THE 2005 ANNUAL REPORT OF THE MONITORING AVIAN PRODUCTIVITY AND SURVIVORSHIP (MAPS) PROGRAM AT NAVAL SECURITY GROUP ACTIVITY SUGAR GROVE AND GEORGE WASHINGTON NATIONAL FOREST

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EXECUTIVE SUMMARY

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 constant-effort mist-netting and banding stations. The purpose of the MAPS program is to provide annual indices of adult population size and post-fledging productivity, as well as estimates of adult survivorship and recruitment into the adult population, for various landbird species. Broad-scale data on productivity and survivorship are not obtained from any other avian monitoring program in North America and are needed to provide crucial information upon which to initiate research and management actions to reverse the recently-documented declines in North American landbird populations. Military installations and national forests in the United States are ideal locations for this large-scale, long-term biomonitoring because they provide substantial areas of breeding habitat for Neotropical migratory landbirds that are subject to varying management practices.

A second objective of the MAPS program is to provide standardized population and demographic data for the landbirds found on federally managed public lands, such as military installations, national forests, national parks, and wildlife refuges. In this vein, it is expected that population and demographic data on the landbirds found on any given military installation will aid research and management efforts on the installation (including Integrated Natural Resource Plans), to protect and enhance its avifauna and ecological integrity while simultaneously helping it fulfill its military mission in an optimal manner.

We re-established and operated two MAPS stations at Navy Security Group Activity (NSGA) Sugar Grove in 2005: the South Fork Potomac River station in bottomland riparian/mixed forest habitat, and the Beaver Creek station in open upland forest habitat. In addition, we established two new stations in 2005 on adjacent lands of the George Washington National Fores, in the same physiographic province, in an attempt to mirror the two Sugar Grove stations. The Lick Run station was established in similar habitats as the South Fork Potomac River station and the Flesh Run station was established in similar habitats as the Beaver Creek station. At Sugar Grove, ten mist nets at each station were operated in the exact same locations at which they were established in 2001 and operated in 2002-2004. Nets remained open for six morning hours per day, on one day per 10-day period for eight consecutive 10-day periods between May 18 and August 2.

A total of 307 captures of 39 species were recorded at the four stations combined. Total adult population sizes in 2005 were highest at South Fork Potomac River (96.5 adults per 600 net-hours), followed by Lick Run (40.1), Beaver Creek (36.7), and Flesh Run (22.7). Reproductive index (number of young to adults) was highest at Lick Run (1.09) followed by South Fork Potomac River (0.53), Beaver Creek (0.36), and Flesh Run (0.33). Species of management concern (because they are locally declining and are listed by the U.S. Fish and Wildlife Service as Birds of Conservation Concern) that were caught at the four stations include Worm-eating Warbler (the most abundantly captured species), Louisiana Waterthrush, and Wood Thrush.

Cluster analysis based on species-specific numbers of adults captured per 600 net hours tested the

validity of our station pairings (by community comparison) between Sugar Grove and George Washington National Forest. The analysis revealed that the Flesh Run and Beaver Creek stations were the most similar pair among the four stations and that the Lick Run station was more similar to the first pair than to the South Fork Potomac River station. Thus, we succeeded in duplicating the Beaver Creek station but were unsuccessful in duplicating the South Fork Potomac River station, primarily due to differences between this station and Lick Run in captures of adult Gray Catbirds and Black-capped Chickadees. The underlying cause for these results is that both George Washington stations along with the Beaver Creek station at Sugar Grove are found in relatively pristine forested habitat whereas the South Fork Potomac River station is adjacent to managed areas (e.g., lawns) that includes a lot more habitat edge, which seems to carry more importance to landbird numbers than physiographic strata (flood plain vs. ridge) or understory thickness. Interestingly, however, productivity at South Fork Potomac River is comparable to that of the other three stations combined. In future analyses, we will thus treat Lick Run and Flesh Run as each being mimics of Beaver Creek, and to treat South Fork Potomac River as divergent based on the increased landscaping creating edge habitats around this station.

The population trend at Sugar Grove for all species pooled was substantially but not significantly negative between 2001 and 2005, showing an annual decline of 7.8%. The increase between 2004 and 2005 helped to offset the significant decrease (of 12% per year) observed after four years (2001-2004) of data were analyzed. However, declines continued to be noted for eight of the nine species, with those of Carolina Wren and Indigo Bunting being substantial, and that of Song Sparrow being both substantial and highly significant. By contrast, the trend for Ovenbird was substantially but non-significantly positive. Trends in productivity for all species pooled increased slightly and non-significantly between 2001 and 2005.

At Sugar Grove, breeding landbird populations increased whereas productivity decreased between 2004 and 2005, offsetting the opposite changes in these parameters that occurred between 2003 and 2004. This type of alternating, two-year cycle is often observed at other MAPS locations and may be driven by density dynamics. Increased productivity one year (as was observed in 2004 at Sugar Grove) causes increased recruitment and thus increased population sizes the next year. This, in turn, results in increased competition and a higher proportion of inexperienced breeders, which causes decreased productivity that year and decreased population sizes the following year. Importantly, a population may still show overall declines or increases which underlie these cycles, and so far the overall pattern at Sugar Grove appears to be one of declining landbird populations.

During 2001-2005, productivity at Sugar Grove was substantially higher than that for the Northeast Region of the MAPS program for Carolina Wren, substantially lower at Sugar Grove for Song Sparrow, and similar for Indigo Bunting. Adult survival estimates compared favorably at Sugar Grove for Song Sparrow and Indigo Bunting. These results indicate that low productivity rather than low survival is contributing to declines in these species. We were unable to calculate adult survival for Carolina Wren but capture probability was estimated at 1.0, generally indicating low survival or dispersal. Because Carolina Wren is a resident species, such problems in survival would likely be occurring on or in the vicinity of Sugar Grove.

Thus, overall, it appears that productivity at Sugar Grove may be driving or influencing the population dynamics of two of the three species that showed declining trends, and that survival of one resident species at Sugar Grove could be driving or influencing declining trends in a third species. This indicates that the population dynamics of Sugar Grove's breeding species are being affected by anthropogenic factors at Sugar Grove, and local declines could be reversed through appropriate management action.

Despite the fact that the NSGA Sugar Grove MAPS stations have been operated for only five years, we have documented a significant decline in landbird populations (all species pooled), and have suggested preliminary causes for the substantial declines in three individual species. As more years of data accumulate we will be able to make inferences about the effects of weather on productivity and the effects of productivity and survivorship on population dynamics. Pooling data at this level will also allow comparison between NSGA Sugar Grove and George Washington National Forest as well as other protected and unprotected areas at which MAPS stations are operated in the Appalachian region.

The long-term goal for the NSGA Sugar Grove and George Washington MAPS program is to provide critical information to clarify the ecological processes leading from environmental stressors to landbird population responses. We will accomplish this by including NSGA Sugar Grove and George Washington National Forest data in analyses of data from other central Appalachian MAPS stations to: (a) determine spatial patterns in productivity indices and survival rate estimates as a function of spatial patterns in population trends for target species; (b) determine the proximate demographic factors causing observed population trends; (c) identify relationships between landscape-level habitat and/or weather characteristics and the primary demographic responses (productivity and survival rates) of target species; (d) generate hypotheses regarding the ultimate environmental causes of the population trends; and (e) make comprehensive recommendations for habitat and use-related management goals both at local scale of the installation and the larger scale of the central Appalachians. We have recently obtained funding from the state of Virginia to begin this work, and continued operation of Sugar Grove stations will be critical in understanding bird dynamics throughout the entire Appalachians.

In addition, MAPS data from NSGA Sugar Grove and George Washington National Forest will provide an important contribution to the determination of accurate indices of adult population size and productivity and precise estimates of adult survival rates on the still larger region-wide scale (e.g., northeastern North American) for a substantial number of landbird species. We conclude that the MAPS protocol is well-suited to provide an integral component of NSGA Sugar Grove's long-term ecological monitoring effort, and we recommend the continued operation of the NSGA Sugar Grove and George Washington National Forest MAPS stations well into the future.

INTRODUCTION

The United States Department of Defense (DoD), including the Department of the Navy, has assumed responsibility for managing natural resources on lands under their jurisdiction in a manner that, as much as possible considering their military mission, maintains the ecological integrity and species diversity of the ecosystems present on those lands. In order to carry out this responsibility, integrated long-term programs are needed to monitor both the natural resources on military installations and the effects of varying management practices on those resources.

The development and implementation of an effective long-term monitoring program on military installations can be of even wider importance than aiding the Department of Defense in its management of those resources. Because military lands often provide large areas of multiple and often relatively pristine ecosystems subject to varying management practices, studies conducted on these lands provide invaluable information for understanding natural ecological processes and for evaluating the effects of large-scale, even global, environmental changes. Thus, long-term monitoring data from military installations can provide information that is crucial for efforts to preserve natural resources and biodiversity on a continental or even global scale.

Landbirds

Landbirds, because of their high body temperature, rapid metabolism, and high ecological position on most food webs, are excellent indicators of the effects of local, regional, and global environmental change in terrestrial ecosystems. Furthermore, their abundance and diversity in virtually all terrestrial habitats, diurnal nature, discrete reproductive seasonality, and intermediate longevity facilitate the monitoring of their population and demographic parameters. It is not surprising, therefore, that landbirds have been selected by the DoD to receive high priority for monitoring. Nor is it surprising that several large-scale monitoring programs that provide annual population estimates and long-term population trends for landbirds are already in place on this continent. These include the North American Breeding Bird Survey (BBS), the Breeding Bird Census, the Winter Bird Population Study, and the Christmas Bird Count.

Recent analyses of data from several of these programs, particularly the BBS, suggest that populations of many landbirds, including forest-, scrubland-, and grassland-inhabiting species, are in serious decline (Peterjohn et al. 1995). Indeed, populations of most landbird species appear to be declining on a global basis. Nearctic-Neotropical migratory landbirds (species that breed in North America and winter in Central and South America and the West Indies; hereafter, Neotropical migratory birds) constitute one group for which pronounced population declines have been documented (Robbins et al. 1989, Terborgh 1989). In response to these declines, the Neotropical Migratory Bird Conservation Program, "Partners in Flight - Aves de las Americas," was initiated in 1991 (Finch and Stangel 1993). The major goal of Partners in Flight (PIF) is to reverse the declines in Neotropical migratory birds through a coordinated program of monitoring, research, management, education, and international cooperation. As one of the major cooperating agencies in PIF, the DoD has established long-term avian monitoring efforts at military installations using protocols developed by the Monitoring Working Group of PIF. Clearly, the long-term monitoring goals of the DoD and the monitoring and research goals of PIF share many common elements.

Primary Demographic Parameters

Existing population-trend data on Neotropical migrants, while suggesting severe and sometimes accelerating declines, provide no information on primary demographic parameters (productivity and survivorship) of these birds. Thus, population-trend data alone provide no means for determining at what point(s) in the life cycles problems are occurring, or to what extent the observed population trends are being driven by causal factors that affect birth rates, death rates, or both (DeSante 1995). In particular, large-scale North American avian monitoring programs that provide only population-trend data have been unable to determine to what extent forest fragmentation and deforestation on the temperate breeding grounds, versus that on the tropical wintering grounds, are causes for declining populations of Neotropical migrants. Without critical data on productivity and survivorship, it will be extremely difficult to identify effective management and conservation actions to reverse current population declines (DeSante 1992).

