	–11	↓	+98 *	–56	↓
Bullfinch	81	67	+4	↓	+10	–3	↔
Reed Bunting	62	45	–2	↓	–30 *	–5	↓

n 2005 = number of sites operated in 2005 at which the species was captured
vs 2004 = percentage change between 2004 and 2005
vs 83–04 = % change with respect to 1983–2004 average
* = significance (at the 5% level) of increase/decrease with respect to previous year only
Long-term trend = long-term trend during the period of CES ringing. See Wider Countryside Report on the BTO website for further details (www.bto.org/birdtrends)
↑ = long-term trend shows an increase, ↓ = long-term trend shows a decline
↔ = long-term trend shows stability

destinations. Knowing the wintering areas of our migrants is important if we are to understand how differences in conditions there might affect overwinter survival.

If you were out birdwatching last spring, you might remember the unusual weather conditions that led to the late arrival of many of our migrants. Their arrival patterns were monitored by the internet project BirdTrack (www.birdtrack.net) and updated daily on the website. North Africa and southern Spain had cold weather and even snow in early spring, which held up migrants such as Swallow and Sand Martin. The results from BirdTrack, based on the presence of species on each birdwatcher's

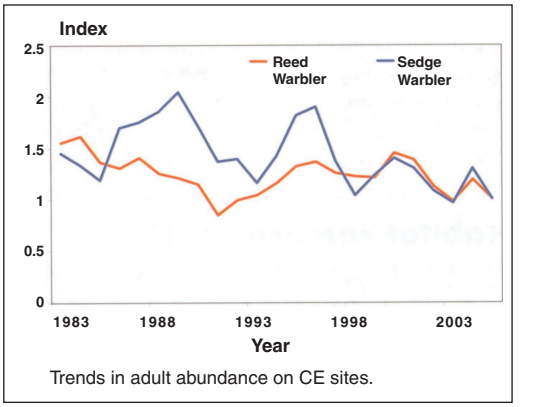

FIGURE 1. Reed Warbler and Sedge Warbler adult abundance Trends in adult abundance on CE sites.

LONG-TERM TRENDS OF OUR 'WHITETHROATS'

It is interesting to see how similar the long-term trends for Whitethroat and Lesser Whitethroat (Fig 2) appear. Given that these two species winter in different areas, this result initially seems quite surprising. Lesser Whitethroats are almost unique amongst our migrant warblers, in that they migrate southeast to winter in Africa, mainly Chad, Sudan, Eritrea and central Ethiopia. To date, there are no recoveries of ringed birds from their wintering area – more expeditions are needed! There is some evidence that, in the spring, they migrate further to the east than they do in the autumn, suggesting a 'loop migration'. Whitethroats, on the other hand, winter in West Africa, in the Sahel. A quick look at rainfall figures across the whole of the wintering area for both species shows no differences in the pattern of rainfall between years, although the west receives more rain than the east, and the central region the lowest amount. So, although these two species winter in geographically distinct areas, the pattern of rainfall is similar across the whole area. There have been significant droughts in Ethiopia in the winters of 1984/85, 1987/88, 1991/92, 1993/94 and 1999/2000 and the effect of these droughts can be seen on the number of birds returning to Britain in the spring. The effects of the 1968/69 drought, on populations of Whitethroats and Sand Martins in particular, have been well documented by the Common Birds Census. Results from CES sites show that, between 1984 and 2003, Lesser Whitethroats have declined by 52% and Whitethroats by 24%. Further information can be found on the Wider Countryside Report site www.bto.org/birdtrends.

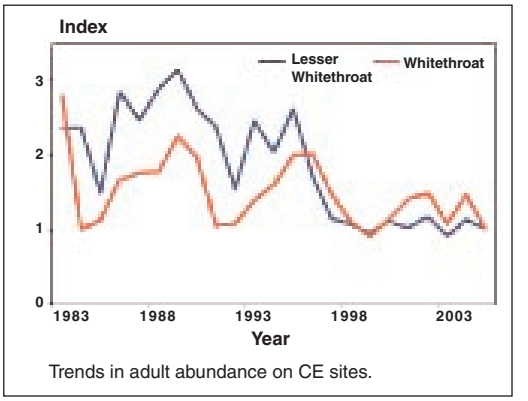

FIGURE 2. Lesser Whitethroat and Whitethroat adult abundance.

lists, showed that the numbers of Chiffchaff and Whitethroat were also down (about 15% for Chiffchaff and 10% for Whitethroat) which corresponds well with the declines picked up by these CES results. In the long term, Chiffchaffs have been doing very well, with adult numbers up by 201% between 1984 and 2003. It is likely that the decline noted in 2005 is related to poor weather conditions on migration and that numbers will bounce back in due course.

POOR BREEDING SEASON

When breeding success in 2005 (defined as the ratio of young birds to adults) is compared to that of 2004, eight species showed a statistically significant decline: Whitethroat, Blackcap, Long-tailed Tit, Blue Tit, Great Tit, Treecreeper, Chaffinch and Reed Bunting. Table 1 also presents a measure of how good or bad the breeding season was in 2005 compared to the average in previous years (1983–2004). The results show that compared to the long-term average, breeding success was mixed.

The weather during the breeding season in 2005 can be best described as unsettled. April had a classic mix of sunshine and showers, heavy rain and gales and high temperatures. May was unusually cold and June was largely unsettled but also with cool periods. As June is often a crucial month for breeding birds, unsettled weather at this time often means success or failure, particularly for single-brooded species. July and August continued with unsettled weather and strong winds at times.

Nest recorders and nestbox ringers will recall the small brood sizes and poor fledging success for Blue Tits and Great Tits in 2005. Localised heavy rain and chilly nights may have contributed to the poor breeding success for these species. Long-tailed Tits show fluctuating breeding success over time, most likely related to local weather conditions. Blackcap, Whitethroat, Chaffinch and Treecreeper have all

CONSTANT EFFORT RINGING

The idea of Constant Effort ringing is simple; nets are put up in the same place and run for the same length of time on each visit. During twelve visits between May and early September, ringers catch, ring, measure and weigh a wide variety of common songbirds of scrub, woodland and reedbed habitats. This 'constant effort' approach allows us to compare catches from one year to the next and therefore look at changes in adult numbers and breeding success. Because many adult birds are faithful to their breeding area, they return to nest in the same area and we can recapture them. These 'retraps' can be used to investigate changes in survival.

THANK YOU

We are grateful to all the ringers and helpers who participated in the scheme in 2005. Space prevents us from listing all CES ringers each year, but we thank the following on rotation: Gordon Avery, Stephen Baillie, Jez Blackburn, Phil Bone, Simon Burton, David Carrington, Cliff Carter, Steve Dodd, Michael O'Donnell, Stuart Downhill, Dubbs RG, Peter Ellis, Brian Etheridge, Trevor Fisher, Cliff Gorman, David Grieve, Phil Grosse, Nancy Harrison, Hersham RG, Peter Holmes, Richard Hunter, Ivel RG, Lackford RG, Iain Livingstone, Llangorse RG, Maple Cross RG, Maurice McNeely, Roger Peart, Neville Powell, Dean Roizer, Rye Meads RG, Paul Newton, Treswell Wood IPM Group, Rob Shaw, David Smith, Rod Smith, Sorby Breck RG, South West Lancs RG, Swaledale RG, John Walshe, Richard Ward-Smith, W J Webber, Mick Whitehouse, Mick Wright. (RG= Ringing Group).

showed increasing productivity in recent years, and the breeding success in 2005, when compared to the 1983–2004 average, is up, although when compared to the previous season (2004), it shows a decline. It is long-term trends of declining productivity for some species that are most worrying, and Reed Bunting falls into this category. Between 1984 and 2003, breeding success has declined by 50%. Perhaps because of this, the numbers of adults caught on CES over the same period has also declined by 47%. Changes in annual survival and increasing nest failure rates have also been shown to have a role in the decline and to have prevented any subsequent recovery of this species.

Only Greenfinch and Linnet showed a statistically significant increase in breeding success between 2004 and 2005. Greenfinch productivity increased in the late 1980s and then dropped in the early 1990s. Since then it has been fairly stable until the last five or six years when productivity has again increased. There were two early reports of Greenfinch fledglings on CES sites in early May, suggesting a hatching date of mid- April and information from nest recorders showed that one nest had four eggs on 23rd March! Is this earlier breeding related to climatic change or a greater reliance on supplementary food, bringing birds into breeding condition earlier? For Linnet, productivity declined in the mid 1980s and has been relatively stable until 2001, since when it has declined.

As usual, CES ringers will be out again in 2006 to catch and ring birds in a 'constant' way, so we can compare changes in numbers. We thank them for their dedication, time and enthusiasm for this important scheme.

ACKNOWLEDGEMENTS

Many thanks to Rob Robinson for overseeing the running of the CES Scheme and for contributing to this report and to Steve Freeman for help with analysis. Jane Waters kindly entered CES data received in a non-computerised format.

The Constant Effort Sites Scheme was undertaken within the Partnership between the BTO and JNCC as part of its programme of research into nature conservation.

Bird Populations 9:217-218
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BTO News 258:21

UNSEASONAL NESTING

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BTO Research Biologist, *David Glue*, describes how a mild mid-winter and excess of natural foods prompted premature nesting among some UK birds in 2005.

ANIDACION PREMATURA

El investigador del BTO *David Glue* describe cómo un invierno suave y la abundancia de alimento natural dieron lugar a una temporada de anidación prematura en varias aves del Reino Unido en 2005.

WATERFOWL AND OWLS AMONG CHRISTMAS NESTING HIGHLIGHTS

Initially, winter 2004/05 maintained the apparent growing strength of unseasonal nesting during the 'non-breeding' season (October-February). My well-thumbed 'bibles'. *The Handbook of British Birds* (Witherby *et al.* 1938-41) and *A Field Guide to Birds' Nests* (Campbell and Ferguson-Lees 1972), both describe how winter nesting attempts by some grebes, ducks, thrushes and sparrows have long been an occasional feature. For some waterfowl, owls, doves and thrushes this is becoming a regular occurrence.

Ongoing, incessant mild westerlies in October (the mildest since 2001) were followed by a grey November, blanketed by cloud (the dullest since 1997), continuing into early December. BTO/CJ Garden BirdWatchers reported Woodpigeon and Collared Dove broods and some Stock Doves turning to birdtable fare in various parts of the country. Many surveyors, though, described quiet, often relatively 'birdless' gardens - Coal Tit, Nuthatch , and Chaffinch, in particular, were in short supply. This was a legacy of the huge berry and seed crops (it was the highest beech mast yield since 2000, and conifer 'coning' year since 1995), which resulted in many birds wintering in the UK's woods.

Gardens and shopping precincts, though, were slowly brightened by an unusually early influx of Waxwings, starting in mid October, initially to Scotland and the northwest, with flocks of 500 or more strong noted in Aberdeen, Renfrew (Clyde), Edinburgh (Lothian), Morpeth (Northumberland), and Newcastle-under-Lyme (Staffs).

The mild weather and wild fruit glut also fuelled buoyant populations locally of voles, mice and rats. These aided late fledging broods of Barn Owl near Peterborough (Cambs) in mid November, and premature broods of nestbox-using Tawny Owl on the Wirral (Cheshire) and in Highclere Forest (Hants). Other unusual nesting resulted in well-grown families of Great Crested Grebe (Stafford), Moorhen (Birmingham) and Mallard (several sites), the latter aided by grain sources on wildfowl reserves. December records of lingering summer visitors, as reported to BTO/RSPB/BirdWatch Ireland BirdTrack, including Swallow (Somerset,

Cornwall), Redstart (London), Willow Warbler (Upton-on-Severn) and Ring Ouzel (Durham), posed growing headaches for County Recorders recording first/last, arrival/departure dates.

ROBIN AND THRUSHES GET OFF TO FLYING START

A brief Arctic blast gave a festive white Christmas for some, arresting most nesting operations. Dominant westerly winds in January (the mildest since 1990, with the daily temperature 1.9°C above average), brought several spring-like episodes, values topping 14.7°C at Church Fenton, ncar York, on 9th, dropping to just 12.7°C at Weybourne (North Norfolk) overnight on 10th. By mid month, egg-laying by Collared Dove was reported family parties of Woodpigeon were observed in several localities. Intriguingly, unusually early fledged broods for other species came from coastal settings by mid month: Song Thrush, Brighton (Sussex) Pavilion gardens; Blackbird, Southampton (Hants) Ocean village; Starling, St Just (Cornwall); while Robin benefited from garden centre surroundings at Bicester (Oxon).

Most coastal stretches of southern England and Wales remained frost-free, helping over-wintering survival prospects of potentially vulnerable Spoonbill, Whimbrel, Common Sandpiper and Little Stint; similarly, long-staying Lesser Yellowlegs (Norfolk), Dusky Warbler (Suffolk) and Yellow-browed Warbler (Devon).

However, not all was rosy. Violent stormy spells, with lashing rain and sleet at times, chiefly to northern parts, saw sustained winds of 60-70 knots, gusting hurricane force in Highlands, topping 120 knots in the Western Isles. Crown-heavy conifers, laden with cones (notably spruces) toppled like cards, causing costly forestry losses. Birds also suffered: nest platforms of divers, Sea Eagle, Red Kite, Long-earned Owl, woodpeckers, and others were damaged or destroyed, alongside battered hides and rafts on reserves. Resilient, paired Crowbills sang lustily, weathering the storm, alongside stay-at-home Siskin and Redpoll in many conifer plantations in the north and west, with only a few resorting to supplementary foods at birdtables.

FEBRUARY SNOW-CHILL CHECKS EARLY NESTING PROMISE

Spring seemed well set at the start of February — a dangerous assertion, as nature chose to turn the screw. Initially, in late January, a 'blocking' anticyclone anchored west of Ireland generated a cold northerly airflow, sweeping seabirds (notably Shag and auks) to East Anglia and further inland.

A swift shift to warmer winds from the south and west saw vegetation developing 2-3 weeks early by mid month. Shelduck, Grey Heron, Ringed Plover and Kingfisher had returned to inland sites and displayed breeding intent. By St Valentine's Day an interesting spectrum of 19 species had been reported to the BTO as having active nesting with eggs or young. Not too unexpected were a scattering of thrushes and Robin: more so were Great Crested Grebe (River Thames, Bucks), Raven (North Devon), Magpie (Essex, Merseyside), Stock Dover (West Norfolk), Wren (London), Blue Tit (North Wales) and Mistle Thrush (Oxon).

Nesting progress was cruelly curtailed from the 20th, a northeasterly airflow sweeping progressively cold air from North Russia, giving snow to most parts, with overnight frosts plunging to -9°C in central England by the month's close. The bitter easterly winds created adverse conditions to rival February 1991 or January 1987, but were not as destructive for UK's birds as February 1986 which hit hard over-wintering waders and resident populations of Bearded Tit, Cetti's Warbler and Dartford Warbler. Despite this untimely late cold snap, winter 2004/05 continued with an increase in the strength and frequency of westerly winds, a feature of the January-February spells starting broadly from 1988. These key months are now 1.7°C warmer than 50 years ago, a feature that has been driving the UK's recent series of mild winters, and contributing to so many unseasonal nesting attempts.

Bird Populations 9:219-220
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BTO News 261:11

BARN OWLS FLOURISH AS BEE-EATERS ARE OUT-FOXED

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David Glue, BTO Research Biologist, reviews the breeding year from New Year success stories to a season cut short by midsummer heat.

EXITO PARA LAS LECHUZAS COMUNES PERO NO PARA LOS ABEJARUCOS
David Glue , investigador del BTO, hace un repaso de la temporada reproductiva, desde historias de éxito en Año Nuevo hasta el abrupto final de la temporada por el calor a mitad de verano.

Following a generally upbeat breeding season in 2004 (BTO News 255), BTO nest recorders, ringers and BTO/JNCC/RSPB Breeding Bird Survey workers sallied forth with high hopes in 2005.

A FLYING START

Spring-like warmth in January (the mildest since 1990) and the first half of February triggered a host of early nesting attempts - now, seemingly, an annual event (*BTO News* 258).

2005 saw further range extensions: inland by Avocet, to the north and west by Cetti's Warbler and Dartford Warbler.

However, advanced nesting operations among many resident waterfowl, owls and songbirds were checked, or halted, an uncomfortable wintery spell from mid-February to mid-March.

REINTRODUCTIONS PROGRESSING

Reintroduction programmes proceeded apace. Sea Eagle enjoyed further successes in Scotland, despite nesting platforms being destroyed in the hurricane-force storms of January. Red Kite expanded to all points of the compass, notably from the Chiltern Hills (Oxon/Bucks) population.

Golden Eagle nested in Co Donegal, the first time in Ireland since at least 1910, though the single egg failed to hatch. It was part of a reintroduction programme, initiated in Glen Veagh National Park in 2001.

