THE 2003 ANNUAL REPORT OF THE MONITORING AVIAN PRODUCTIVITY AND SURVIVORSHIP (MAPS) PROGRAM ON THE FLATHEAD RESERVATION OF THE CONFEDERATED SALISH AND KOOTENAI TRIBES

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TABLE OF CONTENTS

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 some 500 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 annual estimates of adult survivorship, recruitment into the adult population, and population growth rates at multiple spatial scales for many 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.

A second objective of the MAPS program is to provide standardized population and demographic data for the landbirds found in local areas, such as Indian reservations, or on federally managed public or private lands, such as national forests, national parks, and military installations. In this vein, it is expected that population and demographic data on the landbirds found on the Flathead reservation (or any other given tract of land) will aid research and management efforts on the Reservation (or other lands) to protect and enhance the Reservation's (or other land's) avifauna and ecological integrity while allowing it to serve its multi-use purposes.

We operated six MAPS stations in 2003 on the Flathead Reservation. Two of these stations were in the exact same locations at which they were operated from 1993 to 2002, one was in the exact same location where it was established and operated in 2002, and three were new stations established in 2003. With few exceptions, the ten net sites per 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 1583 captures of 62 landbird species was recorded at the six stations during the summer of 2003.

Population and productivity indices indicate excellent overall capture rates at all six Flathead Reservation stations, including the three new stations established in 2003. Population indices for all species pooled at each of the six stations were greater than 129 individual adults captured per 600 net-hours; likewise, productivity indices (proportion of young in the catch) for all species pooled at the six stations varied from 0.23 to 0.43 and were relatively high compared to other MAPS stations.

Constant-effort comparisons between 2002 and 2003 at the three stations operated in both 2002 and 2003 indicate that both population sizes and productivity increased substantially during 2003, with number of young captured showing a significant increase in 2003. These increases were both Reservation-wide (among the three stations at least) and species-wide.

Eleven-year (1993-2003) analyses of chain indices of adult population size indicated a substantial and nearly significant (P=0.059) decline of -2.0% per year for all species pooled at the two long-running stations combined. This trend appears to be region wide, as it was similar to the ten-year (1993-2002) trend for all species pooled over the entire Flathead region, including six stations in the Flathead National Forest (DeSante et al. 2003a). Analyses of trend data at the Flathead Reservation further revealed that two species ("Traill's" Flycatcher and Common Yellowthroat) showed substantial declines ($r \leq -0.5$), with that of "Traill's" Flycatcher being highly significant, while two other species (Cedar Waxwing and Yellow Warbler) showed substantial increases ($r \geq 0.5$), with that of Yellow Warbler being nearly significant. Overall, 11-year population trends for five of the nine target species were negative. Eleven-year trends in productivity were generally fairly stable, especially as compared to trends in adult population size.

We were able to obtain survivorship estimates for eight of the nine target species on Flathead Reservation, using data from just the two long-running stations. $\Delta QAIC_c$ values indicated no time-dependent variation over the 11-year period, and they were high (≥ 10) for six of these eight species, indicating that relatively little interannual variation in survival was detected for most species occurring at Flathead. The relatively small sample sizes available from just two stations, however, make it difficult to detect time dependence in survival. The mean precision (C.V.) of the time-constant survival estimates for the eight species from 11 years of data (24.9%) improved slightly from 25.2% when using ten years of data.

Survival estimates for these eight target species were generally high as compared to elsewhere in North America, suggesting that productivity on the breeding grounds rather than survival on the winter grounds may be affecting population trends at the Flathead Reservation. Indeed, results of analyses for the Flathead Region using 10 years of data (1993-2002) suggest that low productivity was the driving force for the declines of five of six species and may also have contributed to the decline of the sixth species. This suggests that productivity problems leading to population declines may be occurring on Flathead Reservation and thus may be correctable through habitat restoration or other proactive management strategies.

In fact, a third objective of MAPS is to evaluate the success of on-going management actions such as habitat restoration and fire-ecology management. On the Flathead Reservation, four new stations have been established in areas subject to on-going and future habitat restoration efforts in the Jocko River watershed. At two stations, Jocko River and Schall, restoration efforts commenced in 2003 and at the other two, Woodpecker Haven and Spring Creek, efforts will begin in 2004 or 2005. These efforts will be aimed at re-channeling the river to it's original banks and restoring the cottonwood/willow riparian habitat, which has been reduced by grazing and development during the past 100 years from a continuos strip to small patches. We anticipate that MAPS will be very well suited to detect increases in landbird population sizes and productivity that result from this restoration management.

