THE 2003 ANNUAL REPORT OF THE MONITORING AVIAN PRODUCTIVITY AND SURVIVORSHIP (MAPS) PROGRAM AT NAVAL AIR STATION BRUNSWICK AND REDINGTON TRAINING FACILITY

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EXECUTIVE SUMMARY

Since 1989, The Institute for Bird Populations has been coordinating the Monitoring Avian Productivity and Survivorship (MAPS) Program, a cooperative effort among public and private agencies and individual bird banders in North America, to operate a continent-wide network of constant-effort mist-netting and banding stations. The purpose of the MAPS program is to provide annual indices of adult population size and post-fledging productivity, as well as estimates of adult survivorship and recruitment into the adult population, for various landbird species. Broad-scale data on productivity and survivorship are not obtained from any other avian monitoring program in North America and are needed to provide crucial information upon which to initiate research and management actions to reverse the recently-documented declines in North American landbird populations. The system of military installations in the United States may provide one group of ideal locations for this large-scale, long-term biomonitoring because they provide large areas of breeding habitat for Neotropical migratory landbirds that are subject to varying management practices.

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

We sited, established, and operated six MAPS stations on Naval Air Station (NAS) Brunswick and the Redington Training Facility in 2003. These included two stations at NAS Brunswick (Golf Course and Chimney Rock) and four stations at Redington (Potato Nubble, Redington Pond, Blueline Trail, and Highland). Two stations each were selected to sample primarily deciduous forest habitats (Chimney Rock and Redington Pond), primarily mixed deciduous/ coniferous forest habitats (Golf Course and Potato Nubble), and primarily coniferous forest habitats (Blueline Trail and Highland). Ten mist nets at each station were operated for six morning hours per day, on one day per 10-day period, and for seven consecutive 10-day periods between May 31 and August 8.

A total of 361 individual birds of 48 species were newly banded at the two stations during the summer of 2002, various individuals of these species were recaptured a total of 80 times, and 27 birds (many of which were hummingbirds which we do not band) were captured and released unbanded. Thus, a total of 468 captures of 50 species was recorded. The greatest number of captures (118) and species (33) was recorded at the Blueline Trail station and the fewest number of captures (33) and species (13) occurred at the Chimney Rock station.

Capture indices (adults captured/600 net-hrs) suggest that the total adult population size in 2003 was greatest at Blueline Trail, followed by Redington Pond, Highland, Golf Course, Potato

Nubble, and Chimney Rock. The index of productivity, as determined by the proportion of young in the catch, followed a slightly different sequence, being highest at Potato Nubble followed by Blueline Trail, Redington Pond, Highland, Golf Course, and Chimney Rock, where no young birds were captured in 2003. Overall, the eight most abundant breeding species at the six Brunswick and Redington MAPS stations in 2003, as determined by adults captured per 600 net-hrs, were Swainson's Thrush, followed by White-throated Sparrow, Nashville Warbler, Black-capped Chickadee, Magnolia Warbler, Common Yellowthroat, Hermit Thrush, and Ovenbird.

Multivariate ANOVAs showed that population sizes appeared to be fairly similar between the three major habitat types. For all species pooled, numbers were slightly and non-significantly higher in coniferous habitats than in the other two habitat types. Lower breeding populations of Yellow-bellied Flycatcher and Nashville Warbler we found in mixed and deciduous habitats, respectively, than were found in coniferous forest habitats. For all species pooled, we also found that breeding populations were near-significantly lower at Chimney Rock than at Blueline Trail.

Logistic regression analyses of productivity showed that productivity was near-significantly lower in deciduous forest habitats than in coniferous forest habitats. This was caused in part by the fact that productivity at Chimney Rock was zero (no young caught). Productivity at the other NAS Brunswick station, Golf Course, was also very low and was significantly lower than that at the Blueline Trail station. Feral cats were noted by IBP biologists and interns at NAS Brunswick, and these may have been responsible for low productivity noted there. On the other hand, data from military installations elsewhere in eastern U.S. have shown that landscape-scale habitat characteristics, including fragmentation parameters such as mean patch size, amount of forest/agricultural edge, and core area of forest, can have major effects on productivity, presumably by affecting the intensity of nest predation and brood parasitism and by affecting the distribution of habitats needed by young birds during their post-fledging dispersal and preformative molt periods.

Once additional years of data have been gathered, we will be able to further explore these hypotheses and many others concerning landbird dynamics at these two installations. With more years of data not only will we be able to strengthen the power of ANOVA analyses of population levels and logistic regression analyses of productivity (including multivariate examinations of the 13 or more individual target species), we will be able to combine these results with those of constant-effort, year-to-year comparisons of population sizes and productivity to gain insight regarding the effects of local and large-scale weather and climate factors on bird populations. We will also be able examine trends in breeding population size and productivity, make inferences about the long-term population health of the various species, and examine annual estimates of survival and recapture probabilities and proportions of residents among newly captured adults in order to make inferences regarding the effect of survivorship on population dynamics. In addition, pooling data from other current and future MAPS stations along the northern Atlantic seaboard will allow data from Brunswick/ Redington to be compared to data from other military installations, national parks and forests, and other protected areas along the Atlantic seaboard, as well as comparisons of data from these protected landholdings and other unprotected areas along the Atlantic coast.

The long-term goal for the Brunswick and Redington MAPS program is to continue to monitor the primary demographic parameters of landbirds in order to provide critical information to clarify the ecological processes leading from environmental stressors to population responses. We will accomplish this by including Brunswick and Redington data in analyses 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 factor(s) (i.e., productivity or survivorship) causing observed population trends; (c) link MAPS data with landscape-level habitat data and spatially explicit weather data in a geographical information system (GIS); (d) identify relationships between landscape-level habitat and/or weather characteristics and the primary demographic responses (productivity and survival rates) of target species; (e) generate hypotheses regarding the ultimate environmental causes of the population trends; and (f) make comprehensive recommendations for habitat and use-related management goals at both the scale of the installations themselves and the scale of the entire northern Atlantic seaboard.

In addition, MAPS data from NAS Brunswick and Redington Training Facility 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 still larger region-wide (e.g., all of northeastern North American) and continental scales for a substantial number of landbird species. We conclude that the MAPS protocol is well-suited to provide an integral component of Brunswick and Redington's long-term ecological monitoring effort. Based on the above information, we recommend the continued operation of the NAS Brunswick and Redington Training Facility MAPS stations well into the future.

INTRODUCTION

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

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

Landbirds

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

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

of the major cooperating agencies in PIF, the DoD has established long-term avian monitoring efforts at military installations using protocols developed by the Monitoring Working Group of PIF. Clearly, the long-term monitoring goals of the DoD and the monitoring and research goals of PIF share many common elements.

Primary Demographic Parameters

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

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

MAPS

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

Geological Survey [USGS]) to evaluate its utility and effectiveness for monitoring demographic parameters of landbirds.

Now in its 14th year (11th year of standardized protocol and extensive distribution of stations), the MAPS program has expanded greatly from 178 stations in 1992 to over 500 stations in 2002. The substantial growth of the Program since 1992 was caused by its endorsement by PIF and the subsequent involvement of various federal agencies in PIF, including the Department of Defense, Department of the Navy, Department of the Army, Texas Army National Guard, National Park Service, USDA Forest Service, and US Fish and Wildlife Service. Within the past ten years, for example, IBP has been contracted to operate as many as 157 MAPS stations per year on federal properties, including 76 stations on military installations administered by the DoD and the Texas Army National Guard.

Goals and Objectives of MAPS

MAPS is organized to fulfill three tiers of goals and objectives: monitoring, research, and management.

- The specific monitoring goals of MAPS are to provide, for over 100 target species, including many 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, recruitment into the adult population, and population growth rates from modified Cormack- Jolly-Seber (CJS) analyses of mark-recapture data on adult birds.

- The specific research goals of MAPS are to identify and describe:

  (1) 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

  (2) relationships between these patterns and ecological characteristics of the target species, population trends of the target species, station-specific and landscape-level habitat characteristics, and spatially-explicit weather variables.

- The specific management goals of MAPS are to use these patterns and relationships, at the appropriate spatial scales, to:

  (a) identify thresholds and trigger points to notify appropriate agencies and organizations of the need for further research and/or management actions;

  (b) determine the proximate demographic cause(s) of population change;

(c) suggest management actions and conservation strategies to reverse population declines and maintain stable or increasing populations; and

(d) evaluate the effectiveness of the management actions and conservation strategies actually implemented through an adaptive management framework.

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

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

Both long-term objectives are in agreement with the Department of Defense's avian monitoring program. Accordingly, the MAPS program was established on Naval Air Station (NAS) Brunswick and Redington Training Facility in 2003. It is expected that information from the MAPS program will be capable of aiding research and management efforts on these two installations to protect and enhance the installations' avifauna and ecological integrity, while helping them fulfill their military mission in an optimal manner.