BARN OWL AND KESTREL ENJOY RODENT FEAST

Overall, the combined legacy of another mild winter and glut of wild fruits (the highest conifer seed yields in a decade, and beech mast since 2000) had positive knock-on effects. Sustained spring warmth from 16 to 18 March, with countrywide temperatures above 20°C, stimulated concerted egg-laying among populations of Bustard, Raven, Goosander, Ring-necked Parakeet and Dipper. Fuelled by high populations of small rodents (notably Wood Mouse and Brown Rat), the BTO--led Barn Owl Monitoring Programme noted the earliest season in 20 years of recording (mean

first-egg date 5 April). As far afield as the Solway Firth and Devon, broods of 4-7 were successfully raised. Tawny Owl and Long-eared Owl likewise profited, as did Kestrel with bumper broods of 5-7 young f1edging from boxes. Hopefully this may help redress recent marked declines in some areas.

Resident Crossbill and Siskin over-wintered comfortably and bred early. By mid-April, family parties of Siskin were noted at garden feeders, from Radnor to Highland, while mobile flocks of Crossbill were a feature noted by UK birders form mid-June.

LATE SPRING FROSTS HIT TITS AND WARBLERS

A mild showery April initially helped many thrushes, Starling and corvids to raise large first broods. Waxwings lingered from Cambridge to Aberdeen, singing tantalizingly. Regular northerly winds across the UK, combined with storms and late snow over Iberia and North Africa, held hack many spring migrants (this was charted by BTO's BirdTrack - see *www.bto.org/birdtrack*. Many migrants from south of the Sahara arrived somewhat late, rapidly set up territory and nested.

Temperatures see-sawed sharply in a cool changeable May. Mid-month, temperatures plummeted, resulting in destructive night frosts with values slipping to -6°C in Highland and even -3°C in lowland parts from Kent to Cornwall. This scorched blossom and destroyed the aerial and soil invertebrate food supplies of many nesting songbirds and halted the recent sequence of early springs, extending back to 1988.

High nestbox occupancy rates were charted for tits, but they then struggled as defoliating caterpillars were in short supply. Blue Tit and Great Tit brood-sizes varied widely, with extremes of 1-13 and 2-12 young respectively being reported to the BTO's Nest Record Scheme. Complete brood losses were frequent, with sexton beetles kept busy. Those monitoring nestboxes complained, variously, of heavy losses to predatory mammals. Reports of chilled and moribund broods of warblers, wagtails and chats were an ongoing feature in the coldest first half to June in 10 years, with frequent grass frosts, temperatures falling to -1.6°C at Altnaharra (Sutherland) on the 6th.

QUAIL AND GOLDFINCH PROFIT FROM MIDSUMMER HEAT

Increasingly humid sub-tropical heat from mid-June, with temperatures reaching 3O°C from Brighton north to Perth on 19th, improved nesting prospects. Swifts gained from extra aerial plankton foods, many eventually rearing broods of 2-3 young. Quail sang lustily across the country, locally in good strength (e.g. in the Severn Valley), in a broad spectrum of habitats: from dune slacks and coastal headlands, to golf courses and cereal fields. As ever, cases of confirmed breeding were rare. Lucky, therefore, the kite-flyer on Dunstable Downs (Beds) who chanced across an attended brood in grasses flanking an airfield.

Seabirds, as ever, enjoyed mixed fortunes. It was encouraging, then, to see that auks, Shag and Kittiwake, at many of the beleaguered sites in the North Sea, from Orkney and Shetland to Yorkshire, experienced improved breeding success in comparison to recent seasons - a trend hopefully to be sustained by the sand-eel fishing ban imposed by the European Commission.

With high pressure anchored over the UK from 11 July, temperatures topped 32oC: parched habitats and falling water-tables posed growing problems. Studies of Nightjar, Spotted Flycatcher, Goldfinch. Greenfinch and Yellowhammer helped to confirm successful double-brooding; but, for many, nesting activity faded sharply in the dry heat. Exposed nest sites and limited food supplies compounded further the high predation rates of a range of species —Sand Martin to Hobby (Hants), Little Ringed Plover to fox (Cambs) and Willow Tit to Great Spotted Woodpecker (Nottingham). Sadly, a family of young Bee-eaters, well-developed at a river bank site at Hampton Bishop (Hereford), a1so fell to foxes. This attempt followed close on the heels of that at Bishop Middleham Quarry (Co Durham) in 2002, which was only the second successful attempt in the UK.

By August, Constant Effort Site scheme ringers were catching only modest numbers of tits, warblers and Goldcrests, suggesting a mediocre breeding season overall in 2005. However, the true story will emerge only as the BTO's nest record cards return to Thetford HQ.

Bird Populations 9:221-224
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BTO News 267:4-5

NRS CONCERN LIST— FIVE NEW SPECIES ADDED

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The results of the latest Nest Record Scheme analyses are soon to be published in the 2006 Breeding Birds of the Wider Countryside Report — *Dave Leech, Carl Barimore* and *Humphrey Crick* provide BTO members with a sneak.

LA LISTA DE ALERTA DEL NRS AÑADE CINCO ESPECIES

Los resultados de los últimos análisis del Programa de Registro de Nidos (NRS) están a punto de publicarse en el Informe sobre Aves Reproductoras en la Campiña 2006. *Dave Leech, Carl Barimore* y *Humphrey Crick* presentan un resumen en primicia.

Unfortunately, if you are an owl you are unlikely to be reading this article, but should any of you *Strigiformes* have chosen to flick through this particular edition of BTO News then we would like to offer you our sincere condolences on what must have been a particularly trying and unproductive season. A proliferation of unused nesting sites early in the year indicated that the number of Tawny Owl pairs attempting to breed was below average in many parts of the country, possibly due to a combination of low vole densities and poor weather. Although the nest site occupancy of Barn Owls appeared to have been affected to a lesser degree, some adults were obviously still having problems finding enough food for their offspring, resulting in high levels of chick mortality and small brood sizes at fledging, particularly in the south-west of the country.

Thanks to our amazing network of volunteer nest recorders and their insatiable appetite for monitoring the breeding activities of Britain's birds, the Nest Record Scheme (NRS) is able to collate this type of information as the season progresses (see also David Glue's article on page 251). But while it may be the dramatic fluctuations in breeding success, such as those experienced by owls in 2006, that ornithologists, amateur and professional alike, find so fascinating, we need to be able to put this sort of information into a long-term context if it is to be of use to conservationists and policy makers. After all, Barn Owls produce reasonably large clutches and may nest more than once in a single year, so they can potentially recover from any drop in numbers relatively quickly. A smaller, steadier decline in breeding success over a 20-year period, however, could have severe implications for the size of the population.

It is for this reason that the records submitted to the Nest Record Scheme are analysed annually and the results are published in the web-based *Breeding Birds in the Wider Countryside Report* (www.bto.org/ birdtrends) along with those of other surveys including the BTO/JNCC /RSPB Breeding Bird Survey (BBS). The report summarises trends in laying date, clutch size, brood size and nest failure rates for around 90 species each year — approximately 375,000 nest records were used in the current analysis!

LATEST CHANGES TO THE NRS CONCERN LIST

Each year the BTO produces the NRS Concern List incorporating those species that are currently demonstrating statistically significant declines in breeding performance along with declines or uncertainty in their abundance trends (see Box 1 for details). The list is intended to act as an early-warning system, focusing attention on those species that may be in greatest need of conservation action in the future and, as such, it is sent to the Joint Nature Conservation Committee (JNCC), the UK government's conservation advisor and joint funding body of the NRS under the BTO/JNCC partnership.

Using data up to 2005, there are currently 21 species on the NRS Concern List (Box 2), of which

BOX 1. NRS DATA ANALYSIS

Species are placed on the NRS Concern List if a) they demonstrate significant declines in some aspect of breeding performance over at least the last 15 years and b) they have been placed on the Red or Amber Birds of Conservation Concern list due to population declines or if there is some uncertainty over their population status.

NRS data for 94 species were analysed using the methods outlined in a recent review paper in *Bird Study* 50: 254–270. Trends in laying date, clutch and brood sizes, and in daily nest failure rates over the egg and chick periods are described by linear or quadratic regression, as appropriate. Trends were not calculated for those species which have a mean annual sample size of fewer than 10 records and species with a mean annual sample size of between 10 and 30 records were given the caveat of "small sample size."

BOX 2. NRS CONCERN LIST

Species	Years on list	Significant decline in:	Breeding population trend
Kestrel	New	Brood size	>25% decline
Moorhen	14	Clutch size & Nest survival (E)	Fluctuating
Ringed Plover	10	Nest survival (E)	Uncertain
Barn Owl	3	Brood size	Decline
Skylark	2	Nest survival (E)	>50% decline
Tree Pipit	New	Nest survival (C)*	>50% decline
Yellow Wagtail	7	Brood size*	>50% decline
Grey Wagtail	4	Clutch size & Brood size	Probable decline
Pied Wagtail	3	Clutch size & Brood size	Uncertain
Dunnock	4	Nest survival (E)	>25% decline
Whinchat	New	Nest survival (E & C)*	Probable decline
Wheatear	3	Brood size	Possible decline
Willow Warbler	8	Nest survival (E)	>50% decline
Spotted Flycatcher	2	Clutch size, Brood size & Nest survival (E & C)	>50% decline
Starling	2	Brood size	>50% decline
House Sparrow	3	Brood size	>50% decline
Linnet	15	Brood size and Nest survival (C)	>50% decline
Bullfinch	New	Nest survival (E & C)*	>50% decline
Yellowhammer	4	Brood size, Nest survival (E & C)	>50% decline
Reed Bunting	15	Nest survival (E)	>50% decline
Corn Bunting	New	Brood size*	>50% decline

(E) indicates nest survival at the egg stage. (C) indicates nest survival at the chick stage.
* indicates that the average annual sample size is small (between 10 and 30 records per year).
Breeding population trends are taken from www.bto.org/birdtrends.
The inclusion of each species on the Red (**Bold**) and Amber (*Italic*) Lists of Conservation Concern is indicated (see www.bto.org/psob).

17 have been on the list for at least one previous year. Mistle Thrush, the numbers of which had declined by approximately 40% over the last 25 years, was added to the list in 2005 because of a significant decline in brood size, but has been removed again this year as the decline now falls just below significance. However, a further five species have been added to the latest list:

Kestrel — along with other raptors in the UK, Kestrels were affected by the detrimental side-effects of the agricultural use of organochlorine pesticides such as DDT and dieldrin in the 1950s and 60s. Its population recovered as these were withdrawn from use, but then fell back, probably as a result of the intensification of agriculture affecting the grassland habitat of its main small mammal prey. The BBS suggests a fairly rapid decline in Scotland since 1994. Brood sizes have declined significantly since the early 1990s, suggesting that more pairs are now rearing three chicks instead of four or even five (Figure 1).

Tree Pipit — this species is one of a number of long-distance migrant visitors to woodlands in the UK that appear to be in trouble at the moment — it could even be a candidate for being put on the Red List of *Birds of Conservation Concern* due to its steep population decline. While the causes of this decline might lie on its migration route or on its wintering grounds, the significant upturn in the failure rate of its nests at the chick stage detected recently, might suggest a problem on the breeding grounds. It should be noted that annual sample sizes are relatively small, but average nest failure rates have increased from 22% to 38% over the 13 day chick period.

Whinchat — another long distance migrant, but this time of open moorland and heath, Whinchats were not monitored by the BTO until the advent of the BBS, which dectected a population decline of more than 25% since 1994. *The New Atlas of Breeding Birds in Britain and Ireland 1988–91* also showed a significant range contraction and now the NRS has detected increases in nest failure rates at both egg and chick stages. In combination, failure rates from egg laying to fledging have increased from 33% to 52% since 1987. This might reflect a decline in the quality of the marginal agricultural habitats that it inhabits.

Bullfinch — this species has featured on the NRS Concern List previously and appears to show significant declines in breeding performance. It has been suggested that Bullfinch declines are related to changes in the quality of woodland understorey and edge habitats. The NRS shows increased failure rates at both egg (Figure 2) and chick stages which may be an indication of declining habitat quality or of increased predation rates. Overall nest failure rates, from egg-laying to fledging, have increased from 45% to 71%.

Corn Bunting — this once common agricultural species is now declining over most of Europe and has disappeared from large parts of the UK. Although previous analyses had not suggested that these declines were linked to breeding success, it is worrying that brood sizes are now apparently declining. Although sample sizes are inevitably small, average brood size increased from a low in the early 1960s, which may have been due to organochlorine pesticides.

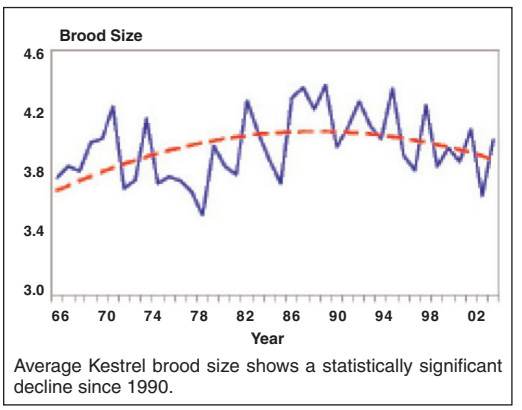

FIGURE 1. Kestrel brood size.

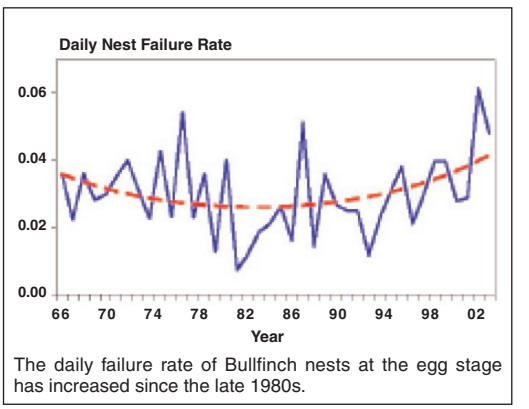

FIGURE 2. Bullfinch nest failure rate.

They peaked in 1986 at just over four young per nest, but have now declined again to about three young per nest (Figure 3). This is a potentially very worrying trend.

Please note that for the last four of these species, we received only very small numbers of records and urgently need more. In fact, there is a worrying decline in the numbers of records submitted for all open–nesting species (*BTO News* 250: 6–7), so please do think about sending in your own records, even for the Blackbird or Song Thrush in your garden!

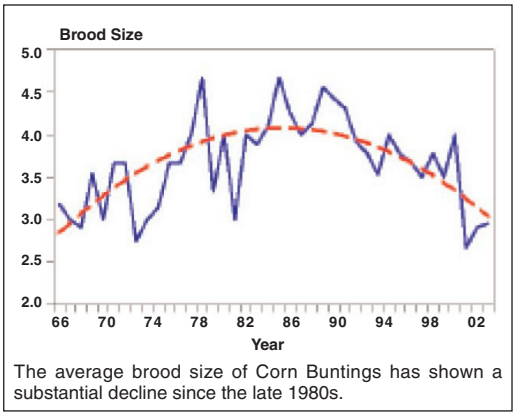

FIGURE 3. Corn Bunting brood size.

THANK YOU

None of this research would be possible without the fantastic amount of time and energy that nest recorders invest in collecting these data each year, so thank you very much to everyone who has contributed to the NRS dataset. If you have not yet, but would like to in the future, contact us at nest.records@bto.org or look at our web pages at www.bto.org/survey/ nest_records/index.htm for more information.

Thanks also to Mandy Andrews for ensuring the NRS runs smoothly, to Karen Wright for all her work on the NRS database, to Mark Cubitt for the design and continued development of the IPMR home-inputting program, which has revolutionised record submission, and to David Glue for his contributions to the scheme. The Nest Record Scheme is funded by the BTO/JNCC partnership.

Bird Populations 9:225-227
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BTO News 273:8-9

WEBS FEAT WORTH CELEBRATING

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For 60 years volunteer counters have kept tabs on the ups and downs of Britain's waterbirds to aid species and habitat conservation. *Mark Collier* explains the value of this impressive long-term contribution.

CELEBRACION DE UN HITO EN EL PROGRAMA WEBS
Durante 60 años los censadores voluntarios han registrado las subidas y bajadas de las aves acuáticas del Reino Unido para promover la conservación de especies y sus hábitats. *Mark Collier* explica el valor de esta impresionante contribución de largo plazo.

If you visit the Norfolk coast on a regular basis, you will be aware that once-rare species such as Little Egret and Avocet are becoming increasingly abundant. That's not headline news and is the type of information that we often take for granted, but what about a much more numerous species such as Dunlin? Is it doing better or worse than ten years ago?

To answer such questions we must have figures to substantiate our observations – not just for the present, but historically. For the last 60 years, this is what the BTO/WWT/RSPB/JNCC Wetland Bird Survey, better known as WeBS, has been doing.

DEDICATED VOLUNTEERS

A dedicated army of up to 3,000 volunteers, including many BTO members, covers more than 2,000 sites nationwide, though in January 2006 half of the 3.5 million waterbirds counted were recorded at just 20 key sites. In addition, almost 200 sites throughout the UK held internationally important numbers of at least one waterbird species.

