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BIRD POPULATIONS

The 2015 Annual Report of the Monitoring Avian Productivity and Survivorship (MAPS) Program on Fort Bragg, North Carolina



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March 2016

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Introduction

The U.S. Department of Defense manages some of the most undeveloped and biologically diverse lands in North America. Fort Bragg which, at more than 255 square miles, is one of the largest military installations in the world has an active program of land management, and has won several awards for its efforts at bird conservation.

The Fort Bragg Integrated Natural Resources Management Plan and the Adaptive Ecosystem Management Program require that migratory birds are considered in natural resource management planning and implementation. The Fort Bragg MAPS Project will improve understanding of the ecological processes and landscape dynamics and their effects on migratory birds under the current regime of land management, which includes prescribed fire. Long-term monitoring of migratory birds and their reproductive success, survival, and recruitment of young will enable managers at Fort Bragg wish to gather data that help management activities to have minimal direct ecological impacts to migratory birds from military training activities.

Landbirds are excellent indicators of habitat quality and environmental change in terrestrial ecosystems due to their rapid metabolism and high ecological position on most food webs. In addition, their diurnal nature and relative abundance and diversity in nearly every terrestrial ecosystem make them relatively easy and cost-efficient to monitor. Over the past several decades, landbird declines, especially among Neotropical migrant populations, have led to the creation of monitoring programs, such as the North American Breeding Bird Survey and the MAPS Program. These monitoring efforts have proven effective in aiding land managers reach their management and conservation goals (Rich et al. 2004).

The MAPS Program 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). For example, analysis of the demographic parameters measured by MAPS (often called “vital rates”) can help researchers and land managers infer whether population change is most affected by changes on the breeding grounds or the wintering grounds, a finding that can help more effectively targeted limited conservation resources.

In addition, through the network of MAPS stations (>300 in North America in 2015), 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).

The long-term operation of constant-effort stations has been a main objective of the MAPS program, especially in large protected areas, such as military installations, which can additionally act as reference sites for assessing the effects of land use and land cover changes on populations. These sites 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 (Simons et al. 1999). Here we report summary monitoring results from the MAPS program in Fort Bragg in 2015.

The MAPS Program previously operated at Fort Bragg from 1995-2009, during which time it was used to assess year-to-year changes in landbird species vital rates, and assist with land management decisions. The program was suspended for several years, but resumed in 2015. The objectives of the Fort Bragg MAPS Program are to:

- monitor year to year changes in population dynamics;
- provide landscape-level population management decision-support tools;
- monitor and subsequently assess the efficacy of specific management actions intended to create or maintain landscapes that support healthy, productive “source” populations.

These conservation goals are particularly relevant to the dispersal and recruitment of individuals into adjacent federal or private lands (Nott and Morris 2007). These data have also contributed to the information and management decision-support tools developed in collaboration with other DoD installations that support MAPS monitoring, modeling, and management efforts (Nott 2008).