We have recently found that patterns of landscape structure detected within a two- to four-kilometer radius area of each MAPS station are good predictors, not only of the numbers of birds of each species captured but, more importantly, of their productivity levels as well. These types

of analyses provide extremely powerful tools to identify and formulate management actions aimed at reversing declining populations and maintaining stable or increasing populations of landbirds, because they can address the particular vital rate responsible for the decline. At Flathead Reservation, we anticipate using habitat modeling to assess the effects of habitat restoration both at the local scale (as correlated with planned vegetation structure modeling) and at the landscape level (as related to the sizes of continuous patches that occur along the Jocko River).

The ultimate objective of the MAPS Program is to identify generalized management guidelines and formulate specific management actions that can be implemented to reverse the population declines of target landbird species and to maintain the populations of stable or increasing species. The identification and formulation of these management guidelines and actions is to be achieved by modeling the vital rates (productivity and survivorship) of the various landbird species as a function of landscape-level habitat characteristics and spatially explicit weather variables. These management strategies will involve efforts to modify the habitat from characteristics associated with low productivity to characteristics associated with high productivity.

In summary, the data collected at the MAPS stations at Flathead Reservation during their first eleven years have revealed that the population dynamics of the breeding birds are complex, as apparently are the causes for population changes and, for those deemed problematic, their likely solutions. This complexity, in turn, underscores the importance of standardized, long-term data. We suggest that the indices and estimates of primary demographic parameters produced by MAPS are extremely useful for the management and conservation of landbirds at Flathead Reservation, and we conclude that the MAPS protocol is very well-suited to provide a critical component of natural resource management and monitoring on the Reservation. Based on the above information, we recommended that the MAPS program continue to be operate on the Reservation well into the future.

INTRODUCTION

The Flathead Reservation of the Confederated Salish and Kootenai Tribes has taken on the responsibility for managing the natural resources on their lands in such a manner that, to the extent possible considering the multi-use purposes of these lands, maintains the ecological integrity and species diversity of the ecosystems present on these lands, and conserves them unimpaired for future generations. In order to successfully carry out these responsibilities, integrated long-term programs are needed to monitor the natural resources on the Reservation and to monitor the effects of varying management practices and restoration efforts on those resources.

The development and implementation of effective long-term biomonitoring programs on the Reservation can be of even wider importance than aiding the Tribes in the management of their natural resources. Because tribal lands provide large areas of multiple 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 both local and large-scale, even global, environmental changes. Thus, long-term monitoring data from reservations can provide information that is crucial for efforts to preserve natural resources and biodiversity on a regional or even continental scale.

Landbirds

Landbirds, because of their high body temperature, rapid metabolism, and high trophic position on most food webs, may be 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 Tribes 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.

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.

The MAPS Program

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. A peer review of the Program and evaluation of the pilot project were completed by a panel assembled by USGS/BRD, which concluded that: (1) MAPS is technically sound and is based on the best available biological and statistical methods; (2) it complements other landbird monitoring programs such as the BBS by providing useful information on

landbird demographics that is not available elsewhere; and (3) it is the most important project in the nongame bird monitoring arena since the creation of the BBS (Geissler 1996).

Now in its 15th year (12th year of standardized protocol and extensive distribution of stations), the MAPS program has expanded greatly from 178 stations in 1992 to nearly 500 stations in 2003. 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 USDA Forest Service, National Park Service, Department of Defense, Department of the Navy, Texas Army National Guard, and US Fish and Wildlife Service, and The Flathead Reservation of the Confederated Salish and Kootenai Tribes. Within the past ten years, for example, IBP has been contracted to operate over 150 MAPS stations on federal lands, including six stations on the Flathead National Forest and six stations on the Flathead Reservation.

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 rates 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 the tribal reservations, along with national forest lands, national parks, DoD military installations, other publicly owned lands, and can 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 tribal reservations, national forests, national parks, or military installations) to aid research and management efforts within the reservations, forests, parks, or installations 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.

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.

The MAPS Program on the Flathead Reservation

Both of the long-term objectives of MAPS, as described above, were found to be in agreement with objectives of the Flathead Reservation. Accordingly, the MAPS Program was initiated on the Flathead Reservation in 1993, with two stations being established there, to accompany six stations established in 1992 on the nearby Flathead National Forest. The overall goal of the initial establishment of the MAPS program on the Flathead National Forest and Flathead Reservation was to provide high quality information on the demographics of landbirds that could be used to aid research and management efforts on the forest and reservation to protect and enhance the avifauna and ecological integrity, while allowing them each to fulfill their multi-use purposes.

