THE 2007 ANNUAL REPORT OF THE MONITORING AVIAN PRODUCTIVITY AND SURVIVORSHIP (MAPS) PROGRAM AT NAVAL INFORMATION OPERATIONS COMMAND SUGAR GROVE, WV AND USDA FOREST SERVICE GEORGE WASHINGTON NATIONAL FOREST, WV

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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-ledging productivity, as well as estimates of adult survivorship and recruitment into the adult population, for various landbird species. The broad-scale productivity and survivorship data are obtained from this monitoring program 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 more specific 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. It is expected that these population and demographic data will aid research and management efforts on the installation, to protect and enhance its avifauna and ecological integrity while simultaneously helping to fulfill its military mission in an optimal manner.

We re-established and operated two MAPS stations at Navy Security Group Activity (NIOC) Sugar Grove in 2007: the South Fork Potomac River station in bottomland riparian/mixed forest habitat, and the Beaver Creek station in open upland forest habitat. We also re-established two stations on adjacent lands of the George Washington National Forest (GWNF), the Lick Run station, intended to be in similar habitats as the South Fork Potomac River station, and the Flesh Run station, in similar habitats as the Beaver Creek station. Ten mist nets at each station were operated in the exact same locations at which they were established in 2001 (Sugar Grove) or 2005 (GWNF). In 2007, nets were opened for six morning hours per day, on one day per 10-day period for six consecutive 10-day periods between June 13 and August 2.

A total of 202 captures of 35 species were recorded at the four stations combined. Total adult population sizes in 2007 were highest at South Fork Potomac River (68.4 adults per 600 net-hours), followed by Flesh Run (36.5), Beaver Creek (26.2), and Lick Run (24.8). Reproductive index (number of young to adults) was highest at Flesh Run (0.81), followed by Lick Run (0.57), South Fork Potomac River (0.34), and Beaver Creek (0.14). 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 (among the most abundantly captured species), Louisiana Waterthrush, and Wood Thrush.

Breeding populations, numbers of young, and reproductive success all showed substantial and significant or near-significant decreases between 2006 and 2007 which were generally both region wide and species wide. It is unusual to have all three parameters change in the same

direction at a MAPS location between two years. Thus, 2007 was an extremely poor year for landbirds in the Appalachian Region, perhaps due to weather or climatic influences. With a few more years of data we hope to be able to quantify the influence of both local weather conditions and global climatic phenomena on the varying landbird population dynamics at Sugar Grove and George Washington National Forest.

Owing in part to the poor year in 2007, the population trend for all species pooled was substantially but non-significantly negative between 2001 and 2007, showing an annual decrease of 4.5%. This compares with a increasing trend of 1.9% per year after six years of data (2001-2006) had been analyzed, indicating how these values can vary after just 6-7 years of data have been collected. Seven-year declines were noted for three of the eight species, whereas the remaining five species showed slightly positive or flat population trends. Trends in productivity for all species pooled decreased slightly and non-significantly between 2001 and 2007, with decreasing trends noted for two of eight species and increasing trends noted for one species.

A primary goal of the MAPS program is to determine the proximate causes (productivity or survival) accounting for declining landbird population sizes. In this year's report we expand our analyses aimed at assessing the causes for the observed population trends for eight target species at the two locations. For the first time we are able to obtain survival estimates based on data that include the two George Washington stations, and the results are encouraging because lower coefficients of variation (C.V.) were obtained when the George Washington stations were included.

The overall reproductive index of 0.80 for eight target species at Sugar Grove and George Washington National Forest observed during 2001-2007 is excellent as compared with the mean value of 0.43 calculated for these same eight species in the Northeast MAPS Region, during the 12-year period 1992-2003. Three species showed substantially higher productivity at the MAPS stations than in the Northeast Region, whereas only one species (Northern Cardinal) showed substantially lower productivity at the MAPS stations than in the Northeast Region. In addition, when compared to expected productivity values based on body mass, higher-than-expected productivity appears to be occurring in five of the eight species at Sugar Grove whereas slightly lower-than expected productivity is only occurring in two species, reinforcing the fact that productivity is higher at Sugar Grove and George Washington than is indicated for the Northeast Region.

Management could be applied to increase the productivity of Indigo Bunting, a species with lower-than-expected productivity and a declining population trend at Sugar Grove. However, the Breeding Bird Survey (BBS, Sauer et al. 2007) shows a long term decline of Indigo Buntings across West Virginia. In fact, over the most recent decade (1997-2006) the BBS trend estimate showed a highly significant decline of nearly 4% per annum ($P<0.0001$). This suggests that the proximal causes of the decline may be operating during the non-breeding season. Nevertheless, management actions designed to increase nesting opportunities by ensuring the availability of dense understory in open edgy woodland may increase local productivity and lead to higher rates of recruitment. Such habitat is common to regenerating forest gaps and the edges of cut areas.

Further south, in Georgia, Indigo Bunting populations have been reported to respond positively to Red-cockaded Woodpecker management through increased abundance and productivity three years after an understory burn.

Using seven years of data from the two Sugar Grove stations, estimates of adult survival and recapture probabilities could be obtained for five of the eight target species breeding at NIOC Sugar Grove. Comparison of estimates from transient models for the two Sugar Grove stations (mean survival 0.473) and non-transient models from all four stations combined (mean survival 0.457) yielded similar results. The mean C.V. for four of these species, that could be compared with estimates based on six years of data, decreased from 49.2% to 44.5%, indicating improvement in precision with the additional year of data. The mean survival for the five species from MAPS data collected throughout the Appalachian Region during 1992-2003 was 0.463, comparable to the 0.473 estimate for these five species using the transient model on data from 2001-2007 at Sugar Grove, indicating average or slightly above-average survival values from Sugar Grove. Compared with expected values based on body mass, survival was higher-than-expected in one species, expected in two species, and slightly lower-than expected in two species. These results reinforce that survival is roughly expected at Sugar Grove as compared with values for the Northeast Region as a whole.

With additional years of data and the addition of data collected at stations in comparable habitats at George Washington National Forest, we hope to better 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 make more informed inferences regarding the effect of productivity and survivorship on population dynamics. Pooling data at this level will also allow comparison between NIOC Sugar Grove, George Washington National Forest, and other protected and unprotected areas at which MAPS stations are operated in the region.

The long-term goal for the NIOC 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 NIOC 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. .

In addition, MAPS data from NIOC 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. Very

recently we undertook an analysis of the entire MAPS program in the Northeastern Region for the Northeast Coordinated Bird Monitoring Partnership. In our report it was recommended that the MAPS program be increased by about 50% throughout the Northeastern United States. All four of the Sugar Grove and George Washington stations were contributing adequately to our understanding of population dynamics for species of concern within Bird Conservation Region 28, the Appalachian Mountains, receiving a mean priority score of 35.8, compared with a mean score of 28.4 for all MAPS stations in the region; thus, the recommendation of the report was to continue operating all four stations.

We conclude that the MAPS protocol is well-suited to provide an integral component of NIOC Sugar Grove's long-term ecological monitoring effort, and we recommend the continued operation of the NIOC Sugar Grove MAPS stations well into the future.

INTRODUCTION

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

Recent important results from MAPS reported in the peer-reviewed literature include the following:

- Age ratios obtained during late summer banding provided a good index to actual productivity in the Kirtland's Warbler (Bart *et al.* 1999).

- Measures of productivity and survival derived from MAPS data were consistent with observed population changes at multiple spatial scales (DeSante *et al.* 1999).

- 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).

- 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).

- 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).

- 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. From these relationships we have formulated conservation management strategies that are currently being validated by follow-up monitoring or "effectiveness monitoring" (Nott *et al.* 2003a).

- A number of large military installations in North Carolina, Indiana, Kentucky, Missouri, and Texas have been monitored since 1994 by IBP under an agreement with the DoD Legacy Resources Management Office. Performance measures of population demographics and landscape showed that, in general, the installations managed large tracts of forest which represented a higher percentage of the land compared to the percentage of forested land within a 20km radius of the installations' boundaries. These forests also featured large "core areas" known to be beneficial to forest species. Consequently, the survival rate estimates and productivity indices of forest bird populations were higher than those of the surrounding MAPS or North American Bird Conservation Initiative's (NABCI) Bird Conservation Regions (Nott and Morris 2007).

- A report of analyses of BCR14 (North Atlantic Forest) MAPS data included Naval Air Station Brunswick and Redington SERE school data and recommended closure of the Chimney Rock station (DeSante *et al.* 2008).

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; 8) suggest management actions and conservation strategies to reverse population declines and maintain stable or increasing populations; and (d) evaluate the effectiveness of the management actions and conservation strategies actually implemented through an adaptive management framework.

All of these monitoring, research, and management goals are in agreement with the Department

of Defense (DoD) and USDA Forest Service's Partners-in-Flight (PIF) strategies. Moreover, because birds are excellent indicators of the health of ecological systems, they can serve as a sensitive barometer of the overall effectiveness of efforts to maintain the biodiversity and ecological integrity of military installations. Accordingly, the MAPS program was initiated on select military installations beginning in 1992 and soon became one of the focus projects of the DoD PIF program. It was expected that information from the MAPS program would be capable of aiding research and management efforts on these military installations to protect and enhance the installations' avifauna and ecological integrity, while allowing them to fulfill their military mission.

More recently, in 2001, the MAPS program was established on Navy Information Operations Command (NIOC) Sugar Grove and adjacent George Washington National Forest. It is expected that information from the MAPS program will be capable of aiding research and management efforts at Sugar Grove and George Washington National Forest to protect and enhance their avifauna and ecological integrity, while helping them fulfill their military and forestry missions in an optimal manner.

The initial objective of the MAPS Program on DoD installations and national forests has been to identify generalized management guidelines and formulate specific management actions that could be implemented at these locations and elsewhere to reverse the population declines of target landbird species and to maintain the populations of stable or increasing species. The identification and formulation of these management guidelines and actions has been achieved for many installations by modeling the vital rates (productivity and survivorship) of the various landbird species as a function of landscape-level habitat characteristics and spatially explicit weather variables. The goal was to identify relationships between adult population size, numbers of young produced, productivity (ratio of young to adults), and trends in those parameters and these habitat and weather variables. Resultant management strategies were designed to involve efforts to modify the habitat from characteristics associated with low population size, population trend, or productivity to characteristics associated with high population size, population trend, or productivity (especially for species for which low productivity was found to be driving the population decline).

The Legacy Resource Management Program allowed us to undertake these analyses and formulate management strategies. These analyses were completed in 2003 and management guidelines were formulated for ten bird species of conservation concern that breed in the southeastern United States (Nott *et al.* 2003). With additional funding from the Legacy Resource Management Program, we are currently implementing these guidelines through management actions on eight military installations in conjunction with efforts to increase military Readiness and Range Sustainment (Nott and Michel 2005). The strategy for implementing these guidelines includes the establishment of new MAPS stations to monitor the effectiveness of such proposed or on-going management, the discontinuance of an equal number of old stations, and the continued operation of others of the old stations to serve as controls for the new management stations. In this way, the total number of stations operated will remain the same.

Because the MAPS program has only been operated for seven years at NIOC Sugar Grove, we are not yet ready to formulate management strategies specific to this installation. However, with the addition of a seventh year of data we are better able to estimate survival and population trends for up to 9 species breeding at NIOC Sugar Grove and George Washington National Forest.