Methods

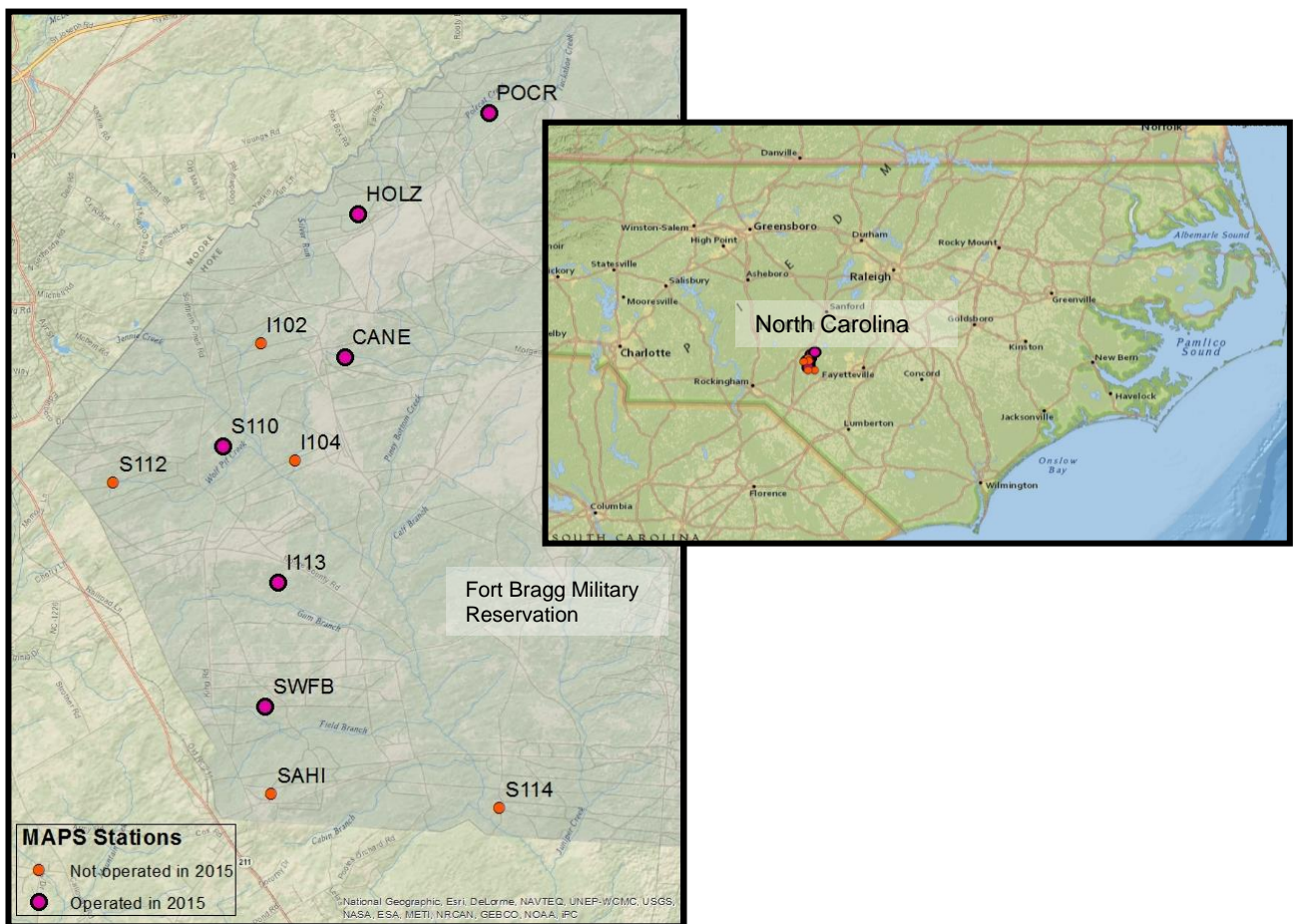
Establishment and operation of stations

Six MAPS stations were operated on Fort Bragg in 2015, two of which were re-established at the same locations they were operated during 2003-09 (Fig. 1) and four new stations were established. The six stations were:

- I-113, located in longleaf pine uplands with clumps of hardwoods and drainages of cane and ferns and human-made dirt roads through and alongside station. The site is control-burned every 3 years (last burned 2015).
- S-110, located in longleaf pine uplands with a small creek running through the center, surrounded by hardwoods, ferns, and cane, and human-made dirt roads through and alongside the station. The site is control-burned every 3 years (we are unsure of the last burn date).
- Canebreak (CANE), located in longleaf pine uplands with areas of thick cane and vegetation around nets 01 through 05. Site has undulating terrain and human-made dirt roads through and alongside the station. It is burned every 3 years, and was scheduled to burn in 2015 after the banding season.
- Holland Landing Zone (HOLZ), located in longleaf pine upland with clumps of hardwoods, and human-made dirt roads through and alongside the station. The site is control-burned every 3 years, last time being in 2015.

- Polecat Creek (POLE), located in longleaf pine upland with clumps of hardwoods and drainages with cane and ferns. There are human-made dirt roads through and alongside the station, which is control-burned every 3 years.
- Southwest Fort Bragg (SWFB), located in longleaf pine uplands on top of a hill. There are hardwoods beyond the site at the bases of the hill on three sides, and human-made dirt roads through and alongside station. The site is control-burned every 3 years.

Figure 1. Locations of MAPS bird banding stations at Fort Bragg, NC.



Through the efforts of IBP biologists Lauren Helton and Ron Taylor, and IBP Interns Jessica Mailhot and Michael Gamble, these six banding stations were operated in 2015 in accordance with the standardized protocol developed for the MAPS Program throughout North America (DeSante et al. 2015). We are also extremely appreciative of the efforts of Fort Bragg Directorate of Public Works and Jessie Schillaci, without whose support and cooperation this project would not have been possible.

Ten net sites were re-established at each of the stations in 2015. One 12-m-long, 30-mm-mesh, nylon mist net was erected at each of the ten net sites on each day of operation. Each of the stations was operated for six morning hours per day (beginning at about local sunrise) during one day in each of eight consecutive 10-day periods between May 12 and August 06.

Data collection

With few exceptions, all birds captured were identified to species, age, and sex. 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 six stations, simple habitat maps (indicating extent and location of major habitats, as well as structures, roads, trails, and streams) were prepared. 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

It is critical to the operation of the MAPS Program that all data are as accurate and complete as possible, and data are carefully vetted. 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:

- 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.
- 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.

- 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.
- 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.
- 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 a migrant (M).

Adult population index and productivity analyses

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

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

Results

2015 Indices of Adult Population Size and Post-Fledging Productivity

We present the 2015 numbers of newly-banded, unbanded, and recaptured birds for each species at each of the six stations individually and for all stations combined in Table 2 and Table 4. A total of 263 captures of 35 species were recorded during the summer of 2015. Newly banded birds comprised 70.7% of the total captures. The greatest number of total captures (80) was recorded at the I-113 station and the smallest number of total captures (16) was recorded at the Southwest Fort Bragg station. The highest species richness occurred at I-113 (22 species) and the lowest species richness occurred at Canebreak, Holland Landing Zone, and Southwest Fort Bragg (10 species).