Recent Important Results from MAPS

Recent important results from MAPS reported in the peer-reviewed literature include the following. (1) Age ratios obtained during late summer, population-wide mist netting provided a good index to actual productivity in the Kirtland's Warbler (Bart et al. 1999). (2) Measures of productivity and survival derived from MAPS data were consistent with observed population changes at multiple spatial scales (DeSante et al. 1999). (3) Patterns of productivity from MAPS at two large spatial scales (eastern North America and the Sierra Nevada) not only agreed with those found by direct nest monitoring and those predicted from theoretical considerations, but were in general agreement with current life-history theory and were robust with respect to both time and space (DeSante 2000). (4) Modeling spatial variation in MAPS productivity indices and survival-rate estimates as a function of spatial variation in population trends provides a successful means for identifying the proximate demographic cause(s) of population change at multiple spatial scales (DeSante et al. 2001). (5) Productivity of landbirds breeding in Pacific Northwest national forests is affected by global climate cycles including the El Niño Southern Oscillation and the

North Atlantic Oscillation, in such a manner that productivity of Neotropical migratory species is determined more by late winter and early spring weather conditions on their wintering grounds than by late spring and summer weather conditions on their breeding grounds (Nott et al. 2002). These results indicate that MAPS is capable of achieving, and in some cases is already achieving, its objectives and goals.

SPECIFICS OF THE NAVAL AIR STATION BRUNSWICK AND REDINGTON TRAINING FACILITY MAPS PROGRAM

Six MAPS stations were established and operated on Naval Air Station (NAS) Brunswick (two stations), near the coast at Brunswick, Maine, and Redington Training Facility (four stations), in a montane region near Rangeley, Maine, in 2003. In April 2003, IBP Biologist Amy McAndrews, with the assistance of Natural Resource Manager Kari Moore, surveyed each installation and selected sites for stations. The goal was to select stations in three different habitat types, deciduous, mixed, and coniferous forests, and along an elevational gradient such that species diversity on each installation could be inventoried and differences in species composition and productivity between habitat types and elevation could be examined. At NAS Brunswick, two stations were established: 1) Golf Course (GOCO) in mixed (primarily balsam fir/eastern hemlock canopy with deciduous understory) habitat at 13 m elevation at the southwestern end on the installation near the golf course, and 2) Chimney Rock (CHRO) in deciduous (primarily northern red oak) habitat at 18 m elevation on the southeastern edge of the installation. At Redington Training Facility, stations were selected in careful consideration of Survival, Evasion, Resistance, and Escape (SERE) training exercises with the help of Facility Captain Charlton Evans and Chief of SERE Operations Merle Wagg. Four stations were established: 3) Potato Nubble (PONU) in mixed (primarily maple and birch with fir/spruce subdominant) habitat at 488 m elevation near the entrance road at the west end of the installation, 4) Redington Pond (REPO) in deciduous (primarily birch and maple) habitat at 507 m elevation on the east end of Redington Pond, 5) Blueline Trail (BLUE) in lowland coniferous (primarily balsam fir and Eastern hemlock) habitat at 515 m elevation in the central region of the installation near the head of Blueline Trail, and 6) Highland (HGHL) in upland coniferous (primarily balsam fir and red spruce) habitat at 724 m elevation in the north-central region of the installation just south of the High Road. A summary of the major habitats represented at each of the six stations is presented in Table 1 and additional details on the habitat species composition, presence of running or standing water, and history of habitat disturbance to the stations is presented in Table 2.

The six stations were established for operation by Amy McAndrews, with the help of Kari Moore and IBP field biologist interns, Katy Goodwin and Jo Leachman, during May 30 to June 6, 2003. The two field biologist interns had received intensive training during a comprehensive course in mist netting and bird-banding techniques given by IBP biologist Amy McAndrews, which took place May 1-13 at the Jug Bay Wetlands Sanctuary in Maryland. The interns began operation of the Brunswick and Redington stations May 31-June 9. Each station was operated for six morning hours per day (beginning at local sunrise) on one day in each of seven consecutive 10-day periods between Period 4 (beginning May 31), and Period 10 (beginning July 29). The operation of all stations occurred on schedule during each of the seven 10-day periods, although some of the periods at Redington had to be completed in close proximity to one another to avoid conflict with SERE exercises. The interns were supervised by Amy McAndrews for the duration of the field season.

METHODS

The operation of each of the six stations during 2003 followed MAPS protocol, as established for use by the MAPS Program throughout North America and spelled out in the MAPS Manual (DeSante et al. 2003). An overview of both the field and analytical techniques is presented here.

Data Collection

With few exceptions, all birds captured during the course of the study were identified to species, age, and sex and, if unbanded, were banded with USGS/BRD numbered aluminum bands. Birds were released immediately upon capture and before being banded if situations arose where bird safety would be comprised. Such situations could involve exceptionally large numbers of birds being captured at once, or the sudden onset of adverse weather conditions such as high winds or heavy rainfall. The following data were taken on all birds captured, including recaptures, according to MAPS guidelines using standardized codes and forms (DeSante et al. 2003):

(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., presence or absence of a 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) fat class;
(12) wing chord and weight;
(13) date and time of capture (net-run time); and
(14) station and net site where captured.

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

For each of the six stations operated, simple habitat maps were prepared on which up to four major habitat types, as well as the locations of all structures, roads, trails, and streams, were identified and delineated. The pattern and extent of cover of each major habitat type identified at

each station, as well as the pattern and extent of cover of each of four major vertical layers of vegetation (upperstory, midstory, understory, and ground cover) in each major habitat type, were classified into one of twelve pattern types and eleven cover categories according to guidelines spelled out in the MAPS Habitat Structure Assessment (HSA) Protocol, developed by IBP Landscape Ecologist, Philip Nott, and the IBP staff (Nott et al. 2003a). These data are summarized in Table 2.

Computer Data Entry and Verification

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

(1) Clean-up programs to check the validity of all codes entered and the ranges of all numerical data;
(2) Cross-check programs to compare station, date, and net fields from the banding data with those from the summary of mist netting effort data;
(3) Cross-check programs to compare species, age, and sex determinations against degree of skull pneumaticization, breeding condition (extent of cloacal protuberance and brood patch), and extent of body and flight-feather molt, primary-feather wear, and juvenal plumage for each record;
(4) Screening programs which allow identification of unusual or duplicate band numbers or unusual band sizes for each species; and
(5) Verification programs to screen banding and recapture data from all years of operation for inconsistent species, age, or sex determinations for each band number.

Any discrepancies or suspicious data identified by any of these programs were examined manually and corrected if necessary. Wing chord, weight, station of capture, date, and any pertinent notes were used as supplementary information for the correct determination of species, age, and sex in all of these verification processes.

Data Analysis

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 2003 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 2003) of individual adult and young birds; and
(3) the proportion of young in the catch.

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

B. Multivariate analyses of adult population size and productivity. We conducted multivariate ANOVAs on indices of adult population size, and logistic regression analyses on productivity indices as a function of habitat and station. Because habitat and station are incorporated into these analyses as non-continuous variables, the analysis format requires the designation of a reference habitat and station against which values for the other habitats and stations are compared. For both Multivariate ANOVAs and logistic regressions we chose the group with the highest abundance of adults captured as the reference group. Thus we chose coniferous forest as the reference habitat and Blueline Trail as the reference station. We set the relative number of adults to be zero and the relative productivity (actually odds ratio) to be one for the reference habitat and station. Because we had only one year of data, multivariate analyses for station could be performed only for all species combined, and these analyses included the addition of a species term to control for relative species abundance. All ANOVA analyses also included a net-hour term to adjust for the variable amount of effort that occurred at each station.

Data preparation for the ANOVA analyses was completed using data-management programs in dBASE4. The multivariate ANOVAs themselves were completed using the statistical-analysis package STATA (Stata Corporation 1995), and statistical significance was determined based on the F-statistic. We conducted these multivariate ANOVAs for all species pooled and for each of 13 target species for which we recorded an average of seven or more individual adult captures per year (only 2003 in this case) at the six stations combined, and at which the species was a regular (B) or usual (U) breeder. The analysis for all species pooled also included species that were transients (T).

Logistic regression, when used in productivity analyses, estimates the probability of an individual bird captured at random being a young bird. The "odds ratio", the term used for the probability value produced by logistic regression, reflects these odds after both variables have been accounted

for. Data preparation for the logistic regression analyses was completed using data-management programs in dBASE4 and the logistic regression analyses themselves were completed on all species pooled and the 13 target species using the statistical-analysis package STATA (Stata Corporation 1995). Statistical significance in logistic regression was determined based on the z-statistic (or Wald Statistic) which equates to the maximum likelihood estimate based on the odds ratio divided by the standard error (Stata Corporation 1995).