In our report of two years ago (Pyle *et al.* 2006) we performed cluster analysis (Ward's Method) based on species-specific numbers of adults captured per 600 net-hours, to test our selection of stations at George Washington National Forest to mimic those already established at Sugar Grove. Last year (Nott *et al.* 2007) we began to assess how population dynamics of landbirds at NIOC Sugar Grove are affected by reproductive success, survival, or both. This year we strengthen this analysis by comparing relative survival and productivity to bird mass, and by including data from both Sugar Grove and George Washington National forest into analyses of population trends and survival.

METHODS

Two MAPS stations were re-established and operated on NIOC Sugar Grove in 2007, 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 2007 operation of each station.

The four stations were re-established for operation by IBP Biologist interns Johanna Dunlop and Sarah Buman during June 13-19, 2007. The season began 10-20 days later than normal due to funding uncertainties. The two field biologist interns had received intensive training during a comprehensive course in mist netting and bird-banding techniques given by IBP biologist Danielle Kaschube, which took place June 3-10 at the Jug Bay Wetlands Sanctuary in Maryland. The two interns began operation of the Sugar Grove and George Washington stations on the same day as set-up occurred, June 13-19. Each station was operated for six morning hours per day (beginning at local sunrise) on one day in each of six consecutive 10-day periods between Period 5 (beginning June 10), and Period 10 (beginning July 29). The operation of all stations occurred on schedule during each of the six 10-day periods (Table 1).

Collection of MAPS Data

All MAPS stations were operated in accordance with the highly standardized banding protocols established by The Institute for Bird Populations for use by the MAPS Program throughout North America and spelled out in detail in the MAPS Manual (DeSante *et al.* 2007). On each day of operation each year, one 12-m long, 30-mm mesh, 4-tier nylon mist net was erected at each of ten fixed mist-net sites within the interior eight ha of each 20-ha station. 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 compromised. The following data were taken on all birds captured, including recaptures, according to MAPS guidelines using standardized codes and forms (DeSante *et al*. 2007):

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

The computer entry, proofing, and verification of all banding, effort, and breeding status data were completed by IBP biologists using specially designed data entry, verification, and editing programs. The critical data for each banding record (capture code, band number, species, age, sex, date, capture time, station, and net number) were proofed by hand against the raw data and any computer-entry errors were corrected. All banding data were then run through a series of verification programs as follows:

(1) Clean-up programs to check the validity of all codes entered and the ranges of all numerical data;
(2) Cross-check programs to compare station, date, and net fields from the banding data with those from the effort and breeding status data;
(3) Cross-check programs to compare species, age, and sex determinations against degree of skull pneumaticization, breeding condition (extent of cloacal protuberance and brood patch), 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 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 3.

A. Population-Size and Productivity Analyses - The proofed, verified, and corrected banding data from 2007 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 2007) 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 each station, we calculated percent changes between 2006 and 2007 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 in the indices of adult population size and post-fledging productivity according to methods developed by the BTO in their CES scheme (Peach *et al.* 1996), by using confidence intervals derived from the standard errors of the mean percentage changes of all six stations. 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 for which $0.05 < P < 0.10$.

For each of the four stations and for each location combined we calculated seven-year (Sugar Grove stations) and three-year (George Washington stations) 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.

B. Analyses of trends in adult population size and productivity - For all four stations combined we examined seven-year (2001-2007) trends in indices of adult population size and productivity, for each target species for which we recorded an average of at least 2.5 individual adults per year 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 seven 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 seven 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 seven-year period, to provide an estimate of the population trend for the species; *APC* was calculated as:

(actual 2002 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. 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 $-0.5 < r < 0.5$ and $SE < 0.071$ (for seven-year trends) are considered to have a stable trend; and those for which $-0.5 < r < 0.5$ and $SE > 0.071$ 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 we do not categorize productivity trends as highly fluctuating.

C. Estimates of Survivorship - Survival of target species was estimated using Modified Cormack-Jolly-Seber (CJS) mark-recapture analyses (Pollock et al.1990, Lebreton et al.1992). We present to sets of estimates, one based on seven years (2001-2007) of capture histories of adult birds from the two Sugar Grove stations combined using a transient model and one based on data from all four stations using a non-transient model. 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 the all stations pooled, at which the species was a breeder during more than half of the years the station was operated. Using the computer program TMSURVIV (White 1983, Hines *et al.* 2003), we calculated, using the transient model on Sugar Grove data, maximum-likelihood estimates and standard errors (SEs) for adult survival probability, adult recapture probability, and the proportion of residents among newly captured adults using time-constant models (Pradel *et al.* 1997, Nott and DeSante 2002, Hines *et al.* 2003). The use of the transient model accounts for the existence of transient adults (dispersing and floater individuals which are only captured once) in the sample of newly captured birds, and provides survival estimates that are unbiased with respect to these transient individuals (Pradel *et al.* 1997). Recapture probability is defined as the conditional probability of recapturing a bird in a subsequent year that was banded in a previous year, given that it survived and returned to the place it was originally banded. The use of the non-transient rather than transient model on the entire data set is necessitated by the fact that only three years of data are available from the two George Washington stations. At least four years of date are needed for the transient model, so we will be able to use it on the entire data set next season.

RESULTS

A total of 1364.3 net-hours was accumulated at the four MAPS stations operated at NIOC Sugar Grove and George Washington National Forest in 2007 (Table 1). Data from 1232.0 of these net-hours could be compared directly to 2006 data in a constant-effort manner.

Indices of Adult Population Size and Post-fledging Productivity

A. 2007 values - The 2007 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 202 captures of 35 species was recorded at the four stations combined. The greatest number of captures (80) was recorded at the South Fork Potomac River station and the least number of captures (26) was recorded at the Beaver Creek station. Species richness was greatest at Flesh Run (22 species) and was lowest at Beaver Creek (11 species). Overall, the most abundantly captured species at the four stations was, Carolina Wren, followed by Worm-eating Warbler Ovenbird, Indigo Bunting, Gray Catbird, and Louisiana Waterthrush (Table 2). Three species of management concern (Nott *et al.* 2003) were caught at the four stations, Worm-eating Warbler, Louisiana Waterthrush, and Wood Thrush. These species are locally declining and are listed by the U.S. Fish and Wildlife Service as Birds of Conservation Concern.

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 2007 was highest at South Fork Potomac River (68.4 adults per 600 net-hours), followed by Flesh Run (36.5), Beaver Creek (26.2), and Lick Run (24.8). Captures of young of all species pooled were highest at Flesh Run (29.5) and lowest at Beaver Creek (3.7). Reproductive index (number of young to adults) was highest at Flesh Run (0.81) followed by Lick Run (0.57), South Fork Potomac River (0.34), and Beaver Creek (0.14).

Overall, the highest breeding populations at the two stations, based on adults captured per 600 net-hours, were Worm-eating Warbler, Indigo Bunting, Ovenbird, Gray Catbird, Tufted Titmouse, 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 2007 (species of concern in italics):

South Fork Potomac River
Worm-eating Warbler
Gray Catbird
Indigo Bunting
Carolina Wren
Ovenbird
Northern Cardinal
American Robin
Eastern Towhee
Song Sparrow

Beaver Creek
Worm-eating Warbler
Ovenbird
Indigo Bunting

Lick Run
Tufted Titmouse
Worm-eating Warbler
Louisiana Waterthrush
Scarlet Tanager
Northern Cardinal
Indigo Bunting

Flesh Run
Indigo Bunting
American Goldfinch
Black-capped Chickadee
Tufted Titmouse
Cedar Waxwing

B. Comparisons between 2006 and 2007 - Constant-effort comparisons between 2006 and 2007 were undertaken at all four 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 all four stations combined decreased substantially and highly significantly, by -43.0% between 2006 and 2007 (Table 4). Decreases between 2006 and 2007 were recorded for 23 of 32 species, a proportion highly significantly greater than 0.50. The number of adults captured of all species pooled decreased at all four stations, by amounts ranging from -38.7% at South Fork Potomac River to -52.9% at Flesh Run. The proportion of decreasing species was significantly or near-significantly greater than 0.50 at three stations (all but Lick Run). Three species experienced significant or near-significant declines across stations, Tufted Titmouse, Ovenbird, and Louisiana Waterthrush.

The number of young birds captured, of all species pooled and for both stations combined, showed a very similar change to that of adults, decreasing substantially and highly significantly (by -69.9%) at all four stations combined (Table 5). Increases between 2006 and 2007 were recorded for 15 of 24 species, a proportion not significantly greater than 0.50. As with adults, young captured for all species pooled decreased at all four stations, by amounts ranging from -61.9% at Flesh Run to -87.5% at Beaver Creek. The proportion of decreasing (or increasing) species was not significantly greater than 0.50 at any station. Two species, Tufted Titmouse and Worm-eating Warbler, showed highly significant declines across stations.

Reproductive index (the number of young per adult) showed a near-significant absolute decrease of -0.343, from 0.725 in 2006 to 0.383 in 2007 for all species and stations combined (Table 6). Decreases in productivity were recorded for 10 of 17 species, a difference not significantly different from 0.50. Reproductive index decreased at all four stations, by amounts ranging from -0.118 at Flesh Run to -0.637 at Lick Run. The proportion of decreasing species was

significantly greater than 0.50 at Lick Run. Four species, Tufted Titmouse, Worm-eating Warbler, Louisiana Waterthrush, and Indigo Bunting showed significant decrease across stations. No species showed significant or near-significant increases in any of the three parameters across stations.

Thus, breeding populations, numbers of young, and reproductive success all showed substantial and significant or near-significant decreases between 2006 and 2007 which were both region wide and species wide. It is unusual to have all three parameters change in the same direction at a MAPS location between two years; however, all three of these parameters increased between 2005 and 2006, indicating that varying climatic conditions are perhaps responsible for these differences.

C. Seven-year and three-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 seven-year period 2001-2007 for the Sugar Grove stations and over the three-year period (2005-2007) for the George Washington stations, are presented in Table 7, for all four stations and for both stations at each location combined. As mentioned in previous reports, there is a substantial disparity in capture rates of adults and young between South Fork Potomac River (97.4 and 72.7 individuals per 600 net-hours, respectively) and Beaver Creek (25.9 and 19.2 per 600 net-hours), although the disparity continues to decrease after the addition of each successive year's data. Productivity (number of young per adult), however, continues to be higher at Beaver Creek (0.93) than at South Fork Potomac River (0.75), despite very low productivity at Beaver Creek in 2007 (Table 3). The two George Washington stations have comparable capture rates of adults (35.5 per 600 net-hours at Lick Run and 38.1 at Flesh Run) for the three years 2005-2007 combined. Reproductive index is higher at Lick Run (0.88 young per adult) than at Flesh Run (0.56 young per adult).

As mentioned in last years report, Lick Run and Beaver Creek will be good stations with which to compare population dynamics between Sugar Grove and George Washington National Forest, but South Fork Potomac River and Flesh Run will not be comparable, as hoped for, probably because of the increased edge habitat found at South Fork Potomac River. However, when the two stations at each location are combined, reproductive success values are very similar (0.76 young/adult at Sugar Grove and 0.75 young/adult at George Washington). We thus believe that we can compare trends and other dynamics involving productivity between the two locations.