The ability to monitor primary demographic parameters of target species must also be an important component of any successful long-term inventory and monitoring program that aims to monitor the ecological processes leading from environmental stressors to population responses (DeSante and Rosenberg 1998). This is because environmental factors and management actions affect primary demographic parameters directly and these effects can be observed over a short time period (Temple and Wiens 1989). Because of the buffering effects of floater individuals and density-dependent responses of populations, there may be substantial timelags between changes in primary parameters and resulting changes in population size or density as measured by census or survey methods (DeSante and George 1994). Thus, a population could be in trouble long before this becomes evident from survey data. Moreover, because of the vagility of many animal species, especially birds, local variations in secondary parameters (e.g., population size or density) may be masked by recruitment from a wider region (George et al. 1992) or accentuated by lack of recruitment from a wider area (DeSante 1990). A successful monitoring program should be able to account for these factors.

MAPS

In 1989, The Institute for Bird Populations (IBP) established the Monitoring Avian Productivity and Survivorship (MAPS) program, a cooperative effort among public agencies, private organizations, and individual bird banders in North America to operate a continent-wide network of constant-effort mist-netting and banding stations to provide long-term demographic data on landbirds (DeSante et al. 1995). The design of the MAPS program was patterned after the very successful British Constant Effort Sites (CES) Scheme that has been operated by the British Trust for Ornithology since 1981 (Peach et al. 1996). The MAPS program was endorsed in 1991 by both the Monitoring Working Group of PIF and the USDI Bird Banding Laboratory, and a four-year pilot project (1992-1995) was approved by the USDI Fish and Wildlife Service and National Biological Service (now the Biological Resources Division [BRD] of the U.S. Geological Survey [USGS]) to evaluate its utility and effectiveness for monitoring demographic parameters of landbirds.

Now in its 17th year (14th year of standardized protocol and extensive distribution of stations), the MAPS program has expanded greatly from 178 stations in 1992 to nearly 500 stations in 2005. The substantial growth of the Program since 1992 was caused by its endorsement by PIF and the subsequent involvement of various federal agencies in PIF, including the Department of Defense, Department of the Navy, Department of the Army, Texas Army National Guard, National Park Service, USDA Forest Service, and US Fish and Wildlife Service. Within the past ten years, for example, IBP has been contracted to operate as many as 159 MAPS stations per year on federal properties, including 78 stations on military installations administered by the DoD and the Texas Army National Guard.

Goals and Objectives of MAPS

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.

The overall objectives of MAPS are to achieve the above-outlined goals by means of long-term monitoring at two major spatial scales. The first is a very large scale — effectively the entire North American continent divided into eight geographical regions. It is envisioned that DoD military installations, along with national parks, national forests, and other publicly owned lands, will provide a major subset of sites for this large-scale objective.

The second, smaller-scale but still long-term objective is to fulfill the above-outlined goals for specific geographical areas (perhaps based on physiographic strata or Bird Conservation Regions) or specific locations (such as individual military installations, national forests, or national parks) to aid research and management efforts within the installations (including contributing to Integrated Natural Resource Management Plans), forests, or parks to protect and enhance their avifauna and ecological integrity. The sampling strategy utilized at these smaller scales should be hypothesis-driven and should be integrated with other research and monitoring efforts. DeSante et al. (1999) showed that measures of productivity and survival derived from MAPS data were consistent with observed populations changes at these smaller spatial scales. This provides considerable assurance that the goals and objectives outlined above can be achieved.

All of these monitoring, research, and management goals are in agreement with the Department of Defense (DoD) Partners-in-Flight (PIF) 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 established on Naval Security Group Activity (NSGA) Sugar Grove in 2001 and expanded to include the George Washington National Forest in 2005. It is expected that information from the MAPS program will be capable of aiding research and management efforts on NSGA Sugar Grove and George Washington National Forest to protect and enhance the installation's avifauna and ecological integrity, while helping it fulfill its military mission in an optimal manner.

Recent Important Results from MAPS

Recent important results from MAPS reported in the peer-reviewed literature include the following. (1) Age ratios obtained during late summer, population-wide mist netting provided a good index to actual productivity in the Kirtland's Warbler (Bart et al. 1999). (2) Measures of productivity and survival derived from MAPS data were consistent with observed population changes at multiple spatial scales (DeSante et al. 1999). (3) Patterns of productivity from MAPS at two large spatial scales (eastern North America and the Sierra Nevada) not only agreed with those found by direct nest monitoring and those predicted from theoretical considerations, but were in general agreement with current life-history theory and were robust with respect to both time and space (DeSante 2000). (4) Modeling spatial variation in MAPS productivity indices and survival-rate estimates as a function of spatial variation in population trends provides a successful means for identifying the proximate demographic cause(s) of population change at multiple spatial scales (DeSante et al. 2001). (5) Productivity of landbirds breeding in Pacific Northwest national forests is affected by global climate cycles including the El Niño Southern Oscillation and the North Atlantic Oscillation, in such a manner that productivity of Neotropical migratory species is determined more by late winter and early spring weather conditions on their wintering grounds than by late spring and summer weather conditions on their breeding grounds (Nott et al. 2002). (6) Analyses describing relationships between four demographic parameters (adult population size, population trend, number of young, and productivity) and landscape-level habitat characteristics for bird species of conservation concern have been completed for 13 military installations in south-central and southeastern United States, allowing conservation management strategies to be formulated and tested (Nott et al. 2003b). These results indicate that MAPS is capable of achieving, and in some cases is already achieving, its objectives and goals.

SPECIFICS OF THE NSGA SUGAR GROVE AND GEORGE WASHINGTON NATIONAL FOREST MAPS PROGRAM

Two MAPS stations were re-established and operated on NSGA Sugar Grove in 2005, at the same locations at which they were originally established in 2001. The two stations were located as follows: (1) the South Fork Potomac River station on the main base in a riparian corridor of mixed forest bordering the southern branch of the Potomac River southern fork; and (2) the Beaver Creek station bordering the George Washington National Forest in open mixed forest on a steep slope. In order to better assess landbird population dynamics at Sugar Grove, two additional stations were established in 2005 on the adjacent George Washington National Forest. The two stations were located as follows: (3) the Lick Run station in mixed deciduous and Virginia pine forest with adequate understory in a riparian valley, and (4) the Flesh Run station in open, mixed pine and maple forest on the side of a ridge. These stations were established in an attempt to mirror the two Sugar Grove stations, the Lick Run station was established in similar habitats as the South Fork Potomac River station and the Flesh Run station was established in similar habitats as the Beaver Creek station. A summary of the major habitats represented at each of the four stations is presented in Table 1 along with a summary of the 2005 operation of each station.

All ten net sites at each Sugar Grove station were established without difficulty at the exact same locations where they were operated in 2001-2004, and ten permanent net sites were established in 2005 at each of the George Washington stations. Each station was operated for six morning hours per day (beginning at local sunrise) on one day in each of eight consecutive 10-day periods between May 18 and August 2 (Table 1). The operation of all stations occurred on schedule during each of the eight 10-day periods.

METHODS

The operation of each of the four stations during 2005 followed MAPS protocol, as established for use by the MAPS Program throughout North America and spelled out in the MAPS Manual (DeSante et al. 2005a). The stations were re-established (Sugar Grove), established (George Washington), and operated by IBP Interns Matt Schapp and Anna Jackson, who had been extensively trained by IBP biologists Nichol Michel and Jennifer McNicoll. An overview of both the field and analytical techniques is presented here.

Data Collection

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 (DeSante et al. 2005a):

(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) presence of molt limits and plumage characteristics;
(12) wing chord;
(13) fat class and body mass;
(14) date and time of capture (net-run time);
(15) station and net site where captured; and
(16) any pertinent notes.

Effort data, i.e., the number and timing of net-hours on each day (period) 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.

For each of the four stations operated, simple habitat maps were prepared on which up to four major habitat types, as well as the locations of all structures, roads, trails, and streams, were identified and delineated. The pattern and extent of cover of each major habitat type identified at each station, as well as 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 spelled out in the MAPS Habitat Structure Assessment (HSA) Protocol, developed by IBP Landscape Ecologist, Philip Nott, and the IBP staff (Nott et al. 2003b).

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, breeding status, and vegetation data was completed by IBP biologists using specially designed data entry programs. 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), extent of juvenal plumage, extent of body and flight-feather molt, extent of primary-feather wear, and presence of molt limits and plumage characteristics;
(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, body mass, 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.

Data Analysis
To facilitate analyses, we first classified the landbird species captured in mist nets into five 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; and a migrant (M) if the station was not located within the overall breeding range of the species. Data from a station for a species classified as a migrant 'M' at the station were not included in any analyses, except those used to produce Table 2.

<u>A. Population-Size and Productivity Analyses</u> — The proofed, verified, and corrected banding data from 2005 were run through a series of analysis programs that calculated for each species and for all species combined at each station and for all stations pooled:

(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 2005) of individual adult and young birds; and
(3) the reproductive index.

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. As our index of post-fledging productivity we are now using "reproductive index" (number of young divided by number of adults) as opposed to "proportion of young in the catch" previously used. Reproductive index is a more intuitive value for productivity, and it is also more comparable to other calculated MAPS parameters such as recruitment indices.

For the two Sugar Grove stations we calculated percent changes between 2004 and 2005 in the numbers of adult and young birds captured, and actual changes in the reproductive index. These between-year comparisons were made in a "constant-effort" manner by means of a specially designed analysis program that used actual net-run (capture) times and net-opening and -closing times on a net-by-net and period-by-period basis to exclude captures that occurred in a given net in a given period in one year during the time when that net was not operated in that period in the other year. We determined the statistical significance of between-year changes according to methods developed by the BTO in their CES scheme (Peach et al. 1996). Thus, for species captured at both stations at NSGA Sugar Grove, we statistically inferred the significance of installation-wide annual changes in the indices of adult population size and post-fledging productivity by using confidence intervals derived from the standard errors of the mean percentage changes. Because of the sample size of only two stations, between-year changes for any given species at NSGA Sugar Grove are unlikely to reach statistical significance unless the changes at the two stations are substantial and very nearly the same. With the addition of the two George Washington stations, we will be able to observe more statistically significant changes when comparing 2005 and 2006 data. The statistical significance of the overall change at a given station was inferred from a one-sided binomial test on the proportion of species at that station that increased (or decreased). Throughout this report, we use an alpha level of 0.05 for statistical significance, and we use the term "near-significant" or "nearly significant" for differences in which $0.05 \leq P < 0.10$.