A third and more recently defined objective of MAPS is to evaluate the success of on-going management actions, such as habitat restoration and fire-ecology management. In 2003 the Flathead Tribe began efforts to restore habitat in the Jocko River watershed. These efforts are aimed at re-channeling the river to it's original banks and restoring the cottonwood/willow riparian habitat, which has been reduced during the past 100 years by grazing and development from a continuos strip to small patches. In the past two years, four new stations have been established in areas subject to on-going and future habitat restoration efforts in the Jocko River watershed. At two stations, Jocko River and Schall, restoration efforts commenced in 2003 and at the other two, Woodpecker Haven and Spring Creek, efforts will begin in 2004 or 2005. Thus, the current and future goals of the MAPS program on Flathead Reservation are to continue the long-term objectives described above as well as to monitor the effects of activities aimed at restoring the Jocko River watershed..

The 2003 Report

In this report we summarize results of the MAPS program at six stations on the Flathead Reservation from 1993 through 2003. The addition of three new stations in 2003 is described. For each station and for all six stations pooled, we present indices of adult population size and productivity. For the three stations operated in 2002, we present constant-effort changes between 2002 and 2003 in the numbers of adult birds captured (an index of adult population size), the numbers of young birds captured, and the proportion of young in the catch (an index of productivity). Based on data from the two long-running stations, we also present 11-year means for the indices of adult population size and productivity for each species and for all species pooled, 11-year trends in adult population size and productivity for a group of target species and for all species pooled, and estimates of annual adult survivorship for those target species. Using these data, we then (1) identify landbird species that are declining on the Flathead Reservation, as well as species that are increasing; (2) identify probable proximate demographic causes (low productivity or low adult survival) for these population changes; and (3) suggest future analyses to confirm these probable causes.

METHODS

Three 20-ha MAPS stations on Flathead Reservation, Safe Harbor Marsh, Jocko River, and Crow Creek were re-established in 2003 at the exact same locations at which they were originally established in 1993 or 2002 (Jocko River). In addition, three new stations, Woodpecker Haven, Schall, and Spring Creek, were established in 2003. In order of decreasing elevation and from east to west, the six stations are: (1) the Woodpecker Haven station, located in cottonwood-willow riparian habitat at 920 m elevation along the Jocko River across from the Arlee Fish Hatchery; (2) the Safe Harbor Marsh station, established in 1993 at 881 m elevation; (3) the Schall station, located in degraded cottonwood-willow riparian habitat at 870 m elevation along the Jocko River; (4) the Spring Creek station, located in cottonwood-willow riparian habitat at 853 m elevation at the junction of Jocko River and Spring Creek; (5) the Jocko River station, established in 2002 at 850 m elevation; and (6) the Crow Creek station, established in 1993 at 786 m elevation. Restoration efforts at the Jocko River station commenced in fall 2003 with the planting of willows and cottonwoods to enhance and enlarge a previously existing patch that had, until recently, been effected by grazing. Restoration efforts at the Schall station commenced in spring 2003 and consisted of removing some abandoned structures, tilling an old hay field, and planting native grasses. Similar restoration efforts are planned for the Woodpecker Haven and Spring Creek sites in 2004 or 2005.

The six stations were operated in 2003 by two field biologist interns of The Institute for Bird Populations (Brett Hartl and Sara Lauerman), who received intensive training from Institute staff field biologists Nicole Michel, Sara Martin, and Tim Pitz, and intermittent supervision through the season from Nicole Michel. On each day of operation, one 12-m long, 30-mm mesh, 4-tier nylon mist net was erected at each of ten fixed net sites within the interior eight ha of each station. These ten nets at each station were operated for six morning hours per day (beginning at local sunrise), and for one day in each of seven consecutive 10-day periods between May 31 and August 8. With very few exceptions, the operation of all stations occurred on schedule in each of the ten-day periods.

The operation of each of the six stations during 2003, and during all preceding years, followed the highly standardized protocols developed by The Institute for Bird Populations for use by the MAPS Program throughout North America and spelled out in the MAPS Manual (DeSante et al. 2003b). An overview of the field and analytical techniques is presented here.