The overall reproductive index of 0.80 at Sugar Grove and George Washington is excellent as compared with the mean value of 0.43 calculated for all species pooled in the Northeast MAPS Region, during the 12-year period 1992-2003. Of the eight target species, three (Carolina Wren, Worm-eating Warbler, and Ovenbird) showed substantially (> 50%) higher productivity at Sugar Grove and George Washington National Forest than in the Northeast Region, four (Tufted Titmouse, Gray Catbird, Song Sparrow, and Indigo Bunting) showed comparable productivity values, and one (Northern Cardinal) showed substantially lower productivity at Sugar Grove and George Washington National Forest than in the Northeast Region. This indicates that

productivity is good at Sugar Grove and George Washington, at least compared with the region as a whole.

D. Seven-year trends in adult population size and productivity - "Chain" indices of adult population size and productivity, at all four stations combined, are presented in Figures 1 and 2 for eight target species and for all species pooled. 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*) and Productivity Trend (*PrT*) for the population. APC and *PrT* along with the standard errors of the slopes (*SE*), the correlation coefficients (*r*), and the significance levels of the correlations (*P*) for each target species and for all species pooled are included in Figures 1 and 2.

The population trend for all species pooled was substantially (absolute $r > 0.5$) but not significantly ($P = 0.207$) negative between 2001 and 2007 (Figure 1), showing an annual decrease of 4.5%. This compares with a increasing trend of 1.9% per year after six years of data (2001-2006) had been analyzed, a change that reflects the substantially decreased breeding populations in 2007 and shows how these values can vary after just 6-7 years of data have been collected. Substantial seven-year declines were noted for three of the eight species, with that of Song Sparrow being highly significant ($P = 0.001$) and those of Carolina Wren and Indigo Bunting being nearly significant ($P = 0.089$ and 0.051, respectively). The remaining five species showed non-substantial trends, with that of Ovenbird being positive ($r = 0.306$) and highly fluctuating (*SE* of the slope < 0.071), that of Tufted Titmouse being essentially flat (absolute $r <$ 0.2) and fluctuating, and those of Gray Catbird, Worm-eating Warbler, and Northern Cardinal being flat and non-fluctuating.

Trends in productivity for all species pooled decreased non-substantially and non-significantly between 2001 and 2007 (Figure 2). Substantial decreases in productivity were noted for two species, Worm-eating Warbler and Ovenbird, neither of which were significant. A substantially increasing but non-significant productivity trend was noted for Carolina Wren. The remaining five species showed non-substantial productivity trends.

Estimates of Adult Survivorship

Estimates of adult survival and recapture probabilities could be obtained for five species, applying both transient models using seven years (2001-2007) of data from Sugar Grove only (Table 8), and applying non-transient models based on three years (2005-2007) of data from all four stations (Table 9). These five species were Gray Catbird, Worm-eating Warbler, Song Sparrow, Northern Cardinal, and Indigo Bunting. The remaining target species had estimates of either 0.0 or 1.0 for survival and/or recapture probability, resulting in unrealistic estimates. Using the transient model (Table 8), the apparent annual adult survival rate (φ) ranged from 0.300 for Gray Catbird and Song Sparrow to 0.711 for Indigo Bunting, with a mean of 0.473. Results from the non-transient model were similar (Table 9): survival rate (φ) ranged from 0.300 for the same two species to 0.745 for Indigo Bunting, with a mean of 0.457. Recapture probability was also very similar using both data sets, ranging from 0.163 for Gray Catbird to 0.416-0.420 for Northern Cardinal, with means of 0.308 using the transient model and 0.274

using the non-transient model. Proportion of residents using the transient model (Table 8) ranged from 0.483 for Worm-eating Warbler to 1.000 for Gray Catbird and Song Sparrow, with a mean of 0.801. The mean C.V. for estimates of these five species based on the transient model (Table 8) was 42.9% which is still considered high (ideally it should be < 30% for accurate survival estimates). However, the mean C.V. for four of these species with six years of data (2001-2006) from Sugar Grove was 49.2% (all but that of Northern Cardinal, which could not be estimated with six years of data), compared with 44.5% with seven years of data, indicating improvement in precision with the additional year of data. Interestingly, the mean C.V. for the five species using the non-transient model (Table 9) was lower, 40.2%, perhaps indicating that the addition of data from George Washington National Forest will be increasing the precision further.

In order to assess survival rate estimates with those of surrounding areas, we compared survival values at Sugar Grove to values estimated from MAPS stations operated in 1992-2003 within Bird Conservation Region (BCR) 28, the Appalachian Mountain Region, in which Sugar Grove is located (Table 8). The mean survival for the five species in the Appalachian Region during 1992-2003 was 0.463, comparable to the 0.473 estimate for these five species using the transient model on data from 2001-2007 at Sugar Grove. Among species, Worm-eating Warbler and Indigo Bunting showed higher survival at Sugar Grove than in the Appalachian Region overall, whereas Gray Catbird, Song Sparrow, and Northern Cardinal showed lower survival at Sugar Grove than in the region overall.

Productivity and Survival as a Function of Body Mass

It has previously been shown that both productivity and survival of birds vary with body mass: on average, the larger the bird the lower the productivity and the higher the survival. Thus, body mass must be considered in order to assess whether or not productivity or survival in a given species is higher or lower than expected,. Figure 3 shows mean productivity indices (Table 7) and non-transient annual adult survival rate estimates (Table 9), recorded at all four stations combined, as a function of mean body mass (log transformed) for 8 (productivity) and 4 (survival) target species for which these parameters could be estimated. The purpose of this analysis was to determine which species showed higher or lower productivity or survival than might be expected given their body mass. The regression line presented on each graph indicates the relationship of productivity and survival with body mass, using data from 210 (productivity) and 89 (survival) species from MAPS data collected across the entire North American continent.

Three of the species shown in Figure 3 (species alpha codes in bold uppercase letters) showed substantial population declines at NIOC Sugar Grove and George Washington National Forest (Figure 1). Carolina Wren (**CARW**) appears to show higher-than average productivity, which is also increasing (Figure 2), but we could not estimate survival for comparison, although with more years of data we may be able to obtain this estimate. Song Sparrow (**SOSP**) shows slightly higher-than-expected productivity and slightly lower-than-expected survival, suggesting that lower survival may be driving population declines. Indigo Bunting (**INBU**) showed the opposite pattern, with lower-than-expected productivity and higher-than-expected survival, suggesting that low productivity at Sugar Grove may be driving the decline.

One species shown in Figure 3 (in regular-font uppercase letters), Ovenbird (OVEN), showed an increasing tendency to the population trend (Figure 1). As with Carolina Wren, Ovenbird showed higher-than average productivity but we could not estimate survival for comparison, although with more years of data we may be able to obtain this estimate. This suggests that good productivity at Sugar Grove may be driving the population increase of this species at Sugar Grove; however, declining productivity (Figure 2) may be of concern.

The remaining four species shown in Figure 3 (in lower-case letters) showed non-substantial (essentially flat) population trends (Figure 1). Two of these species, Worm-eating Warbler (wewa) and Tufted Titmouse (tuti), showed higher-than-expected productivity, with Worm-eating Warbler also showing close-to-expected survival. This suggests that good productivity at Sugar Grove is helping to maintain stable populations for these species, although the declining productivity noted at the stations (Figure 2) may be of concern. The other two species, Gray Catbird (grca) and Northern Cardinal (noca) showed close-to-expected productivity and survival values (survival of Gray Catbird perhaps being a bit low), which would be expected in populations showing stable population trends.

Thus, in summary, higher-than-expected productivity appears to be occurring in five of the eight species at Sugar Grove and George Washington National Forest whereas slightly lower-than expected productivity is only occurring in one or two species. Survival is higher-than-expected in one species, expected in two species, and slightly lower-than expected in two species. These results reinforce those presented above, indicating that productivity is higher at Sugar Grove and George Washington and survival is roughly expected, as compared with values for the Northeast Region as a whole.

DISCUSSION

In previous year's reports (Pyle *et al.* 2006 and Nott *et al.* 2007) based on five or six years (2001-2005 and 2001-2006) of MAPS data we noted that both species richness and 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. 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 last two stations than it was to the South Fork Potomac River station. Thus, we succeeded in duplicating the Beaver Creek station (with the Flesh Run station) but were unsuccessful in duplicating the South Fork Potomac River station. 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 (Pyle *et al.* 2006). Results from seven years of data from Sugar Grove and three year's of data from George Washington National Forest (Table 7) continue to support these conclusions, although the wide differences between South Fork Potomac River and the other three stations appear to be lessening.

A primary goal of the MAPS program is to determine the proximate causes (productivity or survival) accounting for declining landbird population sizes. In this year's report we expanded our analyses aimed at assessing the causes for the observed population trends for eight target species at the two locations. For the first time we are able to obtain survival estimates based on data that include the two George Washington stations, and the results are encouraging (lower C.V.s were obtained when the George Washington stations were included).

The overall reproductive index of 0.80 for eight target species at Sugar Grove and George Washington National Forest observed during 2001-2007 is excellent as compared with the mean value of 0.43 calculated for these same eight species in the Northeast MAPS Region, during the 12-year period 1992-2003. Three species showed substantially higher productivity at the MAPS stations than in the Northeast Region, whereas only one species (Northern Cardinal) showed substantially lower productivity at the MAPS stations than in the Northeast Region. In addition, when compared to values expected based on body mass, higher-than-expected productivity appears to be occurring in five of the eight species at Sugar Grove whereas slightly lower-than expected productivity is only occurring in two species, reinforcing the fact that productivity is higher at Sugar Grove and George Washington than is indicated for the Northeast Region. The population dynamics of Sugar Grove's breeding species thus could be affected through appropriate management action which may server to enhance productivity.

Management could be applied to increase the productivity of Indigo Bunting, a species with lower-than-expected productivity and a declining population trend at Sugar Grove; the Breeding Bird Survey (BBS, Sauer *et al.* 2007) also shows a long term decline of Indigo Buntings across West Virginia. In fact, over the most recent decade (1997-2006) the BBS trend estimate showed a highly significant decline of nearly 4% per annum ($P<0.0001$). This suggests that the proximal

causes of the decline may be operating during the non-breeding season. Nevertheless, management actions designed to increase nesting opportunities by ensuring the availability of dense understory in open edgy woodland may increase local productivity and lead to higher rates of recruitment. Such habitat is common to regenerating forest gaps and the edges of cut areas. Further south in Georgia Indigo Bunting populations have also been reported to respond positively to Red-cockaded Woodpecker management by increased numbers and productivity three years after an understory burn.

Breeding populations, numbers of young, and reproductive success all showed substantial and significant or near-significant decreases between 2006 and 2007 which were generally both region wide and species wide. It is unusual to have all three parameters change in the same direction at a MAPS location between two years. Thus, 2007 was an extremely poor year for landbirds in the Appalachian Region, perhaps due to weather or climatic influences.

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 that changes in productivity in turn have 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 informed inferences regarding the effect of survivorship on population dynamics. Pooling data at this level will also allow comparison between NIOC Sugar Grove, George Washington National Forest, and other protected and unprotected areas at which MAPS stations are operated in the region. Finally, MAPS data from NIOC 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.

MAPS data collected at Sugar Grove data also contributed to a recent report submitted to the Virginia Division of Natural Resources which documented landbird demographics for 23 species of greatest conservation need within Virginia and 150km of the Virginia border. Of those 23 species Sugar Grove contributed data for six species: Gray Catbird, Black-and-white Warbler, Worm-eating Warbler, Ovenbird, Louisiana Waterthrush, and Eastern Towhee.

