The 2014 Annual Report of the Monitoring Avian Productivity and Survivorship (MAPS) Program in Yosemite National Park

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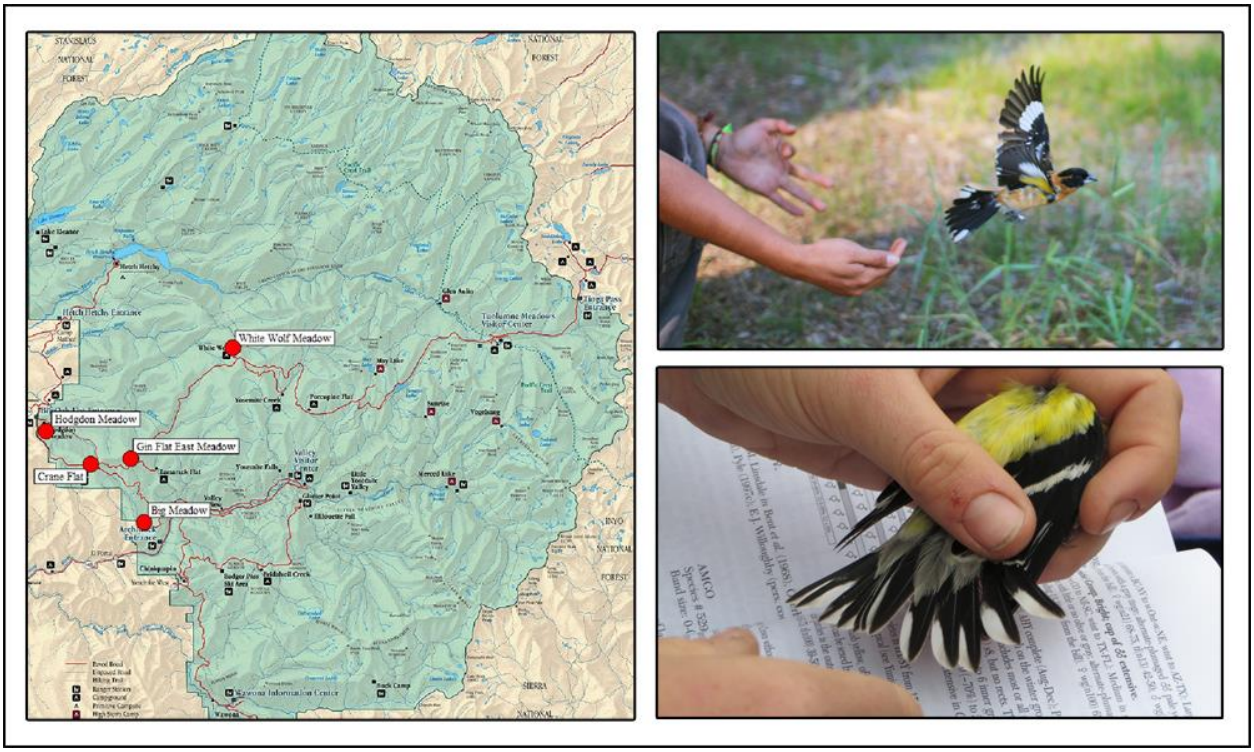

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Introduction

Landbirds are excellent bioindicators of habitat quality and environmental change in terrestrial ecosystems due to their rapid metabolism, high body temperature, and high ecological position on most food webs. Additionally, their relative abundance and diversity in nearly every terrestrial ecosystem, along with their mostly diurnal nature, make them relatively easy and cost-efficient to observe and monitor. Landbird and Neotropical migrant population declines have led to the creation of avian monitoring programs, such as the North American Breeding Bird Survey and MAPS (Monitoring Avian Productivity and Survivorship) program. Over time, these monitoring efforts have proven effective in helping land managers reach their management and conservation goals (Rich et al. 2004, DeSante 2008).

While presence-absence surveys like the North American Breeding Bird Survey provide land managers with useful data regarding relative abundance and species richness of a particular area, they do not provide much insight on the driving forces behind regional population trends (DeSante et al. 2005, Saracco et al. 2008). The MAPS program, through the application of standardized constant-effort mist netting and modern capture-recapture analytical techniques, can impart critical information regarding specific life stages or demographic groups that may be most strongly affected by population stressors (DeSante et al. 2005). In particular, avian mark-recapture studies can provide critical indices and estimates of the survival, productivity, and recruitment rates of bird populations, which can be used to identify environmental as well as demographic causes of population changes (Nott et al. 2002, Saracco et al. 2008, Saracco et al. 2009). Additionally, through the network of MAPS operators (>300 in North America in 2014), the MAPS program provides land managers with information on population trends and demographic rates of many landbird species at a variety of spatial and temporal scales simultaneously (DeSante et al. 2004, Robinson et al. 2009, Saracco et al. 2009).

While habitat destruction, habitat fragmentation, pollution and the continuous growth of urban landscapes challenge avian populations each year, national parks act as their sanctuary. Neotropical migratory landbirds rely on these safeguarded areas not only during the breeding season, but also during migration as stopover sites (Finch 1991). The long-term operation of constant-effort stations has been a main objective of the MAPS program, especially in large protected areas, such as national parks, which can additionally act as reference sites for assessing the effects of land use and land cover changes on bird populations. National Parks and other protected areas can shed light on how land management practices in these areas are impacting birds, without the confounding factors of local changes in land-use practices (Simmons et al. 1999), and are also important laboratories for understanding the effects of climate change and other broader-scale threats to bird populations.

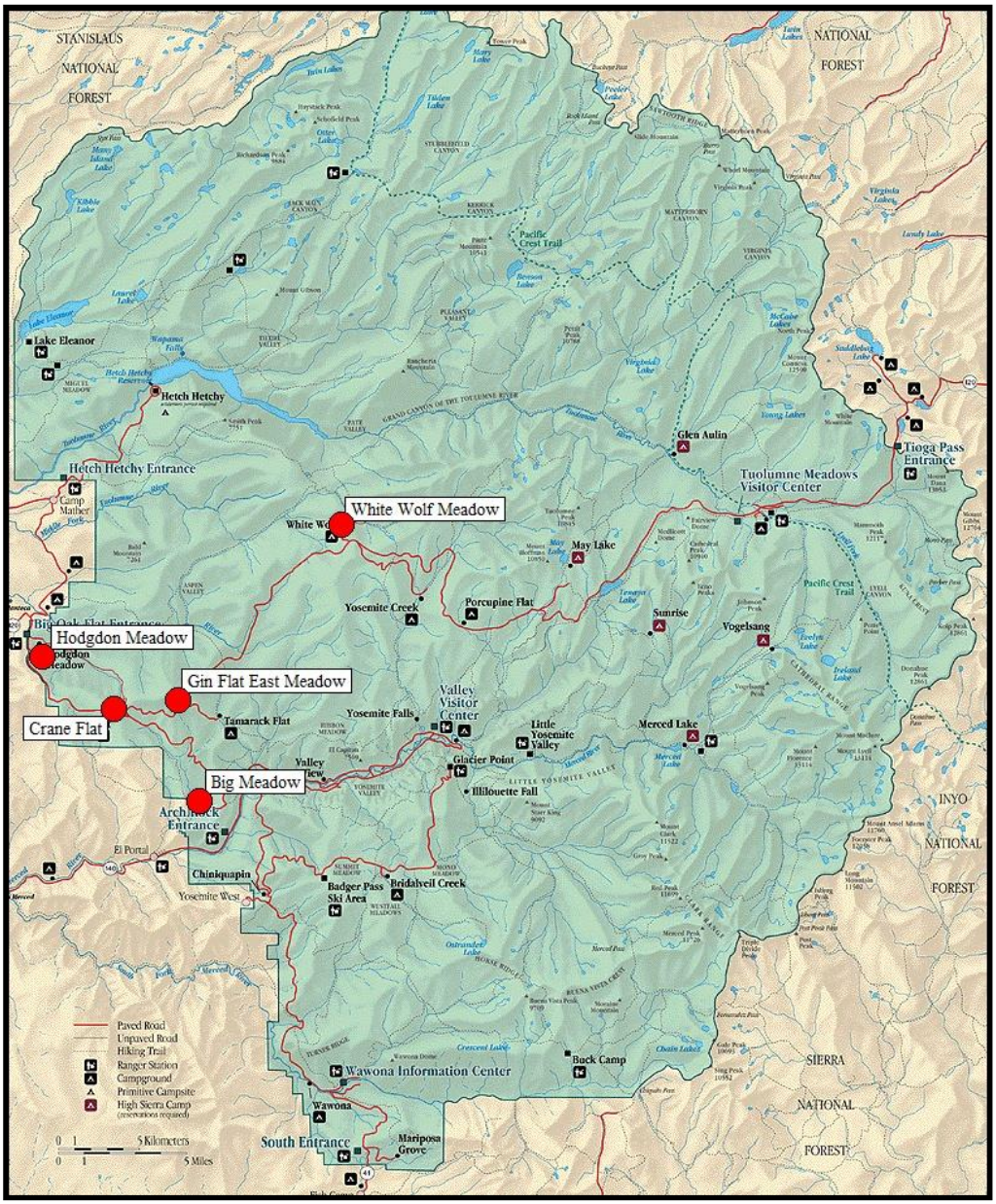
Yosemite National Park is the home of some of the longest-running MAPS stations in the country, several of which have been active now for over twenty years. Here we report summary monitoring results from the MAPS program in Yosemite in 2014.