Data Collection

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

(1) capture code (newly banded, recaptured, band changed, unbanded);
(2) band number;
(3) species;
(4) age and how aged;
(5) sex (if possible) and how sexed (if applicable);
(6) extent of skull pneumaticization;
(7) breeding condition of adults (i.e., 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) wing chord;
(12) fat class and weight;
(13) date and time of capture (net-run time); and
(14) station and net site where captured.

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

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; when suitable maps from previous years were available, these were used. 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 detailed in the MAPS Habitat Structure Assessment Protocol, developed by IBP Landscape Ecologist, M. Philip Nott and the IBP staff (Nott et al. 2003a).

Computer Data Entry and Verification

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

(1) Clean-up programs to check the validity of all codes entered and the ranges of all numerical data;
(2) Cross-check programs to compare station, date, and net fields from the banding data

with those from the effort and breeding status data;
(3) Cross-check programs to compare species, age, and sex determinations against degree of skull pneumaticization, breeding condition (extent of cloacal protuberance and brood patch), and extent of body and flight-feather molt, primary-feather wear, and juvenal plumage;
(4) Screening programs which allow identification of unusual or duplicate band numbers or unusual band sizes for each species; and
(5) Verification programs to screen banding and recapture data from all years of operation for inconsistent species, age, or sex determinations for each band number.

Any discrepancies or suspicious data identified by any of these programs were examined manually and corrected if necessary. Wing chord, weight, 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 (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. All data for a given species from a given station were included in year-specific or mean population size and productivity analyses for the species (e.g., Table 3, a portion of Table 4, Tables 5-7, and Table 8) unless the species was classified as a migrant (M) at the station. For survivorship estimates (Tables 9 and 10), population size and productivity trends (Figures 1 and 2), and any analyses derived from these survivorship estimates and population or productivity trends, data for a given species from a given station were included only if the species was classified as a regular (B) or usual (U) breeder and summer resident at the station. Thus, data from a station for a species classified as a migrant (M) at the station were included only in year-specific summaries of the total numbers of captures (Table 2 and a portion of Table 4).

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 pooled 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 and the proportion of young in the catch was used as an index of post-fledging productivity.

For each of the three stations run in both 2002 and 2003, and for these three stations pooled, we calculated percent changes between 2002 and 2003 in the numbers of adult and young birds captured and actual changes between the two years in post-fledging productivity. These year-to-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. For species captured at more than one station on Flathead Reservation, we followed the methods developed by the BTO in their CES scheme (Peach et al. 1996) and inferred the statistical significance of overall changes in the indices of population size and productivity using confidence intervals derived from the standard errors of the mean percentage changes. 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, but we use the term "near-significant" or "nearly significant" for differences for which $0.05 \leq P < 0.10$.

For each of the two stations operated for 11 years, 1993-2003, and for both stations combined, we calculated 11-year means for the numbers of adult and young birds captured per 600 net hours and for the proportion of young in the catch for each individual species and for all species pooled.

B. Analyses of trends in adult population size and productivity – We examined 11-year (1993-2003) trends in indices of adult population size and productivity for target species for which we recorded an average of six or more adult captures per year at the two long-running stations combined. For trends in adult population size, we first calculated adult population indices for each species for each of the 11 years based on an arbitrary starting index of 1.0 in 1993. Constant-effort changes (as defined above) were used to calculate these "chain" indices in each subsequent year by multiplying the proportional change (percent change divided by 100) 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 ten-year period, to provide an estimate of the population trend for the species; *APC* was calculated as:

(actual 1993 value of *PSI* / predicted 1993 value of *PSI* based on the regression) * *PT*.

We present the *APC*, the standard error of the slope (*SE*), the correlation coefficient (*r),* and the significance of the correlation (*P*) to describe each trend. Again, we use an alpha level of 0.05 for statistical significance. For purposes of discussion, however, we use the terms "nearly significant" or "near-significant" for trends for which $0.05 \leq P < 0.10$. Species for which $r \geq 0.5$ are considered to have a substantially increasing trend; those for which $r \leq -0.5$ are considered to have a substantially decreasing trend; those for which $-0.5 < r < 0.5$ and $SE \leq 0.029$ for 11-year trends are considered to have a stable trend; and those for which $-0.5 < r < 0.5$ and $SE > 0.029$ for 11-year trends are considered to have widely fluctuating values but no substantial trend.

Trends in productivity, *PrT*, were calculated in an analogous manner by starting with actual productivity values in 1993 and calculating each successive year's value based on the actual constant-effort changes in productivity between each pair of consecutive years. For trends in productivity, the slope (*PrT*) and its standard error (*SE*) are presented, along with the correlation coefficient (*r),* and the significance of the correlation (*P*). Productivity trends are characterized in a manner analogous to that for population trends, except that productivity trends are considered to be highly fluctuating if the SE of the slope > 0.017 for 11-year productivity trends.