Table 1. Summary of the 2015 operation of the six MAPS stations on Fort Bragg.

Station		No.	Major Habitat Type	Latitude-longitude	Avg Elev. (m)	2015 operation		
Name	Code					Total number of net-hours	No. of periods	Inclusive dates
I 113	I113	16658	Controlled burn riparian, savanna and longleaf pine-oak woodland	35°05'34"N, 79°19'25"W	107	456.0	9	5/12 – 7/30
S 110	S110	16659	Riparian woodland, pine savanna and longleaf pine-oak woodland	35°07'08"N, 79°20'11"W	94	496.0	9	5/20 – 8/04
Canebreak	CANE	16760	Controlled burn longleaf pine upland, areas of thick cane	35°08'10"N, 079°18'28"W	111	457.5	9	5/18 – 8/06
Holland Landing Zone	HOLZ	16761	Controlled burn longleaf pine-oak upland	35°09'50"N, 079°18'17"W	126	476.3	9	5/14 – 8/01
Polecat Creek	POCR	16762	Controlled burn longleaf pine-oak upland, riparian drainages	35°11'01"N, 079°16'25"W	97	460.7	9	5/13 – 7/31
Southwest Fort Bragg	SWFB	16763	Controlled burn hilltop longleaf pine upland	35°04'06"N, 079°19'36"W	110	469.0	9	5/16 – 8/03
ALL STA. COMBINED						2,815.5	9	5/22 - 8/04

Table 2. Capture summary for MAPS stations on Fort Bragg in 2015. N=Newly Banded, U=Unbanded, R=Recaptures of banded birds.

Species	I 113			S 110			Canebreak			Holland Landing Zone			Polecat Creek			Southwest Fort Bragg		
	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Ruby-throated Hummingbird		2									1							
Red-headed Woodpecker	1	1	1							1			2			1		
Red-bellied Woodpecker	1																	
Hairy Woodpecker	1																	
Red-cockaded Woodpecker									1						2			
Northern Flicker													1					1
Eastern Wood-Pewee	1									1		1	3		1			1
Great Crested Flycatcher	3		3	2						3			2			2		
White-eyed Vireo	1			2		1												
Blue-headed Vireo																		1
Red-eyed Vireo	1	1		1			1											
Blue Jay										1			2					
Carolina Chickadee	1	1		3	1		1						2			1		
Tufted Titmouse	3		1	3		2							2		2	3		
White-breasted Nuthatch	1																	
Brown-headed Nuthatch	1																	
Carolina Wren	10		5	7	1	9	1						1		3			
Blue-gray Gnatcatcher	1						1											
American Robin										1								
Brown Thrasher					1													
Black-and-white Warbler													1					
Kentucky Warbler				1														
Common Yellowthroat	5	1	2	7	1	1	4		2				3					
Hooded Warbler				1														
American Redstart							1											
Pine Warbler	5	2		5						1			15					4

Table 2 (cont.). Capture summary for MAPS stations on Fort Bragg in 2015. N=Newly Banded, U=Unbanded, R=Recaptures of banded birds.

Species	I 113			S 110			Canebreak			Holland Landing Zone			Polecat Creek			Southwest Fort Bragg		
	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Yellow-throated Warbler	1																	
Prairie Warbler	1			6		2	2		1				1	1				
Eastern Towhee	3		2	2		1							2					
Bachman's Sparrow	2															1		
Chipping Sparrow										1								
Summer Tanager				1			1			6		1	3		1			
Northern Cardinal	4		1	4		6	1						1					
Blue Grosbeak				1						1						1		
Indigo Bunting	4	1	5	2									3		3			
ALL SPECIES POOLED	51	9	20	48	4	22	13		4	16	1	2	44	1	12	14	2	
Total Number of Captures		80			74			17			19			57			16	
Number of Species	21	7	8	16	4	7	9		3	9	1	2	16	1	6	8	2	
Total Number of Species		22			17			10			10			17			10	

The 2015 capture rates (per 600 net-hours) of individual adult and young birds and the 2015 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 and Table 4. 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 2015 was greatest at I-113 (52.6 adults/600 net-hours), followed by Polecat Creek (40.4), S-110 (31.5), Holland Landing Zone (20.2), Canebreak (12.1), and Southwest Fort Bragg (11.5). The capture rate of young of all species pooled at each station in 2015 was highest at S-110 (25.4 young/600 net-hours), followed by Polecat Creek (16.9), I-113 (14.5), Southwest Fort Bragg (5.1), Canebreak (3.9), and Holland Landing Zone (0.0).

Reproductive index (the number of young per adult) at the six stations in 2015 was greatest at S-110 (0.81), followed by Southwest Fort Bragg (0.44), Polecat Creek (0.42), Canebreak (0.30), I-113 (0.28), and Holland Landing Zone (0.0). The mean adult capture rate for the six stations combined was 28.1 per 600 net hours and the overall reproductive index was 0.39 in 2015.