Methods

Establishment and operation of stations

Five MAPS stations were re-established and operated in Yosemite National Park in 2014, at the same locations they were operated in previous years (Fig. 1).

Figure 1. Locations of ongoing Monitoring Avian Productivity and Survivorship (MAPS) bird banding stations at Yosemite National Park.



The five stations, located along an elevation gradient from highest to lowest, were:

- White Wolf Meadow (WHWO), set in a wet montane meadow surrounded by mixed red fir and lodgepole pine forest at 2,402 m elevation.

- Gin Flat East Meadow (GFEM), located in a wet montane meadow surrounded by mixed red fir and lodgepole pine forest at 2,073 m elevation.

- Crane Flat Meadow (CRFL), located in a wet montane meadow with willow and aspen thickets, surrounded by mixed conifer forest at 1,875 m elevation.

- Hodgdon Meadow (HODG), located in a wet montane meadow with willow and dogwood thickets, surrounded by mixed conifer forest and a patch of California Black Oak woodland at 1,408 m elevation.

- Big Meadow (BIME), located in riparian willows and mixed conifer forest (largely consumed by a stand-replacing fire in 1990) in an open, dry meadow at 1,311 m elevation.

The Hodgdon Meadow station was established and first operated according to the standardized MAPS protocol in 1990, followed by White Wolf Meadow, Crane Flat, and Big Meadow in 1993, and Gin Flat East Meadow in 1998. See Table 1 for details of habitats and operation of each station in 2014.

Through the efforts of IBP field biologist interns Kim Kayano and Sarah Harris, IBP Biologist Todd Allenger and Yosemite Wildlife Biologist Sarah Stock, these five MAPS banding stations were operated during 2014 in accordance with the standardized bird-banding protocol developed for the MAPS Program throughout North America (DeSante et al. 2009).

Ten net sites (14 sites at the Hodgdon Meadow station) were re-established at each of the stations in 2014, at the exact same locations where they were established and operated in each of the preceding years. One 12-m-long, 30-mm-mesh, nylon mist net was erected at each of the ten net sites at four of the stations on each day of operation. At Hodgdon Meadow, seven of the 14 net sites were operated on one day with the remaining seven net sites operated on a second day. Each of the stations was operated for six morning hours per day (beginning at about local sunrise) during one day (two days for Hodgdon Meadow) in each of eight consecutive 10-day periods between May 21 and August 8 or, for the two higher-elevation stations (White Wolf Meadow and Gin Flat East Meadow), for one day in each of seven periods between May 31 and August 8 (see Table 1). The operation of all stations occurred on schedule in 2014 during each of the ten-day periods.

Data collection

With few exceptions, all birds captured at MAPS stations were identified to species, age, and sex. If unbanded, the birds were banded with USGS/BRD numbered aluminum bands. Birds were released immediately upon capture and before being banded or processed if situations arose where

bird safety was compromised. Such situations could involve exceptionally large numbers of birds being captured at once, or the sudden onset of adverse weather conditions such as high winds or rainfall. The following data were collected from all birds captured, including recaptures:

- capture code (newly banded, recaptured, band changed, unbanded);
- band number
- species
- age and how aged
- sex (if possible) and how sexed (if applicable)
- extent of skull pneumaticization
- breeding condition of adults (i.e., extent of cloacal protuberance or brood patch)
- extent of juvenal plumage in young birds
- extent of body and flight-feather molt
- extent of primary-feather wear
- presence of molt limits and plumage characteristics
- wing chord
- fat class and body mass
- date and time of capture (net-run time)
- station and net site where captured
- any pertinent notes

Effort data (i.e., the number and timing of net-hours on each day of operation) were also collected in a standardized manner. In order to allow constant-effort comparisons of data, the times of opening and closing the array of mist nets and of beginning each net check were recorded to the nearest ten minutes. The breeding (summer residency) status (confirmed breeder, likely breeder, non-breeder) of each species seen, heard, or captured at each MAPS station on each day of operation was recorded using techniques similar to those employed for breeding bird atlas projects.

For each of the five stations, simple habitat maps prepared in previous years (indicating extent and location of major habitats, as well as structures, roads, trails, and streams) were checked and updated where necessary. The pattern and extent of cover of each of four major vertical layers of vegetation (upperstory, midstory, understory, and ground cover), in each major habitat type, were classified into one of twelve pattern types and eleven cover categories according to guidelines in the MAPS Habitat Structure Assessment Protocol (Nott et al. 2003).

Computer data entry and verification

The computer entry of all banding data was completed by John W. Shipman of Zoological Data Processing, Socorro, NM. The critical data for each banding record (capture code, band number, species, age, sex, date, capture time, station, and net number) were proofed by hand against the raw data and any computer-entry errors were corrected. Computer entry of effort and vegetation data

was completed by IBP biologists using custom data entry programs. All banding data were then run through a series of verification programs as follows:

- Clean-up programs to check the validity of all codes entered and the ranges of all numerical data.
- Cross-check programs to compare station, date, and net fields from the banding data with those from the summary of mist netting effort data.
- Cross-check programs to compare species, age, and sex determinations against degree of skull pneumaticization, breeding condition (extent of cloacal protuberance and brood patch), and extent of body and flight-feather molt, primary-feather wear, and juvenal plumage.
- Screening programs which allow identification of unusual or duplicate band numbers or unusual band sizes for each species.
- Verification programs to screen banding and recapture data from all years of operation for inconsistent species, age, or sex determinations for each band number.

Any discrepancies or suspicious data identified by any of these programs were examined manually and corrected if necessary. Wing chord, weight, station of capture, date, and any pertinent notes were used as supplementary information for the correct determination of species, age, and sex in all of these verification processes.

Data analysis

We classified the landbird species captured in mist nets into six groups based upon their breeding or summer residency status. Each species was classified as one of the following:

- a regular breeder (B) if we had positive or probable evidence of breeding or summer residency within the boundaries of the MAPS station *during all years* that the station was operated.

- a usual breeder (U) if we had positive or probable evidence of breeding or summer residency within the boundaries of the MAPS station *during more than half but not all of the years* that the station was operated.

- an occasional breeder (O) if we had positive or probable evidence of breeding or summer residency within the boundaries of the MAPS station *during half or fewer of the years* that the station was operated.

- a transient (T) if the species was *never* a breeder or summer resident at the station, but the station was within the overall breeding range of the species.

- an altitudinal disperser (A) if the species breeds only at lower elevation than that of the station but disperses to higher elevations after breeding.

- a migrant (M) if the station was not located within the overall breeding range of the species.

Data for a given species from a given station were included in productivity analyses if the station was within the breeding range of the species; that is, data were included from stations where the species was a breeder (B, U, or O), or transient (T), but not where the species was an altitudinal disperser (A) or a migrant (M).

Adult population index and productivity analyses

The proofed, verified, and corrected banding data from all sixteen years were run through a series of analysis programs that calculated for each species:

- the numbers of newly banded birds, recaptured birds, and birds released unbanded.

- the numbers and capture rates (per 600 net-hours) of first captures (in a given year) of individual adult and young birds.

- the reproductive index. Following the procedures pioneered by the British Trust for Ornithology (BTO) in their CES Scheme (Peach et al. 1996), we used the number of adult birds captured as an index of adult population size. For each species each year, we calculated a yearly reproductive index as the number of young divided by the number of adults.