The long-term goal for the NIOC Sugar Grove and George Washington National Forest MAPS program is to continue to monitor the primary demographic parameters of landbirds on these installations, 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) determine the proximate demographic factor(s) (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, Nott et al 2003a, Nott and Michel 2005); (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 installations and elsewhere (Nott 2000, Nott *et al.* 2003a).

In addition, MAPS data from NIOC 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. Very recently we undertook an analysis of the entire MAPS program in the Northeastern Region for the Northeast Coordinated Bird Monitoring Partnership (DeSante *et al.* 2008). In this report it was recommended that the MAPS program be increased by about 50% throughout the Northeastern United States. We also analyzed capture results from all 183 stations that have operated in the Northeast Region and made recommendations to either continue or to relocate active MAPS stations, depending on their contributions to understanding population dynamics of species of concern in the region. All four of the Sugar Grove and George Washington stations were contributing adequately to our understanding of population dynamics for species of concern within Bird Conservation Region 28, the Appalachian Mountains, receiving a mean priority score of 35.8, compared with a mean score of 28.4 for all MAPS stations in the region; thus, the recommendation of the report was to continue operating all four stations.

We conclude that the MAPS protocol is well-suited to provide an integral component of NIOC Sugar Grove's long-term ecological monitoring effort, and we recommend the continued operation of the NIOC Sugar Grove MAPS stations well into the future.

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Table 1. Summary of the 2007 MAPS program on Naval Security Group Activity (NSGA) Sugar Grove and the George Washington National Forest.

Station					Avg	2007 operation		
Name	Code	No.	Major Habitat Type	Latitude-longitude	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	359.8 (318.5)	6	6/13 - 7/30
Beaver Creek	BECR	15628	Steep slope, open mixed forest, grassland edge; no understory	38°30'40"N, -79°16'26"W	658	320.2 (300.2)	6	6/14 - 7/31
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	338.7 (325.3)	6	6/16 - 8/01
Flesh Run	FLRU	15666	Virginia pine forest on steep ridgeside, open maple woodland	38°27'18"N, -79°17'36"W	718	345.7 (288.0)	6	6/19 - 8/02
ALL STATIONS COMBINED						1364.3(1232.0)	6	6/13 - 8/02

[1] Total net-hours in 2007. Net-hours in 2007 that could be compared in a constant-effort manner to 2006 are shown in parentheses.

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 2007. 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
Eastern Screech-Owl		1												1	
Ruby-throated Hummingbird		1									4			5	
Downy Woodpecker				1						1			2		
Northern Flicker				1									1		
Pileated Woodpecker					2									2	
Eastern Wood-Pewee	1												1		
Blue-headed Vireo										2			2		
Red-eyed Vireo	1									6			7		
Blue Jay				1						1			2		
Black-capped Chickadee									1	6		1	6		2
Tufted Titmouse				2	1		3			2			7	1	
White-breasted Nuthatch										1			1		
Carolina Wren	8	1	9		1		3		1	1	1		12	3	10
Veery							1						1		
Wood Thrush	1						1						2		
American Robin	6		1										6		1
Gray Catbird	8	1	1										8	1	1
Cedar Waxwing										2			2		
Northern Parula	1												1		
Chestnut-sided Warbler										1			1		
Black-throated Green Warbler										2			2		
Black-and-white Warbler							1	1		3	1		4	2	
American Redstart										1			1		
Worm-eating Warbler	9		2	4		2	3		1	1			17		5
Ovenbird	4		4	3		2	4		2	2	1		13	1	8
Northern Waterthrush	2			1									3		

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 2007. 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
Louisiana Waterthrush			1				2	1	4	1			3	1	5
Scarlet Tanager				1							1		1	1	
Eastern Towhee	2						1				1		3	1	
Chipping Sparrow										2			2		
Song Sparrow	3												3		
Northern Cardinal	1		4				2		1				3		5
Indigo Bunting	5		1	2		2	3		2	5		1	15		6
Baltimore Oriole			1												1
American Goldfinch										6	1		6	1	
ALL SPECIES POOLED	52	4	24	16	4	6	24	2	12	46	10	2	138	20	44
Total Number of Captures		80			26			38			58			202	
Number of Species	14	4	9	9	3	3	11	2	7	19	7	2	31	12	10
Total Number of Species		18			11			12			22			35	

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 2007.

	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
Downy Woodpecker				0.0	1.9	und.[1]				0.0	1.7	und.[1]	0.0	0.9	und.[1]
Northern Flicker				1.9	0.0	0.00							0.4	0.0	0.00
Eastern Wood-Pewee	1.7	0.0	0.00										0.4	0.0	0.00
Blue-headed Vireo										0.0	1.7	und.	0.0	0.4	und.
Red-eyed Vireo	1.7	0.0	0.00							1.7	1.7	1.00	0.9	0.4	0.50
Blue Jay				0.0	0.0	0.00				0.0	0.0	0.00	0.0	0.0	und.
Black-capped Chickadee							1.8	0.0	0.00	5.2	6.9	1.33	1.8	1.8	1.00
Tufted Titmouse				1.9	0.0	0.00	3.5	1.8	0.50	3.5	0.0	0.00	2.2	0.4	0.20
White-breasted Nuthatch										0.0	1.7	und.	0.0	0.4	und.
Carolina Wren	6.7	8.3	1.25				0.0	3.5	und.[1]	0.0	1.7	und.	1.8	3.5	2.00
Veery							0.0	1.8	und.				0.0	0.4	und.
Wood Thrush	0.0	0.0	0.00				0.0	1.8	und.				0.0	0.4	und.
American Robin	3.3	6.7	2.00										0.9	1.8	2.00
Gray Catbird	10.0	3.3	0.33										2.6	0.9	0.33
Cedar Waxwing										3.5	0.0	0.00	0.9	0.0	0.00
Northern Parula	0.0	0.0	0.00										0.0	0.0	und.
Chestnut-sided Warbler										0.0	0.0	0.00	0.0	0.0	und.
Black-throated Green Warbler										1.7	1.7	1.00	0.4	0.4	1.00
Black-and-white Warbler							1.8	1.8	1.00	1.7	3.5	2.00	0.9	1.3	1.50
American Redstart										0.0	1.7	und.	0.0	0.4	und.

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 2007.

	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
Worm-eating Warbler	13.3	1.7	0.13	9.4	0.0	0.00	3.5	0.0	0.00	1.7	0.0	0.00	7.0	0.4	0.06
Ovenbird	6.7	0.0	0.00	5.6	1.9	0.33	1.8	1.8	1.00	0.0	1.7	und.	3.5	1.3	0.38
Northern Waterthrush	0.0	1.7	und.[1]	0.0	0.0	0.00							0.0	0.4	und.
Louisiana Waterthrush	1.7	0.0	0.00				3.5	0.0	0.00	0.0	0.0	0.00	1.3	0.0	0.00
Scarlet Tanager				1.9	0.0	0.00							0.4	0.0	0.00
Eastern Towhee	3.3	0.0	0.00				1.8	0.0	0.00				1.3	0.0	0.00
Chipping Sparrow										1.7	1.7	1.00	0.4	0.4	1.00
Song Sparrow	3.3	1.7	0.50										0.9	0.4	0.50
Northern Cardinal	5.0	0.0	0.00				3.5	1.8	0.50				2.2	0.4	0.20
Indigo Bunting	10.0	0.0	0.00	5.6	0.0	0.00	3.5	0.0	0.00	8.7	1.7	0.20	7.0	0.4	0.06
Baltimore Oriole	1.7	0.0	0.00										0.4	0.0	0.00
American Goldfinch										6.9	1.7	0.25	1.8	0.4	0.25
ALL SPECIES POOLED	68.4	23.3	0.34	26.2	3.7	0.14	24.8	14.2	0.57	36.5	29.5	0.81	39.6	18.0	0.46
Number of Species	13	6		6	2		9	7		10	13		22	22	
Total Number of Species		14			7			12			16			29	

[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 2006 and 2007 in the numbers of individual ADULT birds captured at four constant-effort MAPS stations on Naval Security Group Activity Sugar Grove and the George Washington National Forest .

Species	S. Fork. Potomac R	Beaver Creek	Lick Run	Flesh Run	n[1]	All four stations combined: Number of adults 2006	Number of adults 2007	Percent change	SE[2]	
Downy Woodpecker					0	0	0			
Hairy Woodpecker				-100.0	1	1	0	-100.0		
Northern Flicker		++++[3]			1	0	1	++++[3]		
Eastern Wood-Pewee	++++[3]				1	0	1	++++		
Acadian Flycatcher			-100.0		1	1	0	-100.0		
Eastern Phoebe				-100.0	1	1	0	-100.0		
White-eyed Vireo	-100.0				1	1	0	-100.0		
Blue-headed Vireo					0	0	0			
Red-eyed Vireo	-100.0			-100.0	2	6	0	-100.0	88.9	
Blue Jay		-100.0		-100.0	2	3	0	-100.0	88.9	
Black-capped Chickadee	-100.0		-66.7	-25.0	3	8	4	-50.0	18.8	
Tufted Titmouse	-100.0	-50.0	-60.0	0.0	4	11	5	-54.5	15.2	**
White-breasted Nuthatch					0	0	0			
Carolina Wren	-33.3	-100.0			2	7	4	-42.9	16.3	
Veery					0	0	0			
Hermit Thrush		-100.0			1	1	0	-100.0		
Wood Thrush					0	0	0			
American Robin	++++			-100.0	2	1	2	100.0	400.0	
Gray Catbird	20.0				1	5	6	20.0		
Brown Thrasher	-100.0				1	1	0	-100.0		
Cedar Waxwing				++++[3]	1	0	2	++++		
Northern Parula		-100.0		-100.0	2	3	0	-100.0	88.9	
Black-throated Green Warbler				-50.0	1	2	1	-50.0		
Pine Warbler					0	0	0			
Black-and-white Warbler	-100.0	-100.0	++++[3]	++++	4	5	2	-60.0	50.2	
American Redstart	-100.0				1	3	0	-100.0		

Table 4. (cont.) Percentage changes between 2006 and 2007 in the numbers of individual ADULT birds captured at four constant-effort MAPS stations on Naval Security Group Activity Sugar Grove and the George Washington National Forest .

						All four stations combined				
						Number of adults				
Species	S. Fork. Potomac R	Beaver Creek	Lick Run	Flesh Run	n[1]	2006	2007	Percent change	SE[2]	
Worm-eating Warbler	-38.5	150.0	-50.0	++++	4	19	16	-15.8	28.9	
Ovenbird	-25.0	-25.0	0.0	-100.0	4	11	7	-36.4	15.4	*
Northern Waterthrush					0	0	0			
Louisiana Waterthrush	-66.7	-100.0	-33.3		3	10	3	-70.0	20.0	*
Hooded Warbler		-100.0			1	1	0	-100.0		
Scarlet Tanager		++++			1	0	1	++++		
Eastern Towhee	-33.3		++++		2	3	3	0.0	66.7	
Chipping Sparrow				-75.0	1	4	1	-75.0		
Song Sparrow	0.0				1	2	2	0.0		
Northern Cardinal	-60.0		++++		2	5	4	-20.0	80.0	
Indigo Bunting	-14.3	100.0	-71.4	-60.0	4	20	12	-40.0	19.2	
Baltimore Oriole	0.0				1	1	1	0.0		
American Goldfinch		-100.0		-25.0	2	6	3	-50.0	33.3	
ALL SPECIES POOLED	-38.7	-40.9	-41.7	-52.9	4	142	81	-43.0	3.5	***
No. species that increased4	3(2)	4(2)	3(3)	3(3)				6(4)		
No. species that decreased5	14(7)	10(8)	6(1)	12(7)				23(11)		
No. species remained same	2	0	1	1				3		
Total Number of Species	19	14	10	16				32		
Proportion of increasing (decreasing) species	(0.737)	(0.714)	(0.600)	(0.750)				(0.719)		
Sig. of increase (decrease)[6]	(0.032)	(0.090)	(0.377)	(0.038)				(0.010)		
	**	*		**				***		

Table 4. (cont.) Percentage changes between 2006 and 2007 in the numbers of individual ADULT birds captured at four constant-effort MAPS stations on Naval Security Group Activity Sugar Grove and the George Washington National Forest .

