THE 2003 REPORT OF THE MONITORING AVIAN PRODUCTIVITY AND SURVIVORSHIP (MAPS) PROGRAM ON FORT BRAGG

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Introduction

Since 1989, The Institute for Bird Populations has been coordinating the Monitoring Avian Productivity and Survivorship (MAPS) Program, a cooperative effort among public and private agencies and individual bird banders in North America, to operate a continent-wide network of over 500 constant-effort mist-netting and banding stations. MAPS was designed to provide critically needed information on the vital rates (productivity or birth rate, and survivorship or death rate) of landbirds that is crucial for efforts to identify demographic causes of the severe and sometimes accelerating population declines documented (Robbins et al. 1989, Terborgh 1989, Peterjohn et al.1995) for many species of North American landbirds (DeSante 1992, DeSante et al. 1995, 1999, 2001a). Such data on vital rates are also critically needed in efforts to identify management strategies to reverse such population declines (DeSante 1995, DeSante and Rosenberg 1998).

MAPS is organized to fulfill three sets of goals and objectives, monitoring, research, and management. The specific **monitoring** goals of MAPS are to provide, for over 100 target species, including Neotropical-wintering migrants, temperate-wintering migrants, and permanent residents: (a) annual indices of adult population size and post-fledging productivity from data on the numbers and proportions of young and adult birds captured; and (b) annual estimates of adult population size, adult survival rates, proportions of residents, and recruitment into the adult population from modified Cormack- Jolly-Seber analyses of mark-recapture data on adult birds.

The specific **research** goals of MAPS are to identify and describe: (a) temporal and spatial patterns in these demographic indices and estimates at a variety of spatial scales ranging from the local landscape to the entire continent; and (b) relationships between these patterns and ecological characteristics of the target species, population trends of the target species, station-specific and landscape-level habitat characteristics, and spatially-explicit weather variables.

The specific **management** goals of MAPS are to use these patterns and relationships, at the appropriate spatial scales, to: (a) identify thresholds and trigger points to notify appropriate agencies and organizations of the need for further research and/or management actions; (b) determine the proximate demographic cause(s) of population change; (c) suggest management actions and conservation strategies to reverse population declines and maintain stable or increasing populations; and (d) evaluate the effectiveness of the management actions and conservation strategies actually implemented through an adaptive management framework.

All of these monitoring, research, and management goals are in agreement with the Department of Defense=s (DoD) Partners-in-Flight strategy. Moreover, because birds are excellent indicators of the health of ecological systems, they can serve as a sensitive barometer of the overall effectiveness of efforts to maintain the biodiversity and ecological integrity of military installations. Accordingly, the MAPS program was initiated on select military installations beginning in 1992 and soon became one of the focus projects of the DoD Partners-in-Flight program. It was expected that information from the MAPS program would be capable of aiding

research and management efforts on these military installations to protect and enhance the installations= avifauna and ecological integrity, while allowing them to fulfill their military mission.

Accordingly, in 1995, six MAPS stations were established and operated on Fort Bragg. The operation of these stations was continued during the summers of 1996-2002 by means of funding from the DoD Legacy Resource Management Program. The operation of the six stations was continued during the summer of 2003 by means of modest funding from Fort Bragg.

The ultimate objective of the MAPS Program on DoD installations such as Fort Bragg is to identify generalized management guidelines and formulate specific management actions that can be implemented on military installations and elsewhere to reverse the population declines of target landbird species and to maintain the populations of stable or increasing species. The identification and formulation of these management guidelines and actions is to be achieved by modeling the vital rates (productivity and survivorship) of the various landbird species as a function of landscape-level habitat characteristics and spatially explicit weather variables. Our goal is to identify relationships between productivity (and survivorship for permanent resident species) and these habitat and weather variables. These management strategies will involve efforts to modify the habitat from characteristics associated with low productivity to characteristics associated with high productivity (for species for which low productivity is driving the population decline).

The funding necessary to undertake these analyses and formulate management strategies was obtained from the Legacy Resource Management Program during 2000-2002. These analyses have been completed (Nott et al. 2003) and we are currently implementing these guidelines and actions on DoD installations in conjunction with efforts to increase military Readiness and Range Sustainment. The implementation strategy for these guidelines includes the establishment of new MAPS stations to monitor their effectiveness, the discontinuing of an equal number of old stations, and the continued operation of others of the old stations to serve as controls for the new management stations. In this way, the total number of stations operated has remained the same (e.g., six stations are still being run at Fort Bragg although one original station was dropped and one new station was added in 2003).