ESSENTIAL WATERBIRD INFORMATION

WeBS data from key areas, such as The Wash and Morecambe Bay, are used to assess any changes in waterbird numbers at these and other designated sites and highlight cases of severe declines for further investigation.

Author Mark Collier says; "Continued monitoring helps us understand the impact of habitat loss and climate change on wetland birds." To answer the question about Dunlin posed earlier, WeBS data indicates an eastward shift in the wintering population, following a decline in southwest England since the mid-1980s (see Fig.1). In 2005/06 this decline was reflected throughout Britain and nationally numbers of wintering Dunlin fell to the lowest-ever level.

"There is some good news though. Following a ten-year decline, Dark-bellied Brent Goose numbers have risen in the past two years with numbers at the principal site, The Wash, currently the second highest for 15 years."

However, WeBS is more than simply

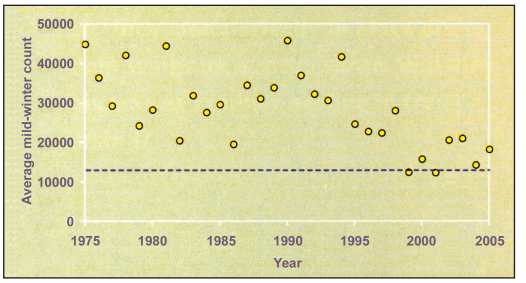
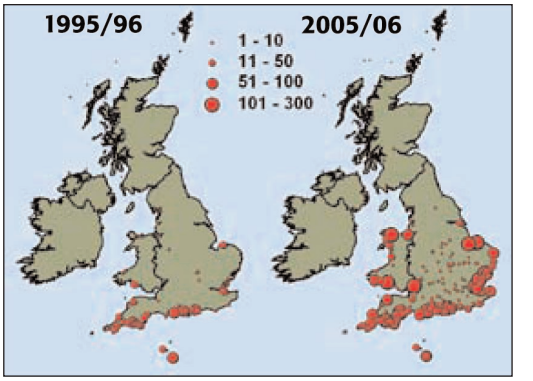


FIGURE 1. Average winter numbers of Dunlin on the Severn Estuary. The international importance threshold (1% of the flyway population) for this species is 13,300 (dashed line).



The number of Little Egrets recorded on WeBS sites.

monitoring the UK's most important sites. By counting at numerous smaller sites, WeBS can detect changes in widespread species such as Mallard, which were recorded on more than 90% of sites counted during 2005/06. Nationally WeBS data can reveal patterns such as the increases in Gadwall, Teal and Shoveler and the declines of both Red-breasted Merganser and Goosander.

In addition, regional differences can be uncovered: a recent decline of Tufted Duck in Northern Ireland is being mirrored by increasing numbers in Britain (Fig. 2).

VOLUNTEERS COMMENT

For Muriel Cadwallender in Northumberland, WeBS surveys have been a way of life since 1979. For most of that time she has counted birds along the beautiful coastline between Bamburgh and Beadnell Bay. "It's a great excuse to get out of the house and enjoy some guilt-free birding," she explains. "By checking on a monthly basis, I become aware of the gradual changes in the bird

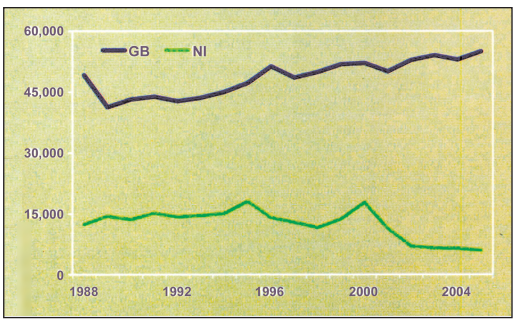


FIGURE 2. Tufted duck numbers in GB and Northern Ireland.

populations – for most waders, numbers have been fairly static though it is clear Purple Sandpipers have been declining here."

As well as the glow of satisfaction that comes by contributing to a nationwide survey, the extra activity means there is always the chance of an unusual sighting. During a May count in 1983, Muriel says she saw a wader showing white trailing edges to its wings. Having seen no Redshanks that day, she looked harder and was rewarded with the record of Collared Pratincole, a species that lives in the Mediterranean region.

Tim Appleton, the reserve manager at Rutland Water, is another long-serving volunteer. "We've been conducting WeBS counts here since the reserve opened in 1975 and the dozen or so of us who participate regularly still get a buzz from it. There is a shared sense of camaraderie and excitement every time we do a count.

"Speaking in a professional capacity, the WeBS data were critical to Rutland Water getting its Ramsar and Special Protection Area designations, which in turn underpins the investment in conservation that has been made here over many years. I would urge all birdwatchers to get involved and ensure the next 60 years of monitoring are just as productive," he said.

HOW YOU CAN GET INVOLVED

Contrary to popular belief, you don't have to live near the coast or even a large water body to participate in WeBS. Small wetland sites – gravel pits, lakes, sewage works, rivers or canals – are vital for waterbirds and need monitoring. For further information visit **www.bto.org/webs** or

e-mail **webs@bto.org**. Every year WeBS results are published in Waterbirds in the UK and this report is sent to all volunteers in appreciation for their hard work. It can also be accessed online at www.bto. org/webs – the report for 2005/06 will be available later this year.

THE WETLAND BIRD SURVEY

– MONITORING THE UK'S WATERBIRDS FOR 60 YEARS

The Wetland Bird Survey (WeBS), the monitoring scheme for non-breeding waterbirds in the UK, aims to provide the principal data for the conservation of their populations and wetland habitats. The data are used to assess the size of waterbird populations, determine trends in numbers and distribution, and assess the importance of individual sites for waterbirds, in line with the requirements of international conservation conventions and directives.

Continuing a tradition begun in 1947, around 3,000 volunteer counters participate in synchronised monthly counts at wetlands of all habitat types, mainly during the winter period. The importance of counts at smaller sites cannot be overstated and are essential for monitoring widespread species such as Little Grebe and Teal.

WeBS is a partnership between the British Trust for Ornithology, the Wildfowl & Wetlands Trust, The Royal Society for the Protection of Birds and the Joint Nature Conservation Committee.

Bird Populations 9:228-231
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BTO News 266:6-7

BRAMBLING AND SISKIN — EARLY AT WINTER BIRDTABLES

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Winter 2005/06 will linger long in the memory of garden birdwatchers: one of the most exciting in the 36-year-long history of the BTO's Garden Bird Feeding Survey, as BTO Research Biologist *David Glue* explains.

PINZON REAL Y LUGANO LLEGAN PRONTO A LOS COMEDEROS

El invierno de 2005/06 permanecerá por mucho tiempo en la memoria de los observadores de aves de jardín: fue uno de los años más emocionantes en los 36 años de historia del Conteo de Aves en Comederos del BTO, como explica el investigador del BTO *David Glue*.

Winter 2005/06, the coldest in a decade, combined with a bare wild fruit larder, led to frenetic activity at UK birdtables. Many garden feeding stations buzzed with Goldfinch and Siskin, others were dominated by Rook, Pheasant and Woodpigeon, a few graced by unexpected visitors, including Hawfinch, Ring-necked Parakeet and Red Kite. All were intriguing features of a hectic winter for the BTO's Garden Bird Feeding Survey (GBFS), in sharp contrast to the previous Winter 2004/05 which was often quiet and birdless, characterized by a glut of wild fruits and lengthy frost-free spells.

BUSIER UK BIRDTABLES

GBFS observers count all species coming to take food and water within their defined garden feeding stations, from October to March. The 258 gardens sampled were broadly representative of dwellings across the UK countryside, both by type and regional spread. The range of species recorded taking food during the 2005/06 winter was relatively high; on average 22.5 species in suburban and 21.3 species in rural settings. Comparative figures for 2004/05 were 19.8 and 16.7 species respectively.

Yet again, species richness varied widely between gardens. The 'barest' birdwise, a wild windswept site covered by Miss L Campbell, of Orkney, attracted just nine species, with Robin, Blue Tit and Great Tit notable among the absentees and Starling and House Sparrow dominant. The 'richest' garden, counted by Mrs J Rayner and Miss K Adie, near Tregaron, Ceredigion, given over largely to wildlife, recorded a remarkable 52 species, including Mute Swan and Corn Bunting to grain, and scavenging Red Kite and foraging Goshawk within the feeding station.

Overall, an impressive 83 species were noted taking food or water during the winter. Robin, Blackbird and Blue Tit remained the top three,

each absent from just three sites (Table 1). The top twelve list was similar to the previous winter. Compared with winters averaged across the 1990s, Collared Dove, Magpie and Coal Tit showed a marked increase, but House Sparrow and Starling showed little changes (Table 1).

TABLE 1. GBFS Top Twelve Garden Birds.

Rank (2005/06)	Species	% of gdns 2005/06	% of gdns 1990s(*)
1 =	Robin	99	99
1 =	Blackbird	99	99
1 =	Blue Tit	99	100
4	Great Tit	98	97
5	Chaffinch	97	96
6	Greenfinch	97	96
7	Dunnock	96	95
8	Collared Dove	90	86
9	Coal Tit	89	85
10	House Sparrow	87	93
11	Starling	84	93
12	Magpie	81	71

(*) Figures are the average of 10 winters from 1990/91 to 1999/2000.

SUCCESSIVE COLD WINTER SPELLS LIVEN UK GARDEN FEEDERS

A string of striking weather episodes dictated the feeding patterns of garden birds over the winter. Initially, balmy, warm, settled conditions in much of October, extending into November (warmest first half since 1998), drew a few late broods of Dunnock, Stock Dove, Greenfinch and Tree Sparrow to enliven birdtables. Bird baths were well used, House Sparrow and Starling often dominating, though Red-legged Partridge, Hawfinch and Lesser Redpoll were recorded.

Although November was the sunniest on record, severe night frosts, and blizzards in Central Scotland and SW England on 25/26th brought an early taste of winter. These conditions led to earliest-ever reports of Brambling and Siskin to garden feeders. Jays, Magpies, Nuthatches and tits were observed food-caching, Coal Tit widely outnumbering Great Tit and Blue Tit at feeders. In the coldest second half of November since 1993, winter thrushes passed through berryless gardens, with Redwings notably in short supply, a feature of recent winters.

In stressful, cold midwinter weather, some birds displayed fresh skills: Stock Doves, Woodpigeons and Pheasants were observed flying at hanging feeders to access spilt contents; Chiffchaffs, Goldcrests and Treecreepers extracted fat and peanut fragments from containers; while Jackdaw and Jay as well as Rook and Carrion Crow, used beak and toes to lift and access food items suspended beneath birdtables.

Snow and destructive frosts on Boxing Day, from a brief blast of Siberian air, brought the first Blackcap, Goldcrest and Reed Bunting to some feeders. With acorns and beech mast in short supply, Jays, Mistle Thrushes and Woodpigeons visited extra garden feeding sites.

It was the coldest January since 2001, and driest since 1997. Southeastern parts of the UK received only one-third of expected rainfall, resulting in rock-hard frozen lawns and pasture. Starlings, thrushes and corvids turned increasingly to birdtable fare. Windfall apples, though sparse, were in great demand, Fieldfare and Mistle Thrush protecting prized items. Elsewhere, Mallard, Moorhen and Pheasant, and locally Green Woodpecker and Water Rail, plundered stocks.

Initially in February, stubborn anticyclones brought hoar frost, fog and sleet, with monthly temperatures 0.3°C below average. Finch flocks swelled in size, with Brambling delighting many. A timely Atlantic airflow during 11–17th lifted temperatures widely to 10°C, but nesting activity was limited compared to recent springs, though juvenile Robin, Blackbird and Song Thrush appeared at feeders.

A cold, snowy Arctic airstream returned from 26 February, spilling over into what turned out to be the coldest March since 1996, with daily temperatures 1.4°C below average. Birdtables provided a vital life-line, with extra Brambling, Bullfinch, Siskin and Lesser Redpoll gracing many feeding stations. In the final week, moist southwesterly winds lifted temperatures to a spring-like 21.8°C at Scampton (Lincs).

BULLFINCH AND NUTHATCH ADD COLOUR TO FEEDERS

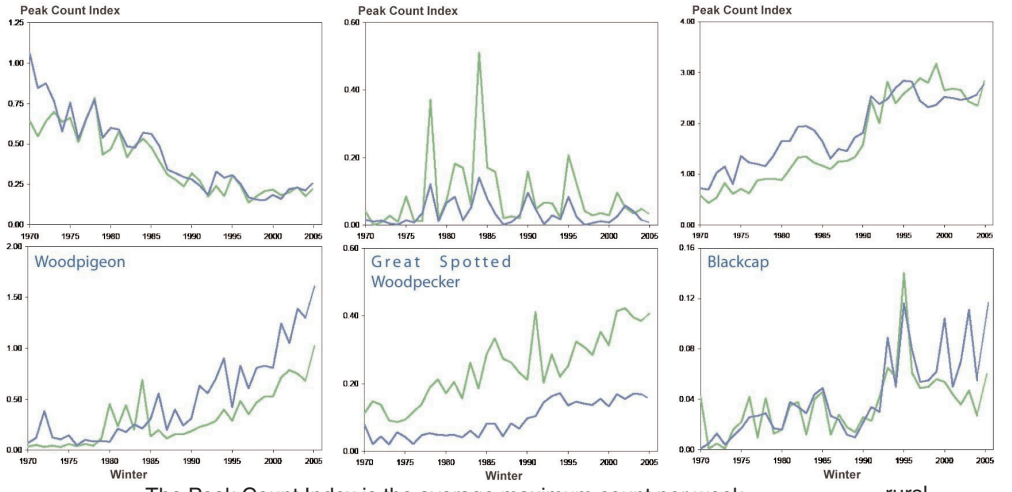
In challenging conditions, a dozen species equalled or broke record attendance levels for

the 36-year-old GBFS. The increasingly adaptable Goldfinch (74%), Wren (58%), Great Spotted Woodpecker (54%), Nuthatch (38%), Bullfinch (26%) and Lesser Redpoll (6% of sites) were positively welcomed, whilst Magpie (81%), Woodpigeon (80%), Carrion Crow (40%), Pheasant (36%) and Herring Gull (12% of sites) received mixed emotions. Sparrowhawk came to chase and kill ever more widely (59% of feeding stations), prey taken ranging in size from Firecrest and Grey Wagtail to Red-legged Partridge and Magpie. Collared Dove, though, was the most frequent victim, prompting observers to re-name this raptor 'Dovehawk', House Sparrow now figuring so low on its hit list.

More Kestrels were drawn to exploit garden bird feeding flocks than in recent winters (5% of sites), mostly in the harsh weather, as rodent populations dipped. Kestrel deployed low-level 'hawking' as well as conventional hovering, perch and pounce techniques. Fortunate observers also noted Merlin, (Tredegar, Gwent), and Hen Harrier, (Douglas and Andreas, I of Man), chasing and killing within gardens. Similarly, scavenging Buzzards were seen from Dartmoor (Devon) to Inverness (Inverness-shire), and Red Kite scavenged within gardens

CHANGING FORTUNES AT UK GARDEN BIRDTABLES — GBFS PEAK COUNT INDEX 1970–2006

In winter 2005/06, GBFS Peak Count Indices helped to identify some interesting emerging and established trends. The number of Song Thrushes feeding in gardens seems now to have stabilised at a much lower figure than in the 1970s. 2005/06 was another quiet winter for Fieldfare. Peak figures for this species correspond with the cold winters of 1978/79, the mid 1980s and 1995/96. Collared Dove populations undertook a meteoric rise until the early 1990s. Garden feeding flock-sizes appear to have plateaued, perhaps having reached population saturation in all but a few places. Woodpigeon provides another modern-day success story, though flocks are viewed with mixed feelings by rural gardeners, and those with farming interests. Ever bolder, birds now increasingly exploit feeding stations in town and city gardens and parks. Since the mid 1980s , Great Spotted Woodpeckers have moved into rural gardens for birdtable fare, and then into suburban gardens from the early 1990s. Blackcap, intriguingly of Continental origin, have appeared at UK garden feeders since the 1970s, and have increased since the mid 1990s.



The Peak Count Index is the average maximum count per week.
Scales of vertical axes vary greatly between species.

in the Thames Valley, Chilterns and mid Wales. Tawny Owl (just 1% of sites) remained top nocturnal predator, with Barn Owl also hunting alongside feeders at Beccles (Suffolk).

Blackcap returned in strength (29% of sites), feeding stations frequently hosting 2–4 birds. Ringing studies in some gardens indicated a turnover of a dozen birds or more. Success of the Blackcap is due, in part no doubt, to strong territorial defence of feeders against strong aggressive combatants, including Robin and Greenfinch, and a catholic diet. Observed preferred foods included apple, banana, cake, pastry, cheese, raisins, sunflower seed and porridge oats.