RESULTS

A total of 2219.5 net-hours was accumulated at the two MAPS stations operated at NAS Bruswick and Redington Training Facility in 2003 (Table 1). Variation in net hours, caused by variation in missed effort due to weather and other factors, ranged from 344.8 net hours at Potato Nubble to 400.0 net hours at Chimney Rock. A summary of the habitat characteristics at each of the six stations (Tables 1 and 2) indicates that two of the stations (Chimney Rock at Brunswick and Redington Pond at Redington) were comprised primarily of deciduous forest, two stations (Golf Course at Brunswick and Potato Nubble at Redington) were comprised primarily of mixed forest, and two stations (Blueline Trail and Highland, both at Redington) were comprised primarily of coniferous forest.

Indices of Adult Population Size and Post-fledging Productivity

The 2003 capture summary of the numbers of newly-banded, unbanded, and recaptured birds is presented for each species and all species pooled at each of the six stations in Table 3 and for all stations combined in Table 5. A total of 468 captures of 50 species was recorded at the six stations combined (Table 5). This total included 361 newly banded birds, 80 recaptures, and 27 birds (7 of which were hummingbirds) released unbanded. Thus, newly banded birds represented 77% of the total captures. The greatest number of captures (Table 3) occurred at Blueline Trail (118), followed by Redington Pond (112), Highland (89), Golf Course (64), Potato Nubble (52), and Chimney Rock (33). Species richness of adults followed a very similar sequence, being greatest at Blueline Trail (33 species), followed by Redington Pond (28), Golf Course (20), Highland (18), Potato Nubble (17), and Chimney Rock (13). Overall, the most abundantly captured species at the six stations, in descending order (Table 5), were Swainson's Thrush (54), followed by White-throated Sparrow (42), Nashville Warbler (28), Black-capped Chickadee (24), Hermit Thrush (24), Common Yellowthroat (24), Magnolia Warbler (22), Ovenbird (19), and Canada Warbler (18).

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 the percentage of young in the catch, for each species and for all species pooled at each station in Table 4 and for all stations combined in Table 5. These capture indices suggest that the total adult population size in 2003 was greatest at Blueline Trail (112.0 adults/600 net hours), followed closely by Redington Pond (111.0), then Highland (88.9), Golf Course (77.1), Potato Nubble (48.7), and finally Chimney Rock (40.5).

Overall, the most abundant breeding species at the six Brunswick and Redington MAPS stations in 2003, as determined by adults captured per 600 net-hrs, was Swainson's Thrush, followed by White-throated Sparrow, Nashville Warbler, Black-capped Chickadee, Magnolia Warbler, Common Yellowthroat, Hermit Thrush, and Ovenbird (Table 5). The following is a list of the common breeding species (captured at a rate of at least 4.0 adults per 600 net-hours), in

decreasing order, at each station in 2003 (see Table 4):

Chimney Rock
Ovenbird
Common Yellowthroat
Hermit Thrush
Black-throated Green Warbler

Golf Course
Hermit Thrush
Black-capped Chickadee
Common Yellowthroat
Ovenbird
White-throated Sparrow

Potato Nubble
Swainson's Thrush
Black-throated Blue Warbler
American Robin
Ovenbird
Common Yellowthroat

Redington Pond
Swainson's Thrush
American Redstart
Red-eyed Vireo
Cedar Waxwing
Magnolia Warbler
Philadelphia Vireo
Canada Warbler
White-throated Sparrow
"Traill's" Flycatcher
Black-throated Blue Warbler

Blueline Trail
White-throated Sparrow
Yellow-bellied Flycatcher
Black-capped Chickadee
Nashville Warbler
Swainson's Thrush
Downy Woodpecker
"Traill's" Flycatcher
Northern Waterthrush
Common Yellowthroat

Highland
Nashville Warbler
Swainson's Thrush
Magnolia Warbler
White-throated Sparrow
Blackpoll Warbler

Captures of young of all species pooled followed a somewhat similar sequence by station to those of adults (Table 4), being highest at Blueline Trail (38.5 young birds/600 net hours) followed by Redington Pond (26.1), Potato Nubble (24.4), Highland (21.1), Golf Course (3.4), and Chimney Rock (0.0). The index of productivity, as determined by the percentage of young in the catch, followed a slightly different sequence, being highest at Potato Nubble (0.33) followed by Blueline Trail (0.26), Redington Pond and Highland (0.19), Golf Course (0.04), and Chimney Rock (0.00), where no young birds were captured in 2003.

Multivariate Analyses of Variance of Adult Population Size and Productivity
Multivariate ANOVAs, assessing variation in numbers of adults captured by habitat, for 13 target species and all species combined, are shown in Figure 1**A**. For all species combined there was little variation in numbers of adults captured by habitat; numbers were slightly and non-significantly higher in coniferous forests (Blueline Trail and Highland), the reference habitat, than in deciduous forest (Chimney Rock and Redington Pond) or, especially, in mixed forest (Golf Course and Potato Nubble). There was similarly little variation in numbers of adults captured by habitat for 11 of the 13 species, although lower numbers in mixed than coniferous habitats was found for eight of the 13 species. For Yellow-bellied Flycatcher the number of adults captured in mixed forests was near-significantly lower than the number captured in coniferous forests (whereas the number captured in deciduous forest was non-significantly lower than that captured in coniferous forest). For Nashville Warbler significantly fewer adults were captured in deciduous than in coniferous forest, with the number captured in mixed forest being slightly and non-significantly lower than the number captured in coniferous forest.

For all species combined, variation in the number of adults captured by station, controlling for

species, is shown in Figure 2**A**. The numbers of adults captured at Chimney Rock was near-significantly lower than those captured at the reference station, Blueline Trail. Numbers of adults captured at all other stations were non-significantly lower than those captured at Blueline Trail.

The odds ratios for productivity indices for eight of the 13 target species and all species combined are presented in Figure 1**B**. For five species, there were not enough young or adults captured in two of the three habitats and the analysis thus could not be performed. For all species combined, when controlling for station, productivity was near-significantly lower in deciduous forest than in coniferous forest, whereas productivity in mixed forest was slightly and non-significantly lower than that of coniferous forest. No significant differences in productivity between habitats was noted among the individual species. Zero productivity in at least one habitat was noted for American Robin, Nashville Warbler, Magnolia Warbler, and White-throated Sparrow; logistic regression does not allow a test for significance in such cases when there is only one year of data. Similarly, for Nashville Warbler in deciduous habitat and Black-throated Blue Warbler in coniferous habitat, young but no adults were captured; the odds ratio for productivity was thus undefined, and tests for significant differences could not be performed. Once two or more years of data have been gathered, we will be able to test for significance in such cases.

For all species combined, variation in productivity by station, controlling for species, is shown in Figure 2**B**. Productivity at Golf Course was significantly lower than that at Blueline Trail and productivity at Chimney Rock (zero) was also likely significantly lower than that at Blueline Trail, but tests could not be performed. Productivity at the remaining three stations varied with respect to that at Blueline Trail but in no instance was the difference significant.

DISCUSSION

Despite the fact that the NAS Brunswick and Redington Training Facility MAPS stations have been run for only one year, important data have been gathered on breeding populations and productivity for many summer resident landbird species on the installations. Data from all six MAPS stations at Brunswick and Redington have been pooled to provide indices of breeding population size and productivity. As more years of data accumulate we will be able to examine between-year changes in these indices in order to make inferences about the effects of weather on productivity and the effect of changes in productivity on population size. We will also be able examine trends in breeding population size and productivity and make inferences about the long-term prospects of the various species. We will also be able to examine annual survival-rate estimates, capture probabilities, and proportion of residents in order to make inferences regarding the effect of survivorship on population dynamics. In addition, pooling data at this level will allow comparison between Brunswick/Redington and other military installations, parks, other protected areas along the Atlantic seaboard that participate in the MAPS program in the future, as well as comparisons between these landholdings and unprotected areas along the Atlantic coast. Finally, MAPS data from Brunswick and Redington can be pooled with other MAPS data to provide large-scale regional (or even continental) indices and estimates of (and longer-term trends in) these key demographic parameters.

Mean numbers of adults captured, an index of breeding population sizes, appeared to be fairly similar among the three major defined habitat types on the installations, deciduous (Chimney Rock and Redington Pond), mixed (Golf Course and Potato Nubble), and coniferous (Blueline Trail and Highland) forest. For all species pooled numbers were slightly and non-significantly higher in coniferous habitat than in the other two habitat types. For Yellow-bellied Flycatcher and Nashville Warbler we found near-significantly or significantly lower breeding populations in mixed and deciduous habitats, respectively, than were found in coniferous forest. For all species pooled, we also found that breeding populations were near-significantly lower at Chimney Rock than at Blueline Trail.

