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

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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.1999) 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 1993, six MAPS stations were established and operated on Fort Leonard Wood. The operation of these stations was continued during the summers of 1994-2002 by means of funding from the DoD Legacy Resource Management Program. The operation of the six stations on Fort Leonard Wood was continued during the summer of 2003 by means of modest funding from Fort Leonard Wood, in conjunction with studies on the Cerulean, Prothonotary, and Hooded warblers on the installation.

The ultimate objective of the MAPS Program on DoD installations such as Fort Leonard Wood 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 Leonard Wood although two original stations were dropped and two new stations were added in 2003).

A complete summary of the results of the MAPS Program on Fort Leonard Wood 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 Leonard Wood during the 2003 breeding season.

Methods

Six MAPS stations were operated in 2003, four of them in the same locations where they

were first established in 1993, and two of them newly established during the season. Following detailed management-related analyses (Nott et al. 2003) it was determined that the Smith Ridge and Miller Ridge stations would be discontinued due to low capture rates and because they were located in mature forest where management results are less achievable. They were replaced by the Tilley Bottoms station (to act as a replicate for the Big Piney station) and the Bradford Cemetery station, a grassland area that is presently undergoing secondary succession and should be monitored. The Big Piney and Laughlin Bottoms stations will be maintained as controls. Fire management of open scrubby habitat around the Miller Pond and Macedonia stations occurred during the spring of 2003, and these two stations will also 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 each station were operated for six morning hours per day (beginning at local sunrise), and for one day in each of eight consecutive 10-day periods between May 21 and August 8. The operation of stations occurred on schedule in each of the ten-day periods and was carried out by IBP field biologist interns Julie Neltner and Andy Noth, who were trained and supervised by IBP field biologist Jeanie Woltz.

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 16 target species using Modified Cormack-Jolly-Seber (CJS) mark-recapture analyses (Pollock et al.1990, Lebreton et al.1992) on 10 (1993-2002) or 11 years (1993-2003) of capture histories of adult birds from the six long-running stations. 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

We operated six MAPS stations on Fort Leonard Wood during the summer of 2003. 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 1238 captures of 51 species occurred at Fort Leonard Wood during the summer of 2003 (Table 4). Newly banded birds comprised 73.1% of the total captures. The greatest number of total captures (324) was recorded at the newly established Tilley Bottoms station and the smallest number of total captures (44) was recorded at the Macedonia station. The highest species richness also occurred at Miller Pond (33 species) and the lowest species richness occurred at Macedonia (17 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 (Table 1). Adult population size (for all species pooled) was highest at the two new stations Tilley Bottoms (264.1 adults/600 net hours; Table 3) and Bradford Cemetery (207.2). These were followed by Miller Pond (186.8), Laughlin Bottoms (155.3), Big Piney (110.6), and Macedonia (41.2).

Among individual species, Yellow-breasted Chat was the most frequently captured species at the six stations in 2003, followed by Indigo Bunting, Field Sparrow, Blue-winged Warbler, White-eyed Vireo, Prairie Warbler, Kentucky Warbler, Common Yellowthroat, and Blue-gray Gnatcatcher (Table 4). The most abundant breeding species, having a capture rate of at least 4.0 adults per 600 net-hours, in decreasing order, were Indigo Bunting, Yellow-breasted Chat, Blue-winged Warbler, Field Sparrow, Prairie Warbler, White-eyed Vireo, Kentucky Warbler, Northern Cardinal, Common Yellowthroat, Red-eyed Vireo, and Carolina Chickadee (Table 4). The most abundant breeding species at each installation, having a capture rate of at least 6.0 adults per 600 net-hours were as follows (Table 3):

Miller Pond
Indigo Bunting
Field Sparrow
Yellow-breasted Chat
Carolina Chickadee
Prairie Warbler
American Goldfinch
Common Yellowthroat
Orchard Oriole
White-eyed Vireo
Carolina Wren
Blue-winged Warbler
Northern Cardinal

Macedonia
Ovenbird

Laughlin Bottoms
Indigo Bunting
Blue-winged Warbler
Kentucky Warbler
Yellow-breasted Chat
Northern Cardinal
Prairie Warbler
White-eyed Vireo
Red-eyed Vireo