Results

A total of 1950.7 net-hours was accumulated at the five MAPS stations operated in Yosemite National Park in 2014 (Table 1). Data from 1607.7 of these net-hours could be compared directly to the previous year's data in a constant-effort manner.

2014 Indices of Adult Population Size and Post-Fledging Productivity

We present the 2014 numbers of newly-banded, unbanded, and recaptured birds for each species at each of the five stations individually and for all stations combined in Table 2. A total of 1,790 captures of 63 species was recorded during the summer of 2014. Newly banded birds comprised 70.28% of the total captures. The greatest number of total captures (638) was recorded at the Hodgdon Meadow station and the smallest number of total captures (186) was recorded at the White Wolf Meadow station. The highest species richness occurred at Hodgdon Meadow (47 species) and the lowest species richness occurred at White Wolf Meadow (27 species).

The 2014 capture rates (per 600 net-hours) of individual adult and young birds and the 2014

Table 1. Summary of the 2014 operation of the five MAPS stations in Yosemite National Park.

Station						2014 operation		
Name	Code	No.	Major Habitat Type	Latitude-longitude	Avg Elev. (m)	Total number of net-hours[1]	No. of periods	Inclusive dates
White Wolf Meadow	WHWO	11904	Wet montane meadow, red fir/ lodgepole pine forest	37°52'10"N,-119°39'08"W	2402	334.3 (286.5)	7	6/05 - 8/01
Gin Flat East Meadow	GFEM	11980	Wet montane meadow, mixed fir forest	37°45'59"N,-119°45'37"W	2073	317.5 (278.5)	7	6/04 - 7/31
Crane Flat	CRFL	11907	Wet montane meadow, willow/ aspen thickets, mixed coniferous forest	37°45'20"N,-119°48'13"W	1875	389.3 (316.2)	8	5/25 - 7/30
Hodgdon Meadow	HODG	11107	Wet montane meadow, willow/ dogwood thickets, mixed oak and coniferous forest	37°47'41"N,-119°51'50"W	1408	564.3 (464.5)	8	5/23 - 8/03
Big Meadow	BIME	11905	Riparian willows, mixed coniferous forest (largely consumed by a stand-replacing fire in 1990), open dry meadow	37°42'16"N,-119°45'07"W	1311	345.2 (262.0)	8	5/22 - 8/04
ALL STATIONS COMBINED						1950.7 (1607.7)	8	5/22 - 8/04

[1] Total net-hours in 2014. Net-hours in 2014 that could be compared in a constant-effort manner to 2013 are shown in parentheses.

Table 2. Capture summary for the five individual MAPS stations rated in Yosemite National Park in 2014, and all stations pooled.
N = Newly Banded, U = Unbanded, R = Recaptures of banded birds.

	White Wolf Meadow			Gin Flat East Meadow			Crane Flat			Hodgdon Meadow			Big Meadow			All five stations combined		
Species	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Mountain Quail														1			1	
California Quail														1			1	
Anna's Hummingbird		1			2			6			79			15			103	
Rufous Hummingbird		2			7			4			5			1			19	
Calliope Hummingbird		1									2						3	
Williamson's Sapsucker				1												1		
Red-breasted Sapsucker	1			8			7		2	23		14	1			40		16
Downy Woodpecker										1			1			2		
Hairy Woodpecker			1	3			1			2			3			9		1
White-headed Woodpecker										4						4		
Northern Flicker										1			1			2		
Olive-sided Flycatcher										1	2					1	2	
Western Wood-Pewee	1			2						8		8	4		1	15		9
Traill's Flycatcher													2			2		
Hammond's Flycatcher	1		1	1			5		1	2						9		2
Dusky Flycatcher	4			11		3	38		13	4						57		16
Western Flycatcher	1			5			5			5						16		
Black Phoebe													1			1		
Cassin's Vireo				1			4			5		1	3			13		1
Warbling Vireo	2			5			29	1	4	17	1	2	3		1	56	2	7
Steller's Jay	1						2			3	1	1				6	1	1
Mountain Chickadee	6		3	6		1	1		2	1						14		6
Oak Titmouse													1			1		
Bushtit										7	1		6		1	13	1	1
Red-breasted Nuthatch	1			6			4	1		13		2				24	1	2
White-breasted Nuthatch													1			1		

Table 2 (continued). Capture summary for the five individual MAPS stations rated in Yosemite National Park in 2014, and all stations pooled.
N = Newly Banded, U = Unbanded, R = Recaptures of banded birds.

	White Wolf Meadow			Gin Flat East Meadow			Crane Flat			Hodgdon Meadow			Big Meadow			All five stations combined		
Species	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Brown Creeper	16	2	2	13	2	4	5			2			1		1	37	4	7
House Wren	1			1			7			9	1	2	7	1	2	25	2	4
Pacific Wren										1						1		
Bewick's Wren													1			1		
Golden-crowned Kinglet	1			11	2	1	9			1						22	2	1
Wrentit													5		3	5		3
Western Bluebird													1			1		
Hermit Thrush				5			4		2							9		2
American Robin	4		2				3		1	6			3		1	16		4
Orange-crowned Warbler	4			11			21	1	2	46	2	4	26		3	108	3	9
Nashville Warbler				3			5	1		6			14	1	7	28	2	7
MacGillivray's Warbler	1			13	1	4	19	1	20	31	2	37	7			71	4	61
Yellow Warbler							2			4		1	3			9		1
Yellow-rumped Warbler	30	2	3	36	1	4	20		2	11			1			98	3	9
Black-throated Gray Warbler				1						1			5			7		
Hermit Warbler	11			8	1		7	1	1	11	1		2			39	3	1
Wilson's Warbler				2		1	4			2	1	1	4			12	1	2
Green-tailed Towhee				4		1										4		1
Spotted Towhee										5	2		10			15	2	
Chipping Sparrow	3			2			10		4					1		15	1	4
Fox Sparrow				2						2				1		4	1	
Song Sparrow	1			3				1	2	26	2	17			4	30	3	23
Lincoln's Sparrow	4	2	8	21	3	23	17		10	10		14				52	5	55
Dark-eyed Junco	39		20	23	2	16	53	4	33	62	3	7				177	9	76
Western Tanager				7					1	11			2			20		1
Black-headed Grosbeak							1			14		4	10			25		4

Table 2 (continued). Capture summary for the five individual MAPS stations rated in Yosemite National Park in 2014, and all stations pooled.
N = Newly Banded, U = Unbanded, R = Recaptures of banded birds.

	White Wolf Meadow			Gin Flat East Meadow			Crane Flat			Hodgdon Meadow			Big Meadow			All five stations combined		
Species	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Lazuli Bunting							3				1		15	1		18	2	
Red-winged Blackbird										3		3				3		3
Brewer's Blackbird										5		1	2		1	7		2
Bullock's Oriole													3	1		3	1	
Pine Grosbeak	1															1		
Purple Finch				2			3			22	1		13		1	40	1	1
Cassin's Finch										6						6		
Pine Siskin	2			25	2	2				1						28	2	2
Lesser Goldfinch				4	1								13			17	1	
Lawrence's Goldfinch										15		1	1			16		1
Evening Grosbeak										1						1		
ALL SPECIES POOLED	136	10	40	246	24	60	289	21	100	411	107	120	176	24	26	1258	186	346
Total Number of Captures		186			330			410			638			226			1790	
Number of Species	23	6	8	32	11	11	28	10	16	43	17	18	35	10	12	58	30	36
Total Number of Species		27			34			32			47			42			63	

reproductive index (number of young birds per adult) are presented for each species and for all species pooled at each station and all stations combined in Table 3. We present capture rates (captures per 600 net-hours) rather than absolute numbers of birds in this table so that the data can be compared among stations which, because of the vagaries of weather and other factors, can differ from one another in effort expended (see Table 1). These capture indices suggest that the total adult population size in 2014 was greatest at Crane Flat (326.7 adults/600 net-hours), followed by Hodgdon Meadow (144.6), Gin Flat East Meadow (272.1), Big Meadow (187.7), and White Wolf Meadow (140.0). The capture rate of young of all species pooled at each station in 2014 was highest at Gin Flat East Meadow (200.3 young/600 net-hours), followed by Hodgdon Meadow (247.8), White Wolf Meadow (131.0), Crane Flat (106.3), and Big Meadow (86.9). Reproductive index (the number of young per adult) at the five stations in 2014 was greatest at White Wolf Meadow (0.94), followed by Gin Flat East Meadow (0.74), Hodgdon Meadow (0.50), Big Meadow (0.46), and Crane Flat (0.33). The mean adult capture rate for the five stations combined was 249.8 per 600 net hours and the overall reproductive index was 0.53 in 2014.