In 2015, Carolina Wren was the most frequently captured species, followed by Pine Warbler, Common Yellowthroat, Indigo Bunting, Northern Cardinal, Tufted Titmouse, Great-crested Flycatcher, and Prairie Warbler (Table 4). Overall, the most abundant breeding species in 2015 (having a capture rate of at least 2.0 adults per 600 net-hours; Table 4), in decreasing order, were Common Yellowthroat, Pine Warbler, Great-crested Flycatcher, and Prairie Warbler. The following is a list of the most frequently captured species, in decreasing order, at each station in 2015 (having a capture rate of at least 3.0 birds per 600 net-hours; see Table 3).

I-113

Carolina Wren, Common Yellowthroat, Northern Cardinal, Indigo Bunting, Great-crested Flycatcher, Pine Warbler, Eastern Towhee

S-110

Prairie Warbler, Common Yellowthroat

Canebreak

Common Yellowthroat

Holland Landing Zone

Summer Tanager, Great-crested Flycatcher

Polecat Creek

Pine Warbler, Eastern Wood-pewee, Common Yellowthroat, Summer Tanager, Indigo Bunting,

Southwest Fort Bragg

No species more than 3.0 captures per 600 net hour

Table 3. Numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the six individual MAPS stations, and all stations pooled, operated on Fort Bragg in 2015.

Species	I 113			S 110			Canebreak			Holland Landing Zone			Polecat Creek			Southwest Fort Bragg		
	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.
Red-headed Woodpecker	1.3	0.0	0.00							1.3	0.0	0.00	2.6	0.0	0.00	1.3	0.0	0.00
Red-bellied Woodpecker	1.3	0.0	0.00															
Hairy Woodpecker	1.3	0.0	0.00															
Northern Flicker													1.3	0.0	0.00			
Eastern Wood-Pewee	1.3	0.0	0.00							1.3	0.0	0.00	3.9	0.0	0.00			
Great Crested Flycatcher	3.9	0.0	0.00	2.4	0.0	0.00				3.8	0.0	0.00	2.6	0.0	0.00	2.6	0.0	0.00
White-eyed Vireo	1.3	0.0	0.00	1.2	1.2	1.00												
Red-eyed Vireo	1.3	0.0	0.00	1.2	0.0	0.00	1.3	0.0	0.00									
Blue Jay										1.3	0.0	0.00	2.6	0.0	0.00			
Carolina Chickadee	0.0	1.3	und. ¹	1.2	1.2	1.00	0.0	1.3	und. ¹				0.0	2.6	und. ¹	0.0	1.3	und. ¹
Tufted Titmouse	2.6	0.0	0.00	1.2	2.4	2.00							2.6	0.0	0.00	2.6	1.3	0.50
White-breasted Nuthatch	1.3	0.0	0.00															
Brown-headed Nuthatch	1.3	0.0	0.00															
Carolina Wren	7.9	5.3	0.67	2.4	6.0	2.50	0.0	1.3	und.				1.3	0.0	0.00			
Blue-gray Gnatcatcher	0.0	1.3	und.				1.3	0.0	0.00									
American Robin										1.3	0.0	0.00						
Black-and-white Warbler													0.0	1.3	und.			
Kentucky Warbler				1.2	0.0	0.00												
Common Yellowthroat	6.6	0.0	0.00	3.6	6.0	1.67	3.9	1.3	0.33				3.9	0.0	0.00			
Hooded Warbler				1.2	0.0	0.00												
American Redstart							1.3	0.0	0.00									
Pine Warbler	3.9	3.9	1.00	0.0	6.0	und. ¹				1.3	0.0	0.00	7.8	11.7	1.50	2.6	2.6	1.00
Yellow-throated Warbler	0.0	1.3	und.															
Prairie Warbler	1.3	0.0	0.00	7.3	0.0	0.00	2.6	0.0	0.00				1.3	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 six individual MAPS stations, and all stations pooled, operated on Fort Bragg in 2015.

Species	I 113			S 110			Canebreak			Holland Landing Zone			Polecat Creek			Southwest Fort Bragg		
	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.
Eastern Towhee	3.9	0.0	0.00	2.4	0.0	0.00							2.6	0.0	0.00			
Bachman's Sparrow	1.3	0.0	0.00													1.3	0.0	0.00
Chipping Sparrow										1.3	0.0	0.00						
Summer Tanager				1.2	0.0	0.00	1.3	0.0	0.00	7.6	0.0	0.00	3.9	0.0	0.00			
Northern Cardinal	5.3	1.3	0.25	2.4	2.4	1.00	1.3	0.0	0.00				0.0	1.3	und.			
Blue Grosbeak				1.2	0.0	0.00				1.3	0.0	0.00				1.3	0.0	0.00
Indigo Bunting	5.3	0.0	0.00	1.2	0.0	0.00							3.9	0.0	0.00			
ALL SPECIES POOLED	52.6	14.5	0.28	31.5	25.4	0.81	13.1	3.9	0.30	20.2	0.0	0.00	40.4	16.9	0.42	11.5	5.1	0.44
Number of Species	18	6		15	7		7	3		9	0		13	4		6	3	
Total Number of Species		21			16			9			9			16			7	

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

Table 4. Summary of results for all six Fort Bragg MAPS stations combined in 2015.