For each of the two Sugar Grove stations, operated for the four years, 2001-2005, and for both stations combined, we calculated five-year means for the numbers of adult and young birds captured per 600 net hours and the reproductive index for each individual species and for all species pooled. While these mean numbers provide an indication of the relative adult population size and productivity of the various species at each station and at all stations pooled, they don't provide sufficient information by themselves for statistical inference of the differences in adult population size or reproductive index among years or between stations. In order to make such inferences, we conducted multivariate analyses of variance (of numbers of adults captured) and logistic regression analyses (of productivity index, or the probability that a captured bird is young).

<u>B. Cluster Analysis to compare stations</u> — In order to test the validity of our station pairings (for community comparisons) at George Washington National Forest and Sugar Grove, we performed cluster analysis (Ward' Method) based on species-specific numbers of adults captured per 600 net-hours. Cluster analysis provides a tree indicating degree of similarity between stations, in the same manner that phylogenetic relationships are determined. We use cluster analysis to test our ability to have selected adequate stations at George Washington National Forest to mimic those already established at Sugar Grove. We report the similarity index between stations in terms of a similarity distance value.

C. Analyses of trends in adult population size and productivity — We examined five-year (2001-2005) trends in indices of adult population size and productivity at the two Sugar Grove stations, for each target species for which we recorded an average of 2.5 or more individual adults per year were recorded at the two stations combined, at stations at which the species was a regular (B) or usual (U) breeder. For trends in adult population size, we first calculated adult population indices for each species in each of the five years based on an arbitrary starting index of 1.0 in 2001. Constant-effort changes (as defined above) were used to calculate these "chain" indices in each subsequent year by multiplying the proportional change between the two years times the index of the previous year and adding that figure to the index of the previous year, or simply:

$$PSI_{i+1} = PSI_i + PSI_i * (d_i/100)$$

where PSI_i is the population size index for year I and d_i is the percentage change in constant-effort numbers from year i to year i+1. A regression analysis was then run to determine the slope of these indices over the four years (*PT*). Because the indices for adult population size were based on percentage changes, we further calculated the annual percent change (*APC*), defined as the average change per year over the five-year period, to provide an estimate of the population trend for the species; *APC* was calculated as:

(actual 2001 value of *PSI* / predicted 2001 value of *PSI* based on the regression) * *PT*.

We present *APC*, the standard error of the slope (*SE*), the correlation coefficient (*r*), and the significance of the correlation (*P*) to describe each trend. Again, we use an alpha level of 0.05 for statistical significance and we use the terms "nearly significant" or "near-significant" for trends for which $0.05 \leq P < 0.10$. Species for which $r > 0.5$ are considered to have a substantially increasing trend; those for which $r < -0.5$ are considered to have a substantially decreasing trend; those for which $-0.5 \leq r \leq 0.5$ and $SE \leq 0.140$ (for five-year trends) are considered to have a stable trend; and those for which $-0.5 \leq r \leq 0.5$ and $SE > 0.140$ (for five-year trends) are considered to have widely fluctuating values but no substantial trend.

Trends in productivity, *PrT*, were calculated in an analogous manner by starting with actual reproductive index values in 2001 and calculating each successive year's value based on the constant-effort changes in productivity between each pair of consecutive years. For trends in productivity, the slope (*PrT*) and its standard error (*SE*) are presented, along with the correlation coefficient (*r*), and the significance of the correlation (*P*). Productivity trends are characterized in a manner analogous to that for population trends, except that productivity trends are considered to be highly fluctuating if the *SE* of the slope > 0.080 (for five-year productivity trends).

D. Survivorship analyses —Survival was estimated for 4 target species using modified Cormack-Jolly-Seber (CJS) mark-recapture analyses (Pollock et al.1990, Lebreton et al.1992) on five years (2001-2005) of capture histories of adult birds from both Sugar Grove stations combined. Target species were those for which, on average, at least 2.5 individual adults per year and at least two between-year returns were recorded from data pooled from the stations at which the species was a breeder during more than half of the years that the station was operated. Using the computer program TMSURVIV (White 1983, Hines et al. 2003), we calculated, for each target species, maximum- likelihood estimates and standard errors (*SE*s) for adult survival probability (φ), adult recapture probability (p), and the proportion of residents among newly captured adults (τ) using a time-constant, between- and within-year transient model (Pradel et al. 1997, Nott and DeSante 2002, Hines et al. 2003). The use of the transient model (φpτ) 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.

Because we had only five years of data, we used a time-constant transient model for estimating survival and recapture probabilities and the proportion of residents among newly captured adults. We did not consider models that included time-dependence, as five years of data are generally insufficient to provide time-dependent estimates with any reasonable precision. We limited our consideration to models that produced estimates for both survival and recapture probability that were neither 0 nor 1, and to models that fit the data. The goodness of fit of the models was tested by using a Pearson's goodness-of-fit test.

RESULTS

A total of 1893.0 net-hours was accumulated at the four MAPS stations operated at NSGA Sugar Grove and George Washington National Forest in 2005 (Table 1). Data from 863.5 of these net-hours could be compared directly to 2004 data (from Sugar Grove only) in a constant-effort manner.

Indices of Adult Population Size and Post-fledging Productivity

A. 2005 values. The 2005 capture summary of the numbers of newly-banded, unbanded, and recaptured birds is presented in Table 2 for each species and all species pooled, at each of the four stations and at all four stations combined. A total of 307 captures of 39 species was recorded at the four stations combined. The greatest number of captures (142) were recorded at the South Fork Potomac River station and the least number of captures (31) was recorded at the Flesh Run station. Species richness was greatest at South Fork Potomac River (26 species) and was lowest at Beaver Creek and Flesh Run (16 species each). Overall, the most abundantly captured species at the four stations were Worm-eating Warbler, followed by Ovenbird, Indigo Bunting, Carolina Wren, Gray Catbird, Northern Cardinal, and Black-capped Chickadee (Table 2). Species of management concern (Nott et al. 2003) because they are locally declining and are listed by the U.S. Fish and Wildlife Service as Birds of Conservation Concern, that were caught at the four stations include Worm-eating Warbler (the most abundantly captured species), Louisiana Waterthrush, and Wood Thrush.

In order to standardize the number of captures with respect to variation in mist-netting effort (due to unsuitable weather conditions and accidental net damage; see Table 1), we present capture rates (per 600 net-hours) of individual adult and young birds, as well as reproductive index, for each species and for all species pooled, at each station and for all stations combined, in Table 3. These capture indices suggest that the total adult population size in 2005 was highest at South Fork Potomac River (96.5 adults per 600 net-hours), followed by Lick Run (40.1), Beaver Creek (36.7), and Flesh Run (22.7). Captures of young of all species pooled followed the same order, being highest at South Fork Potomac River in 2005 (51.4) and lowest at Flesh Run (7.6). Reproductive index (number of young to adults) was highest by far at Lick Run (1.09) followed by South Fork Potomac River (0.53), Beaver Creek (0.36), and Flesh Run (0.33). Overall, the highest breeding populations at the two stations, based on adults captured per 600 net-hours, were Ovenbird, Indigo Bunting, Worm-eating Warbler, Gray Catbird, Tufted Titmouse, Red-eyed Vireo, Black-capped Chickadee, and Northern Cardinal (Table 3). The following is a list of the common breeding species (captured at a rate of at least 3.0 adults per 600 net-hours), in decreasing order, at each station in 2005 (species of concern in italics):

South Fork Potomac River
Gray Catbird
Worm-eating Warbler
Ovenbird
Carolina Wren
American Goldfinch
Common Yellowthroat
Northern Cardinal
Tufted Titmouse
Black-and-white Warbler
Song Sparrow

Beaver Creek
Ovenbird
Worm-eating Warbler
Indigo Bunting

Lick Run
Indigo Bunting
Red-eyed Vireo
Black-capped Chickadee
Worm-eating Warbler
Louisiana Waterthrush

Flesh Run
Indigo Bunting
Ovenbird

B. Comparisons between 2004 and 2005. Constant-effort comparisons between 2004 and 2005 were undertaken at both NSGA Sugar Grove stations for numbers of adult birds captured (index of adult population size; Table 4), numbers of young birds captured (Table 5), and number of young per adult (reproductive index; Table 6).

Adult population size for all species pooled at both stations combined increased substantially but non-significantly, by +47.0% between 2004 and 2005 (Table 4). Increases between 2004 and 2005 were recorded for 17 of 31 species, a proportion not significantly greater than 0.50. The number of adults captured of all species pooled increased at both South Fork Potomac River (by +37.0%) and Beaver Creek (by +91.7%). The proportion of increasing or decreasing species was not significantly greater than 0.50 at either station. Three species (Eastern Phoebe, Worm-eating Warbler, and Ovenbird) showed increases at both stations whereas no species showed decreases at both stations.

The number of young birds captured, of all species pooled and for both stations combined, decreased by -37.5%, a non-significant change (Table 5). Decreases between 2004 and 2005 were recorded for 13 of 20 species, a proportion not significantly greater than 0.50. Young captured for all species pooled decreased at both South Fork Potomac River (by -34.9%) and at Beaver Creek (by -47.1%). The proportion of increasing or decreasing species was not significantly greater than 0.50 at either station. Among individual species, Black-and-white Warbler, Worm-eating Warbler, and Ovenbird showed a consistent decrease in the number of young at both stations whereas Carolina Wren showed a consistent increase.

Reproductive index (the number of young per adult) showed a substantial and near-significant absolute decrease of -0.697, from 1.212 in 2004 to 0.516 in 2005 for all species pooled and both stations combined (Table 6). Decreases in productivity were recorded for 7 of 15 species. Reproductive index decreased at both South Fork Potomac River (by -0.613) and at Beaver

Creek (by -1.025). The proportion of decreasing species was not significantly greater than 0.50 at either station. Worm-eating Warbler and Ovenbird showed consistent decreases in productivity at both stations whereas no species showed consistent increases.

Thus, breeding populations showed consistent increases at both stations whereas young captured and productivity decreased substantially and near-significantly at both stations between 2004 and 2005.

C. Similarity between Sugar Grove and George Washington National Forest stations. We established two stations in the George Washington National Forest in 2005 on the basis of our perceived similarity in habitat and physiographic strata to the two Sugar Grove stations: the Lick Run station was established to mimic the South Fork Potomac River station (mixed riparian forest with adequate understory in a flood plain or valley), and the Flesh Run station was established to mimic the Beaver Creek station (open-understory, upland forest on a steep slope or ridge). Cluster analysis (Ward's Method), based on species-specific numbers of adults captured per 600 net hours, revealed that the Flesh Run and Beaver Creek stations were the most similar pair among the four stations, with a similarity distance value of 1.7. Branching off this cluster was the Lick Run station, with a similarity distance value of 2.7 from Flesh Run and Beaver Creek. The least similar station was South Fork Potomac River, which had a distance value of 3.7 from the other three stations. Thus, we succeeded in finding a good mimic station for Beaver Creek but were unable to find a good match for South Fork Potomac River. Closer examination of the numbers indicates that differences in captures of adult Gray Catbirds (17.5/600 hours at South Fork Potomac River, none at Lick Run) and Black-capped Chickadees (3.8 at Lick Run, none at South Fork Potomac River) were the biggest factors driving the dissimilarity between these two stations.