Even Siskins achieved almost pest levels in a garden in Canterbury, Kent. A flock 350 strong descended, 146 feeding at one sitting. One person's visual pleasure can be muted by an expensive pain in the pocket.

SURPRISE FEEDERS

As ever, unexpected surprise exotic species turned to food provided. At Inverkip (Renfrewshire), Avril Jones's garden feeding station is adjacent to a bay in the Firth of Clyde, where a Whooper Swan was tempted to brown bread during the December cold snap. Meanwhile, Miss K Adie, at Tregaron (Ceredigion), noted Goosanders taking grain. These two brought the GBFS tally to 170 species overall.

Elsewhere, the pulse of keeneyed observers was quickened, variously, by the arrival of Turtle Dove among a dozen Collared Dove, (March, Cambs), a Ring Ouzel that drank from a water container (Catfield, Norfolk), visiting Lesser Spotted Woodpecker (Llanwrda, Carmarthenshire), Raven (New Milton, Hants) and regular Crested Tit (Boat of Garten, Invernessshire). Garden birds never fail to surprise: witness the Water Rail watched by Dr L Maddocks, (St Mary's Isles of Scilly), that dashed to grab a House Sparrow by the neck, plunging the hapless victim beneath the water of her garden pond, before seeking cover of bushes, presumably to consume its victim.

One wonders quite whether the oncoming winter 2006/07 can match the levels of excitement recorded recently.

THANK YOU

The Trust's GBFS, though a small-scale project, requires careful consistent counting and recording during the least clement period of the year. BTO extends a large measure of thanks to the dedicated team of observers countrywide, some with especially highly prized sets of weekly counts extending back to the origins of the Scheme in 1970. Thanks also to Margaret Askew, Jacky Prior, Carol Povey and Fran Bowman for helping with the generation and circulation of recording forms, and to Mike Toms and Dan Chamberlain for the construction of the Peak Count Indices.

Bird Populations 9:232-235
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BTO News 270:4-5

CHANGING FORTUNES OF WOODLAND BIRDS

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Richard Thewlis and *Chris Hewson* of the BTO and Arjun Amar of the RSPB report on the findings of the Repeat Woodland Bird Survey.

CAMBIO DE SUERTE PARA LAS AVES DE BOSQUE
Richard Thewlis y *Chris Hewson* del BTO y Arjun Amar del RSBP informan sobre los resultados del Conteo Repetido de Aves de Bosque.

Regular readers of BTO News will have become aware of the concerns over the downward population trends of some of our woodland birds. Against this background the Repeat Woodland Bird Survey (RWBS) was undertaken between 2002 and 2005. This was a major joint project carried out by the BTO and the RSPB with additional funding from Defra, Natural England, Forestry Commission and the Woodland Trust.

THE BACKGROUND

Our knowledge of long-term woodland bird trends stems largely from the Common Birds Census (CBC), the forerunner of the BTO/JNCC/RSPB Breeding Bird Survey (BBS). The CBC was a visionary monitoring scheme set up in the early 1960s that has proved immensely valuable in providing long-term trend information on bird numbers, although its geographic coverage was biased towards southern Britain. A major aim of RWBS was, therefore, to investigate whether the CBC trends for woodland birds were representative of Britain as a whole. Other aims were to assess regional variations in population changes; to assess gross habitat changes in woodland plots over the last two decades; to collect data on factors that may help to explain the changes in woodland bird numbers; and to examine these data in relation to the major hypotheses proposed for the causes of woodland bird declines (these were outlined in *BTO News* 253, 5–7).

THE METHODS USED

The RWBS involved re-surveys of birds in 2003 and 2004 at more than 400 woodland sites for which data were available from the 1960s, 1970s and 1980s. The BTO surveys at 153 sites were all based on the territory mapping methodology used for the CBC. The RSPB covered 253 sites that had originally been surveyed in the 1980s using point counts. Although using two methods made the analyses more complicated, the BTO and RSPB data sets were complementary, giving wide geographic coverage of England, Wales and Scotland. Data on habitat structure, deer browsing impacts and Grey Squirrel drey numbers were also collected for all plots using standardised methods.

The surveys were carried out for the BTO by contract staff and volunteers using a fourvisit mapping method (instead of the CBC eight or more) to maximise the number of plots that could be covered. The subsequent analyses involved re-interpreting the original CBC maps to make them comparable with the new survey data. The important point is that the data from all the years (historical and contemporary) were compared against each other in a standardised way — this method is not designed to give population estimates for sites but to indicate changes in numbers on sites.

THE FINDINGS — WINNERS AND LOSERS

The results are summarised in Table 1. Of 34 species with sufficient data to permit analysis, eight showed large national declines (>25%) according to both BTO and RSPB data sets between the 1980s and 2003/04. Additionally, Hawfinch showed a large decline based on the data from the RSPB survey sites and a moderate (<25%) decline according to the BTO results, although the latter was based on a small number of territories. Of the 34 species, 11 showed large national increases (>25%) in both data sets (with at least one being significant) for this same period.

EFFECTIVENESS OF THE NATIONAL MONITORING SCHEMES

Comparing declines detected by the national monitoring schemes (combined CBC/BBS) with RWBS estimates showed differing results. The large declines for seven species (Lesser Spotted Woodpecker, Lesser Redpoll, Spotted Flycatcher, Tree Pipit, Willow Tit, Willow Warbler and Wood Warbler) were all confirmed by the RWBS, whereas the national declines of three species (Bullfinch, Marsh Tit and Mistle Thrush) were not supported by the RWBS data. Conversely, the declines detected by the RWBS for Garden Warbler, Pied Flycatcher and Redstart had not been reported by the national monitoring schemes. Most of the increases measured by the national monitoring schemes were confirmed by the RWBS (e.g. for Blackcap and Chiffchaff and several resident passerines) but the large increases detected by the RWBS for Coal Tit, Goldcrest, Great Tit and Treecreeper had not been previously reported.

Overall, more species breeding in woodland have increased than decreased but patterns of population change differ across groups of

TABLE 1. Percentage population changes between the 1980s and 2003/04.

Species	BTO	RSPB	CBC/BBS
Chiffchaff	**154.8**	**190.7**	**198.1**
Goldcrest	*138.3*	87.5	2.4
Long-tailed Tit	**130.8**	12.7	**61.5**
Siskin	107.6	28.4	n/a
Green Woodpecker	**80.7**	**269.3**	**125.4**
Nuthatch	**78.7**	9.8	**58.3**
Coal Tit	**74.0**	48.7	11.7
Gr Sp Woodpecker	**69.8**	*123.1*	**79.4**
Robin	**63.5**	71.3	**51.4**
Blackcap	**57.2**	79.8	**68.1**
Wren	**56.5**	91.0	**47.0**
Treecreeper	**51.5**	95.1	–15.3
Great Tit	**51.2**	31.8	21.2
Blue Tit	**30.8**	32.5	13.0
Chaffinch	**25.9**	–5.5	9.2
Blackbird	15.8	64.3	5.0
Song Thrush	15.7	52.2	–0.6
Bullfinch	10.7	–2.0	**–20.3**
Redstart	7.7	–54.4	12.5
Jackdaw	6.9	–19.0	24.0
Dunnock	–5.8	13.0	8.0
Mistle Thrush	–12.5	8.8	**–21.1**
Hawfinch	–17.4	**–73.5**	n/a
Jay	**–19.9**	–26.8	**–17.0**
Pied Flycatcher	–24.6	–20.1	n/a
Garden Warbler	**–25.6**	–39.4	–10.9
Marsh Tit	*–27.0*	26.5	–22.8
L Sp Woodpecker	–43.6	–58.9	n/a
Wood Warbler	**–64.0**	**–55.0**	n/a
Tree Pipit	**–69.7**	**–85.4**	**–81.2**
Spotted Flycatcher	**–70.4**	–36.3	**–75.8**
Willow Warbler	**–74.2**	**–68.8**	**–63.0**
Willow Tit	**–77.5**	**–72.1**	**–76.2**
Lesser Redpoll	**–88.9**	–58.7	**–94.4**

Comparison of national population changes between the 1980s and 2003/04 as derived from BTO data, RSPB data and the combined CBC/BBS population trend for all habitats. Species are listed in order of their change according to BTO RWBS data.

Species in red showed population declines of greater than 25% from both BTO and RSPB surveys. Species in green showed population increases greater than 25% from both BTO and RSPB surveys.

Changes shown in bold were significant at P<0.05 and changes in italics were significant at P<0.1.

species. All long-distance migrants have declined whereas the two medium-distance migrants, Blackcap and Chiffchaff, have increased strongly. Common species (such as Blue Tit and Great Spotted Woodpecker) appear to have fared better than scarcer species (such as Willow Tit and Lesser Spotted Woodpecker). The regional patterns of change are complex. Both Garden Warbler and Willow Warbler have increased in Scotland but declined elsewhere, and both Blackcap and Chiffchaff appear to be increasing less in the south and east. However, both the BTO and RSPB data sets show a striking increase of Spotted Flycatchers in the southwest of England against very large declines elsewhere.

ENVIRONMENTAL EFFECTS

Changes in bird numbers between the 1980s and 2003/04 were examined in relation to the wide range of environmental variables measured in 2003/04, thus comparing bird changes with a single snapshot of the current state of individual woods. Numerous complex relationships were identified between changes in birds and environmental variables; the relationships for 18 declining species indicated that, based on the data available, changes in woodland structure (especially a loss of vegetation cover up to 2 m) were the most likely cause for many of the bird declines. Additionally, Hawfinch and Lesser Spotted Woodpecker both decreased more heavily in woods with relatively high numbers of Grey Squirrel dreys but there was no other evidence that squirrel drey density was a significant factor.

SUMMARY

By making use of the large quantities of data collected in the 1980s and earlier, this project has been a powerful exploration of woodland bird changes and their possible causes. It is important to recognise that the sites covered by the RWBS are not a random sample of woods but they are probably broadly representative of broadleaved and mixed woodland, with the exception that the number of smaller woods covered is less than their prevalence. Potential biases that this may have introduced are discussed in the report.

The RWBS has confirmed the trends in woodland birds detected by national monitoring schemes and provided a valuable focus on the most likely hypotheses or combinations of hypotheses for the declines of a number of species, as well as highlighting the hypotheses that are not supported by these data. It appears that long-distance migrants may be under particular pressure, possibly as a consequence of problems in their winter range or on migration, although they may be experiencing problems on their breeding grounds. Other strong hypotheses emerging from these analyses are that several declining bird species have been affected by changes in woodland structure, possibly arising from changes in the age structure of woodland stands, changes in woodland management (especially a reduction in active management) and increasing deer grazing and browsing pressure.

ACKNOWLEDGEMENTS

The analysis of the CBC data would not have been possible without the efforts of many volunteers who have gathered these data since the 1960s. We warmly thank all the volunteer observers and contract workers who contributed to the project. The project was funded by Defra, Forestry Commission, Natural England, RSPB, BTO and Woodland Trust. We are grateful to the project's Steering Group, chaired by Fred Currie of Forestry Commission England. Other members of the Group were: Sallie Bailey, Richard Brand-Hardy, Phil Grice, Keith Kirby, Gordon Patterson, Chris Quine, Emma Small and Richard Smithers. In addition to the authors, BTO and RSPB staff who were especially closely involved in the project were Ken Smith, Rob Fuller, Jeremy Lindsell, Greg Conway and Simon Butler. The Met Office provided the climate data. Finally, we thank all the woodland owners, managers and their agents for permission to work on their sites.

FURTHER READING

Amar, A, Hewson, C M, Thewlis, R M, Smith, K W, Fuller, R J, Lindsell, J A, Conway, G, Butler, S, & MacDonald, M A (2006) *What's happening to our woodland birds? Long-term changes in the populations of woodland birds. A re-survey of*

breeding bird populations of broadleaved and mixed woodlands in 2003/04 to examine changes since the 1960s, 1970s and 1980s and test these changes against a range of hypotheses for their causes. BTO Research Report: 169; RSPB Research Report: 19.

This report and the executive summary can be downloaded by visiting:www.forestry.gov.uk/woodlandbirdsurvey

Bird Populations 9:236-238
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BTO News 278:11-12

THE IMPORTANCE OF INDICATORS

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Readers of *BTO News* will have seen 'indicators' mentioned in many previous articles. BTO staff members are involved in several very different pieces of research that involve 'indicators' and here they explain how indicators are being used in three of them.

LA IMPORTANCIA DE LOS INDICADORES

Los lectores del *BTO News* han visto la palabra "indicadores" mencionada en muchos artículos anteriores. Miembros del BTO participan en distintos tipos de investigación que incluyen "indicadores" y aquí explican cómo se usan los indicadores en tres de ellos.

BIRDS INDICATE THE CONDITION OF OUR COUNTRYSIDE

One of the dictionary definitions of indicator is 'a device indicating the condition of a machine etc' says **David Noble**, Head of the Census Unit. As most dedicated surveyors contributing to projects such as BTO /JNC/RSPB Breeding Bird Survey (BBS) know, population trends based on various surveys are annually assembled into composite wild bird indicators. Comprising the average trend for a suite of species associated with particular landscapes (such as farmland, woodland, or our coastal areas), these indicators are used by the Government for an ever-growing number of initiatives.

The most familiar is probably the Farmland Bird Index (one of the original, so-called 'Quality of Life' Indices). Based on trends in 19 farmland bird species at the UK level, this line (along with lines for woodland birds, seabirds and for all native bird species) forms part of the Government's Sustainable Development Strategy, and is part of an elite set of headline indicators along with measures of poverty, human health and education. An equivalent farmland bird index based only on data from England is used in the England Biodiversity Strategy.

Underlying the annual indicators (Fig 1) are smoothed versions with estimates of precision that take into account annual fluctuations and sampling error, and hence provide a robust statistical measure of whether a particular target, such as the government commitment to reverse the decline in farmland birds by 2010, has been achieved. An important assumption in the development of wild bird indicators is that they represent other components of biodiversity (e.g. declines in arable plants and in widespread butterflies and moths) as well as farmland birds. The Environmental Stewardship Scheme, launched in England in 2005, is intended to deliver recovery of farmland birds, and hence there is huge interest in the year-on-year changes in the indicator. The Forestry Commission has adopted the UK Woodland Bird Index as a measure of sustainable forest management, and the Environment Agency has recently funded development of a suite of wetland bird indicators that have the potential to be used to assess the impact of factors driving change in wetland habitats.

This is a rapidly developing area of work at the BTO. The next phases of indicator develop-

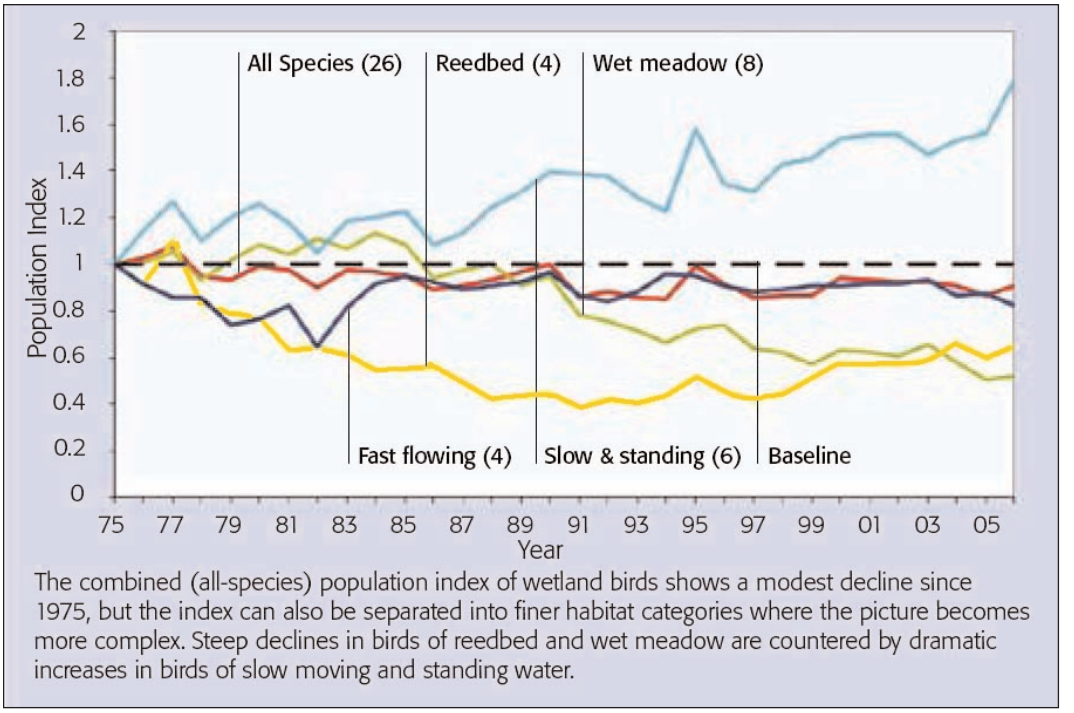

FIGURE 1. Proposed waterway bird indicator from 1975.

ment are likely to focus on better understanding of the relationship between the indicator and the effects of key drivers (agricultural practices, climate change, changes in habitat management). There is interest in new biodiversity indicators for upland and urban landscapes, and regional versions can reveal geographical differences in the fortunes of bird species that can help regional governments to deliver their own conservation priorities.