In 2014, Dark-eyed Junco was the most frequently captured species, followed by MacGillivray's Warbler, Orange-crowned Warbler, Lincoln's Sparrow, Yellow-rumped Warbler, Anna's Hummingbird, Dusky Flycatcher, Warbling Vireo, Red-breasted Sapsucker, and Song Sparrow (Table 2). Overall, the most abundant breeding species in 2014 (as determined by the number of adults captured per 600 net-hours; Table 3), not including Orange-crowned Warbler (because most if not all of the individuals captured in Yosemite are dispersing upslope from lower-elevation breeding sites outside the park) and Anna's Hummingbird (because hummingbirds were not banded to determine the number of individual birds), in decreasing order, were Dark- eyed Junco, MacGillivray's Warbler, Yellow-rumped Warbler, Lincoln's Sparrow, Dusky Flycatcher, Warbling Vireo, Purple Finch, Red-breasted Sapsucker, Hermit Warbler and Nashville Warbler. The following is a list of the most frequently captured species (captured at a rate of at least 8.0 adults per 600 net-hours), in decreasing order, at each station in 2014 (see Table 3):

White Wolf Meadow
Dark-eyed Junco
Yellow-rumped Warbler
Lincoln's Sparrow
Brown Creeper

Gin Flat East Meadow
Lincoln's Sparrow
Yellow-rumped Warbler
Dark-eyed Junco
MacGillivray's Warbler
Dusky Flycatcher
Pine Siskin
Brown Creeper
Western Tanager

Crane Flat
Dusky Flycatcher
Dark-eyed Junco
Warbling Vireo
MacGillivray's Warbler
Yellow-rumped Warbler
Lincoln's Sparrow
Hermit Warbler
Chipping Sparrow

Hodgdon Meadow
MacGillivray's Warbler
Red-breasted Sapsucker
Warbling Vireo
Song Sparrow
Purple Finch
Western Wood-pewee
Black-headed Grosbeak
Lawrence's Goldfinch
Lincoln's Sparrow
Hermit Warbler

Big Meadow
Nashville Warbler
Lazuli Bunting
Purple Finch
Spotted Towhee
House Wren
Black-headed Grosbeak
Lesser Goldfinch

Table 3. Numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the five individual MAPS stations, and all stations pooled, operated in Yosemite National Park in 2014.

	White Wolf Meadow			Gin Flat East Meadow			Crane Flat			Hodgdon Meadow			Big Meadow			All five stations combined		
Species	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.
Williamson's Sapsucker				1.9	0.0	0.00										0.3	0.0	0.00
Red-breasted Sapsucker	1.8	0.0	0.00	5.7	9.4	1.67	4.6	6.2	1.33	20.2	12.8	0.63	1.7	0.0	0.00	8.3	6.5	0.78
Downy Woodpecker										0.0	1.1	und.	1.7	0.0	0.00	0.3	0.3	1.00
Hairy Woodpecker	1.8	0.0	0.00	3.8	1.9	0.50	1.5	0.0	0.00	1.1	1.1	1.00	3.5	1.7	0.50	2.2	0.9	0.43
White-headed Woodpecker										2.1	1.1	0.50				0.6	0.3	0.50
Northern Flicker										0.0	1.1	und.	0.0	1.7	und.	0.0	0.6	und.
Olive-sided Flycatcher										1.1	0.0	0.00				0.3	0.0	0.00
Western Wood-Pewee	0.0	1.8	und.	1.9	1.9	1.00				14.9	0.0	0.00	7.0	0.0	0.00	5.8	0.6	0.11
Traill's Flycatcher													3.5	0.0	0.00	0.6	0.0	0.00
Hammond's Flycatcher	0.0	1.8	und.	0.0	1.9	und.	7.7	0.0	0.00	1.1	1.1	1.00				1.8	0.9	0.50
Dusky Flycatcher	7.2	0.0	0.00	15.1	7.6	0.50	57.0	3.1	0.05	3.2	1.1	0.33				16.0	2.2	0.14
Western Flycatcher	1.8	0.0	0.00	7.6	1.9	0.25	4.6	3.1	0.67	4.3	1.1	0.25				3.7	1.2	0.33
Black Phoebe													1.7	0.0	0.00	0.3	0.0	0.00
Cassin's Vireo				1.9	0.0	0.00	3.1	3.1	1.00	5.3	1.1	0.20	5.2	0.0	0.00	3.4	0.9	0.27
Warbling Vireo	3.6	0.0	0.00	7.6	1.9	0.25	41.6	3.1	0.07	15.9	4.3	0.27	5.2	0.0	0.00	15.7	2.2	0.14
Steller's Jay	1.8	0.0	0.00				3.1	0.0	0.00	4.3	0.0	0.00				2.2	0.0	0.00
Mountain Chickadee	5.4	7.2	1.33	5.7	7.6	1.33	4.6	0.0	0.00	1.1	0.0	0.00				3.1	2.5	0.80
Oak Titmouse													0.0	1.7	und.	0.0	0.3	und.
Bushtit										5.3	1.1	0.20	7.0	1.7	0.25	2.8	0.6	0.22
Red-breasted Nuthatch	1.8	0.0	0.00	3.8	7.6	2.00	3.1	3.1	1.00	4.3	10.6	2.50				2.8	4.9	1.78
White-breasted Nuthatch													0.0	1.7	und.	0.0	0.3	und.
Brown Creeper	9.0	21.5	2.40	11.3	13.2	1.17	3.1	4.6	1.50	2.1	0.0	0.00	1.7	1.7	1.00	4.9	7.1	1.44
House Wren													8.7	3.5	0.40	1.5	0.6	0.40
Pacific Wren										0.0	1.1	und.				0.0	0.3	und.

Table 3 (continued). Numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the five individual MAPS stations, and all stations pooled, operated in Yosemite National Park in 2014.

	White Wolf Meadow			Gin Flat East Meadow			Crane Flat			Hodgdon Meadow			Big Meadow			All five stations combined		
Species	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.
Bewick's Wren													1.7	0.0	0.00	0.3	0.0	0.00
Golden-crowned Kinglet	0.0	1.8	und.	3.8	17.0	4.50	7.7	6.2	0.80	0.0	1.1	und.				2.2	4.6	2.14
Wrentit													5.2	7.0	1.33	0.9	1.2	1.33
Western Bluebird													1.7	0.0	0.00	0.3	0.0	0.00
Hermit Thrush				5.7	3.8	0.67	6.2	0.0	0.00							2.2	0.6	0.29
American Robin	7.2	3.6	0.50				6.2	0.0	0.00	5.3	1.1	0.20	1.7	3.5	2.00	4.3	1.5	0.36
Nashville Warbler										5.3	1.1	0.20	27.8	0.0	0.00	6.5	0.3	0.05
MacGillivray's Warbler	0.0	1.8	und.	24.6	0.0	0.00	27.7	3.1	0.11	38.3	11.7	0.31	5.2	7.0	1.33	21.5	5.5	0.26
Yellow Warbler							1.5	1.5	1.00	5.3	0.0	0.00	1.7	3.5	2.00	2.2	0.9	0.43
Yellow-rumped Warbler	26.9	32.3	1.20	37.8	34.0	0.90	26.2	6.2	0.24	7.4	4.3	0.57	1.7	0.0	0.00	18.5	13.5	0.73
Black-throated Gray Warbler				0.0	1.9	und.				0.0	1.1	und.	7.0	1.7	0.25	1.2	0.9	0.75
Hermit Warbler	0.0	19.7	und.	5.7	9.4	1.67	12.3	0.0	0.00	9.6	2.1	0.22	3.5	0.0	0.00	6.8	5.5	0.82
Wilson's Warbler				3.8	0.0	0.00	4.6	1.5	0.33	1.1	1.1	1.00	5.2	1.7	0.33	2.8	0.9	0.33
Green-tailed Towhee				7.6	0.0	0.00										1.2	0.0	0.00
Spotted Towhee										5.3	0.0	0.00	12.2	5.2	0.43	3.7	0.9	0.25
Chipping Sparrow	5.4	0.0	0.00	1.9	1.9	1.00	9.2	6.2	0.67							3.1	1.5	0.50
Fox Sparrow				3.8	0.0	0.00				2.1	0.0	0.00				1.2	0.0	0.00
Song Sparrow	0.0	1.8	und.	0.0	5.7	und.	3.1	0.0	0.00	15.9	15.9	1.00	3.5	0.0	0.00	5.8	5.8	1.00
Lincoln's Sparrow	10.8	0.0	0.00	47.2	9.4	0.20	23.1	12.3	0.53	10.6	5.3	0.50				17.2	5.5	0.32
Dark-eyed Junco	52.0	35.9	0.69	30.2	20.8	0.69	53.9	41.6	0.77	24.5	44.7	1.83				31.7	30.8	0.97
Western Tanager				11.3	1.9	0.17	1.5	0.0	0.00	10.6	1.1	0.10	3.5	0.0	0.00	5.8	0.6	0.11
Black-headed Grosbeak							0.0	1.5	und.	13.8	3.2	0.23	8.7	8.7	1.00	5.5	2.8	0.50
Lazuli Bunting							4.6	0.0	0.00				15.6	10.4	0.67	3.7	1.8	0.50
Red-winged Blackbird										4.3	0.0	0.00				1.2	0.0	0.00