D. Five-year mean population size and productivity values. Mean numbers of individual adults (an index of adult population size) and young captured per 600 net-hours, and reproductive index (a measure of productivity), averaged over the five-year period 2001-2005, are presented in Table 7, for each Sugar Grove station and for both stations combined. Examination of values for all species pooled confirms that the large disparity in capture rates of adults and young between South Fork Potomac River (99.5 and 85.3 individuals per 600 net-hours, respectively) and Beaver Creek (22.3 and 19.3 per 600 net-hours) has been fairly consistent over the five-year period, although the disparity decreased slightly after the addition of 2005 data. Productivity (number of young per adult), however, has been higher at Beaver Creek (1.12) than at South Fork Potomac River (0.88). Examination of individual species indicates that the species composition between the two stations also differs substantially, nine of 18 species with adults recorded at Beaver Creek showing higher values than at South Fork Potomac River, despite the much lower capture rates overall at Beaver Creek. For both stations combined and all four years pooled, the highest breeding populations were recorded for Worm-eating Warbler, followed by Gray Catbird, Indigo Bunting, Ovenbird, Song Sparrow (despite very few captured in 2005), Carolina Wren, and Northern Cardinal (Table 7).

E. Five-year trends in adult population size and productivity. "Chain" indices of adult population size, at the two Sugar Grove stations combined, are presented in Figure 1 for nine of ten target species and for all species pooled. Trends could not be calculated for Black-capped Chickadee, for which no adults were captured in 2003, precluding analysis. See Methods for an explanation of the calculations used to obtain these indices. We used the slope of the regression line for each species to calculate the Annual Percentage Change (*APC*) for the population. *APC* along with the standard error of the slope (SE), the correlation coefficient *(r*), and the significance of the correlation (*P*) for each target species and for all species pooled are included in Figure 1.

The population trend for all species pooled was substantially (absolute $r > 0.5$) but not significantly ($P = 0.124$) negative between 2001 and 2005 (Fig. 1), showing an annual decline of 7.8%. The increase between 2004 and 2005 helped to negate the significant decrease (of 12% per year) observed after four years (2001-2004) of data were analyzed. However, declines were also noted for 8 of the 9 species, with those of Carolina Wren and Indigo Bunting being substantial, and that of Song Sparrow being both substantial and highly significant. By contrast, the trend for Ovenbird was substantially (but non-significantly) positive. The productivity trend for Tufted Titmouse showed wide inter-annual fluctuation (absolute $r < 0.5$ and *SE* of the slope > 0.140), and those of White-eyed Vireo, Gray Catbird, Worm-eating Warbler, and Northern Cardinal were stable (absolute $r < 0.5$ and *SE* of the slope < 0.140).

Trends in productivity for all species pooled increased slightly and non-significantly between 2001 and 2005 (Fig. 2). Substantial increases in productivity were recorded for Carolina Wren and Song Sparrow, with the increase in Carolina Wren being nearly significant. The productivity trend for White-eyed Vireo was substantially negative. Non-substantial but widely fluctuating (*SE* of the slope > 0.080) trends were recorded for Tufted Titmouse, Worm-eating Warbler, Ovenbird, and Northern Cardinal, and stable trends ($r < 0.5$, SE < 0.80) were recorded for Gray Catbird and Indigo Bunting.

Estimates of Adult Survivorship

Using five years of data from the two stations, estimates of adult survival and recapture probabilities could be obtained for four (Gray Catbird, Worm-eating Warbler, Song Sparrow, and Indigo Bunting) of the nine target species breeding at NSGA Sugar Grove (Table 8). For the remaining five species we obtained estimates of 0.0 or 1.0 for survival and/or recapture probability, and the estimates were thus not realistic. Using the non-transient model, the apparent annual adult survival rate (φ) ranged from 0.396 for Song Sparrow to 0.718 for Indigo Bunting, with a mean of 0.558. Recapture probability ranged from 0.132 (Gray Catbird) to 0.269 (Song Sparrow), with a mean of 0.224. Proportion of residents ranged from 0.410 for Indigo Bunting to 1.000 for Gray Catbird, with a mean of 0.731. Although these are reasonable estimates for these species, the C.V.(φ) was high (> 30% for all four species) indicating that the precision was low.

DISCUSSION

Five years (2001-2005) of MAPS data from two stations on NSGA Sugar Grove confirm that both species richness and the abundance of adult birds at the South Fork Potomac River station, located in bottomland riparian habitat, was substantially higher than that at the Beaver Creek station, located in open upland forest habitat. A similar pattern appears to be emerging at the two new stations, with both abundance and species richness being higher at the riparian station at Lick Run than in the mixed forest at Flesh Run. We believe that riparian habitat can support larger breeding populations due to its denser more diverse canopy and richer understory than more open habitat that largely lacks an understory.

Cluster analysis (Ward's Method) revealed that the Flesh Run and Beaver Creek stations were similar but that the Lick Run station was more similar to these two stations than it was to the South Fork Potomac River station. Thus, we succeeded in duplicating the Beaver Creek station but were unsuccessful in duplicating the South Fork Potomac River station, primarily due to differences between this station and Lick Run in captures of adult Gray Catbirds and Black-capped Chickadees. The underlying cause for these results is that Beaver Creek and both George Washington stations are found in relatively pristine forested habitat whereas the South Fork Potomac River station is adjacent to managed areas (e.g., lawns) that includes a lot more habitat edge, which seems to carry more importance to landbird numbers than physiographic strata (flood plain vs. ridge) or understory thickness. Thus, essentially, an edge effect as would be found in successional habitats is the underlying cause for the higher abundance of landbirds found at South Fork Potomac River than at the other three stations. Interestingly, however, productivity at South Fork Potomac River is comparable to that of the other three stations combined. In future analyses, we will thus treat Lick Run and Flesh Run as each being mimics of Beaver Creek, and to treat South Fork Potomac River as divergent based on the increased landscaping creating edge habitats around this station.

In last year's report (Pyle et al. 2005) we used multivariate analyses to confirm between-station and interannual differences in landbird population sizes and productivity based on four years of data collected at Sugar Grove. We did not have enough data to include the George Washington stations using this approach with only one year of data, but we hope to be able to compare the two locations (after controlling for year and habitat effects) after two years of data have been collected.

Last year we found that the four-year (2001-2004) population trend for all species pooled at Sugar Grove had decreased substantially and significantly, showing a mean annual decline of 12%.This year there was an increase in adults captured, resulting in a substantial but non-significant five-year population decline of 7.8% per year. These are promising results concerning breeding populations; however, at the same time productivity showed declines at both Sugar Grove stations between 2004 and 2005, resulting in positive four-year trends for several species becoming negative. This type of alternating, two-year cycle is often observed at other MAPS locations and appears to be driven by density dynamics. Increased productivity one year (as was observed in 2004 at Sugar Grove) causes increased recruitment and thus increased population sizes the next year, which result in increased competition and a higher proportion of inexperienced breeders which, in turn, causes decreased productivity that year and decreased population sizes the following year. Should this cycle continue (e.g., not be disrupted by climactic events) we might expect to see decreased population sizes with increased productivity in 2006. Importantly, a population may still show overall declines or increases which underlie these cycles, and so far the overall pattern at Sugar Grove appears to be one of declining landbird populations.

A primary goal of the MAPS program is to determine the proximate causes (productivity or survival) accounting for declining landbird population sizes. With five years of data we can begin to assess the causes for the three species with population declines noted at Sugar Grove. To do this we compare mean vital rates for all species pooled to similar data collected during the MAPS program throughout the Northeast Region for the years 1992-2001 and available at the IBP website at http://www.birdpop.org/nbii/NBIIHome.asp.

Productivity (reproductive index) for both Sugar Grove stations and all five years combined (Table 7) was substantially higher than that for the Northeast Region of the MAPS program for Carolina Wren (1.38 *vs.* 0.46), it was substantially lower at Sugar Grove for Song Sparrow (0.59 *vs.* 1.12), and it was similar for Indigo Bunting (0.24 *vs.* 0.22). Adult survival estimates for compared favorably at Sugar Grove for Song Sparrow (0.396 vs 0.336 in the Northeast Region) and Indigo Bunting (0.718 vs. 0.465). These results indicate that low productivity rather than low survival is contributing to declines in these species. We were unable to calculate adult survival for Carolina Wren because capture probability was estimated at an unrealistic 1.0. When this happens, however, it is generally an indication of low survival and suggests that low survival (or dispersal) is the cause for Carolina Wren population declines at Sugar Grove. Because Carolina Wren is a resident species, such problems in survival would likely be occurring on or in the vicinity of Sugar Grove.

Thus, overall, it appears that productivity at Sugar Grove may be driving or influencing the population dynamics of two of the three species that showed declining trends, and that survival of one resident species at Sugar Grove could be driving or influencing declining trends in a third species. This indicates that the population dynamics of Sugar Grove's breeding species are being affected by anthropogenic factors at Sugar Grove, and local declines could be reversed through appropriate management action.

With additional years of data and, especially, the addition of data collected at stations in comparable habitats at George Washington National Forest, we hope to be able to fully understand the population dynamics at Sugar Grove and the causes for the general declines noted in populations there. As more years of data accumulate we will be able to examine additional between-year changes in these indices in order to make inferences about the effects of weather on productivity and the effect of changes in productivity on population sizes and trends. We will also be able to examine more precise annual survival-rate estimates, recapture probabilities, and proportions of residents among newly captured adults in order to make more precise inferences regarding the effect of survivorship on population dynamics. Pooling data at this level will also allow comparison between NSGA Sugar Grove and other protected and unprotected areas at which MAPS stations are operated in the region. Finally, MAPS data from NSGA Sugar Grove will be pooled with MAPS data from outside the installation to provide regional (or even continental) indices and estimates of (and longer-term trends in) these key demographic parameters.

The long-term goal for the NSGA Sugar Grove and George Washington National Forest MAPS program is to continue to monitor the primary demographic parameters of landbirds at both locations, in order to provide critical information that can be used to aid our understanding of the ecological processes leading from environmental stressors to population responses. This is to be accomplished by including data from NSGA Sugar Grove and George Washington National Forest in analyses of data from other central Appalachian MAPS stations to: (1) determine spatial patterns in productivity indices and survival rate estimates as a function of spatial patterns in populations trends for target species (DeSante 2000, DeSante et al. 1999, 2001); (2) better determine the proximate demographic factors (i.e., productivity or survivorship) causing observed population trends in the target species (DeSante et al. 2001); (3) link MAPS data with landscape-level habitat data and spatially explicit weather data in a geographical information system (GIS) (Nott 2002); (4) identify relationships between landscape-level habitat and/or weather characteristics and the primary demographic responses (productivity and survival rates) of the target species (Nott 2002; Nott et al. 2002, 2003a); (5) generate hypotheses regarding the ultimate environmental causes of the population trends; and (6) make comprehensive recommendations for habitat and use-related management strategies both on the installation and elsewhere (Nott 2000, Nott et al. 2003a). We have recently obtained funding from the state of Virginia to begin this work, and continued operation of Sugar Grove stations will be critical in understanding bird dynamics throughout the entire Appalachians.