INDICATOR FOR WATERBIRDS

Building on the successes of the farmland and woodland bird indicators in highlighting bird population change in those habitats, **Andrew Joys** and **John Marchant** describe work done recently, in conjunction with the Environment Agency, to produce an equivalent indicator for waterways. The aim was to develop a new set of wild bird indicators that would reflect the general health of freshwater waterway and wetland habitats across the UK. It is hoped that such indicators may be useful in directing future policies towards improving the health of the aquatic environment and in helping the UK to meet its international obligations in protecting freshwater ecosystems.

To help achieve this we have developed a single waterways indicator, comprising the population indices of a broad range of waterside birds, to reflect change in the overall waterway environment. A number of more specific indicators have also been designed, containing carefully selected subsets of those species, to be directly relevant to particular issues of waterway management policy. These new indicators build on the Water & Wetland Indicator previously reported to the England Biodiversity Group.

For the majority of the species, the Waterways Breeding Bird Survey and the waterway component of the Breeding Bird Survey provide the population trends included in these indicators. Their predecessors, the Waterways Bird Survey and the Common Birds Census, extend the time span back to the mid 1970s. To achieve a more representative and robust trend

for a few species, we have added data from Constant Effort Sites ringing and from the Heronries Census.

The all-species indicator for waterways, and those for fast-flowing water, reedbeds and wet meadow, have all shown a decline since 1975, while the slow and standing water indicator has increased (Fig 1). While the detailed structure of these indicators is still in development, it is already clear that they have an important role in highlighting the general health of our aquatic environment.

INDICATORS FOR CLIMATE CHANGE

Stuart Newson of the Demography Unit describes current work on Indicators of Climate Change for Migratory Species.

Climate change is one of the major factors likely to affect the Earth 's ecosystems in the coming years and centuries. Migrator y species,by travelling large distances between sites are particularly likely to be affected by climate change at some point in their life.Birds comprise the best-studied group of migratory species,but the effects of climate change have been documented among species of migratory marine mammals,fish,turtles, squid,bats,terrestrial mammals and insects.

The Bonn Convention on the Conservation of Migratory Species of Wild Animals recently adopted a Resolution recognising the impacts of climate change on migratory species and called on parties and range states to undertake more research to improve our understanding of these impacts and to implement adaptation measures to help reduce foreseeable adverse effects.In order to achieve this successfully,monitoring of the impacts is required to quantify the problem,but also to assess the success of any implemented measures.Given the great range and diversity of taxa affected by climate change it is impossible to monitor all species and all effects of climate change.However,it is likely that many of the key processes through which climate change may impact wildlife could be monitored using indicator species or groups of species as a proxy for wider assemblages, habitats and ecosystems.

The UK government is a signator y to a number of international treaties and agreements that seek to promote and maintain the conservation status of migratory species of wildlife,for which Defra takes a lead role for the government. Funded by Defra,the BTO is collaborating with experts working on other groups of migrator y wildlife from around the world to identif y a suite of indicators,which can provide information on climate change impacts on the global status of migrator y species.We look for ward to presenting the findings and recommendations that come out of this ambitious project in a future issue of BTO News.

FIND OUT MORE

The Bonn Convention on the Conservation of Migratory Species of Wild Animals (CMS, 1979)www.cms.int

Bird Populations 9:239-241
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BTO News 272:12-14

MORE THAN A MILLION BIRDS COUNTED

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Over 2,600 participants covered a record number of survey squares in 2006. Here, *Mike Raven* and *David Noble* report on the results of the Breeding Bird Survey: 1994–2006.

MAS DE UN MILLON DE AVES CONTADAS

Más de 2.600 participantes cubrieron un número récord de parcelas de conteo en 2006. *Mike Raven* y *David Noble* informan sobre los resultados del Conteo de Aves Reproductoras (BBS): 1994-2006.

The BTO/JNCC/RSPB Breeding Bird Survey (BBS) is the main survey that tracks changes in numbers of widespread terrestrial bird species across the UK. Good information on the status of bird populations is fundamental to their conservation and BBS results are already being used in a variety of ways, from wild bird indicators to identifying species of conservation concern to developing action plans, by both Governments and non-governmental organizations

2006 – A RECORD YEAR

This carefully designed and popular survey attracted more than 2,600 participants in 2006, who managed to count more than one million individual birds on a record 3,295 1-km squares across the UK. Record coverage was also achieved in England (2,172), Scotland (333) and Wales (271) and in all nine English Government Office Regions.

A total of 223 species was recorded, including 103 species recorded on enough squares for UK population trends to be calculated (nearly half of those that regularly breed in the UK). Of these, 29 species declined significantly and 45 species increased significantly between 1994 and 2006. Table 1 shows the longer-term trends for some of the species at risk. Separate trends are also produced for England, Scotland, Wales and Northern Ireland and the English regions allowing us to see how species are faring in different parts of the country. For a complete list of the latest BBS results, please visit: www.bto.org/bbs/trends/index.htm.

SOME OF THE HIGHLIGHTS :

Turtle Dove: Wood Pigeon and Collared Dove may be everywhere today, but numbers of the closely related Turtle Dove have declined by 61% in just 12 years, according to the latest BBS results. Not only has the Turtle Dove disappeared from many parts of the country, such as southwest and northern England, it has become increasingly hard to find in its arable stronghold of East Anglia. In common with many long-distance migrants, numbers returning to our shores each spring are heavily influenced by conditions along their migratory routes and on the wintering grounds in Sub-Saharan Africa. Hunting during migration and changes in agricultural practice at home may all be contributing to the decline. In particular, reductions in the quantity of weed seeds during the breeding

TABLE 1. UK population changes for Red and Amber Listed species that appear in Birds of Conservation Concern.

Species	% Change 1994-2006[1]	Species	% Change 1994-2006[1]
RED LISTED SPECIES			
Willow Tit	-69%*	Yellowhammer	-16%*
Turtle Dove	-61%*	Skylark	-15%*
Corn Bunting	-39%*	Marsh Tit	-10%
Grey Partridge	-37%*	House Sparrow	-6%*
Spotted Flycatcher	-29%*	Song Thrush	17%*
Bullfinch	-28%*	Reed Bunting	39%*
Starling	-27%*	Grasshopper Warbler	49%*
Linnet	-24%*	Tree Sparrow	97%*
AMBER LISTED SPECIES			
Wood Warbler	-66%*	Stock Dove	5%
Curlew	-37%*	Mute Swan	8%
Cuckoo	-30%*	Snipe	14%
Yellow Wagtail	-29%*	Cormorant	14%
Kestrel	-25%*	House Martin	19%*
Redshank	-21%	Grey Wagtail	20%
Tree Pipit	-21%*	Kingfisher	24%
Red Grouse	-18%	Dunnock	25%*
Lapwing	-17%*	Redstart	30%*
Meadow Pipit	-16%*	Swallow	36%*
Mistle Thrush	-13%*	Goldcrest	37%*
Oystercatcher	-10%	Green Woodpecker	44%*
Willow Warbler	-7%*	Sand Martin	115%*
Shelduck	0%	Stonechat	177%*
Lesser Redpoll	4%		

[1]The figures presented are the percentage change in abundance between 1994 and 2006.
*Results marked with an asterisk are significant.

season may have led to a much shorter period of time in which to raise their young.

Reed Bunting: Numbers of Reed Bunting increased by 9% between 2005 and 2006 and are now up by 39% since 1994. This is a marked improvement on the situation between the mid-1970s and mid-1980s when this species underwent a period of steep decline and numbers more than halved. In common with other seed-eating birds, these declines were largely driven by reductions in winter food availability caused by agricultural intensification. Recent changes in land management encouraged by Government funded schemes, such as set-aside, may have benefited this species. It is hoped that new agri-environment schemes will improve conditions for other farmland species that have undergone similar declines.

Ring-necked Parakeet: Originating from birds that escaped from captivity, the Ring-necked Parakeet became established in the Greater London area during the 1970s and was added to the official British List in 1983. Numbers have now increased to such an extent, that for the first time, we are able to monitor the population using the Breeding Bird Survey. From its heartland in Surrey and Kent, birds have gradually spread westwards along the Thames Valley. The Ringnecked Parakeet was recorded on 87 BBS squares in the UK in 2006, compared to only four at the start of the survey in 1994, with numbers increasing on these survey sites by more than four-fold. There are serious concerns that this gregarious and aggressive species is competing with other hole-nesting birds that are native to the UK. See Table 2 for the trends of other similar species.

HIGHLIGHTS FROM THE COUNTRIES

In Scotland, of 54 species monitored by BBS , the Kestrel underwent the greatest decline, with numbers down by 65% since 1994. Kestrels

TABLE 2. Non-native and managed species.

Species	% Change 1994-2006[1]	Species	% Change 1994-2006[1]
Greylag Goose	235%*	Grey Partridge	–37%*
[Canada Goose]	161%*	[Pheasant]	38%*
Mallard	20%*	Feral Pigeon	–12%*
Red Grouse	–18%	[Ring-necked Parakeet]	302%*
[Red-legged Partridge]	36%*	[Little Owl]	0%

[1]The figures presented are the percentage change in abundance between 1994 and 2006.
*Results marked with an asterisk are significant.
NB: species in parenthesis are not native to the UK. The populations of species not in parenthesis are native, but largely derived from escaped birds (Feral Pigeon), partly derived from escaped birds (Greylag Goose and Mallard) or artificially maintained in some areas through restocking (Grey Partridge) or habitat management for commercial activity (Red Grouse).

were seen on only 12% of Scottish squares visited in 2006, compared to more than 40% for Buzzard. In Wales, the once common Starling headed the list of declining species, with numbers down by 51% since the start of the survey (see Figure 1). This matches the pattern in England, where numbers are down by 38%. Of the 26 species for which trends could be calculated in Northern Ireland, two open country species, Meadow Pipit and Hooded Crow, are faring well in comparison to populations elsewhere in Britain.

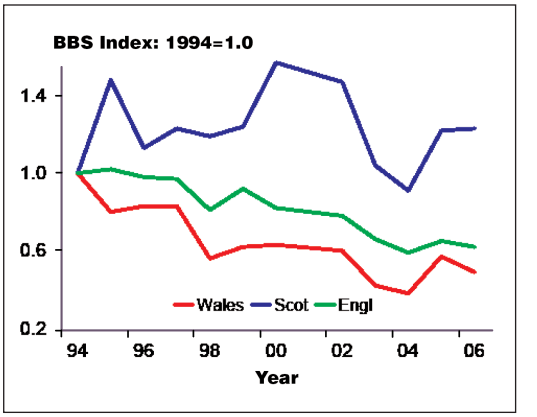

FIGURE 1. The BBS population indices for Starling between 1994 and 2006 in England, Scotland and Wales.

ACKNOWLEDGEMENTS

We are extremely grateful to all the ROs, observers and BTO members who took part in the BBS last year. The BBS is organised by the BTO on behalf of a partnership between the BTO, JNCC and RSPB.

FIND OUT MORE

Baillie, et al. (2007) *Breeding Birds in the Wider Countryside: their conservation status 2006.* BTO Research Report No. 470. BTO, Thetford. (www.bto. org/birdtrends)

Raven, M J, Noble, D G & Baillie, S R. (2007). *The Breeding Bird Survey 2006.* BTO Research Report 471. BTO, Thetford.

If you would like to take part in the scheme, please contact your local RO, or Mike Raven at BTO HQ (e-mail: bbs@bto.org).

WHY NOT TAKE PART?

The BBS survey is very straightforward, requiring only a little time each year. It is an annual survey with randomly selected 1-km grid-squares allocated to participants within each BTO Region by volunteer Regional Organisers (ROs). It uses line-transect methods, with each observer visiting their square on two occasions between April and June to count all the birds they see and hear along a 2-km route. A third visit may be required to record the habitat. That's all!

Bird Populations 9:242-244
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DECISION TIME FOR THE WATERWAYS SURVEYS

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Two waterways monitoring surveys have been running side-by-side since 1998 but only one can continue. *Andrew Joys, David Noble* and *John Marchant* consider the future of the Waterways Bird Survey and Waterways Breeding Bird Survey.

HORA DE DECIDIR SOBRE LOS CONTEOS DE CURSOS FLUVIALES

Dos programas de monitoreo de cursos fluviales han sido implementados simultáneamente desde 1998 pero sólo uno puede continuar. *Andrew Joys, David Noble* y *John Marchant* consideran el futuro del Conteo de Aves Acuáticas (WBS) y el Conteo de Aves Acuáticas Reproductoras (WBBS).

A streak of blue as a Kingfisher darts down a canal, the squeal of a Water Rail from a riverside reedbed: canals and rivers are among our richest and most attractive bird habitats, but they have never been covered particularly well by either the Common Birds Census (CBC) or the BTO/JNCC/RSPB Breeding Bird Survey (BBS). We currently run two separate schemes monitoring these habitats: the long-running Waterways Bird Survey (WBS), a territory-mapping scheme that started in 1974, and the more recent Waterways Breeding Bird Survey (WBBS), which commenced in 1998. Unfortunately we cannot continue to run both, so the decision has to be made soon as to which will survive.

There is a precedent for this, as in 2000 we adopted the BBS as a replacement for the CBC. We now produce joint trends using both CBC and BBS data, so a similar approach should be possible for the waterway schemes. We are now busy investigating whether the two schemes are comparable in their coverage and the population trends they produce. The challenge is linking counts of birds from WBBS with estimates of breeding pairs calculated from the WBS visit maps.

Though the geographical spread of WBS and WBBS plots are similar, there are often marked differences in habitat or type of waterway between WBS and WBBS. The problem here is that WBS observers choose their own stretch of waterway to survey, and it's only natural for them to select a river or canal that provides as great a variety of species as possible. Not many of us would opt to walk a canal that boasts nothing more exciting than a couple of Coots and a few tame Mallard when there's a chance of Goosanders or perhaps Dippers not far away.

COMPARING SURVEYS

We have compared the results from the two schemes, and encouragingly discovered that there was no significant difference in trends except for four species: Moorhen, Sedge Warbler, Reed Warbler and Whitethroat. Fourteen species (61%) have a population change in the same direction on both WBS and WBBS sites (e.g., Fig. 1), and for most of the others the trends are similar or

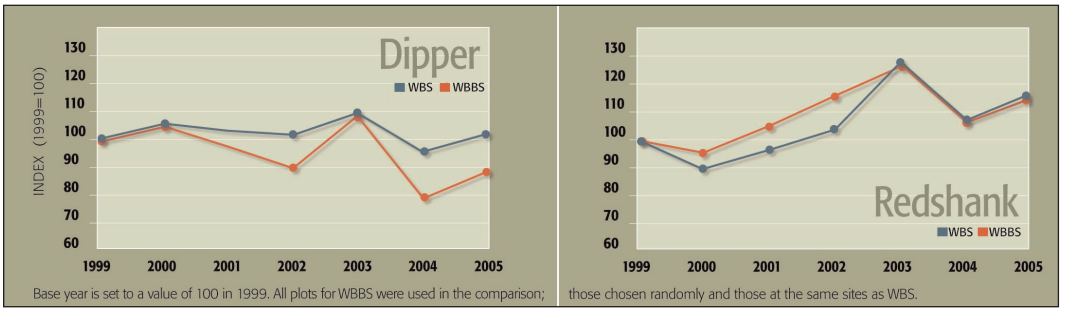

FIGURE 1. Comparison of population trends for 1999-2005 between WBBS and WBS.

roughly stable. Those showing the closest agreement include Common Sandpiper, Coot and the red-listed Reed Bunting. Yellow Wagtail and Curlew have suffered large declines between 1999 and 2005 on both WBS and WBBS.

If WBBS is chosen over WBS then we need a method of producing joint trends to allow the continuity of population monitoring to extend back to the start of the WBS. To this end, we recently calculated joint WBS–WBBS trends for 24 riverine species, using a weighting method based on percentage survey coverage. These analyses showed that Sand Martins have declined by an alarming 51% since 1977 while Yellow Wagtail, Pied Wagtail and Reed Bunting numbers have all fallen by more than 25% since 1974 (see Table 1). In contrast, Sedge Warbler and Reed Warbler have increased by more than

TABLE 1. Long-term trends from the joint WBS-WBBS.