Logistic regression analyses indicated that, for all species pooled, productivity was near-significantly lower in deciduous forest habitat than in coniferous forest habitat. This was reflected by the fact that productivity at Chimney Rock was zero (no young caught) and likely significantly lower than that at Blueline Trail. Productivity at the other NAS Brunswick station, Golf Course, was also very low and significantly lower than that at the Blueline Trail station. Feral cats were noted by IBP biologists and interns at Brunswick, and these may have been at least partially responsible for the low productivity noted there. On the other hand, data from military installations elsewhere in eastern U.S. have shown that landscape-scale habitat characteristics, such as fragmentation parameters like mean patch size, amount of forest/agricultural edge, and core area of forest, can have major effects on productivity, presumably by affecting levels of nest predation and brood parasitism and by affecting the distribution of habitats needed by young birds during their post-fledging dispersal and molt periods (Nott et al. 2003b).

Once additional years of data have been gathered, we will be able to further explore these hypotheses and many others concerning landbird dynamics at these two installations. With more years of data not only will we be able to strengthen the power of ANOVA analyses of adult population sizes and logistic regression analyses of productivity (including multivariate examinations of the 13 or more individual target species), we will be able to combine these results with those of constant-effort, year-to-year comparisons, long-term trends in populations and productivity, and mark-recapture analyses of survival, capture probability, and proportion of residents as well.

The long-term goal for the Brunswick/Redington MAPS program is to continue to monitor the primary demographic parameters of landbirds on these installations, in order to provide critical information that can be used to aid our understanding of the ecological processes leading from environmental stressors to population responses. This is to be accomplished by including data from the Brunswick/Redington MAPS program in analyses of data from other Atlantic slope MAPS stations to: (1) determine spatial patterns in productivity indices and survival rate estimates as a function of spatial patterns in populations trends for target species (DeSante 2000, DeSante et al. 1999, 2001); (2) 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 2003b); (5) generate hypotheses regarding the ultimate environmental causes of the population trends; and (6) make comprehensive recommendations for habitat and use-related management strategies both on the installation and elsewhere (Nott 2000, Nott et al. 2003b). We conclude that the MAPS protocol is very well-suited to achieving these long-term ecological goals and recommend continuing the MAPS program at NAS Brunswick and Redington Training Facility well into the future.

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Table 1. Summary of the 2003 MAPS program on Naval Air Station Brunswick and Redington Training Facility.

Station					Avg Elev. (m)	2003 operation		
Name	Code	No.	Major Habitat Type	Latitude-longitude		Total number of net-hours	No. of periods	Inclusive dates
Naval Air Station Brunswick								
Golf Course	GOCO	15654	Mixed balsam fir and maple forest with boggy areas, golf course	43˚52'15"N,-69˚56'30"W	13	350.2	7	5/31 - 8/03
Chimney Rock	CHRO	15655	Northern red oak and maple forest, shrubs and small firs along seasonal streams	43˚52'30"N,-69˚55'05"W	18	400.0	7	6/03 - 8/01
Redington Training Facility								
Potato Nubble	PONU	15657	Mixed forest of maple/birch deciduous and fir/spruce coniferous components	44˚59'30"N,-70˚30'30"W	488	344.8	7	6/08 - 7/30
Redington Pond	REPO	15656	Primarily birch/maple forest with scattered balsam fir, pond, alder thicket	44˚58'58"N,-70˚24'59"W	507	367.5	7	6/05 - 7/31
Blueline Trail	BLUE	15658	Boggy balsam fir and Eastern hemlock forest, alder thicket	44˚59'25"N,-70˚26'20"W	515	358.8	7	6/07 - 7/29
Highland	HGHL	15659	Stunted red spruce and balsam fir forest, beaver ponds, very boggy areas	45˚00'35"N,-70˚27'15"W	724	398.2	7	6/09 - 7/30
ALL STATIONS COMBINED						2219.5	7	5/31 - 8/03

Table 2. Habitat summary of the six MAPS stations located on Naval Air Station Brunswick and Redington Training Facility.

Station	Habitat Type[1]	% of Sta.[2]	Canopy Height (m)[3]	Dominant Species[4]		Water present	Disturbance history of station
				Upperstory and midstory	Understory and ground level		
Naval Air Station Brunswick							
Golf Course	MF	100	22	Acer rubrum, Acer saccharum, Pinus strobus, Quercus rubra, Populus tremuloides, Ulmus Americana, Picea rubens, Abies balsamea	Acer saccharum, Abies balsamea, Tsuga canadensis, Maianthemum canadense, Trientalis borealis	None	Pipeline and roads bisect the station
Chimney Rock	DW	100	18	Acer saccharum, Pinus strobus, Quercus rubra, Abies balsamea, Picea rubens	Abies balsamea, Pinus strobus, Acer rubrum	Seasonal bog (>50 m^2) ~2% of station	Homestead (~1800), selective logging (~1940-50)
Redington Training Facility							
Potato Nubble	MF	100	15	Picea mariana, Abies balsamea, Betula papyrifera, Betula lutea, Acer saccharum	Alnus serrulata, Picea glauca, Abies balsamea, Corylus cornuta, grass spp., Fragaria virginiana, Trifolium spp., Oxalis montana	None	Selective logging (up to ~1960), bisected by road
Redington Pond	DF	100	12	Betula lutea, Picea mariana, Abies balsamea, Acer rubrum, Acer saccharum, Betula papyrifera	Alnus rugosa, Abies balsamea, Picea mariana, Acer pennsylvanicum, Acer saccharum, Acer rubrum, Betula spp., Cornus Canadensis, Fragaria virginiana	Large stream (2-5 m wide, ~3% of station): permanent lake (>50 m^2, ~9% of station)	Selective logging (up to ~1960), railway track

Table 2. (cont.) Habitat summary of the six MAPS stations located on Naval Air Station Brunswick and Redington Training Facility.

Station	Habitat Type[1]	% of Sta.[2]	Canopy Height (m)[3]	Dominant Species[4]		Water present	Disturbance history of station
				Upperstory and midstory	Understory and ground level		
Blueline Trail	CB	60	15	Abies balsamea, Betula papyrifera, Alnus serrulata	Acer serrulata, Abies balsamea, moss spp., grass spp., fern spp.	Running water (~3% of station); permanent bog (>50 m^2, ~1% of station)	Selective logging (up to ~1960), railway track
	CF	40	15	Abies balsamea, Picea rubens, Betula papyrifera	Acer balsamea, Cornus canadensis, Oxalis montana, fern spp., moss spp.	None	Selective logging (up to ~1960), railway track
Highland	CF	100	12	Picea rubens, Betula papyrifera, Abies balsamea	Ledum groenlandicum, Cornus canadensis, Oxalis montana, fern spp., moss spp.	Small stream (0.5-2m wide, ~1.5% of station); permanent pond (>50m^2, ~6% of station)	Selective logging (up to ~1960), fire (~1980)

[1] General habitat type of the station. DW - deciduous woodland; DF - deciduous forest; MF - mixed forest; CB - coniferous bog; CF - coniferous forest.

[2] Percentage of station area comprised of the indicated habitat type.

[3] Average height of tree canopy.

[4] The dominant and most common species in each vegetative layer. Upperstory and midstory = vegetation found over 5m above ground. Understory and ground cover = vegetation found under 5m above ground.

Table 3. Capture summary for the six individual MAPS stations operated on Naval Air Station Brunswick and Redington Training Facility in 2003. N = Newly Banded, U = Unbanded, R = Recaptures of banded birds.

	Golf Course			Chimney Rock			Potato Nubble			Redington Pond			Blueline Trail			Highland		
Species	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Sharp-shinned Hawk								1			1			1				
Ruby-throated Hummingbird		6															1	
Yellow-bellied Sapsucker													1					
Downy Woodpecker							1			1			4		2			
Hairy Woodpecker	2						1						1					
Eastern Wood-Pewee				1														
Yellow-bellied Flycatcher													7		5	2		
"Traill's" Flycatcher										3			3			1		
Least Flycatcher										2			1			1		
Eastern Phoebe													1					
Blue-headed Vireo	2									1			2					
Philadelphia Vireo										4								
Red-eyed Vireo				1			1			5		4	2	1				
Blue Jay	1		1	1			2											
Black-capped Chickadee	7	1	1	2						3		1	6		1	2		
Boreal Chickadee																2		1
Red-breasted Nuthatch										1			1					
Brown Creeper	1									1	1							
Golden-crowned Kinglet							1						2					
Ruby-crowned Kinglet													2					
Veery	2			2						1			1					
Swainson's Thrush				1			12		3	12		1	4		1	13		7
Hermit Thrush	10		3	3		1	2			2			2	1				
American Robin	2			1			3		1	2			3	1				
Gray Catbird	1																	
Cedar Waxwing										5			1					
Tennessee Warbler										1								
Nashville Warbler	2									1			9		2	12		2
Northern Parula													3	1				

Table 3. (cont.) Capture summary for the six individual MAPS stations operated on Naval Air Station Brunswick and Redington Training Facility in 2003. N = Newly Banded, U = Unbanded, R = Recaptures of banded birds.