Bradford Cemetery
Yellow-breasted Chat
Field Sparrow
Prairie Warbler
Indigo Bunting
White-eyed Vireo
Blue-winged Warbler
Northern Cardinal

Tilley Bottoms
Yellow-breasted Chat
Blue-winged Warbler
Indigo Bunting
Common Yellowthroat
White-eyed Vireo
Carolina Chickadee
Prairie Warbler
Field Sparrow
Blue-gray Gnatcatcher

Big Piney
Red-eyed Vireo
Kentucky Warbler
American Redstart
Worm-eating Warbler
Northern Cardinal
Wood Thrush

Productivity (proportion of young in the catch) showed a different pattern over the six stations than adult population size, being highest by far at Miller Pond (0.42), followed by Big Piney (0.21), Tilley Bottoms (0.19), Macedonia (0.17), Bradford Cemetery (0.16), and Laughlin Bottoms (0.13). The overall productivity index (proportion of young in the catch) for the six stations in 2003 was 0.23. Mean productivity for all species pooled at Fort Leonard Wood during the seven years 1993-1999 was 0.173 (DeSante et al. 2001b), substantially less than the 2003 value. Although productivity at the two newly established stations was higher than at the stations they replaced (DeSante et al. 2001b), it still appears that the generally higher productivity in 2003 than in other years was not due solely to the new stations, and that 2003 was likely a reasonably good year for productivity at Fort Leonard Wood.

Using 11 years of data from the six long-running stations, estimates of adult survival and recapture probabilities were obtained for 16 target species breeding at Fort Leonard Wood. 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 in Table 5. Annual adult survival-rate estimates ranged from a low of 0.459 for Common Yellowthroat to a high of 0.675 for Downy Woodpecker, with a mean of 0.566 for the 16 species. These estimates are high compared to many other stations. Furthermore, the C.V.s for the 16 species at Fort Leonard Wood were low (all 16 < 30%, 13 of 16 < 20%, and 5 of 16 < 10%) indicating quite precise estimates. By comparing survival estimates from the South-Central Region over the seven-year period 1992-1998 (DeSante and O'Grady 2000) with survival estimates from Fort Leonard Wood for 13 species (all but Prairie Warbler, American Redstart, and Worm-eating Warbler for which no or quite imprecise survival rate estimates were available from the South-central region as a whole), we found that survival estimates at Fort Leonard Wood were higher than in the South-Central Region as a whole for nine species, and substantially ($\geq$ 10%) higher for six species, (Acadian Flycatcher, Red-eyed Vireo, Common Yellowthroat, Yellow-breasted Chat, Field Sparrow, and Indigo Bunting). The mean survival estimates for these 13 species was 0.568 at Fort Leonard Wood and 0.544 for the South-Central Region as a whole. Thus, survival of landbirds at Fort Leonard Wood appears to be quite good. We suggest that the populations breeding there consist of high-quality individuals that are attracted to and able to hold territories in the pristine habitats at the Fort and that, on average, display better survival than birds that breed over the South-central Region as a whole. This suggests that Fort Leonard Wood is very important to landbird populations.

As mentioned above, further analyses that have been funded by the Legacy Resource Management Program (Nott et al. 2003) have been completed using data from Fort Leonard Wood. These analyses have identified and described relationships between four demographic variables (adult population size, population trends, numbers of young, and productivity) for a number of target species of Conservation Concern (BCC) and landscape-level habitat characteristics. At Fort Leonard Wood three species emerged as candidates for particular management concern: Acadian Flycatcher, Blue-winged Warbler, and Field Sparrow. Fire management practices undertaken in spring 2003 around the Miller Pond and Macedonia stations should result in increased productivity of Field Sparrow. The establishment of the two new stations should shed further light on declines of Acadian Flycatcher and Blue-winged Warbler. The goal of this work is to evaluate the efficiency of on-going management practices and to modify them in an adaptive management process, to reverse declining populations and maintain stable or increasing populations of target landbird species.

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