Table 3 (continued). Numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the five individual MAPS stations, and all stations pooled, operated in Yosemite National Park in 2014.

	White Wolf Meadow			Gin Flat East Meadow			Crane Flat			Hodgdon Meadow			Big Meadow			All five stations combined		
Species	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.
Brewer's Blackbird										6.4	0.0	0.00	5.2	0.0	0.00	2.8	0.0	0.00
Bullock's Oriole													3.5	1.7	0.50	0.6	0.3	0.50
Pine Grosbeak	1.8	0.0	0.00													0.3	0.0	0.00
Purple Finch				1.9	1.9	1.00	4.6	0.0	0.00	15.9	7.4	0.47	15.6	8.7	0.56	8.6	4.0	0.46
Cassin's Finch										3.2	3.2	1.00				0.9	0.9	1.00
Pine Siskin	1.8	1.8	1.00	13.2	37.8	2.86				1.1	0.0	0.00				2.8	6.5	2.33
Lesser Goldfinch				7.6	0.0	0.00							8.7	13.9	1.60	2.8	2.5	0.89
Lawrence's Goldfinch										13.8	2.1	0.15	1.7	0.0	0.00	4.3	0.6	0.14
Evening Grosbeak										1.1	0.0	0.00				0.3	0.0	0.00
ALL SPECIES POOLED	140.0	131.0	0.94	272.1	200.3	0.74	326.7	106.3	0.33	287.1	144.6	0.50	187.7	86.9	0.46	249.8	133.5	0.53
Number of Species	16	12		26	22		26	16		36	29		32	19		53	44	
Total Number of Species		22			29			27			41			35			57	

[1] Reproductive index (young/adult) is undefined because no adults of this species were captured at this station in this year.

Longevity Records

Analysis of MAPS data collected at the Yosemite stations between 1990-2013 yielded new North American longevity records for Red-breasted Sapsucker (7 years), Williamson's Sapsucker (6 years), White-headed Woodpecker (8 years 1 month), Western Wood-pewee (8 years 1 month), Cassin's Vireo (8 years 1 month), Mountain Chickadee (10 years 1 month), Brown Creeper (6 years 1 month), Lincoln's Sparrow (8 years 11 months), and Cassin's Finch (8 years). During 2014 we compiled these results into a manuscript (Appendix II) which has now been peer-reviewed and published as:

> Rowan, E., R.B. Siegel, D.R. Kaschube, and S. Stock. 2014. North American longevity records for nine landbird species monitored at Yosemite National Park's MAPS stations. North American Bird Bander 39(4):153-159.

Education and Outreach

The Yosemite MAPS program includes an education and outreach component, led by Sarah Stock, that allows park visitors, interpretive rangers, local school groups and volunteers to visit the MAPS stations throughout the season. Eight banding demonstration days were organized with Yosemite National Park Staff, the visiting public, school groups, and Yosemite Conservancy Staff in 2014. Overall, 115 visitors participated in these events. Educating the surrounding community, National Park Service staff, and park visitors about avian conservation and the importance of the MAPS program will enhance their experience in and around Yosemite National Park and may inspire the next generation of field biologists to pursue their dreams.

Discussion

The MAPS Program in Yosemite continues to provide station-specific indices of adult population size and post-fledging productivity, park-wide estimates of annual survival rates of adults, and important information on annual changes and longer-term trends in these indices and estimates, for over 25 target species. The results in this and previous reports underscore the complexity of the population dynamics of Yosemite's breeding birds, which can only be unraveled through long-term data collection.

Looking forward: a study of Black-headed Grosbeak migration connectivity

One of the challenges of understanding the drivers of population change in Neotropical migratory landbirds is that the birds utilize habitats in farflung places during different portions of their life-cycle, including breeding grounds, wintering areas, and in some species, migratory stopover sites. It has consequently been difficult to ascribe observed population changes definitively to

climate or other environmental conditions on the breeding grounds, because such changes could also be driven by processes or conditions on the wintering grounds or at migratory stopover sites, and the specific wintering or stopover sites used by any particular breeding population have historically been unknown.

Recent technological advances in ornithology are increasingly allowing the elucidation of 'migratory connectivity' for individual populations – that, is understanding where within a species' overall winter range a particular breeding populations actually spends the winter. Detailed information about migratory connectivity is a powerful tool for better understanding migratory birds' population dynamics and conservation needs, in part because it allows scientists to account for climate and other environmental conditions during multiple parts of a population's life-cycle. Understanding migratory connectivity of specific populations has consequently become an important goal of the MAPS program (Rundel et al. 2013, Rushing et al. 2013).

The Black-headed Grosbeak is a colorful, charismatic Neotropical migrant whose migration route is poorly understood. The birds breed as far north as Central British Columbia and winter as far south as Mexico City, but we do not know what route they take or whether or not they require the use of multiple stopover sites. What we know about their wintering grounds is also somewhat limited. Black-headed Grosbeaks tend to winter in lowland habitats and prefer areas of high canopy cover, but were also considered habitat generalists due to their omnivorous feeding habits (Whitmore 1977; Hutto 1980). Additionally, some long-distance migrants seen in Mexico were thought to prefer disturbed second-growth habitat, which would likely have less canopy cover than old-growth habitat (Hutto 1989). Most importantly, we have no information on where within the large possible wintering range the particular segment of the population that breeds in Yosemite spends the winter. More study is needed on the distribution of migrants on their wintering grounds to understand migratory connectivity at a greater spatial resolution and to better understand the species' winter habitat preferences and what they require to make it back to their Yosemite breeding grounds safely each spring.

During the 2014 breeding season, we captured 9 Black-headed Grosbeaks at Hodgdon Meadow and attached archival GPS units to each. The units will store highly accurate (within tens of meters) positional location for the marked birds during sampling events throughout the annual life cycle. If we are able to recapture some of the marked birds and recover their GPS units in 2015, we may learn exactly where Yosemite's Black-headed Grosbeaks spend the winter, and the migration routes they use between their wintering grounds and Yosemite.

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Appendix I. Numerical listing (in AOU 2013 checklist order) of all the species sequence numbers, species alpha codes, and species names for all species banded or encountered during the 25 years, 1990-2014, of the MAPS Program on the six stations ever operated in Yosemite National Park.