In addition, MAPS data from NSGA Sugar Grove and George Washington National Forest will provide an important contribution to the determination of accurate indices of adult population size and productivity and precise estimates of adult survival rates on the still larger region-wide scale (e.g., northeastern North American) for a substantial number of landbird species. We conclude that the MAPS protocol is well-suited to provide an integral component of NSGA Sugar Grove's long-term ecological monitoring effort, and we recommend the continued operation of the NSGA Sugar Grove MAPS stations well into the future.

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Table 1. Summary of the 2005 MAPS program on Naval Security Group Activity (NSGA) Sugar Grove and the George Washington National Forest.

Station						2005 operation		
Name	Code	No.	Major Habitat Type	Latitude-longitude	Avg Elev. (m)	Total number of net-hours	No. of periods	Inclusive dates
NSGA Sugar Grove								
South Fork Potomac River	SFPR	15627	Gentle slope, riparian corridor, mixed forest, hayfield edge	38°34'44"N, -79°16'13"W	536	478.7 (457.5)	8	5/18 - 7/30
Beaver Creek	BECR	15628	Steep slope, open mixed forest, grassland edge; no understory	38°30'40"N, -79°16'26"W	658	458.3 (406.0)	8	5/25 - 8/02
George Washington National Forest								
Lick Run	LIRU	15665	Mixed deciduous woodland in riparian valley, Virginia pine forest	38°30'23"N, -79°16'59"W	625	479.3 (n/a)	8	05/30 - 8/01
Flesh Run	FLRU	15666	Virginia pine forest on steep ridgeside, open maple woodland	38°27'18"N, -79°17'36"W	718	476.7 (n/a)	8	5/31 - 7/31
ALL STATIONS COMBINED						1893.0 (863.5)	8	5/18 - 8/02

[1] Total net-hours in 2005. Net-hours in 2005 that could be compared in a constant-effort manner to 2004 are shown in parentheses. The Lick Run and Flesh Run stations began operations in 2005 and therefore do not have any comparable net hours to 2004.

Table 2. Capture summary for the four individual MAPS stations, and all stations pooled, operated on Naval Security Group Activity Sugar Grove and the George Washington National Forest in 2005. N = Newly Banded, U = Unbanded, R = Recaptures of banded birds.

	South Fork Potomac River			Beaver Creek			Lick Run			Flesh Run			All four stations combined		
Species	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
American Woodcock											1			1	
Yellow-billed Cuckoo										1			1		
Ruby-throated Hummingbird		1			2			3			2			8	
Downy Woodpecker				1			3						4		
Hairy Woodpecker				1			3		1	3			7		1
Northern Flicker	1												1		
Pileated Woodpecker					1									1	
Eastern Phoebe	2			2			2						6		
Great Crested Flycatcher							1						1		
Eastern Kingbird	1												1		
White-eyed Vireo	1												1		
Blue-headed Vireo				3			2						5		
Red-eyed Vireo	2						4			1			7		
Blue Jay				2									2		
Black-capped Chickadee	2			2			9			2			15		
Tufted Titmouse	2		1	1			1						4		1
Carolina Wren	13		6	3		1	5	1	1	1			22	1	8
Wood Thrush	1												1		
American Robin	2												2		
Gray Catbird	18		1										18		1
Brown Thrasher	1												1		
Cedar Waxwing	1									1			2		
Northern Parula							1						1		
Chestnut-sided Warbler	1												1		
Black-throated Blue Warbler	1												1		

Table 2. (cont.) Capture summary for the four individual MAPS stations, and all stations pooled, operated on Naval Security Group Activity Sugar Grove and the George Washington National Forest in 2005. N = Newly Banded, U = Unbanded, R = Recaptures of banded birds.

	South Fork Potomac River			Beaver Creek			Lick Run			Flesh Run			All four stations combined		
Species	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Black-throated Green Warbler										1			1		
Black-and-white Warbler	1		2				2			1			4		2
Worm-eating Warbler	20		13	4		3	6		1				30		17
Ovenbird	11		1	7		7	6		2	3		3	27		13
Northern Waterthrush	3		1	1									4		1
Louisiana Waterthrush	3			2		1	8		3	2			15		4
Common Yellowthroat	4												4		
Hooded Warbler							1						1		
Scarlet Tanager	1			2									3		
Chipping Sparrow										1			1		
Song Sparrow	4		2										4		2
Northern Cardinal	3		7				2		3	1			6		10
Indigo Bunting	5		3	3		1	10	2	1	5		1	23	2	6
American Goldfinch										1			1		
ALL SPECIES POOLED	104	1	37	34	3	13	66	6	12	24	3	4	228	13	66
Total Number of Captures		142			50			84			31			307	
Number of Species	25	1	10	14	2	5	17	3	7	14	2	2	36	5	12
Total Number of Species		26			16			18			16			39	

Table 3. Numbers of adult and young individual birds captured per 600 net-hours and reproductive index (young/adult) at the four individual MAPS stations, and all stations pooled, operated on Naval Security Group Activity Sugar Grove and the George Washington National Forest in 2005.

	South Fork Potomac River			Beaver Creek			Lick Run			Flesh Run			All four stations combined		
Species	Ad.	Yg.	Repr. index	Ad.	Yg.	Repr. index	Ad.	Yg.	Repr. index	Ad.	Yg.	Repr. index	Ad.	Yg.	Repr. index
Yellow-billed Cuckoo										1.3	0.0	0.00	0.3	0.0	0.00
Downy Woodpecker				0.0	1.3	und.[1]	0.0	3.8	und.[1]				0.0	1.3	und.[1]
Hairy Woodpecker				1.3	0.0	0.00	1.3	2.5	2.00	0.0	3.8	und.[1]	0.6	1.6	2.50
Northern Flicker	1.3	0.0	0.00										0.3	0.0	0.00
Eastern Phoebe	2.5	0.0	0.00	2.6	0.0	0.00	0.0	2.5	und.				1.3	0.6	0.50
Great Crested Flycatcher							1.3	0.0	0.00				0.3	0.0	0.00
Eastern Kingbird	1.3	0.0	0.00										0.3	0.0	0.00
White-eyed Vireo	1.3	0.0	0.00										0.3	0.0	0.00
Blue-headed Vireo				1.3	2.6	2.00	0.0	2.5	und.				0.3	1.3	4.00
Red-eyed Vireo	2.5	0.0	0.00				5.0	0.0	0.00	1.3	0.0	0.00	2.2	0.0	0.00
Blue Jay				1.3	1.3	1.00							0.3	0.3	1.00
Black-capped Chickadee	0.0	2.5	und.[1]	2.6	0.0	0.00	3.8	7.5	2.00	2.5	0.0	0.00	2.2	2.5	1.14
Tufted Titmouse	3.8	0.0	0.00	0.0	1.3	und.	1.3	0.0	0.00				1.3	0.3	0.25
Carolina Wren	7.5	11.3	1.50	0.0	3.9	und.	2.5	3.8	1.50	0.0	1.3	und.	2.5	5.1	2.00
Wood Thrush	0.0	1.3	und.										0.0	0.3	und.
American Robin	2.5	0.0	0.00										0.6	0.0	0.00
Gray Catbird	17.5	6.3	0.36										4.4	1.6	0.36
Brown Thrasher	1.3	0.0	0.00										0.3	0.0	0.00
Cedar Waxwing	1.3	0.0	0.00							1.3	0.0	0.00	0.6	0.0	0.00
Northern Parula							1.3	0.0	0.00				0.3	0.0	0.00
Chestnut-sided Warbler	1.3	0.0	0.00										0.3	0.0	0.00
Black-throated Blue Warbler	1.3	0.0	0.00										0.3	0.0	0.00

Table 3. (cont.) Numbers of adult and young individual birds captured per 600 net-hours and reproductive index (young/adult) at the four individual MAPS stations, and all stations pooled, operated on Naval Security Group Activity Sugar Grove and the George Washington National Forest in 2005.

	South Fork Potomac River			Beaver Creek			Lick Run			Flesh Run			All four stations combined		
Species	Ad.	Yg.	Repr. index	Ad.	Yg.	Repr. index	Ad.	Yg.	Repr. index	Ad.	Yg.	Repr. index	Ad.	Yg.	Repr. index
Black-throated Green Warbler										1.3	0.0	0.00	0.3	0.0	0.00
Black-and-white Warbler	3.8	0.0	0.00				1.3	1.3	1.00	1.3	0.0	0.00	1.6	0.3	0.20
Worm-eating Warbler	12.5	17.5	1.40	5.2	1.3	0.25	3.8	2.5	0.67				5.4	5.4	1.00
Ovenbird	10.0	3.8	0.38	11.8	0.0	0.00	2.5	5.0	2.00	3.8	0.0	0.00	7.0	2.2	0.32
Northern Waterthrush	2.5	1.3	0.50	1.3	0.0	0.00							1.0	0.3	0.33
Louisiana Waterthrush	1.3	2.5	2.00	2.6	1.3	0.50	3.8	6.3	1.67	0.0	2.5	und.	1.6	3.2	2.00
Common Yellowthroat	5.0	0.0	0.00										1.3	0.0	0.00
Hooded Warbler							0.0	1.3	und.				0.0	0.3	und.
Scarlet Tanager	1.3	0.0	0.00	2.6	0.0	0.00							1.0	0.0	0.00
Chipping Sparrow										1.3	0.0	0.00	0.3	0.0	0.00
Song Sparrow	3.8	1.3	0.33										1.0	0.3	0.33
Northern Cardinal	5.0	0.0	0.00				2.5	0.0	0.00	1.3	0.0	0.00	2.2	0.0	0.00
Indigo Bunting	6.3	3.8	0.60	3.9	0.0	0.00	10.0	5.0	0.50	6.3	0.0	0.00	6.7	2.2	0.33
American Goldfinch										1.3	0.0	0.00	0.3	0.0	0.00
ALL SPECIES POOLED	96.5	51.4	0.53	36.7	13.1	0.36	40.1	43.8	1.09	22.7	7.6	0.33	48.8	29.2	0.60
Number of Species	23	10		11	7		13	12		11	3		33	18	
Total Number of Species		25			14			17			14			36	

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

Table 4. Percentage changes between 2004 and 2005 in the numbers of individual ADULT birds captured at two constant-effort MAPS stations on Naval Security Group Activity Sugar Grove.