Species	Birds captured			Birds/600 net hours		Prop. Young
	Newly banded	Un-banded	Recap-tured	Adults	Young	
Ruby-throated Hummingbird		3				
Red-headed Woodpecker	5	1	1	1.1	0.0	0.00
Red-bellied Woodpecker	1			0.2	0.0	0.00
Hairy Woodpecker	1			0.2	0.0	0.00
Red-cockaded Woodpecker			3			
Northern Flicker	1	1		0.2	0.0	0.00
Eastern Wood-Pewee	5	1	2	1.1	0.0	0.00
Great Crested Flycatcher	12		3	2.6	0.0	0.00
White-eyed Vireo	3		1	0.4	0.2	0.50
Blue-headed Vireo	1					
Red-eyed Vireo	3	1		0.6	0.0	0.00
Blue Jay	3			0.6	0.0	0.00
Carolina Chickadee	8	2		0.2	1.3	6.00
Tufted Titmouse	11		5	1.5	0.6	0.43
White-breasted Nuthatch	1			0.2	0.0	0.00
Brown-headed Nuthatch	1			0.2	0.0	0.00
Carolina Wren	19	1	17	1.9	2.1	1.11
Blue-gray Gnatcatcher	2			0.2	0.2	1.00
American Robin	1			0.2	0.0	0.00
Brown Thrasher		1				
Black-and-white Warbler	1			0.0	0.2	und. ¹
Kentucky Warbler	1			0.2	0.0	0.00
Common Yellowthroat	19	2	5	3.0	1.3	0.43
Hooded Warbler	1		0	0.2	0.0	0.00
American Redstart	1			0.2	0.0	0.00
Pine Warbler	30	2		2.6	4.0	1.58
Yellow-throated Warbler	1			0.0	0.2	und.
Prairie Warbler	10	1	3	2.1	0.0	0.00
Eastern Towhee	7		3	1.5	0.0	0.00
Bachman's Sparrow	3			0.4	0.0	0.00
Chipping Sparrow	1			0.2	0.0	0.00
Summer Tanager	11		2	2.3	0.0	0.00
Northern Cardinal	10		7	1.5	0.9	0.57
Blue Grosbeak	3			0.6	0.0	0.00
Indigo Bunting	9	1	8	1.7	0.0	0.00
ALL SPECIES POOLED	186	17	60	28.1	11.1	0.39
Total Number of Captures		263				
Number of Species	32	12	13	29	10	

Although the two renewed (i.e. stations at the same sites as in 1995-2009, I 113 and S 110) have run for just one year and offer limited data, some basic observations are possible (Table 5). For all species pooled, the number of adults captured (41.6 adults per 600 net-hours) and young captured (20.2) were both lower than numbers recorded in 1995-2009 (53.2 and 23.7, respectively). Productivity, on the other hand, was slightly higher (0.49 in 2015 vs. a mean of 0.46 for 1995-2009). Capture rates in 2015 for the most common species, Great-crested Flycatcher, Carolina Chickadee, Tufted Titmouse, Carolina Wren, Common Yellowthroat, Pine Warbler, Prairie Warbler, and Northern Cardinal, appear similar to the mean for 1995-2009. There were many less-common species that were captured in previous years that were not captured in 2015, but it is highly likely that the species list will expand in coming years. One species, a Yellow-throated Warbler (young), was captured in 2015 which was not captured during 1995-2009. Productivity (the ratio of young per adult) for most species was similar for most species, although Pine Warbler had a ratio of 2.67 in 2015 compared with an average ratio of 0.31 from 1995-2009.

Table 5. Comparison of 2015 capture rates to the mean capture rates, 1995-2009, for the two long running stations, I 113 and S 110 combined.