	Golf Course			Chimney Rock			Potato Nubble			Redington Pond			Blueline Trail			Highland		
Species	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Chestnut-sided Warbler	1									1								
Magnolia Warbler							1			5		2	3	1		8	1	1
Black-throated Blue Warbler							6		1	5	1		1					
Yellow-rumped Warbler										2			2			1		
Black-throated Green Warbler				3		1	1						2		1	1		
Blackburnian Warbler													4					
Bay-breasted Warbler													1			2		1
Blackpoll Warbler																5		
Black-and-white Warbler	1		1															
American Redstart										8		8						
Ovenbird	3		1	4		3	3			2		1	2					
Northern Waterthrush	1						2						4		1	2		
Common Yellowthroat	5		1	4		1	3	1	3				3	1		2		
Canada Warbler	1			2			1			4		6	1			2		1
Unidentified Warbler														3				
Scarlet Tanager				2														
Song Sparrow	1																	
Lincoln's Sparrow	1																	
Swamp Sparrow										1								
White-throated Sparrow	3		2							6		2	11		3	13	1	1
Dark-eyed Junco							2			1				1		3		
Unidentified Sparrow														1				
Purple Finch										3		1						
ALL SPECIES POOLED	47	7	10	27	0	6	42	2	8	83	3	26	90	12	16	72	3	14
Total Number of Captures		64			33			52			112			118			89	
Number of Species	19	2	7	13	0	4	16	2	4	27	3	9	31	8	8	17	3	7
Total Number of Species		20			13			17			28			33			18	

Table 4. Numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the six individual MAPS stations operated on Naval Air Station Brunswick and Redington Training Facility in 2003.

Species	Golf Course			Chimney Rock			Potato Nubble			Redington Pond			Blueline Trail			Highland		
	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.
Yellow-bellied Sapsucker													1.7	0.0	0.00			
Downy Woodpecker							0.0	1.7	1.00	1.6	0.0	0.00	5.0	1.7	0.25			
Hairy Woodpecker	1.7	1.7	0.50				0.0	1.7	1.00				1.7	0.0	0.00			
Eastern Wood-Pewee				1.5	0.0	0.00												
Yellow-bellied Flycatcher													11.7	0.0	0.00	3.0	0.0	0.00
"Traill's" Flycatcher										4.9	0.0	0.00	5.0	0.0	0.00	1.5	0.0	0.00
Least Flycatcher										1.6	1.6	0.50	0.0	1.7	1.00	1.5	0.0	0.00
Eastern Phoebe													1.7	0.0	0.00			
Blue-headed Vireo	3.4	0.0	0.00							1.6	0.0	0.00	1.7	1.7	0.50			
Philadelphia Vireo										6.5	0.0	0.00						
Red-eyed Vireo				1.5	0.0	0.00	1.7	0.0	0.00	8.2	0.0	0.00	3.3	0.0	0.00			
Blue Jay	1.7	0.0	0.00	1.5	0.0	0.00	3.5	0.0	0.00									
Black-capped Chickadee	12.0	0.0	0.00	3.0	0.0	0.00				3.3	1.6	0.33	10.0	0.0	0.00	1.5	1.5	0.50
Boreal Chickadee																3.0	0.0	0.00
Red-breasted Nuthatch										0.0	1.6	1.00	1.7	0.0	0.00			
Brown Creeper	1.7	0.0	0.00							3.3	0.0	0.00						
Golden-crowned Kinglet							0.0	1.7	1.00				1.7	1.7	0.50			
Ruby-crowned Kinglet													3.3	0.0	0.00			
Veery	3.4	0.0	0.00	3.0	0.0	0.00				1.6	0.0	0.00	1.7	0.0	0.00			
Swainson's Thrush				1.5	0.0	0.00	13.9	7.0	0.33	13.1	6.5	0.33	6.7	0.0	0.00	15.1	4.5	0.23
Hermit Thrush	17.1	0.0	0.00	4.5	0.0	0.00	0.0	3.5	1.00	0.0	3.3	1.00	1.7	1.7	0.50			
American Robin	3.4	0.0	0.00	1.5	0.0	0.00	5.2	0.0	0.00	3.3	0.0	0.00	1.7	3.3	0.67			
Gray Catbird	0.0	1.7	1.00															
Cedar Waxwing										8.2	0.0	0.00	1.7	0.0	0.00			
Tennessee Warbler										1.6	0.0	0.00						
Nashville Warbler	3.4	0.0	0.00							0.0	1.6	1.00	10.0	5.0	0.33	16.6	1.5	0.08
Northern Parula													3.3	1.7	0.33			

Table 4. (cont.) Numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the six individual MAPS stations operated on Naval Air Station Brunswick and Redington Training Facility in 2003.

	Golf Course			Chimney Rock			Potato Nubble			Redington Pond			Blueline Trail			Highland		
Species	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.
Chestnut-sided Warbler	1.7	0.0	0.00							1.6	0.0	0.00						
Magnolia Warbler							1.7	0.0	0.00	8.2	0.0	0.00	3.3	1.7	0.33	13.6	0.0	0.00
Black-throated Blue Warbler							7.0	3.5	0.33	4.9	3.3	0.40	0.0	1.7	1.00			
Yellow-rumped Warbler										3.3	0.0	0.00	3.3	0.0	0.00	1.5	0.0	0.00
Black-throated Green Warbler				4.5	0.0	0.00	1.7	0.0	0.00				0.0	3.3	1.00	1.5	0.0	0.00
Blackburnian Warbler													1.7	5.0	0.75			
Bay-breasted Warbler													1.7	0.0	0.00	3.0	0.0	0.00
Blackpoll Warbler																7.5	0.0	0.00
Black-and-white Warbler	1.7	0.0	0.00															
American Redstart										13.1	0.0	0.00						
Ovenbird	5.1	0.0	0.00	6.0	0.0	0.00	5.2	0.0	0.00	3.3	0.0	0.00	3.3	0.0	0.00			
Northern Waterthrush	1.7	0.0	0.00				1.7	1.7	0.50				5.0	1.7	0.25	3.0	0.0	0.00
Common Yellowthroat	8.6	0.0	0.00	6.0	0.0	0.00	5.2	0.0	0.00				5.0	0.0	0.00	3.0	0.0	0.00
Canada Warbler	1.7	0.0	0.00	3.0	0.0	0.00	1.7	0.0	0.00	6.5	0.0	0.00	0.0	1.7	1.00	1.5	1.5	0.50
Scarlet Tanager				3.0	0.0	0.00												
Song Sparrow	1.7	0.0	0.00															
Lincoln's Sparrow	1.7	0.0	0.00															
Swamp Sparrow										0.0	1.6	1.00						
White-throated Sparrow	5.1	0.0	0.00							6.5	3.3	0.33	13.4	5.0	0.27	9.0	10.5	0.54
Dark-eyed Junco							0.0	3.5	1.00	1.6	0.0	0.00				3.0	1.5	0.33
Purple Finch										3.3	1.6	0.33						
ALL SPECIES POOLED	77.1	3.4	0.04	40.5	0.0	0.00	48.7	24.4	0.33	111.0	26.1	0.19	112.0	38.5	0.26	88.9	21.1	0.19
Number of Species	18	2		13	0		11	8		23	10		27	15		17	6	
Total Number of Species		19			13			16			27			31			17	

Table 5. Summary of results for all six Naval Air Station Brunswick and Redington Training Facility MAPS stations combined in 2003.

Species	Birds captured			Birds/600 nethours		
	Newly banded	Un-banded	Recap-tured	Adults	Young	Prop. Young
Sharp-shinned Hawk		3				
Ruby-throated Hummingbird		7				
Yellow-bellied Sapsucker	1			0.3	0.0	0.00
Downy Woodpecker	6		2	1.1	0.5	0.33
Hairy Woodpecker	4			0.5	0.5	0.50
Eastern Wood-Pewee	1			0.3	0.0	0.00
Yellow-bellied Flycatcher	9		5	2.4	0.0	0.00
"Traill's" Flycatcher	7			1.9	0.0	0.00
Least Flycatcher	4			0.5	0.5	0.50
Eastern Phoebe	1			0.3	0.0	0.00
Blue-headed Vireo	5			1.1	0.3	0.20
Philadelphia Vireo	4			1.1	0.0	0.00
Red-eyed Vireo	9	1	4	2.4	0.0	0.00
Blue Jay	4		1	1.1	0.0	0.00
Black-capped Chickadee	20	1	3	4.9	0.5	0.10
Boreal Chickadee	2		1	0.5	0.0	0.00
Red-breasted Nuthatch	2			0.3	0.3	0.50
Brown Creeper	2	1		0.8	0.0	0.00
Golden-crowned Kinglet	3			0.3	0.5	0.67
Ruby-crowned Kinglet	2			0.5	0.0	0.00
Veery	6			1.6	0.0	0.00
Swainson's Thrush	42		12	8.4	3.0	0.26
Hermit Thrush	19	1	4	3.8	1.4	0.26
American Robin	11	1	1	2.4	0.5	0.18
Gray Catbird	1			0.0	0.3	1.00
Cedar Waxwing	6			1.6	0.0	0.00
Tennessee Warbler	1			0.3	0.0	0.00
Nashville Warbler	24		4	5.1	1.4	0.21
Northern Parula	3	1		0.5	0.3	0.33
Chestnut-sided Warbler	2			0.5	0.0	0.00
Magnolia Warbler	17	2	3	4.6	0.3	0.06
Black-throated Blue Warbler	12	1	1	1.9	1.4	0.42
Yellow-rumped Warbler	5			1.4	0.0	0.00
Black-throated Green Warbler	7		2	1.4	0.5	0.29
Blackburnian Warbler	4			0.3	0.8	0.75
Bay-breasted Warbler	3		1	0.8	0.0	0.00
Blackpoll Warbler	5			1.4	0.0	0.00

Table 5. (cont.) Summary of results for all six Naval Air Station Brunswick and Redington Training Facility MAPS stations combined in 2003.