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[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 2006.
[4] No. of species for which adults were captured in 2007 but not in 2006 are in parentheses.
[5] No. of species for which adults were captured in 2006 but not in 2007 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 2006 and 2007 in the numbers of individual YOUNG birds captured at four constant-effort MAPS stations on Naval Security Group Activity Sugar Grove and the George Washington National Forest.

Species	S. Fork. Potomac R	Beaver Creek	Lick Run	Flesh Run	n[1]	All four stations combined: Number of young 2006	All four stations combined: Number of young 2007	All four stations combined: Percent change	All four stations combined: SE[2]	
Downy Woodpecker		++++[3]			1	0	1	++++[3]		
Hairy Woodpecker					0	0	0			
Northern Flicker					0	0	0			
Eastern Wood-Pewee					0	0	0			
Acadian Flycatcher			-100.0		1	1	0	-100.0		
Eastern Phoebe			-100.0		1	1	0	-100.0		
White-eyed Vireo					0	0	0			
Blue-headed Vireo				++++[3]	1	0	1	++++		
Red-eyed Vireo					0	0	0			
Blue Jay			-100.0		1	1	0	-100.0		
Black-capped Chickadee	-100.0	-100.0	-100.0	0.0	4	9	4	-55.6	34.2	
Tufted Titmouse	-100.0	-100.0	-85.7	-100.0	4	20	1	-95.0	4.4	***
White-breasted Nuthatch				++++	1	0	1	++++		
Carolina Wren	33.3	-100.0	0.0		3	10	6	-40.0	46.6	
Veery			++++[3]		1	0	1	++++		
Hermit Thrush					0	0	0			
Wood Thrush			0.0		1	1	1	0.0		
American Robin	100.0			-100.0	2	7	4	-42.9	81.6	
Gray Catbird	-33.3				1	3	2	-33.3		
Brown Thrasher					0	0	0			
Cedar Waxwing					0	0	0			
Northern Parula					0	0	0			
Black-throated Green Warbler					0	0	0			
Pine Warbler				-100.0	1	1	0	-100.0		
Black-and-white Warbler	-100.0		++++	-100.0	3	4	1	-75.0	39.0	
American Redstart					0	0	0			

Table 5. (cont.) Percentage changes between 2006 and 2007 in the numbers of individual YOUNG birds captured at four constant-effort MAPS stations on Naval Security Group Activity Sugar Grove and the George Washington National Forest.

Species	S. Fork. Potomac R	Beaver Creek	Lick Run	Flesh Run	n[1]	All four stations combined: Number of young 2006	All four stations combined: Number of young 2007	All four stations combined: Percent change	All four stations combined: SE[2]	
Worm-eating Warbler	-94.1	-100.0	-100.0		3	23	1	-95.7	1.8	***
Ovenbird	-100.0	++++	-66.7	++++	4	5	3	-40.0	46.6	
Northern Waterthrush	++++[3]				1	0	1	++++		
Louisiana Waterthrush	-100.0	-100.0	-100.0		3	11	0	-100.0	88.9	
Hooded Warbler					0	0	0			
Scarlet Tanager					0	0	0			
Eastern Towhee	-100.0				1	1	0	-100.0		
Chipping Sparrow					0	0	0			
Song Sparrow	0.0				1	1	1	0.0		
Northern Cardinal			++++	-100.0	2	1	1	0.0	200.0	
Indigo Bunting	-100.0		-100.0	-100.0	3	3	0	-100.0	88.9	
Baltimore Oriole					0	0	0			
American Goldfinch				++++	1	0	1	++++		
ALL SPECIES POOLED	-64.9	-87.5	-72.4	-61.9	4	103	31	-69.9	4.3	***
No. species that increased[4]	3(1)	2(2)	3(3)	4(4)				6(6)		
No. species that decreased[5]	9(7)	5(5)	9(7)	6(6)				15(7)		
No. species remained same	1	0	2	1				3		
Total Number of Species	13	7	14	11				24		
Proportion of increasing (decreasing) species	(0.692)	(0.714)	(0.643)	(0.545)				(0.625)		
Sig. of increase (decrease)[6]	(0.133)	(0.227)	(0.212)	(0.500)				(0.154)		

Table 5. (cont.) Percentage changes between 2006 and 2007 in the numbers of individual YOUNG birds captured at four constant-effort MAPS stations on Naval Security Group Activity Sugar Grove and the George Washington National Forest.

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[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 2006.
[4] No. of species for which young birds were captured in 2007 but not in 2006 are in parentheses.
[5] No. of species for which young birds were captured in 2006 but not in 2007 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. Changes between 2006 and 2007 in the REPRODUCTIVE INDEX (young/adult) at four constant-effort MAPS stations on Naval Security Group Activity Sugar Grove and the George Washington National Forest.

Species	S. Fork. Potomac R	Beaver Creek	Lick Run	Flesh Run	n[1]	All four stations combined: Reproductive Index 2006	Reproductive Index 2007	Change	SE[2]	
Downy Woodpecker		nc.[3]			1	und.[4]	und.[4]	nc.[3]		
Hairy Woodpecker				nc.[3]	1	0.000	und.	nc.		
Northern Flicker		nc.			1	und.	0.000	nc.		
Eastern Wood-Pewee	nc.[3]				1	und.	0.000	nc.		
Acadian Flycatcher			nc.[3]		1	1.000	und.	nc.		
Eastern Phoebe			nc.	nc.	2	1.000	und.	nc.		
White-eyed Vireo	nc.				1	0.000	und.	nc.		
Blue-headed Vireo				nc.	1	und.	und.	nc.		
Red-eyed Vireo	nc.			nc.	2	0.000	und.	nc.		
Blue Jay		nc.	nc.	nc.	3	0.333	und.	nc.		
Black-capped Chickadee	nc.	nc.	-1.000	0.333	4	1.125	1.000	-0.125	0.443	
Tufted Titmouse	nc.	-2.000	-0.900	-3.000	4	1.818	0.200	-1.618	0.381	**
White-breasted Nuthatch				nc.	1	und.	und.	nc.		
Carolina Wren	0.500	nc.	nc.		3	1.429	1.500	0.071	1.488	
Veery			nc.		1	und.	und.	nc.		
Hermit Thrush		nc.			1	0.000	und.	nc.		
Wood Thrush			nc.		1	und.	und.	nc.		
American Robin	nc.			nc.	2	7.000	2.000	-5.000	4.000	
Gray Catbird	-0.267				1	0.600	0.333	-0.267		
Brown Thrasher	nc.				1	0.000	und.	nc.		
Cedar Waxwing				nc.	1	und.	0.000	nc.		
Northern Parula		nc.		nc.	2	0.000	und.	nc.		
Black-throated Green Warbler				0.000	1	0.000	0.000	0.000		
Pine Warbler				nc.	1	und.	und.	nc.		
Black-and-white Warbler	nc.	nc.	nc.	nc.	4	0.800	0.500	-0.300	0.969	
American Redstart	nc.				1	0.000	und.	nc.		

Table 6. (cont.) Changes between 2006 and 2007 in the REPRODUCTIVE INDEX (young/adult) at four constant-effort MAPS stations on Naval Security Group Activity Sugar Grove and the George Washington National Forest.

						All four stations combined				
						Reproductive Index				
Species	S. Fork. Potomac R	Beaver Creek	Lick Run	Flesh Run	n[1]	2006	2007	Change	SE[2]	
Worm-eating Warbler	-1.183	-0.500	-1.250	nc.	4	1.211	0.063	-1.148	0.124	***
Ovenbird	-0.500	0.333	-2.000	nc.	4	0.455	0.429	-0.026	0.448	
Northern Waterthrush	nc.				1	und.	und.	nc.		
Louisiana Waterthrush	-0.667	nc.	-1.333		3	1.100	0.000	-1.100	0.195	**
Hooded Warbler		nc.			1	0.000	und.	nc.		
Scarlet Tanager		nc.			1	und.	0.000	nc.		
Eastern Towhee	-0.333		nc.		2	0.333	0.000	-0.333		
Chipping Sparrow				0.000	1	0.000	0.000	0.000		
Song Sparrow	0.000				1	0.500	0.500	0.000		
Northern Cardinal	0.000		nc.	nc.	3	0.200	0.250	0.050	0.409	
Indigo Bunting	-0.143	0.000	-0.143	-0.200	4	0.150	0.000	-0.150	0.017	***
Baltimore Oriole	0.000				1	0.000	0.000	0.000		
American Goldfinch		nc.		0.333	2	0.000	0.333	0.333		
ALL SPECIES POOLED	-0.255	-0.573	-0.637	-0.118	4	0.725	0.383	-0.343	0.136	*
No. species that increased	1	1	0	2				3		
No. species that decreased	6	2	6	2				10		
No. species remained same	3	1	0	2				4		
Total Number of Species5	10	4	6	6				17		
Proportion of increasing (decreasing) species	(0.600)	(0.500)	(1.000)	(0.333)				(0.588)		
Sig. of increase (decrease)[6]	(0.154)	(0.688)	(0.016) **	(0.891)				(0.315)		

Table 6. (cont.) Changes between 2006 and 2007 in the REPRODUCTIVE INDEX (young/adult) at four constant-effort MAPS stations on Naval Security Group Activity Sugar Grove and the George Washington National Forest.

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[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 undefined at this station because no adult individual of the species was captured in 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 four individual MAPS stations operated on Naval Security Group Activity Sugar Grove and the George Washington National Forest averaged over the seven years, 2001-2007[1]. Data for each species are included only from stations that lie within the breeding range of the species.