Species	Time Period	Mean Sample Size	Change %
WINNERS			
Common Sandpiper	1974-2005	39	+865 *
Greylag Goose	1992-2005	9	+623 *
Canada Goose	1980-2005	29	+239 *
Mallard	1974-2005	91	+193 *
Mute Swan	1974-2005	43	+165 *
Goosander	1980-2005	22	+151 *
Coot	1974-2005	38	+116 *
Tufted Duck	1974-2005	22	+83 *
Reed Warbler	1980-2005	21	+71 *
Curlew	1979-2005	21	+54 *
Kingfisher	1974-2005	31	+50
Oystercatcher	1974-2005	22	+50 *
Sedge Warbler	1974-2005	41	+50 *
Little Grebe	1974-2005	16	0
LOSERS			
Grey Wagtail	1974-2005	55	-2
Moorhen	1974-2005	77	-11
Lapwing	1979-2005	37	-14
Dipper	1974-2005	36	-20
Redshank	1974-2005	17	-22
Common Sandpiper	1974-2005	25	-23
Reed Bunting	1974-2005	51	-31 *
Pied Wagtail	1974-2005	64	-38 *
Sand Martin	1977-2005	21	-51 *
Yellow Wagtail	1974-2005	19	-94 *

The sample sizes appear small as they are taken across the complete time series and reflect the lower coverage under WBS

*An asterisk indicates statistical significance.

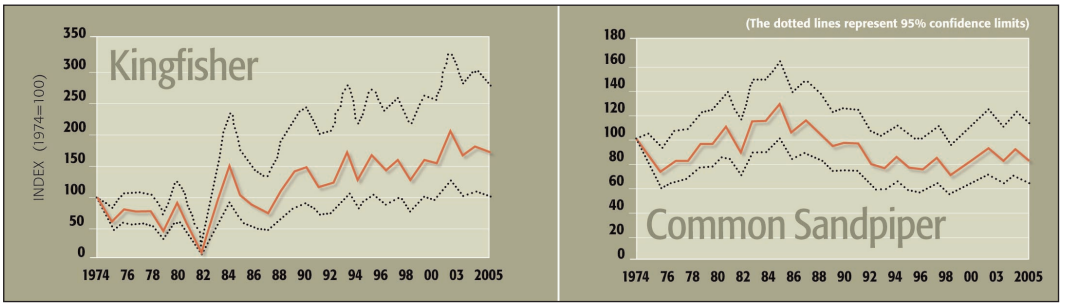

FIGURE 2. Population indices (unsmoothed) for the joint WBS-WBBS trends from 1974 to 2005.

50% since 1974 and 1980 respectively. Most of these 'joint trends' are broadly similar to those reported since last year on the BTO website (www.bto.org/birdtrends) with most differences attributable to annual fluctuations in the numbers of migrant species. Two examples are given (Kingfisher and Common Sandpiper; Fig. 2).

WBBS THE FAVOURITE?

Both schemes are running this year, with WBBS once again supported by the Environment Agency, and the WBS supported by the BTO. By autumn 2007, we should have completed further comparisons of WBS and WBBS trends, and we will then make a final decision on which scheme to continue. At the moment WBBS is probably the favourite, thanks to its better coverage and random plot selection, but WBS provides the most useful data at a site level. If, for example, the WBS is discontinued, then we hope that observers will be able to continue surveying their stretch of river using WBBS methods or take on a new site. We are very grateful to all participants in these two waterways schemes, particularly those carrying out both methods on the same site, and hope to see an indicator of waterway and wetland birds achieve a much higher profile in the near future.

Bird Populations 9:245-248
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BTO News 269:12-13

KEEPING IT CONSTANT TO MEASURE THE CHANGES

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Mark Grantham and *Rob Robinson* report on the results from the Constant Effort Sites ringing scheme in 2006, highlighting changes in the fortunes of our common songbirds.

MANTENER LA CONSTANCIA PARA MEDIR LOS CAMBIOS
Mark Grantham y *Rob Robinson* informan sobre los resultados del programa Sitios de Esfuerzo Constante en 2006, resaltando cambios en la suerte de nuestras aves comunes.

The Constant Effort Sites (CES) concept is a simple one really, and is all about the C: Constant. Every breeding season, ringers at over 120 sites in Britain and Ireland set nets in the same places over the same times on 12 occasions through the summer. By standardising capture effort like this, we can analyse the ringing and recapture information from these visits to assess three key measures of the performance of our commonest songbirds:

- Adult abundance — We can compare the actual number of adults caught at all the sites and measure changes in numbers over time. This does not tell us the size of the population, but gives changes or trends in numbers over time, which is what we are really interested in.
- Productivity — By comparing the number of juveniles caught relative to the number of adults, we can get a handle on how well the breeding season has gone.
- Adult survival — By looking to see which individuals are recaught between years, we can work out what proportion of adult birds survive each year. We are in the final stages of developing methods for this, so next year we should be able to present, for the first time, trends in national survival rates.

THE 2006 SEASON

For many CES ringers, 2006 was a season of dodging rain showers and windy days. It can be difficult to fit in standard visits when the weather is so uncooperative and, as ever, we must say a big thank you to all of our dedicated CES ringers for their hard work during the year. As we go to press, we have received results from 103 sites all over Britain and Ireland. It has been good to have more sites registering in Ireland (now five), and we also have 80 sites in England, 14 in Scotland and four in Wales.

ABUNDANCE CHANGES

Six species showed significant changes in adult numbers in 2006, though all were reversals of changes seen in 2005 (Table 1). Five species showed a decrease (Robin, Blackcap, Blue Tit, Great Tit, Bullfinch), with only Whitethroat showing an increase. Many factors will affect this index — for migrants such as Whitethroat, conditions in the wintering areas and along migration routes may play a very large part in determining the survival rate of adult birds.

One species of concern, though, is Bullfinch. With adult numbers down 16% on 2005, the

TABLE 1. CES trends in 2006.

	Adult numbers		Productivity		
	% change vs 2005	Long-term trend	% change vs 2005	% change vs 1983–2005	Long-term trend
Wren	–10	↑	**–28**	**–28**	↔
Dunnock	+3	↔	**–32**	**–23**	↓
Robin	**–14**	↑	+16	+2	↓
Blackbird	–7	↓	*+22*	*+27*	↓
Song Thrush	–3	↓	–19	–11	↑
Cetti's Warbler	+27	↑	**–62**	**–63**	↔
Sedge Warbler	+1	↓	*+22*	–2	↔
Reed Warbler	+1	↓	*+27*	*+14*	↔
Lesser Whitethroat	+14	↓	–13	–15	↔
Whitethroat	*+58*	↓	+15	–5	↔
Garden Warbler	–4	↓	+4	–4	↓
Blackcap	**–10**	↑	+11	+4	↔
Chiffchaff	–8	↑	**–21**	**–22**	↓
Willow Warbler	–5	↓	+9	–5	↓
Long-tailed Tit	–7	↑	+2	–12	↔
Willow Tit	+31	↓	+22	–8	↔
Blue Tit	**–25**	↔	*+67*	+7	↔
Great Tit	**–15**	↑	*+32*	+7	↓
Treecreeper	+16	↔	+5	24	↔
Chaffinch	–6	↔	–3	+9	↑
Greenfinch	+9	↔	+8	*+45*	↔
Goldfinch	–28	↔	+44	–2	↔
Linnet	–10	↓	+42	+40	↓
Bullfinch	**–16**	↓	–10	–6	↔
Reed Bunting	–8	↓	+7	**–28**	↓

The results above show how the top 25 CES species fared in 2006, compared to 2005 and also compared to the average since the scheme began. Changes in **bold** show statistically significant declines, and changes in *italic* show significant improvements.

downward trend for this species continues. CES results are one part of the jigsaw that, when fitted together, can tell us a lot about bird populations. The numbers of Bullfinches have halved since the 1970s and there have not been any signs of real recovery. Bullfinch was recently added to the Nest Record Scheme Concern List due to increased failure rates of eggs and chicks, and this was also reflected in a 10% drop in productivity compared to 2005.

AN UNPRODUCTIVE BREEDING SEASON

For an idea of how the breeding season has gone, we can look at changes in productivity. This is a measure of the number of juveniles produced by each breeding pair. In 2006, there were some very big changes but, as for adult numbers, some of these were due to a reversal of fortunes in 2005. Of the significant changes, the increases seen in Sedge Warbler, Reed Warbler, Blue Tit and Great Tit were all reversals of poor seasons in 2005. The only other significant increase was for Blackbird, and this may have been due to a mild winter and spring. In fact, nationally, 2006 was the warmest on record in most parts of the UK.

There were also significant declines in productivity though. The most affected birds were some of our resident insectivores, with Wren, Dunnock, Cetti's Warbler and Chiffchaff, all suffering. This may well be due to very poor spring weather washing out or chilling breeding

attempts. Despite a generally warm year, the March temperature was actually a degree lower than average and rainfall was also 30–40% up on average. For many early-nesting and ground-nesting species, this would spell disaster for first broods. Unfortunately, as later clutches were laid or chicks were being reared, May was also wet, with most areas seeing over 50% more than normal rainfall.

To put these declines into context, we can look at how productivity in 2006 compared to the long-term average. The most significant changes were for three species where productivity was up (Blackbird, Reed Warbler, Greenfinch) and five species where it declined (Wren, Dunnock, Cetti's Warbler, Chiffchaff, Reed Bunting). These latter decreases are mostly explained above, but it is interesting to note that even though Reed Bunting productivity increased slightly on the 2005 figure, it was still 28% below the long-term average. This poor productivity may be contributing to the lack of recovery in Reed Bunting numbers.

For more details about how CES fits into the big picture of BTO surveys, check out the UK bird trends on the BTO website at www.bto.org/birdtrends

WANT TO GET INVOLVED?

CES is an integral part of the Ringing Scheme: to find out more about ringing and how to become a ringer, visit www.bto. org/ringing or contact the Ringing Unit at BTO Thetford HQ. The CES Scheme does rely on new sites coming into the scheme each year to keep the level of monitoring sufficiently high. For further details contact Mark Grantham or Rob Robinson or email us at ces@bto.org

LAST BUT NOT LEAST

The CES scheme relies on the dedication and hard work of a large number of ringers, and we'd like to thank everyone who has put up a CES net, ringed a CES bird or made a CES cup of tea in 2006. We cannot name everyone here, but worthy of mention are some notable site birthdays in 2006:

25 years (including pilot years) — Treswell Wood (Treswell Wood IPM Group); Llangorse Lake (Llangorse Ringing Group).

20 years — Kippo (Jim Cobb).

15 years — Turnhouse (Lothian Ringing Group); Bainton (Chris Hughes); Lackford Pits (Lackford Ringing Group).

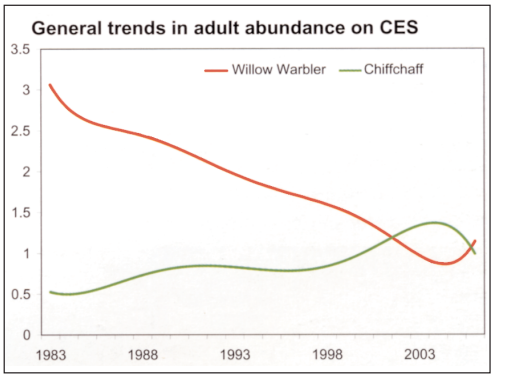
10 years — Stockbury (Rod Smith); Levington (Paul Newton); Little Crossthwaite (Peter Davies); Braes (Jim Cobb); Arley Hall (Mark Woodhead).

5 years — Gosforth Park (Natural History Society of Northumbria).

We would also like to thank all the ringers who set up new sites in 2006 — Waterhay (Cotswold Waterpark Ringing Group); Longstock (Martin de Retuerto); Pensthorpe (Holme Bird Observatory); Ashton's Callow (Alex Copland); Thurles (Alex Copland).

The Constant Effort Sites Scheme was undertaken within the partnership between the BTO and JNCC as part of its programme of research into nature conservation.

A TALE OF TWO WARBLERS: THE UPS AND DOWNS OF OUR BREEDING 'PHYLLOSCS'



Willow Warbler and Chiffchaff, the two common Phylloscopus warblers in the UK, have suffered very different fates in recent years. Their scientific name Phylloscopus (loosely translated as leaf gleaner) describes their behaviour aptly, as they flit about in the tree canopy searching for small insects.

Here the similarity ends though, as these two species have very different lives. The longer-winged Willow Warbler is a long-distance migrant, spending winters south of the Sahara. Most birds return in early April with first breeding on average in mid May. In contrast, the shorter-winged Chiffchaff makes a much shorter winter migration to the near Continent. Hence they can arrive back on territory earlier (in mid March) and many will be laying clutches in late April. It is clear then that these two closely related species may be affected by different factors. Understanding these differences in ecology can help us gain insights into the reasons underlying population changes.

Between 1967 and 2004, Willow Warblers in England suffered a 61% drop in the number of breeding pairs, and they are currently Red-listed as a species of UK conservation concern. This decline was most evident from the mid 1980s and the numbers of adults caught on CES showed a similar decline of 69% between 1984 and 2006. The decline also seems to have been greatest in the south, and in the last 11 years, whilst the English population has dropped by 29% the Scottish population has increased by 40%. CES results also reflect this change and many Scottish sites reported good years for Willow Warblers in 2005 and 2006.

Conversely, since CES began in the mid 1980s, Chiffchaffs have been doing very well in the UK, probably because of warmer winters in Europe. Since 1979 the population has seen a 130% increase in numbers, with the greatest increase being in the mid 1980s. Again, CES results show a similar trend, with a 64% increase since 1983.

However, the last two years have seen some quite drastic changes in catches of Chiffchaffs by CES ringers, with the species disappearing completely from some catch totals. So whilst this is bad news for Chiffchaffs, there does seem to have been a concurrent upturn in the fortunes of Willow Warblers. So as weather patterns continue to change, CES is well placed to monitor future changes in the populations of these species, so watch this space for news in the coming years.

Bird Populations 9:249-250
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BTO News 264:22

TESTING SEASON BECKONS FOR UK'S BREEDING BIRDS

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BTO Research Biologist, *David Glue*, chronicles the limited early nesting activity among Britain and Ireland's birds in 2006.

UNA TEMPORADA DE RETOS PARA LAS AVES REPRODUCTORAS DEL REINO UNIDO
El investigador *David Glue* del BTO relata el lento inicio de la actividad anidadora en el Reino Unido e Irlanda en 2006

BARN OWL AND GREENFINCH CLOSE SUB-STANDARD SEASON

The mild 2004/05 winter was characterised by an exceptional glut of woodland foods (notably berries, beech mast and conifer seeds). Many resident species survived in high numbers and in good condition. Unfortunately, late frosts in May and early June checked the available invertebrate food and led to heavy losses of broods of many resident species.

Summer migrant numbers were down, partly a result of cold weather in North Africa and Iberia. Added to this, sizzling heat and unsettled weather in late June and July led to parched habitats and reduced breeding success of many species.

Few birds took advantage of late summer heat in September and October and surreal sub-tropical conditions in early November (warmest first half since 1993). The elements helped late families of Great Crested Grebe (Abingdon, Oxon) and Song Thrush (Matlock, Derby), and a scattering of House Martin, Swallow and Stock Dove with late broods. Similarly, Barn Owl incubating clutches (south Lincs) and Greenfinch with third broods (Hitchin, Herts) in mid October, were rather unusual for a 2005 season that had promised so much but failed to deliver (*BTO News* 261, 263).

COLD SNAPS AND EMPTY WILD FOOD LARDER LIMIT MIDWINTER BREEDING

High pressure anchored over the UK from 14 November produced the sunniest November on record, but temperatures plunged overnight, to as low as –6°C. The second half of November was the coldest since 1993 and nesting operations were effectively terminated. With damaging wind chill and depleted rodent numbers, Barn Owl, Little Owl, Kestrel and Buzzard increasingly resorted to roadside hunting and scavenging for kills. Shrivelled fruits of bramble and elder (a product of the dry summer) were swiftly consumed, while conifer seeds and berries of hawthorn, holly, rowan, among others, were in short supply. Chaffinch, Brambling, Blackbird, Woodpigeon and modest numbers of tits (reflecting the tardy breeding season) rapidly resorted to birdtable fare. A severe shortage of beech mast and acorns saw Mistle Thrush and Jay highly mobile. Groups of 62 Mistle Thrushes (Radnor) and 35 Jays (Bucks)

were reported.

Conditions generated a striking influx of Hawfinches and modest numbers of Waxwing. Most Redwings and Fieldfares quickly passed through berryless hedges and woods, moving south and west, few pausing in gardens to exploit windfall apples. Temperatures 0.4°C below average by day in December reflected an uncomfortable mix of weather for birds and humans. Warm, dry conditions over Christmas brought widespread reports from Garden BirdWatch (GBW) participants of juvenile Woodpigeons and Collared Doves at birdtables in suburbia. However, temperatures plunged from Boxing Day, to a bone-chilling –12.8°C at Aviemore in Inverness-shire, with snow on high ground short-term. Birds took the strain with ailing, moribund gulls, Song Thrush and finches noted at GBW feeding stations. None-theless, shorelines remained effectively ice-free. Over-wintering Whimbrel and Common Sandpiper, Spoonbill and Avocet (all in southwest England), Forster's Tern and Lesser Yellowlegs (both in Co Cork), among others, survived. Unseasonal midwinter nesting attempts, by waterfowl, owls and thrushes, an eye-catching feature of the previous two years, remained rare.