Species	S. Fork Potomac	Beaver Creek	n[1]	Both stations combined: Number of adults 2004	Number of adults 2005	Percent change	SE[2]
Downy Woodpecker	-100.0		1	1	0	-100.0	
Hairy Woodpecker		+[3]	1	0	1	+[3]	
Northern Flicker	+[3]		1	0	1	+	
Eastern Phoebe	+	+	2	0	4	+	
Great Crested Flycatcher		-100.0	1	1	0	-100.0	
Eastern Kingbird	+		1	0	1	+	
White-eyed Vireo	-75.0		1	4	1	-75.0	
Blue-headed Vireo		+	1	0	1	+	
Red-eyed Vireo	+		1	0	2	+	
Blue Jay		-100.0	1	1	0	-100.0	
Black-capped Chickadee	-100.0	0.0	2	3	2	-33.3	44.4
Tufted Titmouse	50.0	-100.0	2	4	3	-25.0	75.0
Carolina Wren	100.0		1	3	6	100.0	
Wood Thrush			0	0	0		
American Robin	+		1	0	2	+	
Gray Catbird	20.0		1	10	12	20.0	
Brown Thrasher	-50.0		1	2	1	-50.0	
Chestnut-sided Warbler	+		1	0	1	+	
Black-throated Blue Warbler	+		1	0	1	+	
Pine Warbler			0	0	0		
Black-and-white Warbler	200.0		1	1	3	200.0	
American Redstart			0	0	0		
Worm-eating Warbler	25.0	300.0	2	9	14	55.6	54.3
Ovenbird	166.7	350.0	2	5	17	240.0	88.0
Northern Waterthrush	0.0	0.0	2	3	3	0.0	88.9
Louisiana Waterthrush	+	+	2	0	3	+	
Mourning Warbler	-100.0		1	1	0	-100.0	
Common Yellowthroat	300.0		1	1	4	300.0	
Hooded Warbler	-100.0		1	1	0	-100.0	
Canada Warbler			0	0	0		
Scarlet Tanager	+	-100.0	2	1	1	0.0	200.0
Eastern Towhee	-100.0		1	1	0	-100.0	
Song Sparrow	-57.1		1	7	3	-57.1	
Northern Cardinal	0.0		1	4	4	0.0	
Indigo Bunting	150.0	0.0	2	3	6	100.0	66.7
ALL SPECIES POOLED	37.0	91.7	2	66	97	47.0	16.3

Table 4. (cont.) Percentage changes between 2004 and 2005 in the numbers of individual ADULT birds captured at two constant-effort MAPS stations on Naval Security Group Activity Sugar Grove.

Species	S. Fork Potomac	Beaver Creek	Both stations combined
No. species that increased[4]	17(9)	6(4)	17(10)
No. species that decreased[5]	8(5)	4(4)	11(6)
No. species remained same	2	3	3
Total Number of Species	27	13	31
Proportion of increasing (decreasing) species	0.630	0.462	0.548
Sig. of increase (decrease)[6]	0.124	0.709	0.360

[1] Number of stations lying within the breeding range of the species at which at least one individual adult bird of the species was captured in either year.
[2] Standard error of the percent change in the number of individual adults captured.
[3] Increase indeterminate (infinite) because no adult was captured during 2004.
[4] No. of species for which adults were captured in 2005 but not in 2004 are in parentheses.
[5] No. of species for which adults were captured in 2004 but not in 2005 are in parentheses.
[6] Statistical significance of the one-sided binomial test that the proportion of increasing (decreasing) species is not greater than 0.50.
*** $P < 0.01$; ** $0.01 < P < 0.05$; * $0.05 < P < 0.10$.

Table 5. Percentage changes between 2004 and 2005 in the numbers of individual YOUNG birds captured at two constant-effort MAPS stations on Naval Security Group Activity Sugar Grove.

				Both stations combined			
				Number of young			
Species	S. Fork Potomac	Beaver Creek	n[1]	2004	2005	Percent change	SE[2]
Downy Woodpecker			0	0	0		
Hairy Woodpecker			0	0	0		
Northern Flicker			0	0	0		
Eastern Phoebe			0	0	0		
Great Crested Flycatcher			0	0	0		
Eastern Kingbird			0	0	0		
White-eyed Vireo			0	0	0		
Blue-headed Vireo		+[3]	1	0	2	+[3]	
Red-eyed Vireo			0	0	0		
Blue Jay		+	1	0	1	+	
Black-capped Chickadee	100.0	-100.0	2	3	2	-33.3	88.9
Tufted Titmouse		-80.0	1	5	1	-80.0	
Carolina Wren	350.0	+	2	2	12	500.0	300.0
Wood Thrush	0.0		1	1	1	0.0	
American Robin	-100.0		1	4	0	-100.0	
Gray Catbird	-16.7		1	6	5	-16.7	
Brown Thrasher			0	0	0		
Chestnut-sided Warbler			0	0	0		
Black-throated Blue Warbler		-100.0	1	1	0	-100.0	
Pine Warbler		-100.0	1	1	0	-100.0	
Black-and-white Warbler	-100.0	-100.0	2	6	0	-100.0	88.9
American Redstart	-100.0		1	1	0	-100.0	
Worm-eating Warbler	-50.0	-50.0	2	30	15	-50.0	88.9
Ovenbird	-70.0	-100.0	2	11	3	-72.7	5.0
Northern Waterthrush	+[3]		1	0	1	+	
Louisiana Waterthrush	0.0	0.0	2	3	3	0.0	88.9
Mourning Warbler			0	0	0		
Common Yellowthroat			0	0	0		
Hooded Warbler			0	0	0		
Canada Warbler	-100.0		1	1	0	-100.0	
Scarlet Tanager			0	0	0		
Eastern Towhee			0	0	0		
Song Sparrow	-75.0		1	4	1	-75.0	
Northern Cardinal	-100.0		1	1	0	-100.0	
Indigo Bunting	+		1	0	3	+	
ALL SPECIES POOLED	-34.9	-47.1	2	80	50	-37.5	4.1

Table 5. (cont.) Percentage changes between 2004 and 2005 in the numbers of individual YOUNG birds captured at two constant-effort MAPS stations on Naval Security Group Activity Sugar Grove.

Species	S. Fork Potomac	Beaver Creek	Both stations combined
No. species that increased4	4(2)	3(3)	5(4)
No. species that decreased5	9(5)	7(5)	13(7)
No. species remained same	2	1	2
Total Number of Species	15	11	20
Proportion of increasing (decreasing) species	(0.600)	(0.636)	(0.650)
Sig. of increase (decrease)[6]	(0.304)	(0.274)	(0.132)

[1]Number of stations lying within the breeding range of the species at which at least one individual young bird of the species was captured in either year.
[2] Standard error of the percent change in the number of individual young captured.
[3] Increase indeterminate (infinite) because no young bird was captured during 2004.
[4] No. of species for which young birds were captured in 2005 but not in 2004 are in parentheses.
[5] No. of species for which young birds were captured in 2004 but not in 2005 are in parentheses.
[6] Statistical significance of the one-sided binomial test that the proportion of increasing (decreasing) species is not greater than 0.50.
*** $P < 0.01$; ** $0.01 < P < 0.05$; * $0.05 < P < 0.10$.

Table 6. Absolute changes between 2004 and 2005 in the REPRODUCTIVE INDEX (young/adult) at two constant-effort MAPS stations on Naval Security Group Activity Sugar Grove.

Species	S. Fork Potomac	Beaver Creek	n[1]	Both stations combined: Reproductive Index 2004	Reproductive Index 2005	Change	SE[2]
Downy Woodpecker	nc.[3]		1	0.000	und.[4]	nc.[3]	
Hairy Woodpecker		nc.[3]	1	und.[4]	0.000	nc.	
Northern Flicker	nc.		1	und.	0.000	nc.	
Eastern Phoebe	nc.	nc.	2	und.	0.000	nc.	
Great Crested Flycatcher		nc.	1	0.000	und.	nc.	
Eastern Kingbird	nc.		1	und.	0.000	nc.	
White-eyed Vireo	0.000		1	0.000	0.000	0.000	
Blue-headed Vireo		nc.	1	und.	2.000	nc.	
Red-eyed Vireo	nc.		1	und.	0.000	nc.	
Blue Jay		nc.	1	0.000	und.	nc.	
Black-capped Chickadee	nc.	-1.000	2	1.000	1.000	0.000	2.000
Tufted Titmouse	0.000	nc.	2	1.250	0.333	-0.917	1.417
Carolina Wren	0.833	nc.	2	0.667	2.000	1.333	
Wood Thrush	nc.		1	und.	und.	nc.	
American Robin	nc.		1	und.	0.000	nc.	
Gray Catbird	-0.183		1	0.600	0.417	-0.183	
Brown Thrasher	0.000		1	0.000	0.000	0.000	
Chestnut-sided Warbler	nc.		1	und.	0.000	nc.	
Black-throated Blue Warbler	nc.	nc.	2	und.	0.000	nc.	
Pine Warbler		nc.	1	und.	und.	nc.	
Black-and-white Warbler	-2.000	nc.	2	6.000	0.000	-6.000	8.000
American Redstart	nc.		1	und.	und.	nc.	
Worm-eating Warbler	-2.100	-1.750	2	3.333	1.071	-2.262	0.555
Ovenbird	-2.958	-0.500	2	2.200	0.177	-2.024	1.373
Northern Waterthrush	0.500	0.000	2	0.000	0.333	0.333	0.222
Louisiana Waterthrush	nc.	nc.	2	und.	1.000	nc.	
Mourning Warbler	nc.		1	0.000	und.	nc.	
Common Yellowthroat	0.000		1	0.000	0.000	0.000	
Hooded Warbler	nc.		1	0.000	und.	nc.	
Canada Warbler	nc.		1	und.	und.	nc.	
Scarlet Tanager	nc.	nc.	2	0.000	0.000	0.000	0.000
Eastern Towhee	nc.		1	0.000	und.	nc.	
Song Sparrow	-0.238		1	0.571	0.333	-0.238	
Northern Cardinal	-0.250		1	0.250	0.000	-0.250	
Indigo Bunting	0.600	0.000	2	0.000	0.500	0.500	0.167
ALL SPECIES POOLED	-0.613	-1.025	2	1.212	0.516	-0.697	0.095

Table 6. (cont.) Absolute changes between 2004 and 2005 in the REPRODUCTIVE INDEX (young/adult) at two constant-effort MAPS stations on Naval Security Group Activity Sugar Grove.

Species	S. Fork Potomac	Beaver Creek	Both stations combined
No. species that increased	3	0	3
No. species that decreased	6	3	7
No. species remained same	4	2	5
Total Number of Species[5]	13	5	15
Proportion of increasing (decreasing) species	(0.462)	(0.600)	(0.467)
Sig. of increase (decrease)[6]	(0.709)	(0.500)	(0.696)

[1] Number of stations lying within the breeding range of the species at which at least one individual aged bird of the species was captured in either year.
[2] Standard error of the change in the reproductive index.
[3] The change in reproductive index is not calculable at this station because no adult individual of the species was captured in one of the two years, i.e. the value was undefined in at least one of the two years.
[4] Reproductive index not given because no adult individual of the species was captured in the year shown.
[5] Species for which the change in the reproductive index is undefined are not included.
[6] Statistical significance of the one-sided binomial test that the proportion of increasing (decreasing) species is not greater than 0.50.
*** $P < 0.01$; ** $0.01 \leq P < 0.05$; * $0.05 \leq P < 0.10$

Table 7. Mean numbers of aged individual birds captured per 600 net-hours and reproductive index at the two individual MAPS stations operated on Naval Security Group Activity Sugar Grove averaged over the five years, 2001-2005. Data for each species are included only from stations that lie within the breeding range of the species.