Species	South Fork Potomac River 2001-2007			Beaver Creek 2001-2007			Both NGSA stations pooled 2001-2007			Lick Run 2005-2007			Flesh Run 2005-2007			Both George W. stations pooled 2005-2007			All four stations pooled 2001-2007[1,3]		
	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]
Yellow-billed Cuckoo				0.2	0.0	0.00	0.1	0.0	0.00				0.4	0.0	0.00	0.2	0.0	0.00	0.1	0.0	0.00
Downy Woodpecker	0.4	0.6	0.50	0.0	0.5	und.[4]	0.2	0.5	0.50	0.0	1.3	und.[4]	0.0	0.6	und.[4]	0.0	0.9	und.[4]	0.2	0.6	0.50
Hairy Woodpecker	0.0	0.2	und.[4]	0.4	0.0	0.00	0.2	0.1	0.50	0.4	0.8	2.00	0.4	1.3	0.00	0.4	1.0	2.50	0.2	0.3	1.17
Northern Flicker	0.2	0.0	0.00	0.3	0.0	0.00	0.2	0.0	0.00										0.1	0.0	0.00
Eastern Wood-Pewee	0.2	0.0	0.00				0.1	0.0	0.00										0.1	0.0	0.00
Acadian Flycatcher										0.9	0.4	0.50				0.4	0.2	0.50	0.1	*0.0*	0.50
Eastern Phoebe	1.0	0.0	0.00	0.4	0.0	0.00	0.7	0.0	0.00	0.0	1.3	und.	0.4	0.0	0.00	0.2	0.6	1.00	0.6	0.1	0.38
Great Crested Flycatcher	0.2	0.0	0.00	0.4	0.0	0.00	0.3	0.0	0.00	0.4	0.0	0.00				0.2	0.0	0.00	0.3	0.0	0.00
Eastern Kingbird	0.2	0.0	0.00				0.1	0.0	0.00										*0.0*	*0.0*	*0.00*
White-eyed Vireo	3.1	0.6	0.13				1.6	0.3	0.13										1.5	0.3	0.13
Blue-headed Vireo				0.2	0.4	2.00	0.1	0.2	2.00	0.0	0.8	und.	0.9	0.6	0.00	0.4	0.7	0.00	0.1	0.2	2.00
Red-eyed Vireo	2.2	0.0	0.00	0.0	0.2	und.	1.1	0.1	0.17	1.7	0.0	0.00	3.6	0.6	0.33	2.7	0.3	0.33	1.4	0.2	0.25
Blue Jay	1.0	0.0	0.00	1.0	0.4	0.33	1.0	0.2	0.40	0.4	0.4	1.00	0.9	0.0	0.00	0.7	0.2	0.33	0.9	0.2	0.43
Carolina Chickadee	0.2	0.0	0.00	0.0	0.5	und.	0.1	0.2	0.00										*0.0*	0.2	und.[4]
Black-capped Chickadee	1.4	0.9	0.50	1.4	1.7	0.50	1.4	1.3	1.25	3.6	3.8	0.92	5.2	4.5	0.72	4.4	4.2	1.00	2.2	2.0	1.21
Tufted Titmouse	2.1	2.2	1.25	2.2	4.4	1.75	2.1	3.3	1.39	3.8	3.7	0.63	2.0	2.6	1.50	2.9	3.2	0.70	2.4	3.6	1.42
White-breasted Nuthatch				0.0	0.2	und.	0.0	0.1	und.[4]				0.0	0.6	und.	0.0	0.3	und.	0.0	0.2	und.
Carolina Wren	8.1	8.1	1.11	0.2	2.0	5.00	4.2	5.2	1.32	0.8	3.3	1.50	0.0	1.0	und.	0.4	2.2	2.00	3.4	4.4	1.47
House Wren	0.0	0.2	und.				0.0	0.1	und.										0.0	0.1	und.
Blue-gray Gnatcatcher				0.2	0.0	0.00	0.1	0.0	0.00										0.1	0.0	0.00
Veery										0.0	0.6	und.				0.0	0.3	und.	0.0	0.1	und.
Hermit Thrush				0.6	0.0	0.00	0.3	0.0	0.00										0.1	0.0	0.00
Wood Thrush	0.0	0.4	und.				0.0	0.2	und.	0.0	1.0	und.				0.0	0.5	und.	0.0	0.2	und.
American Robin	1.4	2.3	1.00	0.2	0.0	0.00	0.9	1.2	0.83				0.4	2.2	5.00	0.2	1.1	5.00	0.6	1.1	1.08
Gray Catbird	14.1	4.6	0.33				7.3	2.4	0.33	0.0	0.4	und.				0.0	0.2	und.	5.7	1.9	0.34
Brown Thrasher	1.2	1.4	0.38				0.6	0.7	0.38										0.5	0.7	0.38

Table 7. (cont.) Mean numbers of aged individual birds captured per 600 net-hours and reproductive index at the four individual MAPS stations operated on Naval Security Group Activity Sugar Grove and the George Washington National Forest averaged over the seven years, 2001-2007[1]. Data for each species are included only from stations that lie within the breeding range of the species.

Species	South Fork Potomac River 2001-2007			Beaver Creek 2001-2007			Both NGSA stations pooled 2001-2007			Lick Run 2005-2007			Flesh Run 2005-2007			Both George W. stations pooled 2005-2007			All four stations pooled 2001-2007[1,3]		
	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]
Cedar Waxwing	0.5	0.0	0.00				0.3	0.0	0.00				1.6	0.0	0.00	0.8	0.0	0.00	0.4	0.0	0.00
Northern Parula				0.4	0.0	0.00	0.2	0.0	0.00	0.4	0.0	0.00	0.9	0.0	0.00	0.7	0.0	0.00	0.3	0.0	0.00
Yellow Warbler	0.2	0.0	0.00				0.1	0.0	0.00										0.1	0.0	0.00
Chestnut-sided Warbler	0.2	0.0	0.00				0.1	0.0	0.00										*0.0*	*0.0*	*0.00*
Magnolia Warbler	0.4	0.0	0.00				0.2	0.0	0.00				0.4	0.0	0.00	0.2	0.0	0.00	0.3	0.0	0.00
Black-throated Blue Warb.	0.2	0.0	0.00	0.0	0.2	und.	0.1	0.1	0.00										*0.0*	0.1	und.
Black-throated Green Warb.	0.0	0.2	und.				0.0	0.1	und.				1.9	0.6	0.33	0.9	0.3	0.33	0.2	0.2	0.33
Pine Warbler				0.2	0.4	1.00	0.1	0.2	1.00				0.0	0.4	und.	0.0	0.2	und.	*0.0*	0.2	2.00
Black-and-white Warbler	2.8	1.3	0.82	0.2	0.7	0.00	1.5	1.1	1.48	1.0	1.0	1.00	1.0	2.5	1.00	1.0	1.7	1.00	1.3	1.4	1.60
American Redstart	1.3	0.4	0.33				0.7	0.2	0.33				0.0	0.6	und.	0.0	0.3	und.	0.6	0.3	0.33
Worm-eating Warbler	14.0	30.4	2.31	4.7	1.0	0.50	9.6	16.2	1.86	4.2	3.1	0.64	0.6	0.0	0.00	2.4	1.5	0.64	7.9	14.9	1.85
Ovenbird	7.8	8.4	1.47	4.3	1.4	0.81	6.1	5.0	1.21	2.3	3.6	1.50	2.1	0.6	0.00	2.2	2.1	1.18	4.9	5.0	1.27
Northern Waterthrush	1.5	0.4	0.13	0.4	0.0	0.00	1.0	0.2	0.08										0.8	0.1	0.08
Louisiana Waterthrush	1.9	1.5	0.69	1.4	1.6	0.58	1.6	1.6	0.67	3.8	3.9	1.00	0.4	0.8	0.00	2.1	2.3	1.11	1.5	1.6	0.78
Mourning Warbler	0.4	0.0	0.00				0.2	0.0	0.00										0.1	0.0	0.00
Common Yellowthroat	1.5	0.0	0.00	0.2	0.0	0.00	0.9	0.0	0.00										0.6	0.0	0.00
Hooded Warbler	0.2	0.0	0.00	0.2	0.0	0.00	0.2	0.0	0.00	0.0	0.4	und.				0.0	0.2	und.	0.1	*0.0*	0.00
Canada Warbler	0.0	0.6	und.				0.0	0.3	und.										0.0	0.3	und.
Scarlet Tanager	0.4	0.2	0.00	1.0	0.0	0.00	0.7	0.1	0.00										0.5	0.1	0.00
Eastern Towhee	2.2	0.6	0.33				1.2	0.3	0.33	0.6	0.0	0.00				0.3	0.0	0.00	0.9	0.2	0.33
Chipping Sparrow				0.8	3.0	1.67	0.4	1.4	1.67				2.7	0.6	0.33	1.4	0.3	0.33	0.6	1.1	0.67
Song Sparrow	7.4	4.2	0.56				3.9	2.2	0.56										3.5	2.1	0.56
Northern Cardinal	6.6	1.0	0.21				3.4	0.5	0.21	2.5	0.6	0.17	0.4	0.4	0.00	1.4	0.5	0.50	2.9	0.6	0.26
Indigo Bunting	9.1	2.0	0.19	3.9	0.6	0.06	6.6	1.4	0.19	8.5	2.1	0.20	7.2	1.0	0.13	7.9	1.6	0.20	6.9	1.5	0.19
Common Grackle	0.4	0.0	0.00				0.2	0.0	0.00										0.2	0.0	0.00
Baltimore Oriole	1.0	0.0	0.00				0.6	0.0	0.00										0.4	0.0	0.00

Table 7. (cont.) Mean numbers of aged individual birds captured per 600 net-hours and reproductive index at the four individual MAPS stations operated on Naval Security Group Activity Sugar Grove and the George Washington National Forest averaged over the seven years, 2001-2007[1]. Data for each species are included only from stations that lie within the breeding range of the species.

	South Fork Potomac River 2001-2007			Beaver Creek 2001-2007			Both NGSA stations pooled 2001-2007			Lick Run 2005-2007			Flesh Run 2005-2007			Both George W. stations pooled 2005-2007			All four stations pooled 2001-2007[1,3]		
Species	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]	Ad.	Yg.	Repr. Ind.[2]
American Goldfinch	0.2	0.0	0.00	0.6	0.0	0.00	0.4	0.0	0.00				4.5	0.6	0.08	2.3	0.3	0.08	0.7	0.1	0.06
ALL SPECIES POOLED	97.4	72.7	0.75	25.9	19.2	0.93	63.1	47.0	0.76	35.5	32.7	0.88	38.1	22.0	0.56	36.8	27.4	0.75	57.0	46.2	0.80
Number of Species	38	24		26	17		46	32		16	19		21	19		25	27		48	38	
Total Number of Species		43			31			51			23			26			33			58	

[1] Data for seven years (2001-2007) is included for the South Fork Potomac River and Beaver Creek stations and for three years (2005-2007) for the Lick Run and Flesh Run stations.

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

[3] For numbers presented in italics, the mean number of adults or young is greater than 0.1 at one or more stations, but over the entire location the mean number is less than 0.05. The species is counted in the number of species over all stations pooled.

[4] 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 five species breeding at the two MAPS stations on Naval Security Group Activity Sugar Grove obtained from seven years (2001-2007) 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]	Survival prob. Appalachian Mountains 1992-2003[9]
Gray Catbird ‡+	1	67	88	4	0.300 (0.226)	75.2	0.163 (0.215)	1.000 (1.224)	0.499 (0.025)
Worm-eating Warbler	2	79	104	12	0.561 (0.143)	25.6	0.328 (0.153)	0.483 (0.263)	0.470 (0.071)
Song Sparrow ‡+	1	32	54	5	0.300 (0.179)	59.6	0.395 (0.337)	1.000 (0.989)	0.401 (0.051)
Northern Cardinal	1	26	48	7	0.492 (0.180)	36.5	0.420 (0.233)	0.819 (0.548)	0.536 (0.046)
Indigo Bunting	2	49	78	13	0.711 (0.126)	17.7	0.234 (0.101)	0.703 (0.334)	0.409 (0.046)

[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).