Cumulative breeding status for all years in which each station was operated are also included (**B** = Regular Breeder (all years); **U** = Usual Breeder (>½, not all, years); **O** = Occasional Breeder (<½ years); **T** = Transient; **M** = Migrant; **A**= Altitudinal Disperser; **?** = Uncertain Species ID

SSN	SPEC	SPECIES NAME	White Wolf (WHWO)	Gin Flat East Meadow (GFEM)	Crane Flat (CRFL)	Hodgdon Meadow (HODG)	Big Meadow (BIME)	Tamarack Meadow (TAME)
550	MALL	Mallard		O		O	O	
940	COME	Common Merganser					T	
1140	MOUQ	Mountain Quail	O	U	O	U	U	
1170	CAQU	California Quail				O	U	
1500	DUGR	Dusky Grouse	T	T	O	O		
1510	SOGR	Sooty Grouse	O					
1550	WITU	Wild Turkey				T	T	
2700	GBHE	Great Blue Heron					T	
3020	TUVU	Turkey Vulture	T	T	T	T	T	
3060	OSPR	Osprey					T	
3220	NOHA	Northern Harrier					T	
3280	SSHA	Sharp-shinned Hawk		T		T	T	
3290	COHA	Cooper's Hawk	T	T	T	O	T	
3320	NOGO	Northern Goshawk	T	T		T		
3460	RSHA	Red-shouldered Hawk	T		T	T	T	
3560	RTHA	Red-tailed Hawk	T	O	T	U	O	
3620	GOEA	Golden Eagle					T	
3770	VIRA	Virginia Rail				T		T
3830	SORA	Sora				M		
4280	KILL	Killdeer					T	
4350	SPSA	Spotted Sandpiper	O					
5910	ROPI	Rock Pigeon				T		
5980	BTPI	Band-tailed Pigeon	T	T	T	O	T	
6120	MODO	Mourning Dove		T	T	O	U	
6700	WESO	Western Screech-Owl				T		
6830	GHOW	Great Horned Owl	T		T	O	T	
6860	NOPO	Northern Pygmy-Owl		T		O	T	
6970	SPOW	Spotted Owl				O		
7010	GGOW	Great Gray Owl	T	O	O	O		

Appendix I, continued.

SSN	SPEC	SPECIES NAME	WHWO	GFEM	CRFL	HODG	BIME	TAME
7080	NSWO	Northern Saw-whet Owl				T		
7400	BLSW	Black Swift					T	
7480	VASW	Vaux's Swift				T	T	
7610	WTSW	White-throated Swift	T	O		T	T	
8160	BCHU	Black-chinned Hummingbird			T	T	T	
8190	ANHU	Anna's Hummingbird	T	U	O	U	U	T
8200	COHU	Costa's Hummingbird					T	
8240	RUHU	Rufous Hummingbird	M	M	M	M	M	M
8250	ALHU	Allen's Hummingbird	M	M	M	M	M	
8290	CAHU	Calliope Hummingbird	T	O	O	U	O	T
9190	BEKI	Belted Kingfisher			T	T	U	
9470	LEWO	Lewis's Woodpecker					M	
9510	ACWO	Acorn Woodpecker	T	T	T	O	U	
9650	WISA	Williamson's Sapsucker	U	O	T	O		
9690	RBSA	Red-breasted Sapsucker	O	B	B	B	O	O
9740	NUWO	Nuttall's Woodpecker				T	T	
9750	DOWO	Downy Woodpecker	T	T	T	U	U	T
9770	HAWO	Hairy Woodpecker	U	U	U	U	U	B
9810	WHWO	White-headed Woodpecker	O	B	B	B	O	B
9830	BBWO	Black-backed Woodpecker	T	T	T			U
9910	NOFL	Northern Flicker	T					
9930	NFIN	Northern Flicker Intergrade	T			T		
9940	RSFL	Red-shafted Flicker	U	B	U	B	B	U
10000	PIWO	Pileated Woodpecker	O	U	U	B	T	O
10160	AMKE	American Kestrel					U	
10240	PEFA	Peregrine Falcon					M	
12270	OSFL	Olive-sided Flycatcher	T	U	O	B	O	B
12310	WEWP	Western Wood-Pewee	O	U	O	B	B	B
12410	TRFL	Traill's Flycatcher		T	T	U	O	T
12420	WIFL	Willow Flycatcher		T	T	U	O	T
12460	HAFL	Hammond's Flycatcher	O	U	U	U	T	O
12480	GRFL	Gray Flycatcher	M		M	M	M	
12490	DUFL	Dusky Flycatcher	U	B	B	B	T	B
12510	PSFL	Pacific-slope Flycatcher	T	O	O	U	O	T
12520	WEFL	Western Flycatcher	T	O	O	U	O	T
12580	BLPH	Black Phoebe	O	O	T	O	B	
12600	SAPH	Say's Phoebe		T			T	
12720	ATFL	Ash-throated Flycatcher					O	T
13010	WEKI	Western Kingbird	T			T	T	
13680	CAVI	Cassin's Vireo	O	U	B	B	U	U

Appendix I, continued.

SSN	SPEC	SPECIES NAME	WHWO	GFEM	CRFL	HODG	BIME	TAME
13710	HUVI	Hutton's Vireo		T	O	O		
13730	WAVI	Warbling Vireo	U	U	B	B	B	B
13760	REVI	Red-eyed Vireo			M	M		
14050	STJA	Steller's Jay	B	B	B	B	U	B
14090	WESJ	Western Scrub-Jay	T			T	O	
14130	CLNU	Clark's Nutcracker	T	T		T		
14170	AMCR	American Crow		M		M		
14290	CORA	Common Raven	U	U	U	U	U	O
14420	TRES	Tree Swallow		T		T	O	T
14450	VGSW	Violet-green Swallow		T		T	O	T
14500	NRWS	Northern Rough-winged Swallow				T	O	
14530	CLSW	Cliff Swallow					T	
14550	BARS	Barn Swallow				T	O	
14610	MOCH	Mountain Chickadee	B	B	B	U	O	B
14630	CBCH	Chestnut-backed Chickadee	T	T	T	O		T
14680	OATI	Oak Titmouse					O	
14730	BUSH	Bushtit		T	T	O	U	T
14740	RBNU	Red-breasted Nuthatch	B	B	B	B	O	B
14750	WBNU	White-breasted Nuthatch	T	O	O	O	O	O
14760	PYNU	Pygmy Nuthatch		T				
14780	BRCR	Brown Creeper	B	B	B	B	U	B
14860	HOWR	House Wren	A	A	A	A	U	A
14920	PAWR	Pacific Wren	T	T	O	O	O	T
14980	BEWR	Bewick's Wren	T	T		T	O	
15300	BGGN	Blue-gray Gnatcatcher				T	T	
15380	AMDI	American Dipper					O	
15410	GCKI	Golden-crowned Kinglet	B	B	B	B	T	U
15420	RCKI	Ruby-crowned Kinglet	O			T		
15510	WREN	Wrentit					U	
15770	WEBL	Western Bluebird		T		O	U	
15800	TOSO	Townsend's Solitaire	T	O	O	O	T	
16030	SWTH	Swainson's Thrush	T	T		O		
16040	HETH	Hermit Thrush	B	O	B	U	T	T
16240	AMRO	American Robin	B	B	B	B	B	B
16560	EUST	European Starling				O	O	
16720	CEDW	Cedar Waxwing				M	M	
16930	NOWA	Northern Waterthrush					M	
17050	OCWA	Orange-crowned Warbler	A	A	A	A	A	A
17080	NAWA	Nashville Warbler	A	A	A	B	U	A
17140	MGWA	MacGillivray's Warbler	O	B	B	B	U	B

Appendix I, continued.

SSN	SPEC	SPECIES NAME	WHWO	GFEM	CRFL	HODG	BIME	TAME
17220	COYE	Common Yellowthroat				M		
17280	HOWA	Hooded Warbler				M		
17290	AMRE	American Redstart				M		
17330	NOPA	Northern Parula					T	
17390	YEWA	Yellow Warbler	O	T	O	B	B	T
17490	YRWA	Yellow-rumped Warbler		T	T		T	
17510	AUWA	Audubon's Warbler	B	B	B	B	O	B
17600	BTYW	Black-throated Gray Warbler	T	T	T	O	O	T
17610	TOWA	Townsend's Warbler	M	M	M	M		M
17630	HEWA	Hermit Warbler	U	B	B	B	T	U
17750	WIWA	Wilson's Warbler	T	O	U	U	O	B
17830	YBCH	Yellow-breasted Chat				T	T	
18920	GTTO	Green-tailed Towhee		U	T	T	T	
18930	SPTO	Spotted Towhee		O	O	U	U	
19040	CALT	California Towhee					T	
19170	CHSP	Chipping Sparrow	U	O	U	U	U	B
19240	LASP	Lark Sparrow					T	
19260	BTSP	Black-throated Sparrow					T	
19280	SAGS	Sage Sparrow					T	
19310	SAVS	Savannah Sparrow				M	M	
19350	GRSP	Grasshopper Sparrow					M	
19470	FOSP	Fox Sparrow	T	U	O	O	T	O
19480	SOSP	Song Sparrow	O	O	U	B	B	O
19490	LISP	Lincoln's Sparrow	B	B	B	B	O	B
19560	MWCS	Mountain White-crowned Sparrow	T			T		
19660	ORJU	Oregon Junco	B	B	B	B	U	B
19890	WETA	Western Tanager	O	B	B	B	U	B
20060	RBGR	Rose-breasted Grosbeak				M		
20070	BHGR	Black-headed Grosbeak	O	O	U	B	U	O
20140	LAZB	Lazuli Bunting	T	T	U	O	B	T
20160	INBU	Indigo Bunting			M	M		
20230	RWBL	Red-winged Blackbird	T	T	T	B	O	O
20320	WEME	Western Meadowlark					O	
20330	YHBL	Yellow-headed Blackbird					M	
20370	BRBL	Brewer's Blackbird	U	O	O	B	B	
20470	BHCO	Brown-headed Cowbird	O	T	O	U	U	
20670	BUOR	Bullock's Oriole		T		O	U	T
21070	PIGR	Pine Grosbeak	U	T	T			
21420	HOFI	House Finch			T	T	O	
21430	PUFI	Purple Finch	O	O	U	B	U	O

Appendix I, continued.