C. Survivorship analyses – Modified Cormack-Jolly-Seber (CJS) mark-recapture analyses (Pollock et al.1990, Lebreton et al.1992) were conducted on target species using 11 years (1993-2003) of capture histories of adult birds from the two long-running stations. Using the computer program SURVIV (White 1983), we calculated, for each target species, maximum-likelihood estimates and standard errors (*SE*s) for adult survival probability (ϕ), adult recapture probability (p), and the proportion of residents among newly captured adults (τ) using both a between-year and within-year transient model (Pradel et al. 1997, Nott and DeSante 2002). The use of the transient model ($\phi p \tau$) 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 11 years of data allowed us to consider all possible combinations of both time-constant and time-dependent models for each of the three parameters estimated, for a total of eight models. We limited our consideration to models that produced estimates for both survival and recapture probability that were neither 0 nor 1. The goodness of fit of the models was tested by using a Pearson's goodness-of-fit test. Of those models that fit the data, the one that produced the lowest Akaike Information Criterion, correcting for dispersion of data and for use with smaller sample sizes relative to the number of parameters examined ($QAIC_C$), was chosen as the optimal model (Burnham et al. 1995). Models showing $QAIC_C$'s within 2.0 $QAIC_C$ units of each other were considered effectively equivalent (Anderson and Burnham 1999). The $QAIC_C$ was calculated by multiplying the log-likelihood for the given model by -2, adding two times the number of estimable parameters in the model, and providing corrections for overdispersed data and small sample sizes.

To assess the degree of annual variation in survival for each species, we calculated $\Delta QAIC_C$ as the difference between the completely time-constant model ($\phi p \tau$) and the best model with time-dependent survival but time-constant capture probability and proportion of residents ($\phi_t p \tau$); thus, $\Delta QAIC_C$ was calculated as $QAIC_C(\phi_t p \tau)$-$QAIC_C(\phi p \tau)$, with lower (or more negative) $\Delta QAIC_C$ values indicating stronger interannual variation in survival.

RESULTS

A total of 2411.5 net-hours was accumulated at the six MAPS stations operated on the Flathead Reservation in 2003, of which 1116.5 net-hours (from the three stations also operated in 2002) could be compared with data from 2002 in a constant-effort manner (Table 1)

Indices of Adult Population Size and Post-fledging Productivity

A. 2003 values – 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 on the Flathead Reservation in Table 2, and for all stations combined in Table 4. A total of 1583 captures of 62 species was recorded during the summer of 2003. Newly banded birds comprised 70.9% of the total captures. The greatest number of total captures (403) was recorded at the Jocko River station and the smallest number of total captures (148) was recorded at the Crow Creek station. The highest species richness occurred at Safe Harbor Marsh (35 species) and the lowest species richness occurred at Woodpecker Haven (22 species).

The capture rates (per 600 net-hours) of individual adult and young birds and the percentage of young in the catch during 2003 are presented for each species and for all species pooled at each of the six stations on the Flathead Reservation in Table 2, and for all stations combined in Table 4. We present capture rates (captures per 600 net-hours) of adults and young in these tables so that the data can be compared among stations which, because of the vagaries of weather and accidental net damage, can differ from one another in effort expended (see Table 1). These capture indices indicate that the total adult population size in 2003 was greatest at Jocko River, followed in descending order by Spring Creek, Schall, Crow Creek, Safe Harbor Marsh, and Woodpecker Haven.

The capture rate of young (Table 3) of all species pooled at each station in 2003 followed a somewhat similar sequence to that of adults: Jocko River had the highest number followed by Schall, Spring Creek, Safe Harbor Marsh, Woodpecker Haven, and Crow Creek. The index of productivity at the stations in 2003 (Tables 3; the proportion of young in the catch) was highest at Schall (0.43) followed by Jocko River (0.36), Safe Harbor Marsh (0.31), Woodpecker Haven (0.26), Spring Creek (0.24), and Crow Creek (0.23).