Species	Birds captured			Birds/600 nethours		
	Newly banded	Un-banded	Recap-tured	Adults	Young	Prop. Young
Black-and-white Warbler	1		1	0.3	0.0	0.00
American Redstart	8		8	2.2	0.0	0.00
Ovenbird	14		5	3.8	0.0	0.00
Northern Waterthrush	9		1	1.9	0.5	0.22
Common Yellowthroat	17	2	5	4.6	0.0	0.00
Canada Warbler	11		7	2.4	0.5	0.18
Unidentified Warbler		3				
Scarlet Tanager	2			0.5	0.0	0.00
Song Sparrow	1			0.3	0.0	0.00
Lincoln's Sparrow	1			0.3	0.0	0.00
Swamp Sparrow	1			0.0	0.3	1.00
White-throated Sparrow	33	1	8	5.7	3.2	0.36
Dark-eyed Junco	6	1		0.8	0.8	0.50
Unidentified Sparrow		1				
Purple Finch	3		1	0.5	0.3	0.33
ALL SPECIES POOLED	361	27	80	79.5	18.7	0.19
Total Number of Captures		468				
Number of Species	48	13	22	46	23	
Total Number of Species		50			48	

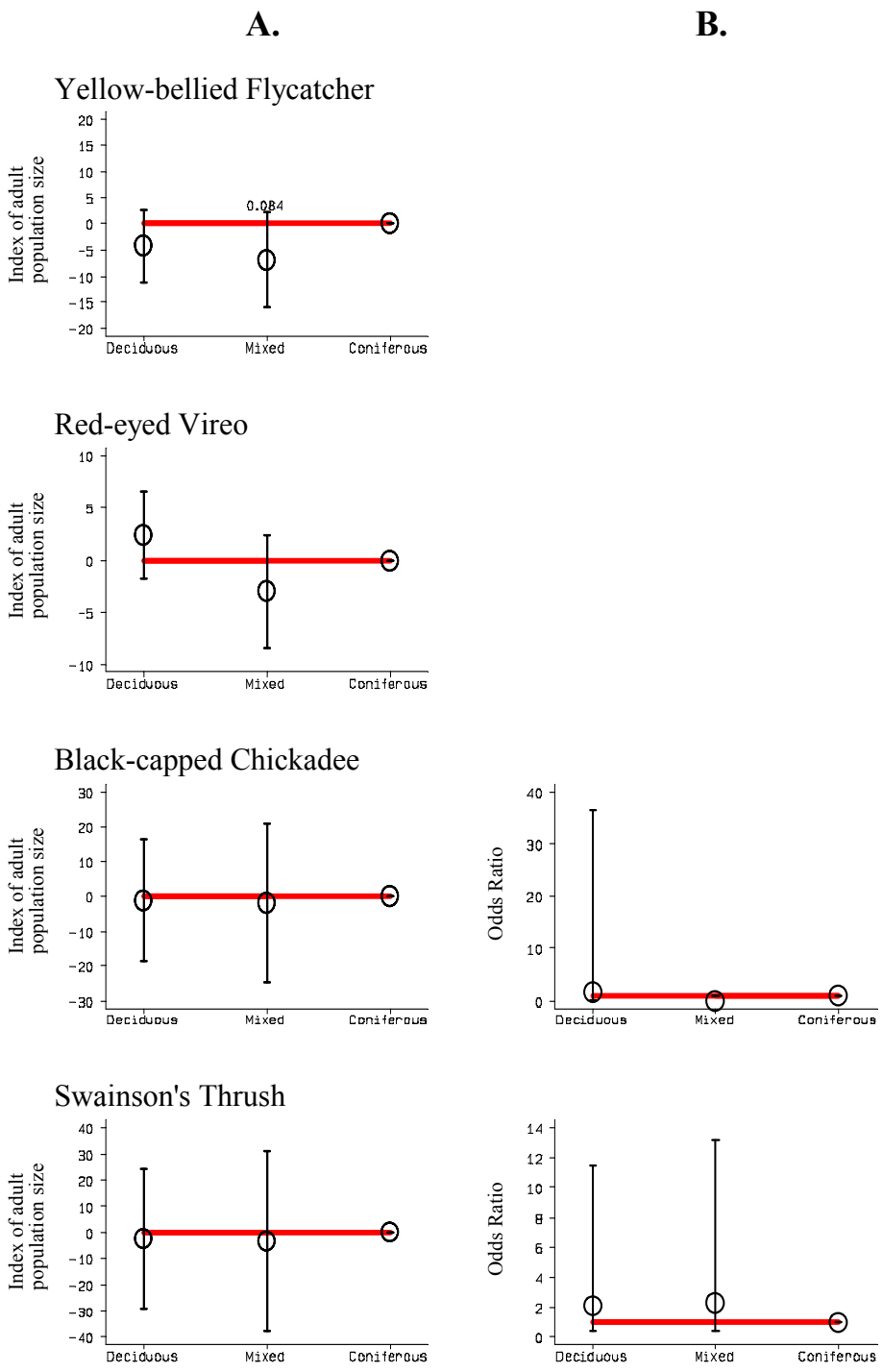

Figure 1. Relative mean numbers of adults (A) and odds ratios for productivity indices (B) with 95% confidence intervals for 13 individual species and all species combined captured at six stations on Naval Air Station Brunswick and Redington Training Facility. Relative mean numbers of adults were estimated using ANOVA controlling for the number of net hours for the variable forest type (A). The odds ratios for the design variable forest type (B) were estimated using univariate logistic regression. The estimates were compared to a reference point (lacking a 95% confidence interval and equivalent to the reference line), and the reference point and a reference line are plotted for ease of comparison. *P*-values are indicated for significant and near-significant comparisons.