ROBIN AND RAVEN JILTED BY VALENTINE'S DAY PROMISE

The New Year's weather was regularly influenced by continental high pressure systems and January temperatures were the coldest since 2001. Fortunately, the UK largely avoided the bitter freeze in central and Eastern Europe. In UK, a timely mild southwesterly airflow in the third week produced spring-like temperatures. Conditions prompted a scattering of nesting attempts: Mallard, Romsey (Hants), Harlow (Essex), Moorhen, River Severn (Gloucester), Collared Dove and Woodpigeon (several sites) attending young; Robin, Lockerbie (Dumfries), Starling (Worcester) and House Sparrow, Jedburgh (Borders) with active nests.

Under bright blue skies in a dry end to January (sunniest second half since 1994), tits, Mandarin, Tawny Owl and Ring-necked Parakeet were reported nest claiming, while Goshawk, Red Kite, Golden Eagle, spotted woodpeckers and Crossbill were busy displaying. A blast of Siberian air in the final two days once again stemmed nesting activity.

February maintained the generally cold theme, often wintery with snowy episodes. By Valentine's Day just eight species with active nests containing eggs or young had been reported to the BTO's Nest Record Scheme (compared to 17 and 18 species in 2004 and 2005 respectively). Highlights mid month included broods of Mistle Thrush atop a traffic light, Barnsley (South Yorks) and Blackbird in a motorway service station, Wirral (Cheshire); elsewhere, clutches were started by Dipper (Gwent), Raven (Beds), Wren (Essex) and Collared Dove (several localities) in the third week. Limited early breeding activity in the UK was made more difficult by exceptionally parched habitats. February 2006 registered minimal rainfall, a below-average sequence that, for all but two months in hard-hit parts of the southeast, extended back to November 2004. This contributed to retarded leaf development, and reduced invertebrate and insect food supplies. A bitter arctic blast on St David's Day, and the coldest March in a decade, further compounded a tardy start to the 2006 breeding season in UK. Concerns also extended toward the overwintering fortunes of spring migrants in Africa, severe drought continuing to affect much of the continent south of the Sahara.

Data from BTO surveys will assess the impact of some severe weather, both at home and abroad.

Bird Populations 9:251-252
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BTO News 267:27

SCOPS OWL AND BLACK-WINGED STILT RAISE FALSE HOPES

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Woodlark incubating in March snows, Lapwing eggs floating in May floodwater, Swallow broods baking beneath hot summer tin roofs: all ingredients of an intriguing 2006, as BTO Research Biologist *David Glue* describes.

EL AUTILLO Y LA CIGÜEÑUELA NO CUMPLEN EXPECTATIVAS
Totovías incubando en las nieves de marzo, huevos de avefría flotando en las inundaciones de mayo, pollos de golondrina asándose bajo tejados ardientes en verano: todo esto ocurrió durante el intrigante 2006, como describe el investigador del BTO *David Glue*.

DIPPER AND STONECHAT DEFY LATE SPRING CHILL

In contrast to recent years, little unseasonable nesting activity was reported in New Year 2006. This may have been because of low recruitment from the below-par 2005 breeding season, and poor condition of some adult birds, both probably the result of a sparse wild fruit larder and the coldest midwinter in a decade.

Testing times in the cold dry January, with rock-hard frozen soils, limited early nesting activity to unsuccessful attempts by Mallard, Moorhen, Robin and House Sparrow in built-up areas, while Woodpigeon and Collared Dove were recorded with fledged young. Raw, bone-chilling dreich weather in early February are thought to have placed nesting operations on hold.

By mid February, reports of a meagre nine species with active nests had been received by the BTO's Nest Record Scheme, including Blackbird (Oxford), Mistle Thrush (South Yorks), Wren (Essex) and Raven (several sites), with the total number of nest record cards less than half that of the previous two years.

March was the coldest since 1996, with daily temperatures 1.4°C below average. The incessant cold, continental airflow saw Great Crested Grebes, Rooks, Carrion Crows, thrushes and Robins deferring egglaying and incubation. Few birds defied the adverse elements, which were severe at times in Scotland. Grey Heron (Bucks), Dipper (Monmouth), Stonechat (New Forest, Hants), Woodlark (Thetford Forest, Norfolk), were observed incubating in ice, sleet and snow by the third week.

BARN AND TAWNY OWL NESTING CHECKED BY FEWER RODENT PREY

Cool, westerly winds sweeping UK over the first 12 days of April, with regular night frosts, prolonged the wintry feel. These conditions further delayed egg-laying among many species, including most dabbling ducks, corvids, thrushes, tits and finches by a few weeks. Warm temperatures and plentiful sunshine but another very dry month, especially in southeast and central England, compounded the drought conditions and populations of Field Vole and

Wood Mouse may have stayed low.

Contributors to the Barn Owl Monitoring Programme reported 'patchy' egg-laying, sometimes three weeks later than in the spring of 2005 (although that was an exceptionally early year).

Tinder-dry habitats sparked off destructive spring fires on coastal grassland, moss, heath and moor. Key fragments of nesting habitat for chats, pipits and Dartford Warblers were lost from Cornwall, Dorset, Hants and the Pennines. Countrywide, extra-limital nesting attempts included Nuthatch, Raven, Eider and Avocet to the north, east, south and west respectively.

GREAT TIT AND PIED FLYCATCHER PROFIT DESPITE MAY DOWNPOURS

Hot southeasterly winds in May swept waves of overshooting vagrants from the Continent, notably Hoopoe, Red-backed Shrike, Woodchat Shrike and Spoonbill: potential colonists, with global warming a reality. Black-winged Stilts settled at Martin Mere Wildfowl & Wetlands Trust Reserve (Lancs), but unfortunately the eggs failed to hatch. Scops Owl summered in the Oxford village of Thrupp, many twitchers homing in on the noddy-bike-like 'bleeping' call, the first 'stayer' since one in Dummer (Hants) in 1980. Elsewhere, Serin, (Portland, Dorset), Bee-eater, (Meon Valley, Hants) and Great Reed Warbler, (Loch of Kinnordy, Tayside) lingered and sang but failed to attract mates.

Tail winds helped sweep delayed Swifts, hirundines, warblers and other migrants back to breeding sites. Birds were quick to lay eggs and only sang briefly, to the frustration of surveyors and nest finders. Parched soils and probably limited invertebrate prey posed problems for many species, including foraging adult corvids, thrushes and Robins. Late-returning Pied Flycatchers found ample free nestboxes. Flash floods from thundery storms in mid May led to clutch and brood losses for many species including river bank-nesting Kingfisher, Sand Martin, and Common Sandpiper; similarly, Jackdaw, Starling and House Sparrow within buildings, Lapwing, Red Grouse and Skylark on farm and moor. Many, though, had time and energy to repeat nesting.

NIGHTJAR AND SWIFT PROFIT FROM MIDSUMMER SCORCHER

High pressure throughout June gave a very warm month, with temperatures topping 31°C at Weybourne (Norfolk) on 11th; it was the driest and sunniest June since 1995, exceeded only by the famous 1976. Ongoing 'Mediterranean-like' weather in July, as successive heatwaves saw monthly records tumble, topping 36.5°C at Wisley (Surrey) on 19th, had mixed effects on the UK's breeding birds. Moribund exposed broods were reported of Swallow beneath farm barn roofs, House Martin under the eaves of houses, Spotted Flycatcher and Robin in open-fronted nestboxes.

A welcome boost in hither to disappointing volumes of aerial insect 'plankton' helped many Swift to rear broods of 2–3 young. Equally, multi-brooded success stories were reported by nest recorders for Nightjar, Goldfinch, House Martin, Greenfinch, Swallow (2–3), Tree Sparrow, House Sparrow (2, 4 families respectively). Searing heat reduced nesting activity, but by mid July and through August monsoon-like periods gave some relief. Hobbies, House Martins, Stock Doves, Song Thrushes and Yellowhammers continued to rear late broods in some parts of the UK.

For many UK birds, though, a sluggish season, slow to unfold, faded markedly and, for a second successive year, overall production of young appeared to be below average. BTO members' nest record cards and census survey returns will help to quantify the full story.

Bird Populations 9:253-255
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BTO News 273:18-19

VOLUNTEER BOOM

DAVE LEECH, CARL BARIMORE AND HUMPHREY CRICK
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More people than ever are contributing to nest recording for the BTO and, as *Dave Leech, Carl Barimore* and *Humphrey Crick* report. Their efforts are revealing some worrying long-term productivity trends for Kestrels and Lapwings.

EXPLOSION DE VOLUNTARIOS

Más gente que nunca está contribuyendo al registro del nidos del BTO, y como *Dave Leech, Carl Barimore* y *Humphrey Crick* informan, sus esfuerzos revelan preocupantes tendencias en productividad para cernícalos y avefrías.

It may seem an incredibly simple thing to do, but the value of peering briefly into a nest and counting the eggs or chicks inside cannot be overestimated – information such as this is key to understanding why bird numbers change from year to year.

Thanks to another tremendous response from the Nest Record Scheme (NRS) volunteers, coupled with the launch of the webbased Nest Box Challenge (in collaboration with the BBC), the 2007 breeding season has been incredibly productive in terms of monitoring effort.

Sadly, feedback received from nest recorders and ringers suggests that the year has been less successful for many of the birds themselves, with a general impression that many species, including Great and Blue Tits, had a hard time coping with the incessant downpours during early summer.

OWLS AND RAPTORS IN 2006

Large between-year fluctuations in breeding success are not the preserve of small passerines, however. Last year, the UK's owl population appeared to have experienced a fairly poor season and now that 2006's data have been added to the NRS data set (which, for some species, stretches back as far as 1939), it is clear that productivity was indeed below par for several owl and raptor species.

Barn Owl, Tawny Owl and Kestrel, all of which feed primarily on small rodents and particularly Field Voles, produced significantly smaller broods than normal (based on their long-term trends in productivity).

The fact that brood sizes were unaffected for species such as Buzzard, Peregrine, Merlin, Sparrowhawk and Little Owl, which are less reliant on rodent prey, suggests that this drop in productivity was caused by a reduction in vole abundance in 2006.

When looking at productivity changes over time, it is important to put them into context. Vole populations in the UK are well studied, so it is known that numbers fluctuate regularly on a three-to-five-year cycle – a variation that is paralleled by changes in the productivity of those bird species feeding on them. Thus, a decline in breeding success in one year may be compensated for by aboveaverage productivity the following season.

CAUSES FOR CONCERN

It is when the average number of offspring produced per pair starts to decline over a longer period (for species with stable or declining abundance) that conservationists should start to become concerned (see NRS Data Analysis box).

While the most recent trends for Barn Owl and Tawny Owl indicate that productivity has not changed markedly, it appears that Kestrel brood sizes have declined significantly over the last 15 years, leading to its inclusion on the NRS Concern List (Fig 1). This follows the species' recovery from a previous decline in breeding performance, presumed to be a result of the long-lasting effects of organochlorine pesticides, such as DDT, in the 1950s and 1960s.

The NRS Concern List contains species that are demonstrating simultaneous declines in abundance and at least one aspect of productivity. It is important to exclude species that are increasing in number, as a fall in breeding success may result simply from heightened competition between individuals as they become more common.

NEW NRS CONCERN LIST

Lapwing is the most recent addition to the list due to a decrease in survival rates of nests containing eggs, caused by a number of particularly bad years since 1996 (Fig 2). Lapwing populations have been in decline since the mid-1980s, due primarily to the loss of the agricultural mosaic, drainage of wetland areas, increased grazing pressure in upland areas and heightened levels of nest predation.

JOIN IN NEXT YEAR

If you think that reading about the breeding success of different bird species is fascinating, it really is nothing compared to witnessing it firsthand. While the weather may seem cold and miserable now, it's amazing how quickly spring begins and birds start to breed, so when things start to warm up again remember to keep your eyes open for signs of nesting.

Records of any species, even Robins and Blackbirds in the garden, are incredibly useful as long as you can see what's in their nests. If you do find one, please get in touch with us at nest.records@bto.org and become part of the national band of nest recorders.

THANK YOU

We thank all the nest recorders and ringers who have contributed information this year – without your tireless efforts, none of this would have been possible. We are also grateful to Mandy Andrews who helps make the scheme run smoothly, Karen Wright for her help with the database, volunteer Mark Cubitt for the amazing new version of the IPMR home-inputting program introduced in 2006 and to David Glue for his contributions and advice.

The BTO/JNCC Partnership funds the Nest Record Scheme and we are grateful for the help provided by Helen Baker and her JNCC colleagues.

FIND OUT MORE

For more information on all aspects of the Nest

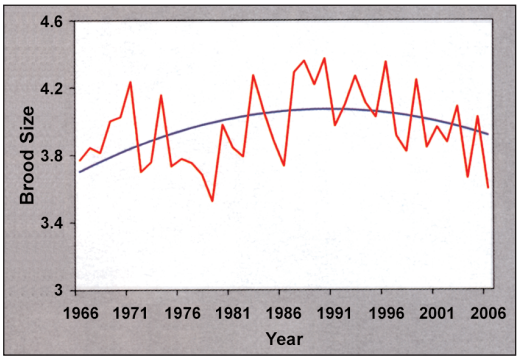

FIGURE 1. Change of Kestrel brood size since 1966.

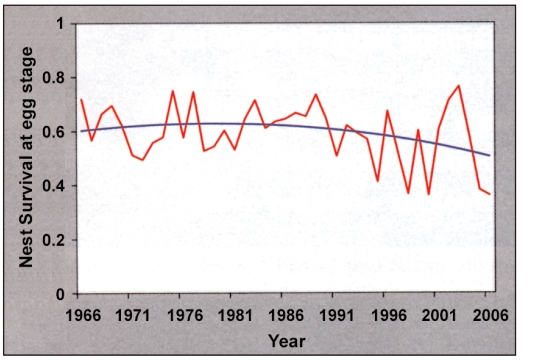

FIGURE 2. Changes in survival at the egg stage in Lapwing nests.

Record Scheme go to www.bto.org/goto/nrs.htm

For information about Red and Amber lists and Birds of Conservation Concern see www.bto.org/psob

The Breeding Birds in the Wider Countryside Report can be found online at www.bto.org/birdtrends

If you want to be involved with the Nest Record Scheme, e-mail nest.records@bto.org

THE NRS CONCERN LIST

Species	Years on list	Significant decline in:
Lapwing	New	NE *
Kestrel	2	B
Tree Pipit	2	NN *
Whinchat	2	NE *
Bullfinch	2	NE & NN
Corn Bunting	2	B *
Spotted Flycatcher	3	C, B, NE & NN
Starling	3	B
Pied Wagtail	4	C & B
House Sparrow	4	B
Grey Wagtail	5	C & B
Dunnock	9	NN
Yellowhammer	5	B, NE & NN
Yellow Wagtail	8	B *
Willow Warbler	9	NE
Ringed Plover	11	NE
Moorhen	15	C & NE
Linnet	16	B, NE & NN
Reed Bunting	16	NE

C = clutch size B = brood size
NE = nest survival at the egg stage NN = nest survival at the nestling stage
* indicates that the average annual sample size is small (between 10 and 30 records per year)
The inclusion of each species on the Red and Amber Lists of Conservation Concern is indicated by:
Red = **bold** Amber = *italics*

NRS DATA ANALYSIS

Each year, NRS data are used to create trends in productivity for more than 90 species, spanning the past 40 years of submitted records. These are made available to browse on-line as part of the Breeding Birds in the Wider Countryside Report (www.bto.org/ birdtrends).

Species are placed on the NRS Concern List if:

a) They demonstrate significant declines in some aspect of breeding performance over at least the last 15 years; and

b) They have been placed on the Red or Amber lists of Birds of Conservation Concern list due to population declines, or if there is some uncertainty over their population status.

Bird Populations 9:256-258
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MILDER WINTERS DRIVE CHANGE

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WeBS Research Officer, *Mark Collier*, describes the 2006/2007 winter for waterbirds, with results from the WeBS Annual Report hot off the press.

INVIERNOS SUAVES GENERAN CAMBIOS

Mark Collier, oficial de investigación de WeBS, describe el invierno 2006/2007 para aves acuáticas, con los resultados del informe anual de WeBS recién salidos de la imprenta.

Autumn may mean the end of summer signalled by the departure of migrants such as Swallow and Whitethroat for many, but as these species are starting their journey south thousands of other birds are doing the same, although instead of heading for the African sun are travelling towards Britain for the winter. The majority of these species are waterbirds and, every year BTO/WWT/RSPB/JNCC Wetland Bird Survey (WeBS) volunteers carefully monitor their numbers at a variety of wetland sites across the UK.