	South Fork Potomac River			Beaver Creek			Both Stations Pooled		
Species	Ad.	Yg.	Repr. Ind.[1]	Ad.	Yg.	Repr. Ind.[1]	Ad.	Yg.	Repr. Ind.[1]
Yellow-billed Cuckoo				0.3	0.0	0.00	0.1	0.0	0.00
Downy Woodpecker	0.5	0.8	0.50	0.0	0.3	und.[2]	0.3	0.6	0.50
Hairy Woodpecker	0.0	0.3	und.[2]	0.6	0.0	0.00	0.3	0.1	0.50
Northern Flicker	0.3	0.0	0.00				0.1	0.0	0.00
Eastern Phoebe	1.4	0.0	0.00	0.5	0.0	0.00	1.0	0.0	0.00
Great Crested Flycatcher	0.3	0.0	0.00	0.3	0.0	0.00	0.3	0.0	0.00
Eastern Kingbird	0.3	0.0	0.00				0.1	0.0	0.00
White-eyed Vireo	4.1	0.8	0.15				2.1	0.4	0.15
Blue-headed Vireo				0.3	0.5	2.00	0.1	0.3	2.00
Red-eyed Vireo	1.9	0.0	0.00	0.0	0.3	und.	1.0	0.1	0.25
Blue Jay	0.8	0.0	0.00	0.5	0.6	0.50	0.7	0.3	0.50
Carolina Chickadee				0.0	0.7	und.	0.0	0.3	und.[2]
Black-capped Chickadee	1.4	1.0	0.50	2.0	2.1	0.50	1.7	1.5	1.30
Tufted Titmouse	2.4	2.2	1.20	2.1	5.1	2.13	2.3	3.7	1.60
White-breasted Nuthatch				0.0	0.3	und.	0.0	0.1	und.
Carolina Wren	8.0	8.6	1.19	0.0	1.5	und.	4.1	5.2	1.38
House Wren	0.0	0.3	und.				0.0	0.1	und.
Blue-gray Gnatcatcher				0.3	0.0	0.00	0.2	0.0	0.00
Wood Thrush	0.0	0.5	und.				0.0	0.3	und.
American Robin	1.1	1.3	0.33	0.3	0.0	0.00	0.7	0.7	0.25
Gray Catbird	14.8	5.0	0.33				7.6	2.6	0.33
Brown Thrasher	1.4	1.7	0.17				0.7	0.9	0.17
Cedar Waxwing	0.8	0.0	0.00				0.4	0.0	0.00
Northern Parula				0.3	0.0	0.00	0.2	0.0	0.00
Yellow Warbler	0.3	0.0	0.00				0.2	0.0	0.00
Chestnut-sided Warbler	0.3	0.0	0.00				0.1	0.0	0.00
Black-throated Blue Warbler	0.3	0.0	0.00	0.0	0.3	und.	0.1	0.1	0.00
Black-throated Green Warbler	0.0	0.3	und.				0.0	0.1	und.
Pine Warbler				0.0	0.3	und.	0.0	0.1	und.
Black-and-white Warbler	2.8	1.6	0.93	0.0	1.0	und.	1.4	1.4	1.73
American Redstart	1.1	0.5	0.50				0.6	0.3	0.50
Worm-eating Warbler	13.4	37.6	2.95	4.2	1.1	0.63	9.1	20.0	2.35
Ovenbird	8.5	10.3	1.80	3.6	1.6	1.13	6.1	6.2	1.55
Northern Waterthrush	2.1	0.3	0.13	0.5	0.0	0.00	1.4	0.1	0.08
Louisiana Waterthrush	1.5	1.6	0.88	0.8	0.9	0.25	1.2	1.3	0.75
Mourning Warbler	0.3	0.0	0.00				0.1	0.0	0.00

Table 7. (cont.) Mean numbers of aged individual birds captured per 600 net-hours and reproductive index at the two individual MAPS stations operated on Naval Security Group Activity Sugar Grove averaged over the five years, 2001-2005. Data for each species are included only from stations that lie within the breeding range of the species.

	South Fork Potomac River			Beaver Creek			Both Stations Pooled		
Species	Ad.	Yg.	Repr. Ind.[1]	Ad.	Yg.	Repr. Ind.[1]	Ad.	Yg.	Repr. Ind.[1]
Common Yellowthroat	1.8	0.0	0.00				0.9	0.0	0.00
Hooded Warbler	0.3	0.0	0.00				0.1	0.0	0.00
Canada Warbler	0.0	0.8	und.				0.0	0.4	und.
Scarlet Tanager	0.5	0.3	0.00	1.1	0.0	0.00	0.8	0.1	0.00
Eastern Towhee	1.7	0.3	0.33				0.9	0.1	0.33
Chipping Sparrow				0.6	2.0	0.50	0.3	0.9	0.50
Song Sparrow	9.2	5.3	0.59				4.8	2.8	0.59
Northern Cardinal	5.8	1.3	0.30				3.0	0.7	0.30
Indigo Bunting	8.8	2.5	0.24	3.8	0.9	0.09	6.5	1.8	0.24
Common Grackle	0.6	0.0	0.00				0.3	0.0	0.00
Baltimore Oriole	0.8	0.0	0.00				0.5	0.0	0.00
American Goldfinch				0.3	0.0	0.00	0.1	0.0	0.00
ALL SPECIES POOLED	99.5	85.3	0.88	22.3	19.3	1.12	62.6	53.7	0.89
Number of Species	34	24		19	17		41	32	
Total Number of Species		39			27			48	

[1] Years for which the reproductive index was undefined (no adult birds were captured in the year) are not included in the mean reproductive index.

[2] The reproductive index is undefined at this station because no young individual of the species was ever captured in the same year as an adult individual of the species.

Table 8. Estimates of adult annual survival and recapture probabilities and proportion of residents among newly captures adults using a time-constant model for four species breeding at MAPS stations on Naval Security Group Activity Sugar Grove obtained from five years (2001-2005) of mark-recapture data.

Species	Num. sta.[1]	Num. ind.[2]	Num. caps.[3]	Num. ret.[4]	Survival probability[5]	Surv. C.V.[6]	Recapture probability[7]	Proportion of residents[8]
Gray Catbird †‡	1	51	65	3	0.421 (0.326)	77.6	0.132 (0.201)	1.000 (1.362)
Worm-eating Warbler ‡	2	55	74	8	0.695 (0.238)	34.2	0.245 (0.168)	0.520 (0.373)
Song Sparrow ‡	1	29	50	4	0.396 (0.251)	63.5	0.269 (0.295)	0.993 (1.061)
Indigo Bunting ‡	2	37	59	7	0.718 (0.231)	32.2	0.250 (0.162)	0.410 (0.282)

[1] Number of stations where the species was a regular or usual breeder and at which adults of the species were captured. Stations within one km of each other were combined into a single super-station to prevent individuals whose home ranges included portions of two or more stations from being counted as multiple individuals.
[2] Number of adult individuals captured at stations where the species was a regular or usual breeder (i.e., number of capture histories).
[3] Total number of captures of adult birds of the species at stations where the species was a regular or usual breeder.
[4] Total number of returns. A return is the first recapture in a given year of a bird originally banded at the same station in a previous year.
[5] Survival probability presented as the maximum likelihood estimate (standard error of the estimate).
[6] The coefficient of variation for survival probability.
[7] Recapture probability presented as the maximum likelihood estimate (standard error of the estimate).
[8] The proportion of residents among newly captured adults presented as the maximum likelihood estimate (standard error of the estimate).

‡ The estimate for survival probability should be viewed with caution because it is based on fewer than five between-year recaptures, or the estimate is very imprecise (SE(φ)>0.200 or CV(φ)>50.0%).
† The estimate for survival probability, recapture probability, or both may be biased low because the estimate for τ was 1.000.

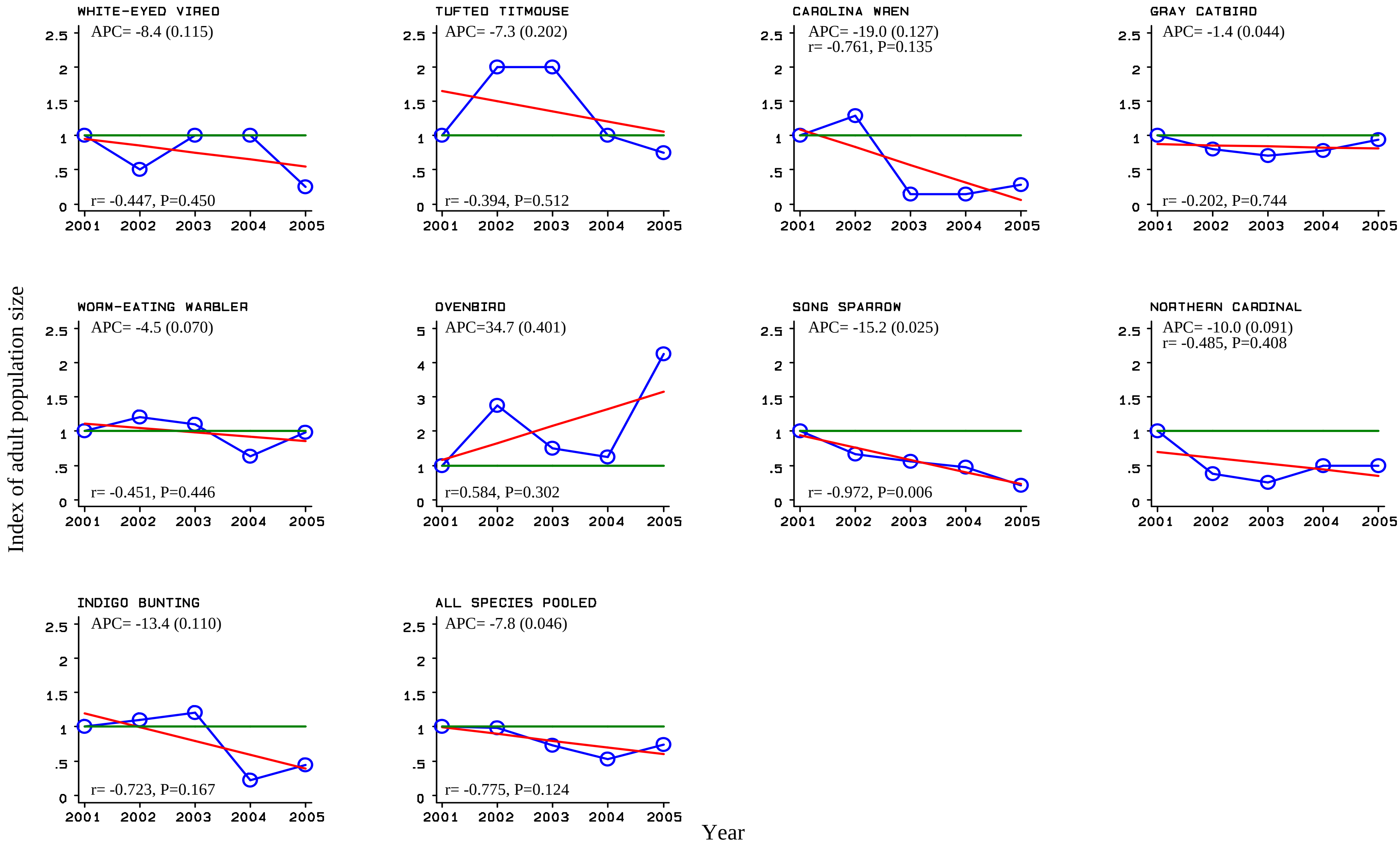

Figure 1. Population trends for nine species and all species pooled on the two MAPS stations on Naval Security Group Activity Sugar Grove (South Fork Potomac River and Beaver Creek) over the five years 2001-2005. The index of population size was arbitrarily defined as 1.0 in 2001. Indices for subsequent years were determined from constant-effort between-year changes in the number of adult birds captured from stations where the species was a regular or usual breeder and summer resident. The annual percentage change in the index of adult population size was used as the measure of the population trend (APC), and it and the standard error of the slope (in parentheses) are presented on each graph. The correlation coefficient (r) and significance of the correlation coefficient (P) are also shown on each graph.