[9] Survival probability (φ) presented as the maximum likelihood estimate (standard error of the estimate) for Bird Conservation Region 28,the Appalachian Mountains, over the 12 years 1992-2003.

‡ 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.

Table 9. Estimates of adult annual survival and recapture probabilities and proportion of residents among newly captures adults using a non-transient time-constant model for five species breeding at the four MAPS stations on Naval Security Group Activity Sugar Grove and the George Washington National Forest obtained from seven years (2001-2007)[1] of mark-recapture data.

Species	Num. sta.[2]	Num. ind.[3]	Num. caps.[4]	Num. ret.[5]	Survival probability[6]	Surv. C.V.[7]	Recapture probability[8]
Gray Catbird ‡	1	67	88	4	0.300 (0.220)	73.3	0.163 (0.169)
Worm-eating Warbler	3	89	116	12	0.488 (0.136)	27.9	0.203 (0.098)
Song Sparrow ‡	1	32	54	5	0.300 (0.154)	51.3	0.395 (0.284)
Northern Cardinal	3	31	57	8	0.453 (0.155)	34.2	0.416 (0.211)
Indigo Bunting	3	76	117	20	0.745 (0.107)	14.4	0.195 (0.065)

[1] Data for seven years (2001-2007) is included for the South Fork Potomac River and Beaver Creek stations and for three years (2005-2007) for the Lick Run and Flesh Run stations.

[2] 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.

[3] Number of adult individuals captured at stations where the species was a regular or usual breeder (i.e., number of capture histories).

[4] Total number of captures of adult birds of the species at stations where the species was a regular or usual breeder.

[5] 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.

[6] Survival probability presented as the maximum likelihood estimate (standard error of the estimate).

[7] The coefficient of variation for survival probability.

[8] Recapture probability presented as the maximum likelihood estimate (standard error of the estimate).

[9] The proportion of residents among newly captured adults presented as the maximum likelihood estimate (standard error of the estimate).

[10] Survival probability (φ) presented as the maximum likelihood estimate (standard error of the estimate) for Bird Conservation Region 28, the Appalachian Mountains, over the 12 years 1992-2003.

‡ 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 ($SE(\varphi)>0.200$ or $CV(\varphi)>50.0\%$).

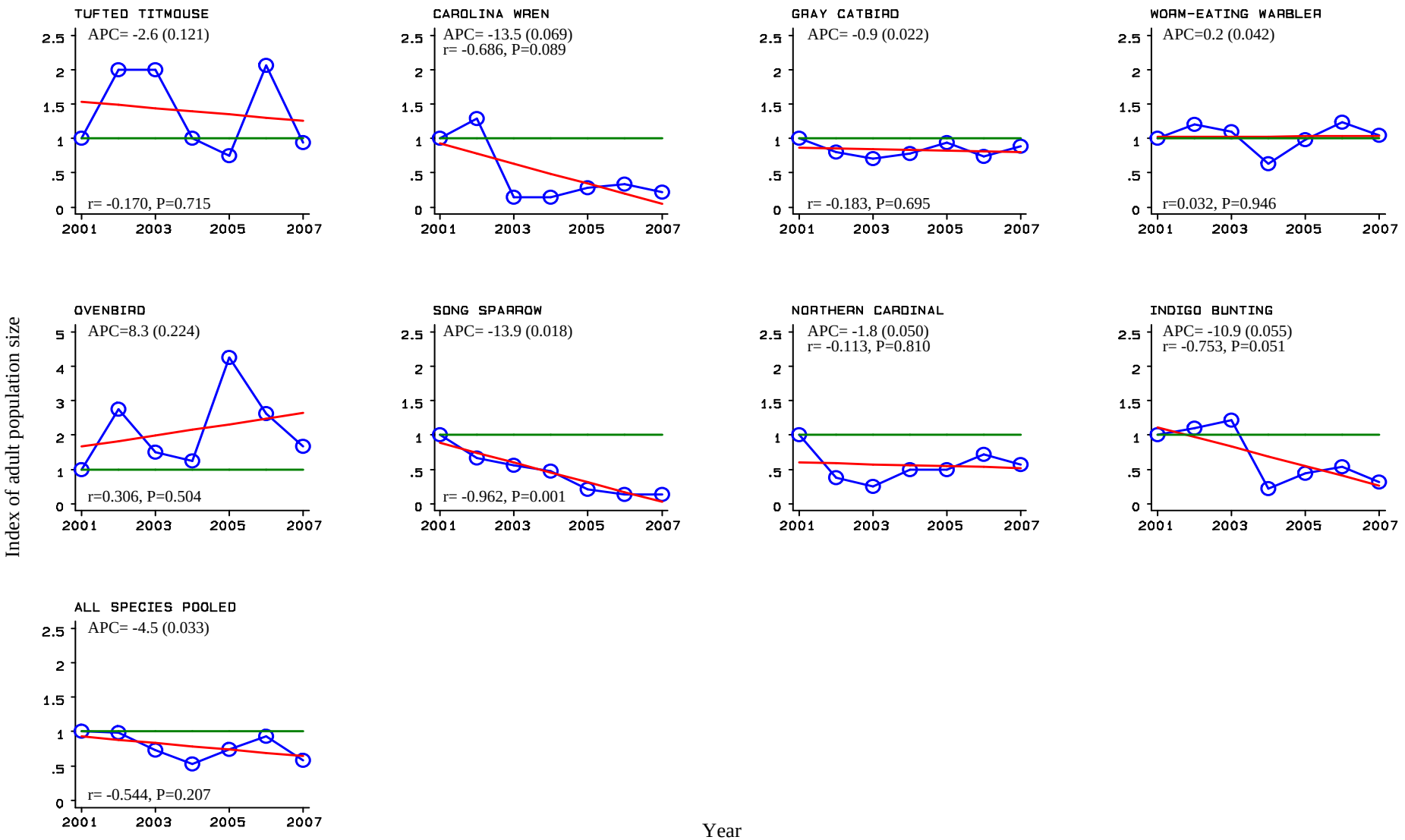

Figure 1. Population trends for eight species and all species pooled at the four MAPS stations combined on Naval Security Group Activity Sugar Grove and the George Washington National Forest over the seven years 2001-2007(2001-2007 for the two NAS Sugar Grove stations and 2005-2007 for the two George Washington NF stations). 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.

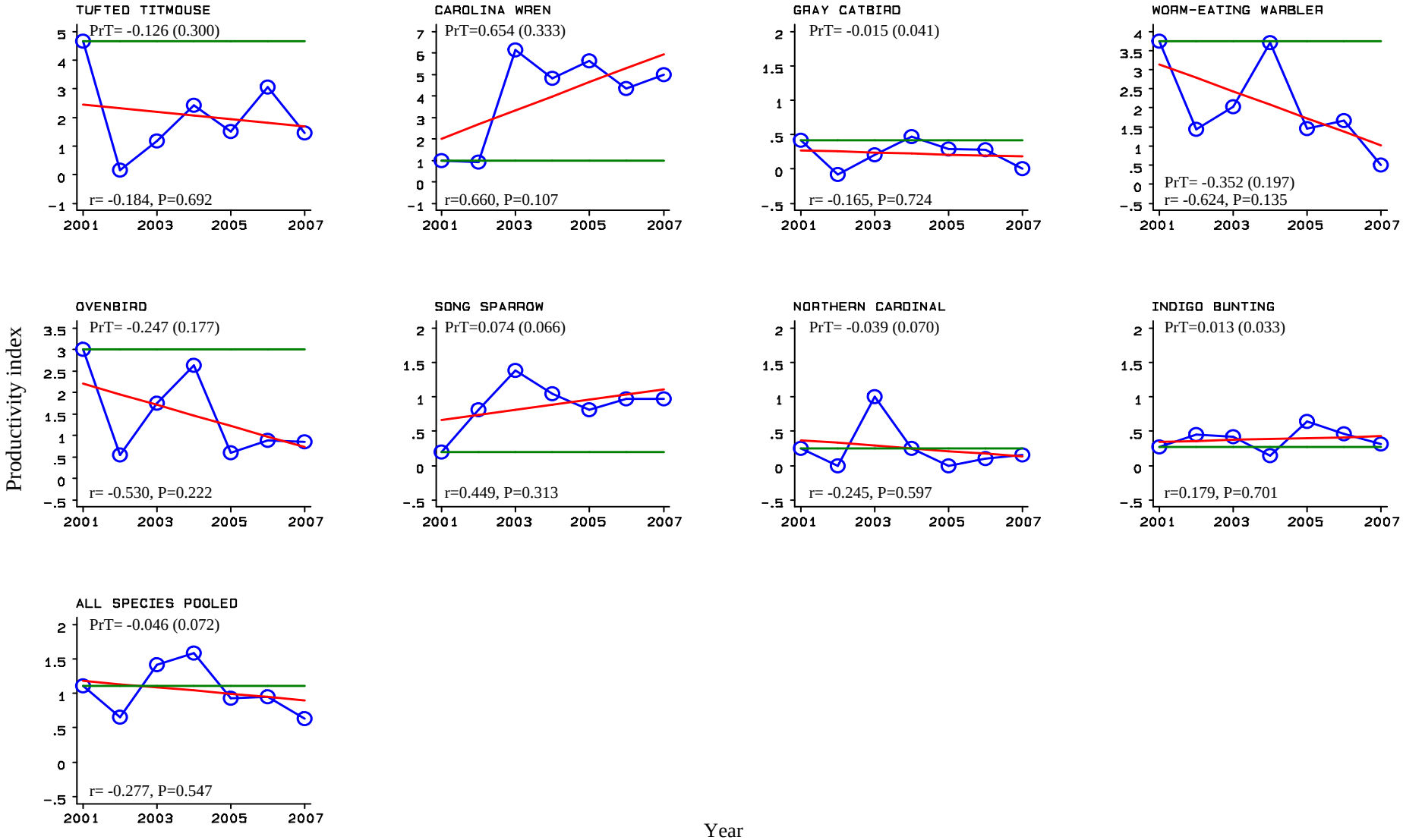

Figure 2. Trend in productivity for eight species and all species pooled at the four MAPS stations combined on Naval Security Group Activity Sugar Grove and the George Washington National Forest over the seven years 2001-2007(2001-2007 for the two NAS Sugar Grove stations and 2005-2007 for the two George Washington NF stations). 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.