A complete summary of the results of the MAPS Program on Fort Bragg from 1993-1999, as well as on 12 other installations or groups of nearby installations in eastern United States, was presented by DeSante et al. (2001b). This report briefly updates that earlier report and documents the operation of the six MAPS stations on Fort Bragg during the 2003 breeding season.

Methods

Six MAPS stations were operated in 2003, five of them in the same locations where they were first established in 1995, and one of them newly established during the season. Following detailed management-related analyses (Nott et al. 2003), it was determined that the I102 station would be discontinued to reduce the probability of capturing the endangered Red-cockaded

Woodpeckers that breed within the boundaries of that station. It was replaced by the Sandstone Hill station in a mosaic of upland patchy forest, shrubland, and grasslands that are frequently managed to reduce fire risks. This station will be operated to assess the effects of these management actions.

All MAPS stations were operated in accordance with the highly standardized banding protocols established by The Institute for Bird Populations for use by the MAPS Program throughout North America and spelled out in detail in the MAPS Manual (DeSante et al. 2003). On each day of operation each year, one 12-m long, 30-mm mesh, 4-tier nylon mist net was erected at each of ten fixed mist-netting sites within the interior eight ha of each 20-ha station. These ten nets at five of the six stations were operated for six morning hours per day (beginning at local sunrise), and for one day in each of nine consecutive 10-day periods between May 11 and August 8. Because of the time required to site and establish the Sandstone Hill station, initial operation of the station occurred during Period 5 (June 10-19). It was thus operated for only six consecutive 10-day periods between June 12 and August 4. Otherwise, the operation of stations occurred on schedule in each of the ten-day periods. The operation of the six stations was carried out by IBP field biologist intern Kendra Noyes who was assisted by volunteers Chris Helms, Keith Jensen, Mike Leonowicz, Susan Campbell, and Erin Guinn.

With few exceptions, all birds captured during the course of the study were identified to species, age, and sex and, if unbanded, 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 would be comprised. The following data were taken on all birds captured, including recaptures, according to MAPS guidelines using standardized codes and forms:

(1) capture code (newly banded, recaptured, band changed, unbanded);
(2) band number;
(3) species;
(4) age and how aged;
(5) sex (if possible) and how sexed (if applicable);
(6) extent of skull pneumaticization;
(7) breeding condition of adults (i.e., extent of cloacal protuberance or brood patch);
(8) extent of juvenal plumage in young birds;
(9) extent of body and flight-feather molt;
(10) extent of primary-feather wear;
(11) wing chord;
(12) fat class and weight;
(13) date and time of capture (net-run time); and
(14) station and net site where captured.

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 to be made, 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.

The computer entry, proofing, and verification of all banding, effort, and breeding status data were completed by IBP biologists using specially designed data entry, verification, and editing programs. 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. All banding data were then run through a series of verification programs as follows:

(1) Clean-up programs to check the validity of all codes entered and the ranges of all numerical data;
(2) Cross-check programs to compare station, date, and net fields from the banding data with those from the effort and breeding status data;
(3) 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;
(4) Screening programs which allow identification of unusual or duplicate band numbers or unusual band sizes for each species; and
(5) 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, fat content, date and station of capture, and any pertinent notes were used as supplementary information for the correct determination of species, age, and sex in all of these verification processes.

The proofed, verified, and corrected banding data from each year were then run through a series of analysis programs that calculated for each species and for all species pooled at each station and for all stations pooled on each forest:

(1) the numbers of newly banded birds, recaptured birds, and birds released unbanded;
(2) the numbers and capture rates (per 600 net-hours) of first captures (in each year) for individual adult and young birds; and
(3) the proportion of young in the catch.

Following the procedures pioneered by the British Trust for Ornithology (BTO) in their CES Scheme (Peach et al. 1996), the number of adult birds captured was used as an index of adult population size, and the proportion of young in the catch was used as an index of post-fledging productivity.