Among individual species, Yellow Warbler was the most frequently captured species at the six stations in 2003, followed by Black-capped Chickadee, Gray Catbird, Song Sparrow, American Robin, "Traill's" Flycatcher, Western Wood-Pewee, Cedar Waxwing, and Calliope Hummingbird (Table 4). The most abundant breeding species, having a capture rate of at least 6.0 adults per 600 net-hours, in decreasing order, were Gray Catbird, Yellow Warbler, American Robin, Song Sparrow, "Traill's" Flycatcher, Black-capped Chickadee, Cedar Waxwing, Western Wood-Pewee, Swainson's Thrush, and American Goldfinch (Table 4). The following is a list of the common breeding species (captured at a rate of at least 6.0 adults per 600 net-hours), in decreasing order, at each station in 2003:

Woodpecker Haven
American Robin
Black-capped Chickadee
Yellow Warbler
Northern Flicker
Western Wood-Pewee
Song Sparrow
Gray Catbird

Spring Creek
Yellow Warbler
"Traill's" Flycatcher
Song Sparrow
Gray Catbird
Black-capped Chickadee
Cedar Waxwing
Lazuli Bunting
Brown-headed Cowbird
Swainson's Thrush
American Redstart
Common Yellowthroat

Safe Harbor Marsh
Cedar Waxwing
"Traill's" Flycatcher
Spotted Towhee
Brown-headed Cowbird
Dusky Flycacther
Black-capped Chickadee
American Robin

Jocko River
Gray Catbird
Yellow Warbler
Swainson's Thrush
Song Sparrow
Black-capped Chickadee
Black-headed Grosbeak
Red-eyed Vireo
"Traill's" Flycatcher
Cedar Waxwing
American Robin
American Goldfinch
Spotted Towhee

Schall
American Robin
Western Wood-Pewee
American Goldfinch
Yellow Warbler
Song Sparrow
Black-capped Chickadee
Brown-headed Cowbird
Gray Catbird
"Traill's" Flycatcher
Cedar Waxwing
Red-naped Sapsucker
Downy Woodpecker
Lazuli Bunting

Crow Creek
Gray Catbird
Yellow Warbler
Lazuli Bunting
House Wren
American Robin
Song Sparrow
Black-capped Chickadee

B. Comparisons between 2002 and 2003 – Constant-effort comparisons between 2002 and 2003 were undertaken at the three stations operated in 2002 for numbers of adult birds captured (adult population size; Table 5), numbers of young birds captured (Table 6), and proportion of young in the catch (productivity; Table 7). Adult population size for all species pooled for all stations combined increased substantially, but non-significantly, by +45.1% (Table 5). It should be noted, however, that it is difficult to obtain significant results from only three stations. Increases between 2002 and 2003 were recorded for 31 of 46 species, a proportion that was significantly greater than 0.50 ($P = 0.013$). The overall adult population size for all species pooled increased at all three stations by amounts ranging from +6.0% at Safe Harbor Marsh to +66.1% at Jocko River. The proportion of increasing species was significantly greater than 0.50 at both Jocko River and Crow Creek. Near-significant or significant increases in the number of adults captured for all stations combined was recorded for Gray Catbird and Yellow Warbler whereas such decreases were recorded for Cedar Waxwing and Chipping Sparrow.

Captures of young birds for all species pooled for all stations combined increased by a significant +114.5% between 2002 and 2003 (Table 6). Increases between 2002 and 2003 were recorded for 22 of 29 species, a proportion that was highly significantly greater than 0.50. Number of young captured for all species pooled increased at all three stations by amounts ranging from +90.5% at Safe Harbor Marsh to +130.2% at Jocko River. The proportion of increasing species was highly significantly greater than 0.50 at Jocko River. No species showed near-significant or significant increases or decreases in the number of young captured for all

stations combined.

With the numbers of both adults and young captured increasing, productivity (the proportion of young in the catch) showed a non-significant increase of +0.078 from 0.238 in 2002 to 0.315 in 2003 for all species pooled and all stations combined (Table 7). Increases were recorded for 15 of 31 species, a proportion not significantly greater than 0.50. Increases in productivity were observed at all three stations by amounts ranging from +0.036 at Crow Creek to +0.111 at Safe Harbor Marsh. No station recorded a proportion of increasing (or decreasing) species that was significantly greater than 0.50, and no species showed significant or near-significant increases or decreases across stations.

Thus, in general, both population sizes and productivity increased substantially between 2002 and 2003, with number of young captured showing a significant increase. These increases were both Reservation-wide (among the three stations operated in 2002 at least) and species-wide.