SSN	SPEC	SPECIES NAME	WHWO	GFEM	CRFL	HODG	BIME	TAME
21440	CAFI	Cassin's Finch	U	O	O	O	O	O
21460	RECR	Red Crossbill	O	T	T	O	O	
21530	PISI	Pine Siskin	B	B	U	U	O	U
21590	LEGO	Lesser Goldfinch	T	O	T	O	B	T
21600	LAGO	Lawrence's Goldfinch		T	T	O	O	T
21610	AMGO	American Goldfinch				M	M	M
21670	EVGR	Evening Grosbeak	O	T	T	T	O	T
21690	HOSP	House Sparrow					T	

Appendix II. Rowan, E., R.B. Siegel, D.R. Kaschube, and S. Stock. 2014. North American longevity records for nine landbird species monitored at Yosemite National Park's MAPS stations. North American Bird Bander 39(4):153-159.

North American Longevity Records for Nine Landbird Species Monitored at Yosemite National Park's MAPS Stations

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ABSTRACT

Information on longevity of birds may provide insight into ecological pressures faced by particular species and populations and may also be useful in developing conservation approaches. However, longevity can be difficult to study in wild birds, and efforts to determine the ecological, evolutionary, behavioral and physiological factors that govern longevity of landbirds have been constrained by the quantity and quality of long-term monitoring data available. The Monitoring Avian Productivity and Survivorship (MAPS) program provides a framework that encourages the long-term operation of mark-recapture monitoring stations in North America, with more than 300 stations that have been operated for at least ten consecutive years since the program was established. Analysis of mark-recapture data from MAPS stations operated at Yosemite National Park between 1990-2013 yielded new North American longevity records for nine species: Red-breasted Sapsucker (Sphyrapicus ruber), *Williamson Sapsucker* (Sphyrapicus thyroideus), *White-headed Woodpecker* (Picoides albolavatus), *Western Wood-Peewee* (Contopus sordidulus), *Cassin's Vireo* (Vireo cassinii), *Mountain Chickadee* (Poecile gambeli), *Brown Creeper* (Certhia americana), *Lincoln's Sparrow* (Melospiza lincolnii), *and Cassin's Finch* (Haemorhous cassinii). *We suggest that the larger, continent-wide MAPS dataset likely contains a wealth of information for revealing patterns in avian longevity and the ecological factors, evolutionary constraints, and life history characteristics that may drive those patterns.*

INTRODUCTION

Longevity of organisms is likely regulated by many inter-related factors, including evolutionary history as well as more proximate constraints imposed by physiology, behavior, and genetics (Finch 1990, Holmes and Austad 1995, Harvey and Purvis 1999, de Magalhaes et al. 2007, Wasser and Sherman 2010). Despite the complex set of factors involved, information on longevity may provide insight into ecological pressures faced by particular species and populations, and may also be useful in developing conservation strategies (de Magalhaes and Costa 2009). Although longevity is an important component of the life history of organisms, it can be particularly difficult to study in wild, relatively long-lived vertebrates such as birds.

Summaries of maximum longevity records for landbirds in North America (Knappen 1928, Kennard 1975, Clapp et al. 1982, Clapp et al. 1983, Klimkiewicz et al. 1983, Klimkiewicz and Futcher 1987, Klimkiewicz and Futcher 1989) and efforts to describe patterns across species and attribute them to ecological correlates or life-history traits (Wasser and Sherman 2010) have necessarily been constrained by the amount and quality of long-term monitoring data available. In general, greater numbers of banded birds and more intensive efforts to recapture or re-sight those birds over a longer period of time are likely to yield longevity records that more closely approach the actual maximum longevity in the population under study (Clapp et al. 1982), while less robust monitoring efforts will, on average, yield longevity records that are further from the true maximum values within the population.

Appendix II continued.

The Monitoring Avian Productivity and Survivorship Program (MAPS) program (DeSante et al. 2014), established in the early 1990s, provides a standardized protocol for constant-effort mist-netting of landbirds during the breeding season in North America, and a central repository for mark-recapture data collected using the protocol. The program was developed to facilitate monitoring of landbird vital rates such as survival, productivity and population growth rate, and to identify environmental causes of change in those vital rates (Nott et al. 2002, Saracco et al. 2009, Saracco et al. 2010). MAPS provides a framework that encourages the long-term operation of mark-recapture monitoring stations.

Some of the longest-running MAPS stations are within Yosemite National Park, located in the central Sierra Nevada of California, USA (Fig. 1). The park's MAPS stations were established during the 1990s (with the first station established in 1990) and subsequently operated every year since, yielding up to a 24-year run of continuous data from the park's relatively pristine meadow and forest ecosystems. Long-term monitoring data from protected areas like national parks are particularly valuable because they can serve as reference information for assessing the effects of regional land-use and land-cover changes on ecological processes outside the parks (Silsbee and Peterson 1991, Simons et al. 1999, Siegel et al. 2011).

We reviewed mark-recapture records from Yosemite's MAPS stations to assess maximum observed longevity for the landbird species monitored there. We compared the values we obtained with published summaries of landbird longevity records and with an on-line database of such records maintained by the United States Bird Banding Laboratory (Lutmerding and Love 2014). Here we report observed longevity values that represent new maximum records for North American landbird species.

METHODS

We examined mark-recapture records from five long-running MAPS stations at Yosemite National Park (Fig. 1). The stations were established in various years between 1990 and 1998 (Table 1) and each station was operated every year subsequent to establishment following standard MAPS protocol (DeSante et al. 2004, DeSante et al. 2014). Ten or 14 (Hodgdon Meadow only) fixed net sites were established within the central eight hectares of each station. For all stations except Hodgdon Meadow, nets were run on a single day within 5-8 ten-day periods between 21 May and 8 Aug. At Hodgdon Meadow, mist-netting was typically conducted across two days within each ten day period, with half of the 14 nets operated one day and the remaining nets operated on the second day. The maximum number of periods of operation at the highest-elevation stations, White Wolf and Gin Flat East Meadow, was seven due to later arrival of spring-like conditions and limited or no accessibility during the late spring.

On each day of station operation, four-tier nylon mist-nets (12m x 2.5mm, 30mm mesh) were erected at each net site and were opened for approximately six hours beginning at local sunrise. Individual nets were occasionally closed due to inclement weather, unusually high capture rates that jeopardized the crews' ability to safely process all of the captured birds, or other logistical reasons. Nets were checked and birds extracted approximately every 40 minutes.