Survival was estimated for 11 target species using Modified Cormack-Jolly-Seber (CJS)

mark-recapture analyses (Pollock et al.1990, Lebreton et al.1992) on eight years (1995-2002 for station I102 which was discontinued in 2003) or nine years (1995-2003 for the other five long-running stations) of capture histories of adult birds. Target species were those for which, on average, at least six individual adults per year were recorded from the six stations pooled at which the species was a breeder during more than half of the years the station was operated. Using the computer program SURVIV (White 1983), we calculated, for each target species, maximum-likelihood estimates and standard errors (*SE*s) for adult survival probability, adult recapture probability, and the proportion of residents among newly captured adults using a time-constant, between- and within-year transient model (Pradel et al. 1997, Nott and DeSante 2002). The use of the transient model accounts for the existence of transient adults (dispersing and floater individuals which are only captured once) in the sample of newly captured birds, and provides survival estimates that are unbiased with respect to these transient individuals (Pradel et al. 1997). Recapture probability is defined as the conditional probability of recapturing a bird in a subsequent year that was banded in a previous year, given that it survived and returned to the place it was originally banded.

Results and Discussion

We operated six MAPS stations on Fort Bragg during the summer of 2003. A total of 2914.3 net-hours were accumulated at all six stations pooled. The details of the operation of these six stations during 2003 are presented in Table 1.

For each individual species and for all species pooled, the numbers of individual birds newly banded, captured and released unbanded (including hummingbirds, which we are not licensed to band), and recaptured, are presented for each station in Table 2, and for all stations combined in Table 4. A total of 487 captures of 41 species occurred at Fort Bragg during the summer of 2003 (Table 4). Newly banded birds comprised 58.5% of the total captures. The greatest number of total captures (111) was recorded at Station I113 and the smallest number of total captures (58) was recorded at the Sandstone Hill station (which was only operated for six, rather than nine periods). The highest species richness occurred at Station I104 (26 species) and the lowest species richness occurred at Sandstone Hill (10 species).

The capture rates (per 600 net-hours) of individual adult and young birds and the proportion of young in the catch are presented for each species and for all species pooled at each station in Table 3, and for all stations combined in Table 4. We present capture rates (captures per 600 net-hours) of adults and young in these tables so that the data can be compared among stations which, because of the vagaries of weather and accidental net damage, can differ from one another in effort expended, as was the case for Sandstone Hill in 2003 (Table 1). Adult population size (for all species pooled) was highest at Station I104 (55.7 adults/600 net hours; Table 3), followed by population sizes at Station I113 (50.9), Sandstone Hill (49.5), Station S112 (38.3), Station S114 (36.3), and Station S110 (32.3). Productivity (proportion of young in the catch) showed a different pattern, being highest at Station S114 (0.40) followed by Station I113 (0.39), Station I104 (0.37), Station S110 (0.26), Sandstone Hill (0.22), and Station S112 (0.18). The Sandstone Hill breeding population size may be biased low and the productivity value may be

biased high by the lack of effort during the first three periods when additional adults are often captured.

Among individual species, Carolina Wren was the most frequently captured species at the six stations in 2003, followed by Prairie Warbler, Northern Cardinal, Common Yellowthroat, Tufted Titmouse, Hooded Warbler, and White-eyed Vireo (Table 4). The most abundant breeding species, having a capture rate of at least 2.0 adults per 600 net-hours, in decreasing order, were Prairie Warbler, Common Yellowthroat, Northern Cardinal, Tufted Titmouse, Carolina Wren, Eastern Towhee, and Red-eyed Vireo. The most abundant breeding species at each station, having a capture rate of at least 3.0 birds per 600 net-hours (Table 3), were as follows:

Sandstone Hill	**I 104**	**I 113**
Prairie Warbler	Common Yellowthroat	Prairie Warbler
Pine Warbler	Blue-gray Gnatcatcher	Common Yellowthroat
Bachman's Sparrow	Brown Thrasher	Northern Cardinal
Summer Tanager	Prairie Warbler	Tufted Titmouse
Field Sparrow	Eastern Towhee	Brown Thrasher
Blue Grosbeak	Chipping Sparrow	Eastern Towhee
S 110	**S 114**	**S 112**
Prairie Warbler	Red-eyed Vireo	Tufted Titmouse
Carolina Wren	Carolina Wren	Red-eyed Vireo
Common Yellowthroat	Hooded Warbler	Wood Thrush
Summer Tanager	Tufted Titmouse	Hooded Warbler
	Kentucky Warbler	Ovenbird
	Northern Cardinal	Northern Cardinal