MILD WEATHER AFFECTS NUMBERS

On the whole, the 2006/07 winter was fairly mild across much of Britain and this is likely to have contributed to the low numbers of Bewick's and Whooper Swans in the country during this period. Bewick's Swan numbers in Britain were around half those of the previous year and the lowest for thirty years. Much of this decline was due to low numbers at the country's key site, the Ouse Washes, but evidence was also seen further afield. Information from the Dutch waterbird monitoring scheme revealed that fewer birds were present in The Netherlands as well and that many of these had started leaving eastwards by the end of December; a whole month earlier than twenty years ago.

The numbers of several goose species counted were also lower than in recent years, although for differing reasons. Peak numbers of Pink-footed Geese fell considerably, as fewer birds used some of the main winter roosts in north Norfolk and eastern Scotland. Numbers of European White-fronted Geese also fell but this was due to fewer birds wintering in Britain and whilst lower breeding success will have had an influence on the low numbers seen in 2006/07, it is likely that a continuing shift in the wintering range eastwards onto the continent, due to milder winters, is the most important factor driving this change. Greenland White-fronted Geese, which winter predominantly on Islay, declined by over 10% compared to the previous year and reflects a genuine population decline. A few increases were noted, however; in Greenland Barnacle Geese at several key sites, including the principal site for this population on Islay, and in Dark-bellied Brent Geese.

MORE WATER - FEWER DUCKS

Following several years of steady growth, numbers of wintering Wigeon fell in Britain by over 20% with numbers at several key sites,

most notably the Ouse Washes, lower than usual. As for several other species of wildfowl, such as Gadwall, Teal, Pintail and Shoveler, high water levels at the Ouse Washes during 2006/07 proved unfavourable and are thought to explain the dramatic changes in wildfowl numbers at this key site. The long-term decline of Mallard continued in 2006/07 and although the reasons for this are unclear may include fewer winter immigrants, poor breeding success, fewer released birds and fewer cold weather aggregations.

Despite the general fall in wildfowl numbers not all species were in decline nationally, numbers of most diving duck were similar to those of recent years. Also, in August 2006 the number of Little Egret counted by WeBS outnumbered those of Grey Heron for the first time with almost 3,500 birds being recorded. Peak numbers at both the Thames Estuary and The Wash exceeded 300 birds and up to 133 were counted at Lavan Sands in North Wales. Avocet continued their long-term increase and in February 2007 reached record levels (Fig 1). Other waders on the increase included Sanderling, Greenshank and Black-tailed Godwit, the latter reaching a new all-time high. Declines were noted in Grey Plover, Lapwing, Knot, Dunlin, Bar-tailed Godwit and Redshank. In common with several of the goose species the reasons for these declines could include a change in bias in the wintering range, both locally and at the flyway level as well as population decline.

ACKNOWLEDGEMENTS

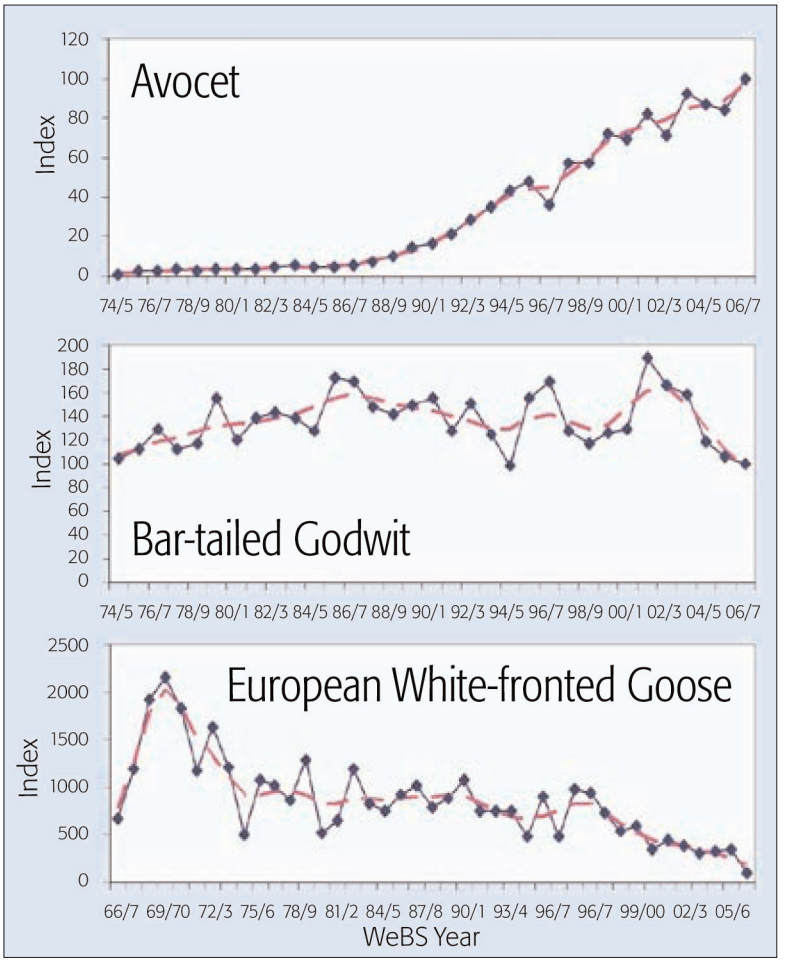
Counts from an incredible 3,825 count sectors across Great Britain and Northern Ireland are included in 'Waterbirds in the UK 2006/07'. This represents a tremendous effort by WeBS volunteers who between them counted over 3.2 million waterbirds in December alone. It is only through this hard work and dedication that WeBS is able to provide the firm background of data that is used for a whole variety of applications including site protection, species conservation and climate change research.

BTO/WWT/RSPB/JNCC WeBS is a partnership between the British Trust for Ornithology, the Wildfowl & Wetlands Trust, the Royal Society for the Protection of Birds and the Joint Nature Conservation Committee -the last on behalf of Natural England, Scottish Natural Heritage, the Countryside Council for Wales and the Council for Nature Conservation and the Countryside (Northern Ireland), and the Environment and Heritage Service (Northern Ireland).

FIND OUT MORE

For further information about WeBS and to download the complete Waterbirds in the UK 2006/07 visit www.bto.org/webs or E-mail webs@bto.org

Austin, G.E., Collier, M.P., Calbrade, N.A., Hall, C. & Musgrove, A.J. 2008. Waterbirds in the UK 2006/07: The Wetland Bird Survey. BTO/WWT/RSPB/JNCC, Thetford.



Here we show the contrast trends for three Wetland Birds. Avocet numbers are still hitting all-time highs, while Bar-tailed Godwit and European White-fronted Goose may be wintering elsewhere in response to milder winters.

Figure 1. Wetland Bird Trends in Focus.

Bird Populations 9:259-261
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BTO News 272:16-17

GOLDFINCH JOINS THE CHART-TOPPERS

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Is the red-faced finch a fixture at your bird feeder too? BTO Garden Bird Feeding Survey observers reported new levels of sightings last winter, as *David Glue* reports.

EL JILGUERO ALCANZA LA CABEZA DE LA LISTA
¿También en su comedero abunda ese pájaro de cara roja? Los observadores del conteo de aves en comederos del BTO registraron un alto número de avistamientos el pasado invierno, como informa *David Glue*.

The diminutive Goldfinch, once a rarity at garden bird tables, has leapt into the Top 12 of species visiting birdfeeders watched by contributors to the BTO's Garden Bird Feeding Survey.

While Chaffinch, Greenfinch and Coal Tit populations – benefiting greatly from afforestation and maturing gardens – have all turned to extra birdtables compared to the 1970s (see Table 1), it is the meteoric rise in Goldfinch in gardens that catches the eye. Formerly a scarce feeder, it now comes to exploit seeds of teasel, nyger and sunflower hearts and has leapfrogged Magpie in the GBFS league for the first winter.

Ever-reliable Robin, Blackbird and Blue Tit retained 'Top Trio' status for winter 2006/07, but House Sparrow and Starling slipped to their lowest-ever attendance levels. Only time will tell if this is a true reflection of overall population losses or the exceptionally mild weather conditions allowing them to feed elsewhere.

The 257 GBFS contributors who completed weekly counts between October and March experienced one of the quietest periods in the history of the scheme, though a very respectable total of 87 species took food or water provided.

Numbers ranged from a meagre six species in coastal Ramsgate (Kent) to 57 species in Llwynygroes, Tregaron (Dyfed), the latter including Water Rail, Snipe and Skylark to food, plus foraging Merlin and Goshawk.

On average, 19.1 species were attracted to gardens in towns and cities (22.5 in 05/06) and 19.8 species to gardens in rural settings (21.3 in 05/06).

COLD SNAPS AND QUAGMIRES

Six key factors helped to shape last winter's feeding community:

- A late, condensed, below-par 2006 breeding season, contributing fewer first-year tits, thrushes and finches.
- The warmest autumn (September-November), largely frost-free in many regions.
- The mildest winter (December–February) on record in many parts of UK, the result of prevailing southwesterly winds.
- An abundance of hedgerow fruits and berries, and forest conifer seeds and mast.
- The lack of sustained cold spells, lengthy snow lay, penetrating frosts or glazed ice, triggering unseasonable midwinter breeding attempts by Tawny Owl, Robin, thrushes and doves alongside feeding stations.
- Disease-related losses, chiefly Trichomoniasis among finches (see next page).

TABLE 1. GBFS Top Twelve Species in gardens where supplementary food is provided.

Rank	Species	Winter 2006/07 % gardens	1970s(*) % gardens
1	Robin	100	99
2	Blackbird	99	99
3	Blue Tit	98	99
4	Great Tit	97	93
5	Dunnock	97	95
6	Chaffinch	95	92
7	Greenfinch	95	92
8	Collared Dove	90	60
9	Coal Tit	84	70
10	House Sparrow	82	97
11	Goldfinch	81	3
12	Starling	79	96

* 1970s decade = average percentage of gardens occupied winters 1970/71 to 1979/80..

In the recent winter, just a handful of birdtable 'regulars', such as Jackdaw, Dunnock and Goldfinch, matched or exceeded earlier attendance levels. The great majority, notably winter thrushes and treeseed specialists such as Great Spotted Woodpecker, Nuthatch, Woodpigeon, Coal Tit, Siskin and Brambling, were in short supply.

Brief cold snaps (before Christmas and mid January) and the new millennium's heaviest accumulations of snow (early February), drew in extra essentially insectivorous Wrens, Blackcaps and Goldcrests to suet, fine seeds and mealworms.

GREENFINCHES SUCCUMB

Disease-related instances of sickly, moribund or dead birds in GBFS gardens were considered higher in winter 2006/07 than in any previous year, seemingly triggered by the hot humid weather of July 2006. From early October, GBFS participants attributed 87 cases to Trichomoniasis, determined by visual observations or postmortems undertaken by the Garden Bird Health Initiative (GBHI).

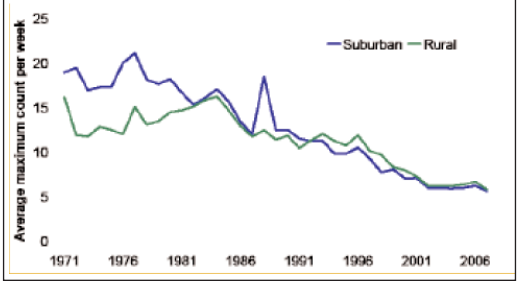
Birds appeared, variously, lethargic, fluffedup, gaping with swollen throats, stiff-winged or with a weak flight. Greenfinch dominated (57 cases), followed by Chaffinch, Goldfinch, House Sparrow and Collared Dove (in descending order), plus single instances of Woodpigeon and Sparrowhawk. The impact on local populations varied, from locally acute, single instances to no discernible effect.

Fewer cases were reported following early sharp frosts in November, while some sick birds in the New Year were shown to suffer from Salmonella poisoning and the sub-lethal Papillomas virus (produces warts on soft parts) affected Chaffinch, Brambling and House Sparrow.

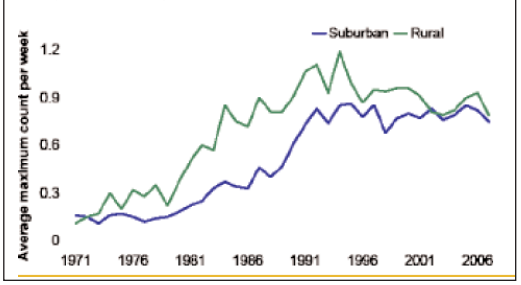
RAPTORS BRING EXCITEMENT

Countering the generally quieter garden scene, scarce raptors and scavengers were drawn to

House Sparrow. Still on the slippery slope?



Magpie. Have gardens reached a saturation level?



more feeding stations than in previous years. Red Kite, Buzzard and Raven were observed from Bodmin Moor, the New Forest and Chiltern Hills to the Scottish Borders.

Sparrowhawk remained easily the most frequently observed diurnal raptor, prey taken ranging in size from Coal Tit and Siskin to Magpie and Red-legged Partridge. Individual Sparrowhawks were watched regularly spooking feeding flocks and returning to collect stunned window-strike victims, others roadrunning to collect songbirds beneath bushes.

Elsewhere, lucky observers recorded garden hunting Goshawk (Angus, Dyfed), Hen Harrier (Essex), Merlin (Cornwall, Hants, Powys), Barn Owl (Suffolk) and Little Owl (Dyfed), individuals often hunting at feeding stations at dusk or dawn for a late or early meal.

GARDEN WATER WONDERLAND

After two dry winters, regular downpours ensured aquifers and reservoirs were replenished, but many gardens were reduced to quagmire no-go areas at times. However, some suitably stocked and sited small GBFS gardens logged first-time feeding Mallard and Moorhen, with a welcome short-term return of Reed Bunting for a few.

The large hillside garden at Llwynygroes, near Tregaron (Dyfed), mentioned earlier, drew Greylag Goose and Wigeon to grain, both new species for the GBFS, bringing the 37-year tally to 172 species.

Elsewhere, delighted observers charted faithful visiting Water Rail (Dyfed, Cornwall), Coot (Suffolk) and Lesser Black-backed Gull (Avon), plus fleeting visits for supplementary foods by Mandarin (Hants) and Kingfisher (Gwent).

THANK YOU

Thanks to all dedicated GBFS counters, plus Margaret Askew, Frances Bowman, Carol Povey and Jacky Prior for help with the production and collation of recording forms, and to Mike Toms for help with production of the average maximum counts per week .

Bird Populations is an annual journal of dynamic global avian demography and biogeography that publishes original research and review papers dealing with changes in the numbers, distributions, and ecological relationships of birds. Papers providing documentation of quantitative changes in bird populations or distributions are preferred, but papers providing baseline population or distribution information are also acceptable. Papers describing or evaluating field techniques or analytical methods for assessing population and distribution changes are also welcome. Contributions are encouraged from throughout the world from both well-known and little-studied avifaunas. *Bird Populations* is published in English with abstracts in Spanish.

Authors should submit three complete double-spaced copies of each manuscript, in English, to: David G. Ainley, Editor, *Bird Populations*, H.T. Harvey and Associates, 983 University Avenue, Bldg D, Los Gatos, CA 95032; dainley@penguinscience.com. Guidelines for preparing and submitting papers to *Bird Populations*, including the format for literature citations, are similar to those of *The Condor* and *Studies in Avian Biology*. Authors are urged to examine a recent issue of *Bird Populations* and follow the niceties of the journal's style. All research papers and review articles submitted to *Bird Populations* are subject to peer review. Submission of accepted papers on computer-readable magnetic media (MS-Word or WordPerfect files in Windows or Macintosh format) is encouraged strongly and will be appreciated greatly.

Bird Populations also prints or reprints annual or interim reports of major avian monitoring programs from around the world. These reports are an important focus of the journal which is intended to serve as a yearbook on the status of the Earth's birdlife by bringing together, under a single cover, information from many widespread localities on the changes in the abundance and distribution of birds. We believe that the printing or reprinting of these reports will draw attention, in a timely manner, to short-term population fluctuations that may turn out to be geographically widespread or that may signal the beginnings of longer-term trends. We hope that the publication of these reports will provide ornithologists with a global informational network for addressing avian population changes, will encourage an integrative global approach to avian monitoring studies, will stimulate the establishment of additional avian monitoring programs, particularly in the developing nations, and ultimately will aid in the conservation of global avian diversity.

Any agency or organization from anywhere in the world conducting a long-term, relatively large-scale, standardized, avian monitoring program is invited to submit an annual or interim report of that program to *Bird Populations* for printing or reprinting. Reports submitted for original printing will undergo peer review; please submit three copies of such reports. Already published reports submitted for reprinting will not be peer reviewed, but will be screened by the Editor when first submitted with regard to the scope and scientific merit of the monitoring program and the appropriateness of the methods and analyses; please submit one copy of such reports. Reports of programs included for publication will be printed or reprinted without page charges. Submission of reports on computer-readable magnetic media is encouraged and will be appreciated.

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