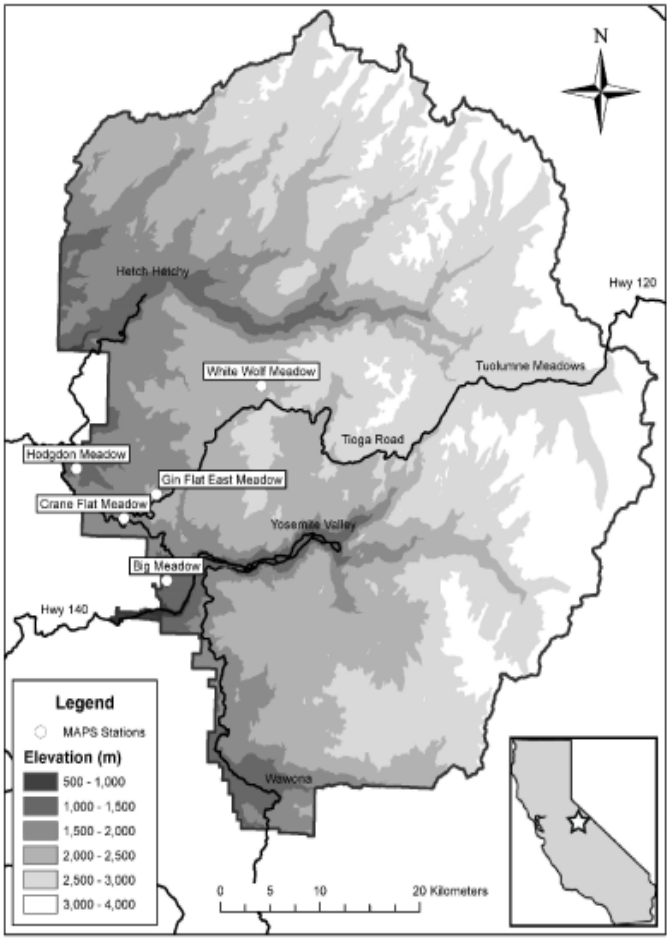
With few exceptions, birds captured at the stations were identified to species, age, and sex based on Pyle (1997), and previously unbanded birds were banded with numbered aluminum leg bands obtained from USGS Biological Resources Division. Band numbers of recaptured birds were carefully recorded.

The banding data were then entered electronically by John W. Shipman of Zoological Data Processing, Socorro, NM, proofed manually for entry errors and then run through a series of automated verification programs that checked for within- or between-record discrepancies. Any discrepancies or questionable data identified were examined individually and corrected if necessary.

The minimum ages of birds were calculated assuming a hatch date of 1 Jun, following protocol

Appendix II continued.

Figure 1. Locations of five long-running MAPS stations in Yosemite National Park, California



established by Clapp et al. (1982), in combination with the inferred age of the bird at its original capture, and the number of years and months that passed between subsequent recaptures. One of the following ages was assigned to each bird upon its' original capture, as determined by breeding condition, skull ossification or plumage characteristics, outlined in Pyle (1997): Hatching Year (born within the calendar year and in juvenal plumage), Second Year (in its second calendar year and in formative plumage), After Second Year (in its third or greater calendar year and in basic plumage), and After Hatching Year (an adult, but unknown whether a Second Year or After Second Year in non-juvenal plumage). Recaptured birds were released healthy and alive; therefore, the longevity records we present represent the youngest possible age for the individuals considered.

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Appendix II continued.

Table 1. Year established, elevation, and habitat associated with five long-running Monitoring Avian Productivity and Survivorship (MAPS) Stations at Yosemite National Park, California.

Station	Year Established	Elevation (ft.)	Habitat
Big Meadow	1993	1,311	Riparian willows (*Salix* sp.) surrounded by montane meadow, Sierran mixed conifer forest, and montane chaparral.
Hodgdon Meadow	1990	1,408	Wet montane meadow with extensive willow and Mountain Dogwood (*Cornus nuttallii*) thickets, surrounded by Sierran mixed conifer forest.
Crane Flat Meadow	1993	1,875	Wet montane meadow with small willow thickets surrounded by Sierran mixed conifer and California Red Fir (*Abies magnifica*) forest.
Gin Flat East Meadow	1998	2,073	Wet meadow surrounded by Red Fir and Lodgepole Pine (*Pinus contorta*) forest.
White Wolf Meadow	1993	2,402	Wet meadow surrounded by Red Fir and Lodgepole Pine forest.

Table 2. New North American maximum longevity records from the MAPS stations at Yosemite National Park.

Species	Band Number	Station	First Year Captured (age) [1]	Last Year Captured	Minimum Age at Last Capture [2]
Red-breasted Sapsucker (*Sphyrapicus ruber*)	1841-27360	Hodgdon Meadow	2009 (ASY)	2013	7 yr. 0 mo
Williamson's Sapsucker (*Sphyrapicus thyroideus*)	1681-48723	White Wolf Meadow	2000 (ASY)	2004	6 yr. 0 mo
White-headed Woodpecker (*Picoides albolarvatus*)	1681-49403	Crane Flat Meadow	2001 (AHY)	2008	8 yr. 1 mo
Western Wood-Peewee (*Contopus sordidulus*)	2320-07501	Hodgdon Meadow	2004 (AHY)	2011	8 yr. 1 mo.
Cassin's Vireo (*Vireo cassinii*)	1851-20312	Hodgdon Meadow	2004 (AHY)	2011	8 yr. 1 mo.
Mountain Chickadee (*Poecile gambeli*)	2320-07215	Crane Flat Meadow	2003 (ASY)	2011	10 yr. 1 mo.
Brown Creeper (*Certhia americana*)	2330-94553	Gin Flat East Meadow	2006 (AHY)	2011	6 yr. 1 mo.
Lincoln's Sparrow (*Melospiza lincolnii*)	2121-55897	Crane Flat Meadow	1993 (HY)	2002	8 yr. 11 mo.
Cassin's Finch (*Haemorhous cassinii*)	1531-57414	White Wolf Meadow	1997 (ASY)	2003	8 yr. 0 mo.

[1] HY=Hatching Year (hatched within the calendar year); ASY=After Second Year (in its third or greater calendar year); AHY=After Hatching Year (adult, unknown between Second Year and After Second Year).
[2] Ages are minimums, as all birds were released alive at the time of their last capture.

Appendix II continued.

RESULTS

Between 1990 and 2013, 39,654 birds were banded at the Yosemite MAPS stations and 2,001 of those were recaptured in at least one subsequent year. The mark-release-recapture data for these birds yielded longevity records (Table 2) for seven species that exceed maximum values for North America published previously or posted online (http://www.pwrc.usgs.gov/BBl/longevity/longevity_main.cfm last updated Jun 2014) by the USGS Bird Banding Laboratory: Red-breasted Sapsucker (*Sphyrapicus ruber*), White-headed Woodpecker (*Picoides albolavatus*), Western Wood-Peewee (*Contopus sordidulus*), Mountain Chickadee (*Poecile gambeli*), Brown Creeper (*Certhia americana*), Lincoln's Sparrow (*Melospiza lincolnii*), and Cassin's Finch (*Haemorhous cassinii*). Additionally, we were unable to find any previously published maximum longevity records for Williamson's Sapsucker (*Sphyrapicus thyroideus*) or Cassin's Vireo (*Vireo cassinii*), so our maximum values for those two species (6 years, 0 months and 8 years, 1 month, respectively) are also included in Table 2, yielding new North American maximum longevity records for nine species.

DISCUSSION

Despite their high metabolism, high body temperatures, and high blood glucose levels, all of which are associated with rapid aging in most vertebrates (Holmes and Austad 1995), birds show very little physical evidence of senescence and, as a group, are relatively long-lived for their body size when compared with mammals (Holmes and Austad 1995, Munshi-South and Wilkinson 2010). While birds' cell resistance to oxidation and aging is not permanent, most bird deaths appear to be due to disease, starvation, accidents, or predation rather than simply age (Harrison 1990, Vleck et al. 2007, Ogburn et al. 2001). Understanding landbird senescence and mortality patterns has historically been constrained by the rather limited information available on maximum longevity for most species (Wasser and Sherman 2010, Holmes and Austad 1995).

The maturing of the MAPS program means that data on longevity of wild birds are becoming increasingly more abundant. Fewer than 10% of banded birds (based on all banding records, not just records from the MAPS program) are ever recaptured, collected, or found dead (Harrison 1990), indicating that extensive, sustained bird-banding efforts are needed to describe robustly longevity patterns in landbirds. Since the MAPS program was established in the early 1990s, well over 300 MAPS stations have operated for at least ten consecutive years, producing the kind of long-term mark-release-recapture data necessary for meaningfully assessing longevity in a large number of landbird species. Here we provide longevity records from a cluster of MAPS stations in one national park. It is unclear whether the substantial number of new longevity records obtained from the Yosemite data reflects particularly high longevity at Yosemite, perhaps due to the relatively pristine condition of the habitat, or whether similar numbers of new maximum longevity records can be expected from other long-running MAPS stations across North America. Either way, the larger, continent-wide MAPS dataset likely contains a wealth of information for advancing our understanding of patterns in avian longevity, and the myriad ecological factors, evolutionary constraints, and life-history characteristics that may drive them.

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Appendix II continued.

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