Using eight (1995-2002) or nine (1995-2003) years of data from the six long-running stations, estimates of annual adult survival and recapture probabilities were obtained for 11 target species breeding at Fort Bragg. Maximum-likelihood estimates of annual adult survival probability, recapture probability, and proportion of residents among newly captured adults from the time-constant transient model are presented for these 11 species in Table 5. Survival-rate estimates for three species (Great Crested Flycatcher, Pine Warbler, and Summer Tanager) had poor precision (CVs > 30%). Survival-rate estimates for the remaining eight species ranged from a low of 0.272 for Carolina Wren to a high of 0.524 for Gray Catbird, with a mean of 0.405. These estimates are low compared to many other locations. For example, survival-rate estimates with adequate precision (CV < 30%) are available for seven of these eight species (all but Prairie Warbler) from the entire Southeast Region over the seven-year period 1992-1998 (DeSante and O'Grady 2000) and can be compared to those from Fort Bragg. We found that the mean survival-rate estimates for the seven species that could be compared between Fort Bragg and the Southeast Region as a whole were 0.397 on Fort Bragg and 0.476 for the Southeast Region. Indeed, survival estimates at Fort Bragg were *lower* than in the entire Southeast Region for six of the seven species (all but Gray Catbird), and were *substantially (> 17%) lower* for five species, (Carolina Chickadee, Tufted Titmouse, Carolina Wren, Eastern Towhee, and Northern Cardinal).

Interestingly, breeding individuals of four of these species are year-round, permanent residents on Fort Bragg, and breeding individuals of the fifth species, Eastern Towhee, may be permanent residents as well. The mean survival-rate estimates for these five permanent resident species on Fort Bragg was 0.376 $\pm$ 0.096 (sd) compared to 0.501 $\pm$ 0.103 (sd) for the Southeast Region as a whole, a difference of -0.125 + 0.098 (sd) that was statistically significant ($t = -2.86$, d.f. = 4, $P < 0.05$). In contrast, survival rates of individuals breeding on Fort Bragg for the two migratory species (Gray Catbird and Common Yellowthroat) averaged 0.037 *higher* on Fort Bragg than over the Southeast Region as a whole.

These results provide a strong suggestion that overwintering survival of individuals wintering on Fort Bragg may be poor. The Institute for Bird Populations has initiated the MAWS (Monitoring Avian Wintering Survival) Program to assess habitat-specific overwintering survival rates for species wintering the southern parts of the United States. Six of initial 24 MAWS stations have been established on Fort Bragg through funding from the Legacy Resources Management Program. Four or five years of data from these MAWS stations should be able to provide information as to the extent of this overwintering survival problem and relationships between it and various habitat variables. Eventually, the MAWS Program, in conjunction with MAPS, should lead to the formulation of management strategies and guidelines to enhance overwintering survival, especially for declining species of conservation concern.

As mentioned earlier, analyses aimed at identifying and describing relationships between four demographic parameters (adult population size, population trends, numbers of young, and productivity) and landscape-level habitat characteristics have been completed for 13 military installations including Fort Bragg (Nott et al. 2003). These analyses were also funded by the Legacy Resource Management Program. At Fort Bragg, two species (Wood Thrush and Prairie Warbler) emerged as candidates for particular management concern. The establishment of the new Sandstone Hill MAPS station should shed further light on declines of Prairie Warbler, the most abundant species caught at this station. It may also shed some light on the population dynamics of Bachman's Sparrow, a species of concern in the region. Another objective of this monitoring work on Fort Bragg is to evaluate the effectiveness of avian management guidelines that can be integrated into both new and on-going land management practices, such as those near the Sandstone Hill station, and to modify them according to the adaptive management process in order to achieve the long-term goal of reversing declining populations and maintaining stable or increasing populations of target landbird species.

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Literature Cited

DeSante, D.F. (1992) Monitoring Avian Productivity and Survivorship (MAPS): a sharp, rather than blunt, tool for monitoring and assessing landbird populations. *In*: D. R. McCullough and R. H. Barrett (Eds.), Wildlife 2001: Populations, pp. 511-521. (London, U.K.: Elsevier Applied Science).