C. Eleven-year mean population size and productivity values – Table 8 presents mean numbers of individual adults captured (an index of adult population size), mean numbers of individual young captured, and mean proportions of young in the catch (an index of productivity) during the eleven-year period 1993-2003 for each of the long-running stations and for both stations pooled. Examination of all-species-pooled values indicates that both adult population sizes and productivity, as well as species richness, were higher at Safe Harbor Marsh than at Crow Creek. We suspect that the presence of wetter habitats at Safe Harbor Marsh results in a higher diversity of both vegetation and birds than is found at the drier Crow Creek station.

D. Eleven-year trends in adult population size and productivity – "Chain" indices of adult population size for the 11 years, 1993-2003, for nine target species and for all species pooled at the two long-running stations, are shown in Figure 1. For each species, we used the slope of the regression line to calculate the Annual Percentage Change (*APC*) of the population. *APC* along with the standard error of the slope (*SE*), the correlation coefficient (*r)*, and the significance of the correlation (*P*) for each target and all species pooled are included in Figure 1.

Two species ("Traill's" Flycatcher and Common Yellowthroat) showed substantial declining population trends ($r \leq -0.5$), with that of "Traill's" Flycatcher being highly significant. Similarly, two species (Cedar Waxwing and Yellow Warbler) showed substantial increasing population trends ($r \geq 0.5$), with that of Yellow Warbler being nearly significant. Five of the nine species show highly fluctuating ($SE \leq 0.029$) population trends with no substantial increases or decreases (absolute $r < 0.5$). Overall, five species showed positive trends while four showed negative trends. The population trend for all species pooled was substantial and near-significantly ($P = 0.059$) negative, and indicated an annual decline of 2.0% per year.

"Chain" indices of productivity for each of the 11 years, 1993-2003, for the nine target species and all species pooled are shown in Figure 2. One species, Song Sparrow, showed a declining trend in productivity ($r \leq -0.5$) that was significant ($P = 0.029$), while another species, Common Yellowthroat, showed an increasing trend in productivity ($r \geq 0.5$) that was nearly significant. The remaining seven species showed consistent and essentially stable productivity trends

(absolute $r < 0.5$ and *SE* of the slope ≤ 0.017). The productivity trend for all species pooled was essentially flat (PrT = -0.001).

Estimates of Adult Survivorship

Using all 11 years of data (1993-2003) from the two long-running stations, estimates of adult survival and recapture probabilities and proportion of residents were obtained for eight of the nine target species breeding on the Flathead Reservation (Tables 9-10). Survival estimates could not be calculated for Cedar Waxwing due to low between-year recapture rates, presumably due to relatively low site fidelity in this species.

Because of the existence of floaters, failed breeders, and dispersing adults, transient models, which account for the proportion of residents in the population, produce less biased estimates of adult survivorship than do non-transient models, provided there are sufficient data (four years or more) to estimate the proportion of residents. Thus, we only present the results of transient models. Table 9 indicates that the time-constant transient model ($\phi p \tau$) was selected over all time-dependent transient models (by having a $QAIC_C$ that was at least 2.0 $QAIC_C$ units lower than any other model) for all eight species. $\Delta QAIC_C$ (see Methods), a measure of the degree to which adult survival varied with time over the eleven-year period, was 2.3 for both Black-capped Chickadee and Yellow Warbler, indicating some degree of time-dependence, but not quite enough for the time-dependent model to be considered equivalent to the time-independent model (i.e., $\Delta QAIC_C > 2.0$). For the remaining six species $\Delta QAIC_C$ ranged from 10.1 for Gray Catbird to to 16.1 in Song Sparrow, indicating effectively no time-dependence in survival. The relatively small sample sizes available from just two stations, however, make it difficult to detect time-dependence in survival.

Table 10 presents the maximum-likelihood estimates and standard errors for annual adult survival probability, recapture probability, and the proportion of residents for the time-constant model, along with the precision (Coefficients of Variation, C.V.) of the estimates of survival probability. The mean C.V. of the time-constant survival estimates for the eight species using 11 years of data was 24.9%, a slight improvement from 25.2% recorded using ten years of data for 21 species at Flathead National Forest and Flathead Reservation following the 2002 season.

Survivorship estimates for the eight species (Table 10), using time-constant models, ranged from a low of 0.364 for House Wren to a high of 0.732 for American Robin, with a mean of 0.527. Recapture probability ranged from a low of 0.155 for House Wren to a high of 0.628 for Song Sparrow, with a mean of 0.356. Proportion of residents varied from a low of 0.132 for "Traill's" Flycatcher to a high of 1.000 for House Wren, with a mean of 0.566. These estimates indicate that, on average, annual adult survival rates appear to be good for landbird species on the Flathead Reservation.