Species	2015			Mean 1995-2009		
	Birds/600 net hours		Prop. of Young	Birds/600 net hours		Prop. of Young
	Adults	Young		Adults	Young	
Yellow-billed Cuckoo				0.2	0.0	0.00
Red-headed Woodpecker	0.6	0.0	0.00	0.2	0.0	0.00
Red-bellied Woodpecker	0.6	0.0	0.00	0.3	0.0	0.00
Downy Woodpecker				0.0	0.0	1.00
Hairy Woodpecker	0.6	0.0	0.00	0.1	0.0	0.00
Red-cockaded Woodpecker				0.0	0.1	und. ¹
Northern Flicker				0.1	0.0	0.50
Eastern Wood-Pewee	0.6	0.0	0.00	0.4	0.0	0.00
Acadian Flycatcher				0.2	0.0	0.20
Great Crested Flycatcher	3.2	0.0	0.00	2.6	0.1	0.11
White-eyed Vireo	1.3	0.6	0.50	1.2	1.0	0.68
Yellow-throated Vireo				0.2	0.0	0.00
Red-eyed Vireo	1.3	0.0	0.00	1.0	0.2	0.17
Blue Jay				0.7	0.2	0.19
Carolina Chickadee	0.6	1.3	2.00	1.9	1.7	0.94
Tufted Titmouse	1.9	1.3	0.67	2.7	2.5	1.07
White-breasted Nuthatch	0.6	0.0	0.00	0.1	0.0	0.00
Brown-headed Nuthatch	0.6	0.0	0.00	0.2	0.3	0.50
Carolina Wren	5.0	5.7	1.13	3.4	5.6	2.67
Blue-gray Gnatcatcher	0.0	0.6	und. ¹	1.1	0.6	0.49
Wood Thrush				0.1	0.0	0.00
American Robin				0.1	0.0	0.00

Table 5 (continued). Comparison of 2015 capture rates to the mean capture rates, 1995-2009, for the two long running stations, I 113 and S 110 combined.

Species	2015			Mean 1995-2009		
	Adults	Young	Prop. Young	Adults	Young	Prop. Young
Gray Catbird				1.2	0.2	0.17
Brown Thrasher				1.4	0.6	0.39
Ovenbird				0.5	0.4	0.75
Worm-eating Warbler				0.1	0.0	0.00
Louisiana Waterthrush				0.1	0.0	0.50
Black-and-white Warbler				0.3	0.1	0.00
Kentucky Warbler	0.6	0.0	0.00	0.0	0.1	und.
Common Yellowthroat	5.0	3.2	0.63	6.3	3.0	0.53
Hooded Warbler	0.6	0.0	0.00	1.8	0.2	0.27
American Redstart				0.4	0.0	0.00
Pine Warbler	1.9	5.0	2.67	2.8	0.8	0.31
Yellow-throated Warbler	0.0	0.6	und.			
Prairie Warbler	4.4	0.0	0.00	6.4	1.4	0.25
Eastern Towhee	3.2	0.0	0.00	3.5	0.7	0.20
Bachman's Sparrow	0.6	0.0	0.00	1.0	0.2	0.14
Chipping Sparrow				1.7	0.1	0.11
Summer Tanager	0.6	0.0	0.00	1.8	0.4	0.21
Northern Cardinal	3.8	1.9	0.50	4.0	2.5	0.69
Blue Grosbeak	0.6	0.0	0.00	0.5	0.1	0.20
Indigo Bunting	3.2	0.0	0.00	1.6	0.2	0.11
Brown-headed Cowbird				0.1	0.0	0.00
Orchard Oriole				0.1	0.0	0.00
American Goldfinch				0.9	0.0	0.00
ALL SPECIES POOLED	41.6	20.2	0.49	53.2	23.7	0.46
Number of Species	23	9		41	26	

Discussion

Because this was the first year of operation for four of the six stations, few inferences are able to be made based on the available data. Several species were captured in prior years (1995-2009) though this was of course a much larger and longer-term data set. Still, capture rates in 2015 were low compared to other MAPS stations. This is largely due to the habitat types in which the stations were operating, i.e. areas that have been managed to reduce understory. In coming years, we recommend revising protocols to either change or modify station and net locations; or test alternate methods of capture, e.g. higher nets. In addition, supplemental methods of bird survey, such as point counts, could be integrated into sampling procedures.

The MAPS Program in Fort Bragg continues to provide station-specific indices of adult population size and post-fledging productivity. In coming years, as the data set grows more robust and we begin to recapture birds banded in prior years, estimates of annual survival rates of adults, and important information on annual changes and longer-term trends in these indices and estimates will be calculated. The results in this and previous reports underscore the complexity of the population dynamics of Fort Bragg's breeding birds, which can only be unraveled through long-term data collection.

Capture species and rates were roughly similar in 2015 to rates obtained during previous studies. Some species were not captured, though it is likely that more species will be captured as the project proceeds in future years. The continuation of the MAPS Program at Fort Bragg is a welcome step in re-establishing this important long-term data set, and we look forward to collecting more data in the future to strengthen these comparisons.

Bird populations continue to decline across North America. Many short-term projects and programs are aimed at tracking population trends, but few offer the depth and breadth, and the ability to look at the proximate causes of population decline, as the MAPS Program. With the manifold changes and pressures such as habitat loss, climate change, and disease, it is extremely important that rigorously scientific long-term studies such as these continue. The U.S. Department of Defense, with its large land base, can play a vital role in this effort.

Acknowledgments

We are grateful to our 2015 field interns, Jessica Mailhot and Michael Gamble, and for the support of the Fort Bragg administration and staff, especially Wildlife Biologist Jessie Schillaci. Financial support for the MAPS Program in Fort Bragg during 2015 was provided by the U.S. Army, Fort Bragg. This is Contribution Number 532 of The Institute for Bird Populations.