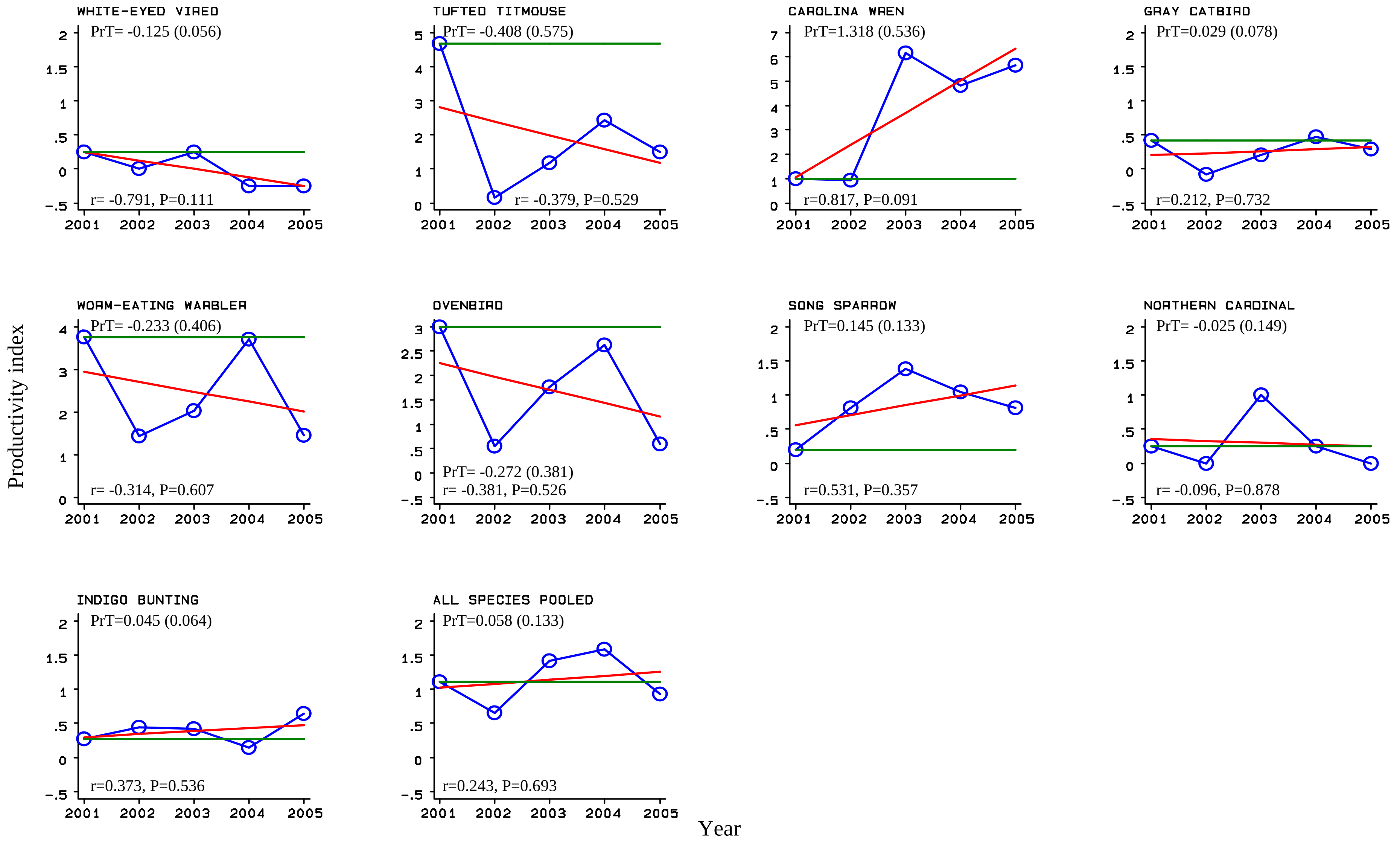

Figure 2. Trend in productivity for nine species and all species pooled on the two MAPS stations on Naval Security Group Activity Sugar Grove (South Fork Potomac River and Beaver Creek) over the five years 2001-2005. The productivity index was defined as the actual productivity value in 2001. Indices for subsequent years were determined from constant-effort between-year changes in reproductive index from stations where the species was a regular or usual breeder and summer resident. The slope of the regression line for annual change in the index of productivity was used as the measure of the productivity trend (PrT), and it and the standard error of the slope (in parentheses) are presented on each graph. The correlation coefficient (r) and significance of the correlation coefficient (P) are also shown on each graph.

Appendix I. Numerical listing (in AOU checklist order) of all the species sequence numbers, species alpha codes, and species names for all species banded or encountered during the five years, 2001-2005, of the MAPS Program on the four stations operated Naval Security Group Activity Sugar Grove and the George Washington National Forest.

NUMB	SPEC	SPECIES NAME
00860	DCCO	Double-crested Cormorant
01010	GBHE	Great Blue Heron
01130	GRHE	Green Heron
01290	BLVU	Black Vulture
01300	TUVU	Turkey Vulture
01460	CANG	Canada Goose
01570	WODU	Wood Duck
01630	MALL	Mallard
02020	OSPR	Osprey
02130	BAEA	Bald Eagle
02170	NOHA	Northern Harrier
02200	SSHA	Sharp-shinned Hawk
02210	COHA	Cooper's Hawk
02380	RSHA	Red-shouldered Hawk
02400	BWHA	Broad-winged Hawk
02460	RTHA	Red-tailed Hawk
02510	GOEA	Golden Eagle
02630	AMKE	American Kestrel
02940	RUGR	Ruffed Grouse
03040	WITU	Wild Turkey
03750	SEPL	Semipalmated Plover
03780	KILL	Killdeer
03970	SOSA	Solitary Sandpiper
04020	SPSA	Spotted Sandpiper
04490	AMWO	American Woodcock
05570	MODO	Mourning Dove
06400	BBCU	Black-billed Cuckoo
06410	YBCU	Yellow-billed Cuckoo
06680	EASO	Eastern Screech-Owl
06800	GHOW	Great Horned Owl
06950	BADO	Barred Owl
07080	CONI	Common Nighthawk
07230	WPWI	Whip-poor-will
07400	CHSW	Chimney Swift
08630	RTHU	Ruby-throated Hummingbird
09110	BEKI	Belted Kingfisher
09550	RBWO	Red-bellied Woodpecker
09650	DOWO	Downy Woodpecker
09660	HAWO	Hairy Woodpecker

Appendix I. continued.

NUMB	SPEC	SPECIES NAME
09800	YSFL	Yellow-shafted Flicker
09860	PIWO	Pileated Woodpecker
11390	EAWP	Eastern Wood-Pewee
11450	YBFL	Yellow-bellied Flycatcher
11460	ACFL	Acadian Flycatcher
11610	EAPH	Eastern Phoebe
11760	GCFL	Great Crested Flycatcher
12030	EAKI	Eastern Kingbird
12550	WEVI	White-eyed Vireo
12690	YTVI	Yellow-throated Vireo
12720	BHVI	Blue-headed Vireo
12760	WAVI	Warbling Vireo
12780	PHVI	Philadelphia Vireo
12790	REVI	Red-eyed Vireo
12930	BLJA	Blue Jay
13190	AMCR	American Crow
13270	FICR	Fish Crow
13300	CORA	Common Raven
13340	PUMA	Purple Martin
13410	TRES	Tree Swallow
13490	NRWS	Northern Rough-winged Swallow
13510	BANS	Bank Swallow
13520	CLSW	Cliff Swallow
13540	BARS	Barn Swallow
13560	CACH	Carolina Chickadee
13570	BCCH	Black-capped Chickadee
13575	UPCH	Unidentified Poecile Chickadee
13660	TUTI	Tufted Titmouse
13690	RBNU	Red-breasted Nuthatch
13700	WBNU	White-breasted Nuthatch
13730	BRCR	Brown Creeper
14000	CARW	Carolina Wren
14070	HOWR	House Wren
14250	RCKI	Ruby-crowned Kinglet
14350	BGGN	Blue-gray Gnatcatcher
14560	EABL	Eastern Bluebird
14820	HETH	Hermit Thrush
14830	WOTH	Wood Thrush
15000	AMRO	American Robin
15130	GRCA	Gray Catbird
15150	NOMO	Northern Mockingbird
15370	EUST	European Starling
15200	BRTH	Brown Thrasher

Appendix I. continued.

NUMB	SPEC	SPECIES NAME
15510	AMPI	American Pipit
15550	CEDW	Cedar Waxwing
15630	BWWA	Blue-winged Warbler
15730	NOPA	Northern Parula
15750	YWAR	Yellow Warbler
15760	CSWA	Chestnut-sided Warbler
15770	MAWA	Magnolia Warbler
15790	BTBW	Black-throated Blue Warbler
15800	MYWA	Myrtle Warbler
15830	BTNW	Black-throated Green Warbler
15910	PIWA	Pine Warbler
15930	PRAW	Prairie Warbler
15970	BLPW	Blackpoll Warbler
16030	BAWW	Black-and-white Warbler
16040	AMRE	American Redstart
16060	WEWA	Worm-eating Warbler
16080	OVEN	Ovenbird
16090	NOWA	Northern Waterthrush
16100	LOWA	Louisiana Waterthrush
16130	MOWA	Mourning Warbler
16150	COYE	Common Yellowthroat
16280	HOWA	Hooded Warbler
16290	WIWA	Wilson's Warbler
16300	CAWA	Canada Warbler
16830	SCTA	Scarlet Tanager
17820	EATO	Eastern Towhee
18020	CHSP	Chipping Sparrow
18140	GRSP	Grasshopper Sparrow
18230	SOSP	Song Sparrow
18270	WTSP	White-throated Sparrow
18560	NOCA	Northern Cardinal
18600	RBGR	Rose-breasted Grosbeak
18670	INBU	Indigo Bunting
18730	RWBL	Red-winged Blackbird
18800	EAME	Eastern Meadowlark
18870	COGR	Common Grackle
18960	BHCO	Brown-headed Cowbird
19160	BAOR	Baltimore Oriole
19370	HOFI	House Finch
19510	AMGO	American Goldfinch
19920	HOSP	House Sparrow
20085	UNBI	Unidentified Bird