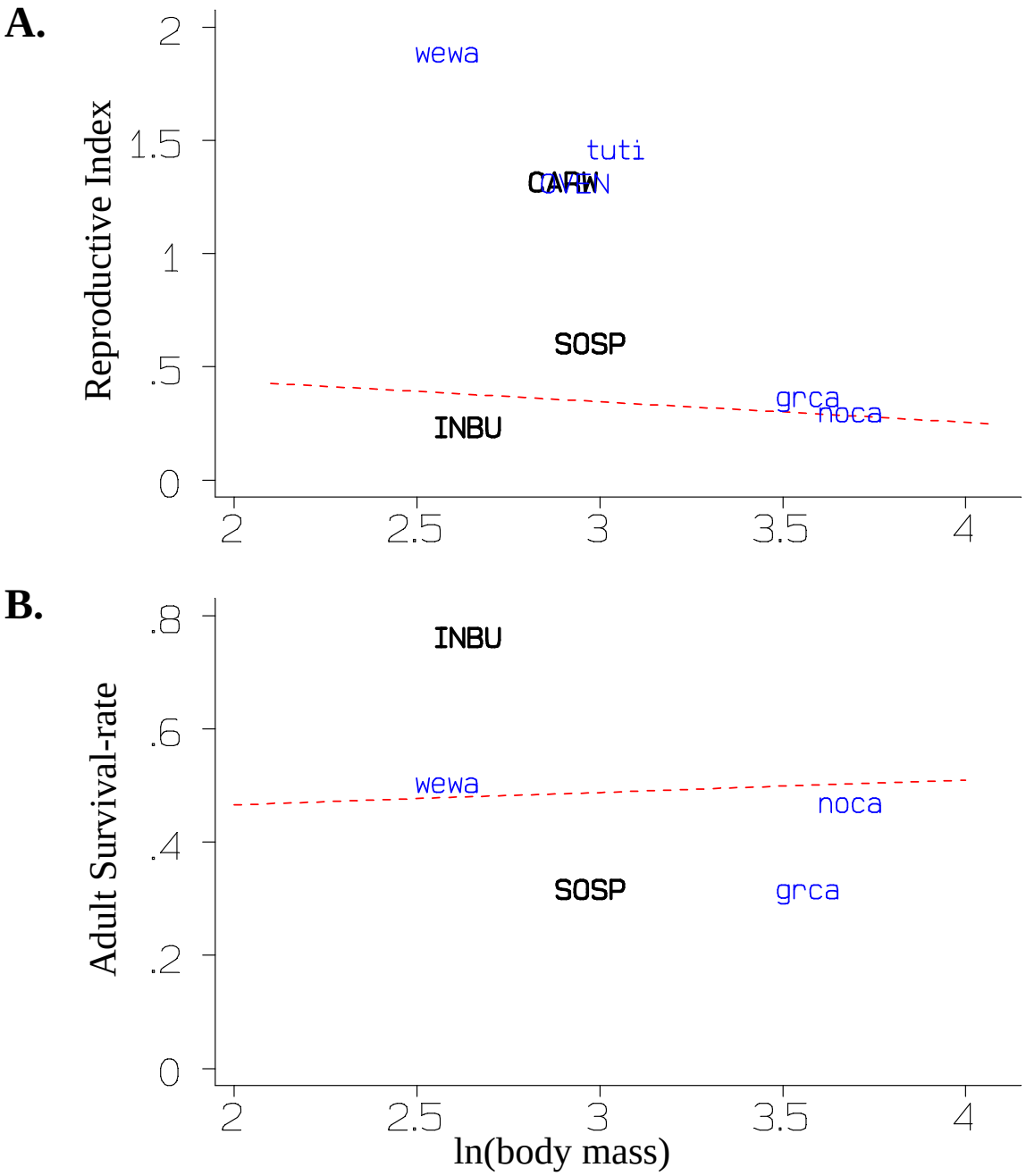

Figure 3. Regressions of mean reproductive index (**A**) and non-transient time-constant annual adult survival rate (**B**) at the four stations combined on Naval Security Group Activity Sugar Grove and the George Washington National Forest on the natural log of body mass for five target species for which survival estimates could be provided and eight target species for which reproductive index was not zero in any years for the seven years 2001-2007 (data was only available for the three years (2005-2007) for the stations on the George Washington NF). Four-letter codes (see Appendix I) in bold upper-case letters represent species that had decreasing population trends; those in non-bold upper-case letters had substantially increasing trends; and those in lower-case letters had highly fluctuating data without any substantial linear trend. A regression line is presented comparing these parameters with mass for species throughout North America (see text).

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 seven years, 2001-2007, of the MAPS Program on the four stations operated on Naval Security Group Activity (NSGA) Sugar Grove and the on George Washington National Forest.

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

NUMB	SPEC	SPECIES NAME	South Fork Potomac River (SFPR)	Beaver Creek (BECR)	Lick Run (LIRU)	Flesh Run (FLRU)
00860	DCCO	Double-crested Cormorant	M			
01010	GBHE	Great Blue Heron	T	T	T	
01130	GRHE	Green Heron	U			
01290	BLVU	Black Vulture		T	T	T
01300	TUVU	Turkey Vulture	T	O	B	B
01460	CANG	Canada Goose	U	T	T	
01570	WODU	Wood Duck	O	T		
01630	MALL	Mallard	T	T		
02020	OSPR	Osprey	T			
02130	BAEA	Bald Eagle	T	T		
02170	NOHA	Northern Harrier		T		
02200	SSHA	Sharp-shinned Hawk		T		
02210	COHA	Cooper's Hawk	T	T	T	O
02380	RSHA	Red-shouldered Hawk		O	T	U
02400	BWHA	Broad-winged Hawk	T	U	U	T
02460	RTHA	Red-tailed Hawk	T	T	T	T
02510	GOEA	Golden Eagle		T		
02630	AMKE	American Kestrel	T	T		
02940	RUGR	Ruffed Grouse	O	O	T	T
03040	WITU	Wild Turkey		U	O	O
03750	SEPL	Semipalmated Plover		M		
03780	KILL	Killdeer	B	B	O	
03970	SOSA	Solitary Sandpiper		M		
04020	SPSA	Spotted Sandpiper	T	T		
04490	AMWO	American Woodcock				T
05570	MODO	Mourning Dove	O	U	B	U
06400	BBCU	Black-billed Cuckoo	T		T	
06410	YBCU	Yellow-billed Cuckoo	U	U	B	U
06680	EASO	Eastern Screech-Owl	T	O		
06800	GHOW	Great Horned Owl	T	T	T	
06950	BADO	Barred Owl		T		

Appendix I. Continued.

NUMB	SPEC	SPECIES NAME	SFPR	BECR	LIRU	FLRU
07080	CONI	Common Nighthawk		O		
07230	WPWI	Whip-poor-will		T	T	
07400	CHSW	Chimney Swift	O	U	T	T
08630	RTHU	Ruby-throated Hummingbird	U	O	U	U
09110	BEKI	Belted Kingfisher	U	O	T	T
09550	RBWO	Red-bellied Woodpecker	O	T	T	T
09650	DOWO	Downy Woodpecker	U	U	B	O
09660	HAWO	Hairy Woodpecker	U	U	U	U
09800	YSFL	Yellow-shafted Flicker	U	U	U	U
09860	PIWO	Pileated Woodpecker	U	B	U	U
11390	EAWP	Eastern Wood-Pewee	O	O	T	T
11450	YBFL	Yellow-bellied Flycatcher		M		
11460	ACFL	Acadian Flycatcher		O	O	U
11610	EAPH	Eastern Phoebe	U	O	U	B
11760	GCFL	Great Crested Flycatcher	U	U	U	U
12030	EAKI	Eastern Kingbird	U	T		T
12550	WEVI	White-eyed Vireo	U		T	
12690	YTVI	Yellow-throated Vireo	O	T		T
12720	BHVI	Blue-headed Vireo	T	U	T	B
12760	WAVI	Warbling Vireo	O	T		
12780	PHVI	Philadelphia Vireo		M		M
12790	REVI	Red-eyed Vireo	B	B	B	B
12930	BLJA	Blue Jay	U	B	B	B
13190	AMCR	American Crow	B	B	B	B
13270	FICR	Fish Crow	O			
13300	CORA	Common Raven	U	B	B	U
13340	PUMA	Purple Martin	U	T		
13410	TRES	Tree Swallow	U	O		
13490	NRWS	Northern Rough-winged Swallow	O			
13510	BANS	Bank Swallow	O			
13520	CLSW	Cliff Swallow	T			
13540	BARS	Barn Swallow	U	U	T	
13560	CACH	Carolina Chickadee	T	O	O	O
13570	BCCH	Black-capped Chickadee	U	B	B	B
13575	UPCH	Unidentified Poecile Chickadee	?			
13660	TUTI	Tufted Titmouse	U	B	B	B
13690	RBNU	Red-breasted Nuthatch	T	O	U	U
13700	WBNU	White-breasted Nuthatch	O	U	B	U
13730	BRCR	Brown Creeper		O		
14000	CARW	Carolina Wren	B	O	B	B
14070	HOWR	House Wren	O			

Appendix I. Continued.

NUMB	SPEC	SPECIES NAME	SFPR	BECR	LIRU	FLRU
14250	RCKI	Ruby-crowned Kinglet	M			
14350	BGGN	Blue-gray Gnatcatcher	U	O	U	O
14560	EABL	Eastern Bluebird	O	T		
14780	VEER	Veery			T	
14790	GCTH	Gray-cheeked Thrush	M			
14820	HETH	Hermit Thrush		O	T	
14830	WOTH	Wood Thrush	T	T	O	
15000	AMRO	American Robin	B	U	T	O
15130	GRCA	Gray Catbird	B		T	
15150	NOMO	Northern Mockingbird	T			
15200	BRTH	Brown Thrasher	U		O	T
15370	EUST	European Starling	U			
15510	AMPI	American Pipit		M		
15550	CEDW	Cedar Waxwing	U	U	O	U
15630	BWWA	Blue-winged Warbler		T		
15730	NOPA	Northern Parula	O	U	U	U
15750	YWAR	Yellow Warbler	T		T	
15760	CSWA	Chestnut-sided Warbler	T			T
15770	MAWA	Magnolia Warbler	T			T
15790	BTBW	Black-throated Blue Warbler	T	T	T	O
15800	MYWA	Myrtle Warbler	T			
15830	BTNW	Black-throated Green Warbler	T	O	U	B
15860	BLBW	Blackburnian Warbler		T		T
15910	PIWA	Pine Warbler	T	U	U	U
15930	PRAW	Prairie Warbler		T		
15970	BLPW	Blackpoll Warbler	M	M		
16030	BAWW	Black-and-white Warbler	U	T	U	U
16040	AMRE	American Redstart	O	T		T
16060	WEWA	Worm-eating Warbler	B	B	B	B
16080	OVEN	Ovenbird	U	U	B	B
16090	NOWA	Northern Waterthrush	T	T	T	
16100	LOWA	Louisiana Waterthrush	U	O	B	U
16130	MOWA	Mourning Warbler	T			
16150	COYE	Common Yellowthroat	O	T		T
16280	HOWA	Hooded Warbler	T	T	T	
16290	WIWA	Wilson's Warbler	M			
16300	CAWA	Canada Warbler	T			
16830	SCTA	Scarlet Tanager	U	B	U	U
17820	EATO	Eastern Towhee	B	T	U	B
18020	CHSP	Chipping Sparrow	U	B	O	B
18050	FISP	Field Sparrow	T			

Appendix I. Continued.

NUMB	SPEC	SPECIES NAME	SFPR	BECR	LIRU	FLRU
18140	GRSP	Grasshopper Sparrow		U		
18230	SOSP	Song Sparrow	B		T	
18270	WTSP	White-throated Sparrow	M			
18560	NOCA	Northern Cardinal	B	O	B	U
18600	RBGR	Rose-breasted Grosbeak	T			
18670	INBU	Indigo Bunting	B	B	B	B
18730	RWBL	Red-winged Blackbird	U	T		
18800	EAME	Eastern Meadowlark	O	T		
18870	COGR	Common Grackle	U	T	O	
18960	BHCO	Brown-headed Cowbird	O	O		
19160	BAOR	Baltimore Oriole	B			
19370	HOFI	House Finch	O	O	T	
19510	AMGO	American Goldfinch	B	B	B	B
19920	HOSP	House Sparrow	O			
20085	UNBI	Unidentified Bird	?			