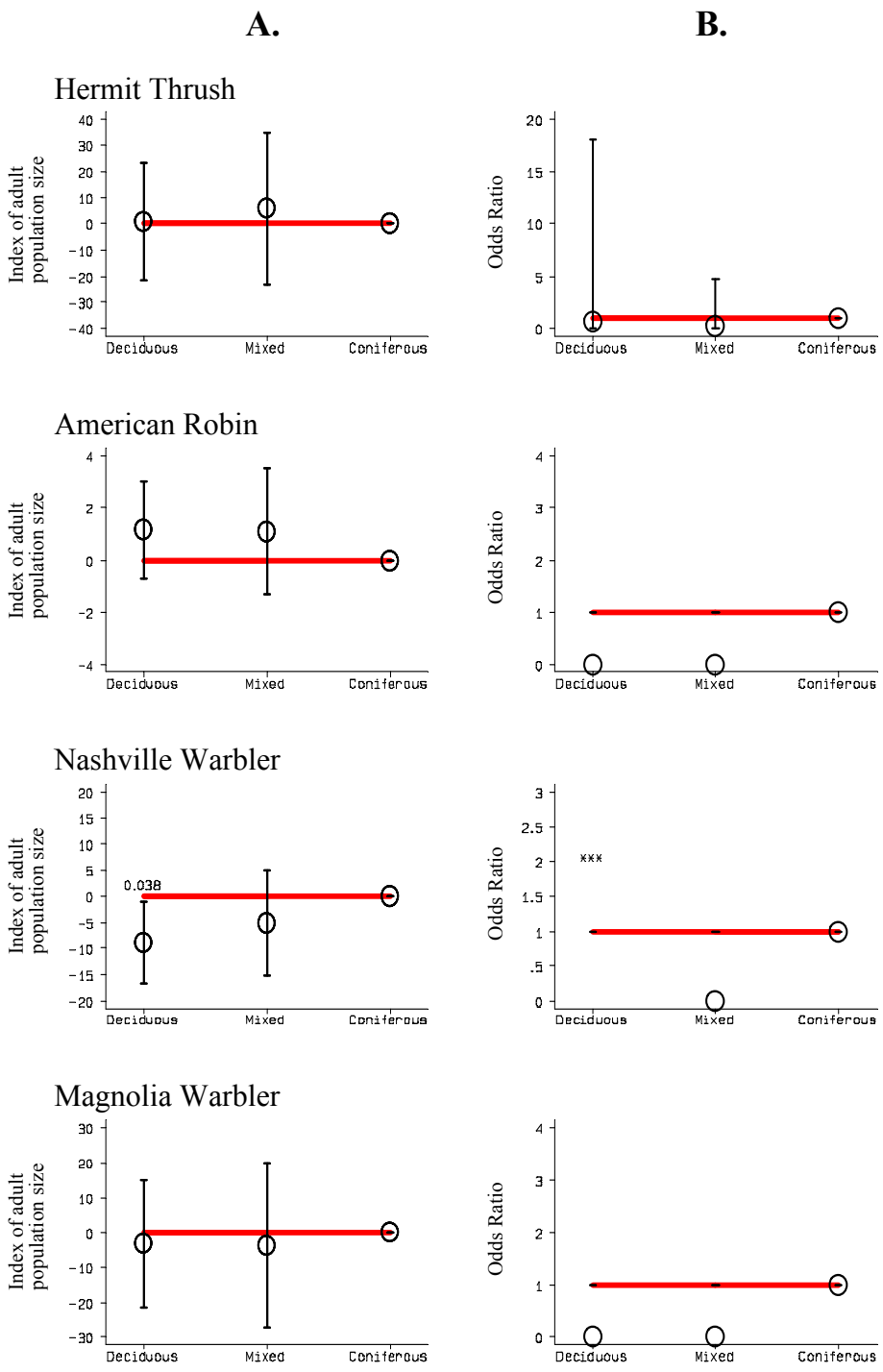

Figure 1. (cont.) Relative mean numbers of adults (A) and odds ratios for productivity indices (B) with 95% confidence intervals for 13 individual species and all species combined captured at six stations on Naval Air Station Brunswick and Redington Training Facility. Relative mean numbers of adults were estimated using ANOVA controlling for the number of net hours for the variable forest type (A). The odds ratios for the design variable forest type (B) were estimated using univariate logistic regression. The estimates were compared to a reference point (lacking a 95% confidence interval and equivalent to the reference line), and the reference point and a reference line are plotted for ease of comparison. *P*-values are indicated for significant and near-significant comparisons.

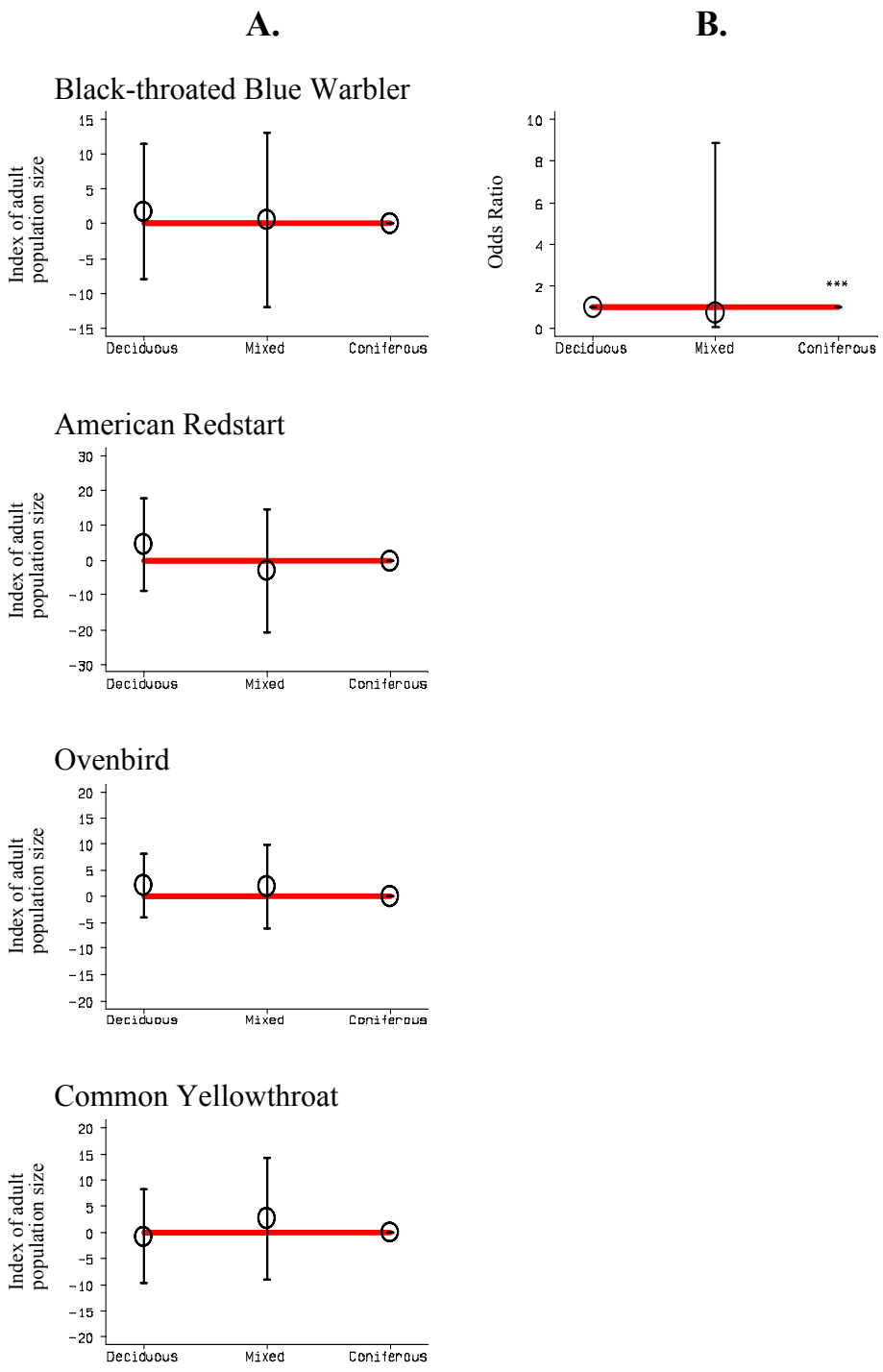

Figure 1. (cont.) Relative mean numbers of adults (A) and odds ratios for productivity indices (B) with 95% confidence intervals for 13 individual species and all species combined captured at six stations on Naval Air Station Brunswick and Redington Training Facility. Relative mean numbers of adults were estimated using ANOVA controlling for the number of net hours for the variable forest type (A). The odds ratios for the design variable forest type (B) were estimated using univariate logistic regression. The estimates were compared to a reference point (lacking a 95% confidence interval and equivalent to the reference line), and the reference point and a reference line are plotted for ease of comparison. *P*-values are indicated for significant and near-significant comparisons.

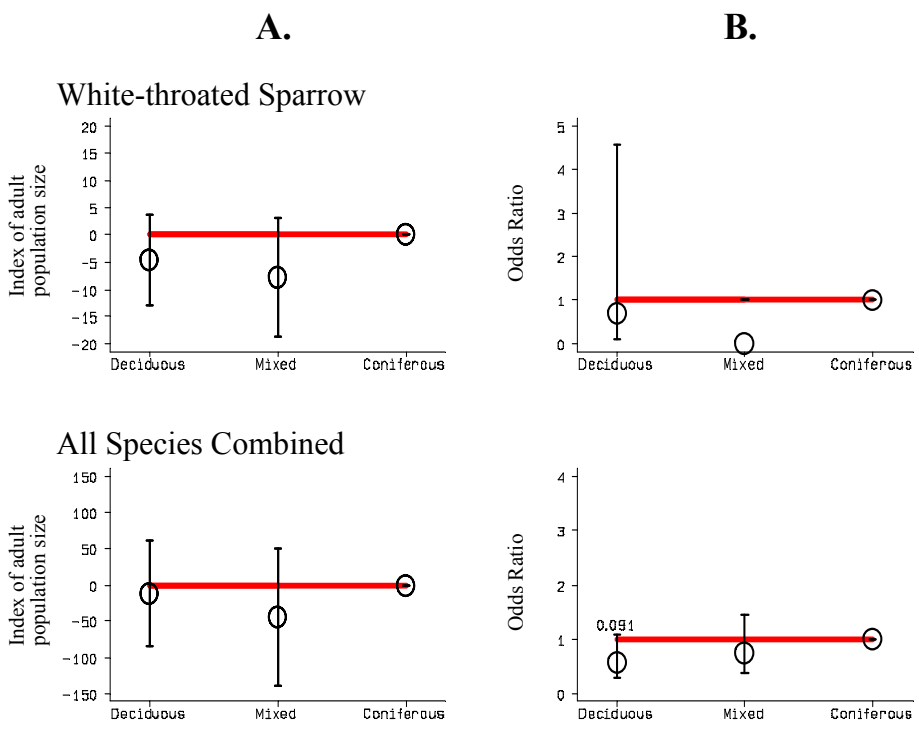

Figure 1. (cont.) Relative mean numbers of adults (A) and odds ratios for productivity indices (B) with 95% confidence intervals for 13 individual species and all species combined captured at six stations on Naval Air Station Brunswick and Redington Training Facility. Relative mean numbers of adults were estimated using ANOVA controlling for the number of net hours for the variable forest type (A). The odds ratios for the design variable forest type (B) were estimated using univariate logistic regression. The estimates were compared to a reference point (lacking a 95% confidence interval and equivalent to the reference line), and the reference point and a reference line are plotted for ease of comparison. *P*-values are indicated for significant and near-significant comparisons.