DeSante, D.F. (1995) Suggestions for future directions for studies of marked migratory landbirds from the perspective of a practitioner in population management and conservation. Journal Applied Statistics 22, pp. 949-965.

DeSante, D.F., Burton, K.M., Saracco, J.F., & Walker, B.L. (1995) Productivity indices and survival rate estimates from MAPS, a continent-wide programme of constant-effort mist netting in North America. Journal Applied Statistics, 22, pp. 935-947.

DeSante, D.F., Burton, K.M., Velez, P., & Froehlich, D. (2003) MAPS Manual, Point Reyes Station, CA: The Institute for Bird Populations; 49 pp.

DeSante, D.F., Nott, M.P., & O=Grady, D.R. (2001a) Identifying the proximate demographic cause(s) of population change by modeling spatial variation in productivity, survivorship, and population trends. Ardea 89 (special issue):185-207.

DeSante, D.F, and D.R. O'Grady. (2000). The Monitoring Avian Productivity and Survivorship (MAPS) program 1997 and 1998 report. Bird Populations 5:49-101.

DeSante, D.F., O'Grady, D.R. & Pyle, P. (1999) Measures of productivity and survival derived from standardized mist netting are consistent with observed population changes. Bird Study 46 (suppl.):S178-188.

DeSante, D.F., Pyle, P., and O=Grady, D.R. (2001b) The 1992-1999 report of the Monitoring Avian Productivity and Survivorship (MAPS Program on military installations in eastern United States. The Institute for Bird Populations, Point Reyes Station, CA 113 pp. plus figs. and tables.

DeSante, D.F., & Rosenberg, D.K. (1998) What do we need to monitor in order to manage landbirds? *In*: J. Marzluff & R. Sallabanks (Eds.), Avian Conservation: Research Needs and Effective Implementation, pp. 93-106. Island Press, Washington, DC.

Lebreton, J.-D., Burnham, K.P., Clobert, J., & Anderson, D.R. (1992) Modeling survival and testing biological hypotheses using marked animals: a unified approach with case studies, Ecological Monographs, 62, pp. 67-118.

Nott, M.P., & DeSante, D.F. (2002) Demographic monitoring and the identification of transients in mark-recapture models. Pp. 727-736 *in:* J.M. Scott & P. Heglund (eds.), Predicting Species Occurrences: Issues of Scale and Accuracy. Island Press, NY.

Nott, M.P., D.F. DeSante, and N. Michel. (2003) Management strategies for reversing declines in landbirds of conservation concern on military installations: A landscape-scale analysis of MAPS data. The Institute for Bird Populations, Pt. Reyes Station, CA.

Peach, W.J., Buckland, S.T., & Baillie, S.R. (1996) The use of constant effort mist-netting to measure between-year changes in the abundance and productivity of common passerines. Bird Study, 43, pp. 142-156.

Peterjohn, B.G., Sauer, J.R., & Robbins, C.S. (1995) Population trends from the North American Breeding Bird Survey. *In*: T.E. Martin and D.M. Finch, Ecology and Management of Neotropical Migratory Birds, New York: Oxford University Press; pp. 3-39.

Pollock, K.H., Nichols, J.D., Brownie, C., & Hines, J.E. (1990) Statistical inference for capture-recapture experiments, Wildlife Monographs, No. 107.

Pradel, R., Hines, J., Lebreton, J.-D., & Nichols, J.D. (1997) Estimating survival probabilities and proportions of >transients= using capture-recapture data. Biometrics, 53, pp. 60-72.

Robbins, C.S., Sauer, J.R., Greenberg, R.S., & Droege, S. (1989) Population declines in North American birds that migrate to the Neotropics, Proceedings of the National Academy of Sciences (USA), 86, pp. 7658-7662.

Terborgh, J. (1989) Where Have All the Birds Gone? Essays on the Biology and Conservation of Birds that Migrate to the American Tropics, Princeton, NJ: Princeton Univ. Press; 207 pp.

White, G.C. (1983) Numerical estimation of survival rates from band-recovery and biotelemetry data. J. Wildlife Management, 47, pp. 716-728.