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Appendix I. Numerical listing (in AOU 2015 checklist order) of all the species sequence numbers, species alpha codes, and species names for all species banded or encountered during the 16 years, 1995-2009 and 2015, of the MAPS Program on the eleven stations ever operated on Fort Bragg.

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	I 113 (I113)	S 110 (S110)	Canebreak (CANE)	Holland Landing Zone (HOLZ)	Polecat Creek (POCR)	Southwest Fort Bragg (SWFB)	I 102 (I102)	I 104 (I104)	S 112 (S112)	S 114 (S114)	Sandstone Hill (SAHI)
350	CANG	Canada Goose	T	T	T	T				T	F		
480	WODU	Wood Duck	T	T					T	U	T	T	
550	MALL	Mallard								F			
1200	NOBO	Northern Bobwhite	U	U	T	B	T	T	B	U	U	U	U
1550	WITU	Wild Turkey	T	T								F	F
2570	DCCO	Double-crested Cormorant								T			
2650	AMBI	American Bittern								T			
2720	GBHE	Great Blue Heron	T	T				T	T	O	T		T
2770	GREG	Great Egret									T		
2880	GRHE	Green Heron								T			
3030	BLVU	Black Vulture		T		T		T		T			
3040	TUVU	Turkey Vulture	T	T	T		T		T	T	O	T	T
3300	SSHA	Sharp-shinned Hawk		M						M			
3310	COHA	Cooper's Hawk		T		T			T			T	
3480	RSHA	Red-shouldered Hawk	T	T						T	O	O	
3500	BWHA	Broad-winged Hawk	T	T						T	T	T	
3580	RTHA	Red-tailed Hawk	T	T				T	T	T	O	T	
4320	KILL	Killdeer				T							
5000	AMWO	American Woodcock	T	T						T			
6430	MODO	Mourning Dove	B	B	B	B	B	B	B	U	B	U	B
6500	YBCU	Yellow-billed Cuckoo	U	U					O	U	U	U	O
6750	EASO	Eastern Screech-Owl	O	T					T	T	T	T	
6870	GHOW	Great Horned Owl	T		T					T			
7030	BADO	Barred Owl											T
7180	CONI	Common Nighthawk	U	O	B	B	B	B	U	U	O	O	U
7270	CWWI	Chuck-will's-widow		O						O	O	O	T
7330	EWPW	Eastern Whip-poor-will	O	O	T					T	T		
7510	CHSW	Chimney Swift	T	T		T		T	T	O	O	T	T

Appendix I, continued.

SSN	SPEC	SPECIES NAME	I113	S110	CANE	HOLZ	POCR	SWFB	I102	I104	S112	S114	SAHI
8190	RTHU	Ruby-throated Hummingbird	O	U		B	B		O	O	U	O	O
9230	BEKI	Belted Kingfisher	T	T					T	O	T	T	T
9540	RHOW	Red-headed Woodpecker	U	O	B	B	B	B	U	U	O	O	O
9670	RBWO	Red-bellied Woodpecker	U	U	B	B	B	B	B	B	U	U	O
9790	DOWO	Downy Woodpecker	U	U	B	T		T	O	U	U	U	O
9810	HAWO	Hairy Woodpecker	O	T	T				O	O	U	O	
9840	RCWO	Red-cockaded Woodpecker	U	O	B	T	T	B	B	O	T	T	U
9960	YSFL	Yellow-shafted Flicker	U	U	B	T	B	B	B	U	U	U	B
10040	PIWO	Pileated Woodpecker	U	O	B	B	B	B	U	O	U	U	O
10200	AMKE	American Kestrel	O	T	T	T	T	B	U	O	T	T	O
12360	EAWP	Eastern Wood-Pewee	B	U	B	B	B	B	B	B	O	O	U
12430	ACFL	Acadian Flycatcher	T	T		T	T		T	T	O	O	
12630	EAPH	Eastern Phoebe					T		T	T			
12780	GCFL	Great Crested Flycatcher	B	B	B	B	B	B	B	B	B	U	B
13060	EAKI	Eastern Kingbird	T	O		B				O	T	T	O
13510	LOSH	Loggerhead Shrike											T
13540	WEVI	White-eyed Vireo	O	U			T	T	O	U	O	O	T
13690	YTVI	Yellow-throated Vireo	O	O						O	O	O	T
13730	BHVI	Blue-headed Vireo	M	M				M	M		M		
13800	REVI	Red-eyed Vireo	U	U	T	T			T	O	B	U	O
14100	BLJA	Blue Jay	U	U	B	B	B	B	B	U	B	U	B
14210	AMCR	American Crow	O	O	B	B	B	B	O	O	U	O	U
14290	FICR	Fish Crow	O	O	B	B	T	B	O	U	T	O	B
14390	PUMA	Purple Martin	T	T	B	B	B	B	T	T	T	T	T
14460	TRES	Tree Swallow							M		M	M	M
14540	NRWS	Northern Rough-winged Swallow	T										
14590	BARS	Barn Swallow	T	T	T	T	T	T	T		T	T	T
14620	CACH	Carolina Chickadee	B	B	B	B	B	B	B	B	B	B	U
14740	TUTI	Tufted Titmouse	B	B	B	B	B	B	B	B	B	B	B
14790	WBNU	White-breasted Nuthatch	U	O	T	T	B	B	U	U	U	U	U
14810	BHNU	Brown-headed Nuthatch	U	U	B	B	B	B	U	U	O	T	B
15010	CARW	Carolina Wren	B	B	B		B	B	B	B	B	B	O
15340	BGGN	Blue-gray Gnatcatcher	U	B	B	T	B	T	U	B	B	U	O
15820	EABL	Eastern Bluebird	O	O	B	T	T		U	U	O	O	U
16050	VEER	Veery		M					M		M		
16060	GCTH	Gray-cheeked Thrush		M						M		M	
16090	SWTH	Swainson's Thrush		M					M	M	M		
16110	WOTH	Wood Thrush	T	T						T	U	O	T
16300	AMRO	American Robin	O	O	T	B		T	U	O	O	O	O
16410	GRCA	Gray Catbird	O	O					U	U	O	O	
16490	BRTH	Brown Thrasher	O	U			T		U	U	O	O	O
16610	NOMO	Northern Mockingbird	T		B	T	B			T			T