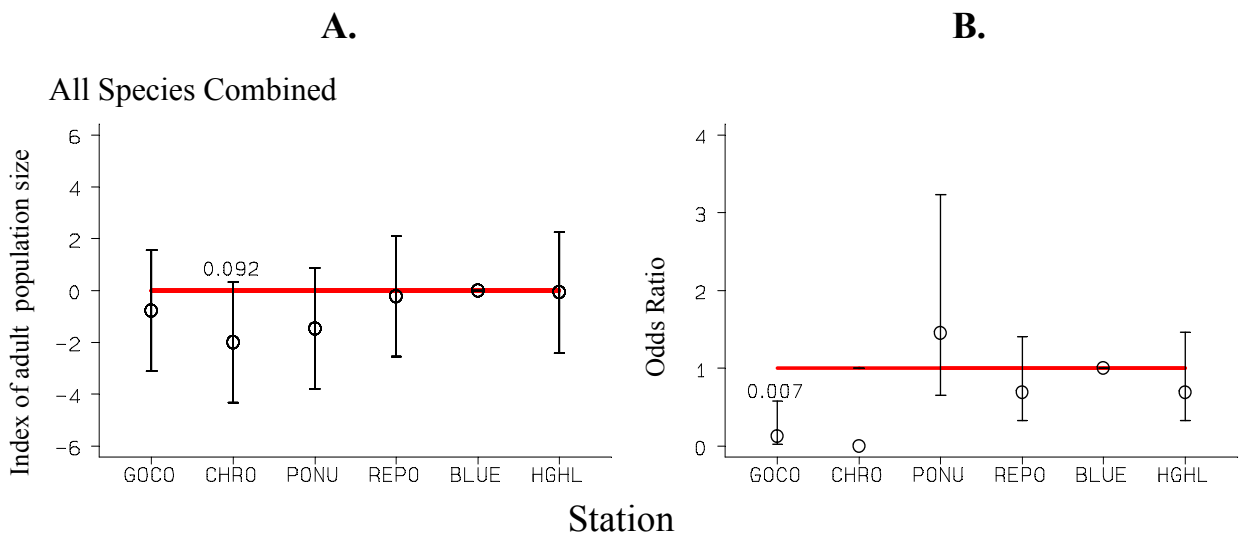

Figure 2. Relative mean numbers of adults (A) and odds ratios for productivity indices (B) with 95% confidence intervals for all 13 target species combined, captured at six stations on Naval Air Station Brunswick and Redington Training Facility. Relative mean numbers of adults were estimated using ANOVA controlling for species abundance and the number of net hours for the variable station(A). The odds ratios for the design variable station(B) were estimated using univariate logistic regression. The estimates were compared to a reference point (lacking a 95% confidence interval and equivalent to the reference line), and the reference point and a reference line are plotted for ease of comparison. *P*-values are indicated for significant and near-significant comparisons.

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 year, 2003, of the MAPS Program on the six stations on Naval Air Station Brunswick and Naval Survival Escape and Evasion Training Facility Rangeley.

NUMB	SPEC	SPECIES NAME
00100	COLO	Common Loon
00860	DCCO	Double-crested Cormorant
01010	GBHE	Great Blue Heron
01620	ABDU	American Black Duck
01980	COME	Common Merganser
02020	OSPR	Osprey
02130	BAEA	Bald Eagle
02200	SSHA	Sharp-shinned Hawk
02210	COHA	Cooper's Hawk
02400	BWHA	Broad-winged Hawk
02460	RTHA	Red-tailed Hawk
02640	MERL	Merlin
02940	RUGR	Ruffed Grouse
03040	WITU	Wild Turkey
03780	KILL	Killdeer
04020	SPSA	Spotted Sandpiper
04710	HERG	Herring Gull
05570	MODO	Mourning Dove
06400	BBCU	Black-billed Cuckoo
06950	BADO	Barred Owl
08630	RTHU	Ruby-throated Hummingbird
09110	BEKI	Belted Kingfisher
09580	YBSA	Yellow-bellied Sapsucker
09650	DOWO	Downy Woodpecker
09660	HAWO	Hairy Woodpecker
09710	BBWO	Black-backed Woodpecker
09800	YSFL	Yellow-shafted Flicker
09860	PIWO	Pileated Woodpecker
11390	EAWP	Eastern Wood-Pewee
11450	YBFL	Yellow-bellied Flycatcher
11475	ALFL	Alder Flycatcher
11475	TRFL	"Traill's" Flycatcher
11500	LEFL	Least Flycatcher
11610	EAPH	Eastern Phoebe
11760	GCFL	Great Crested Flycatcher
12030	EAKI	Eastern Kingbird
12720	BHVI	Blue-headed Vireo
12780	PHVI	Philadelphia Vireo
12790	REVI	Red-eyed Vireo
12910	GRAJ	Gray Jay
12930	BLJA	Blue Jay
13190	AMCR	American Crow
13300	CORA	Common Raven
13410	TRES	Tree Swallow

Appendix I. (cont.) 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 year, 2003, of the MAPS Program on the six stations on Naval Air Station Brunswick and Naval Survival Escape and Evasion Training Facility Rangeley.

NUMB	SPEC	SPECIES NAME
13540	BARS	Barn Swallow
13570	BCCH	Black-capped Chickadee
13610	BOCH	Boreal Chickadee
13660	TUTI	Tufted Titmouse
13690	RBNU	Red-breasted Nuthatch
13700	WBNU	White-breasted Nuthatch
13730	BRCR	Brown Creeper
14110	WIWR	Winter Wren
14240	GCKI	Golden-crowned Kinglet
14250	RCKI	Ruby-crowned Kinglet
14560	EABL	Eastern Bluebird
14780	VEER	Veery
14810	SWTH	Swainson's Thrush
14820	HETH	Hermit Thrush
15000	AMRO	American Robin
15130	GRCA	Gray Catbird
15550	CEDW	Cedar Waxwing
15650	TEWA	Tennessee Warbler
15670	NAWA	Nashville Warbler
15730	NOPA	Northern Parula
15760	CSWA	Chestnut-sided Warbler
15770	MAWA	Magnolia Warbler
15790	BTBW	Black-throated Blue Warbler
15800	MYWA	Myrtle Warbler
15830	BTNW	Black-throated Green Warbler
15860	BLBW	Blackburnian Warbler
15910	PIWA	Pine Warbler
15960	BBWA	Bay-breasted Warbler
15970	BLPW	Blackpoll Warbler
16030	BAWW	Black-and-white Warbler
16040	AMRE	American Redstart
16080	OVEN	Ovenbird
16090	NOWA	Northern Waterthrush
16130	MOWA	Mourning Warbler
16150	COYE	Common Yellowthroat
16300	CAWA	Canada Warbler
16495	UNWA	Unidentified Warbler
16830	SCTA	Scarlet Tanager
18020	CHSP	Chipping Sparrow
18230	SOSP	Song Sparrow
18240	LISP	Lincoln's Sparrow
18250	SWSP	Swamp Sparrow
18270	WTSP	White-throated Sparrow
18320	SCJU	Slate-colored Junco

Appendix I. (cont.) 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 year, 2003, of the MAPS Program on the six stations on Naval Air Station Brunswick and Naval Survival Escape and Evasion Training Facility Rangeley.

NUMB	SPEC	SPECIES NAME
18335	UNSP	Unidentified Sparrow
18560	NOCA	Northern Cardinal
18600	RBGR	Rose-breasted Grosbeak
18720	BOBO	Bobolink
18730	RWBL	Red-winged Blackbird
18850	RUBL	Rusty Blackbird
18870	COGR	Common Grackle
18960	BHCO	Brown-headed Cowbird
19160	BAOR	Baltimore Oriole
19350	PUFI	Purple Finch
19370	HOFI	House Finch
19430	PISI	Pine Siskin
19510	AMGO	American Goldfinch
19580	EVGR	Evening Grosbeak