Appendix I, continued.

SSN	SPEC	SPECIES NAME	I113	S110	CANE	HOLZ	POCR	SWFB	I102	I104	S112	S114	SAHI
16780	CEDW	Cedar Waxwing		M	M	M	M	M		M			M
16960	OVEN	Ovenbird	O	O	T				T	O	U	U	T
16970	WEWA	Worm-eating Warbler	T								T		
16980	LOWA	Louisiana Waterthrush		O						T	T	T	
16990	NOWA	Northern Waterthrush	M							M	M	M	
17020	BWWA	Blue-winged Warbler								M			
17050	BAWW	Black-and-white Warbler	O	O			T			T	U	O	
17060	PROW	Prothonotary Warbler	T						T	T	T	O	
17220	KEWA	Kentucky Warbler	O	O	T		B		T		O	U	
17280	COYE	Common Yellowthroat	B	B	B		B		B	B	U	U	T
17340	HOWA	Hooded Warbler	O	U					U	O	U	B	
17350	AMRE	American Redstart	T	T	T				T	O	T	T	
17390	NOPA	Northern Parula	T	T					T	T	T	T	
17420	MAWA	Magnolia Warbler		M					M	M	M	M	
17450	YEWA	Yellow Warbler	M								M		
17480	BLPW	Blackpoll Warbler							M	M	M		
17490	BTBW	Black-throated Blue Warbler	M	M					M	M	M	M	
17540	PIWA	Pine Warbler	B	B	B	B	B	B	B	B	U	U	B
17580	YTWA	Yellow-throated Warbler	T	O					T	O	O	O	T
17610	PRAW	Prairie Warbler	U	B	B		B	T	B	B	O	O	U
17710	BTNW	Black-throated Green Warbler								M	M		
17800	CAWA	Canada Warbler										M	
17810	WIWA	Wilson's Warbler								M			
17890	YBCH	Yellow-breasted Chat	O	T					T	O	T	T	
19020	EATO	Eastern Towhee	B	B	B	B	B	B	B	B	B	U	B
19200	BACS	Bachman's Sparrow	U	U	T	B	T	B	U	U	O		B
19240	CHSP	Chipping Sparrow	U	U		B			U	U	T	O	U
19270	FISP	Field Sparrow	T	O					T	O			O
19300	VESP	Vesper Sparrow								T			
19590	WTSP	White-throated Sparrow							M	M			
19950	SUTA	Summer Tanager	B	B	B	B	B	B	U	B	B	U	B
20100	NOCA	Northern Cardinal	B	B	B	T	B	B	B	B	B	B	O
20140	RBGR	Rose-breasted Grosbeak										M	
20210	BLGR	Blue Grosbeak	O	O		T		B	T	O	O	O	U
20240	INBU	Indigo Bunting	U	B	T		B	B	U	U	B	U	O
20310	RWBL	Red-winged Blackbird	T		T	T	T			O			
20390	EAME	Eastern Meadowlark	T					T					
20460	COGR	Common Grackle	T	O	T	B		T	T	O	T		T
20550	BHCO	Brown-headed Cowbird	O	U	T	B		T	U	O	U	O	O
20680	OROR	Orchard Oriole	T						T			T	
20820	BAOR	Baltimore Oriole									M		
21500	HOFI	House Finch	T	T	T			T			O		T

Appendix I, continued.

SSN	SPEC	SPECIES NAME	I113	S110	CANE	HOLZ	POCR	SWFB	I102	I104	S112	S114	SAHI
21690	AMGO	American Goldfinch	U	U	T	B	T	T	U	B	B	U	O
21770	HOSP	House Sparrow		T								T	