DISCUSSION OF RESULTS AND CONCLUSIONS

Population and productivity indices indicate excellent capture rates at all six Flathead Reservation stations, including the three new stations established in 2003. All six stations showed population indices of > 129 adults captured per 600 net-hours and productivity values of between 0.23 and 0.43 young captured per adult. These are relatively high values when compared to other stations in the MAPS program as a whole. At the four recently established stations, the mean adult capture rate was 231.1 individual adults per 600 net-hours and mean productivity was 0.323. These rates should provide an excellent baseline for assessing the effects of habitat restoration at these riparian sites in years to come. It should be noted, however, that the tilling of old hay fields at the Schall station during June 2003 may have attracted unusually large numbers of birds to this station, especially American Robins that were feeding on invertebrates in the fields. It will be interesting to see how 2004 numbers vary at this station, assuming no new tilling, and as affected by restoration efforts undertaken in 2003 and 2004.

Constant-effort comparisons between 2002 and 2003 indicated that both population sizes and productivity increased substantially, with number of young captured showing a significant increase. These increases were both Reservation-wide (among the three stations at least) and species-wide. It was noted by IBP biologists and Reservation staff that the summer of 2003 was one of the driest on record, but that vegetation at the stations remained moist and lush through the period. It is possible that the apparent increases represent an "oasis" effect, birds being attracted to these wet areas in higher-than-normal numbers. It will be very interesting to see how comparisons between 2003 and 2004, with all six stations included, compare with these changes in relation to changes in weather during the 2004 season.

Analyses of productivity vs. the Southern Oscillation Index (SOI) using MAPS data from across the continent have revealed stronger effects in Pacific coastal areas than in interior areas. For example, both observed and predicted productivity trends on Region Six national forests, most of which are located in central or western Washington and Oregon, indicated that the El Niño/ Southern Oscillation has a greater effect on avian productivity on those forests than on the Flathead National Forest. Other recent work at IBP suggests that the North Atlantic Oscillation (NAO) can also influence productivity across the northern part of the U.S. including the Flathead region (Nott et al. 2002). Once more data have been collected at Flathead Reservation, further analyses may show that productivity trends can best be modeled by considering both SOI and NAO. This will allow a more robust assessment of the effects of habitat restoration at Flathead, after climate variables have been statistically controlled.

Eleven-year (1993-2003) analyses of chain indices of adult population size indicated a substantial and nearly significant (P=0.059) decline of -2.0% per year for all species pooled at the two long-running stations combined. This trend appears to be region wide, as it was similar using 10 years of data (1993-2002) in the entire Flathead region (DeSante et al. 2003). Analyses of Flathead Reservation data further revealed that two species (“Traill’s”, Fycatcher and Common Yellowthroat) showed substantial ($r \leq -0.5$) declines, with that of "Traill’s" Flycatcher being highly significant. Eleven-year trends in productivity were generally fairly stable,

especially as compared to trends in population size. Only one species (Song Sparrow) showed a substantial and significant declining productivity trend ($r \leq -0.5$) and one species (Common Yellowthroat) showed substantial and near-significant increasing productivity trend ($r \geq 0.5$).

We were able to obtain survivorship estimates for eight of nine target species on Flathead Reservation, using data from just the two long-running stations. $\Delta QAIC_c$ values indicated no time-dependent variation over the 11-year period, and they were high (≥ 10) for six of these eight species, indicating that relatively little interannual variation in survival was detected for most species occurring at Flathead. As mentioned previously, the relatively small sample sizes available from just two stations make it difficult to detect time dependence in survival. In addition, as has been mentioned in previous reports, increased years of data have resulted in increased numbers of species for which survival rate estimates can be obtained as well as increased precision of the survival estimates themselves. The mean precision (C.V.) of the time-constant survival estimates for the eight species (24.9%) improved slightly from 25.2% using ten years of data. This supports the suggestion that maximum precision may not be obtained until 12 or more years of data are available (Rosenberg et al. 1996, 1999).

Survival estimates for the eight target species were generally high as compared to elsewhere in North America, suggesting that productivity on the breeding grounds rather than survival on the winter grounds may be affecting population trends at the Flathead Reservation. Indeed, results of analyses for the Flathead Region using 10 years of data (1993-2002) suggest that, for five of six species with substantial population declines ("Traill's" Flycatcher, Hammond's Flycatcher, Warbling Vireo, Orange-crowned Warbler, and Common Yellowthroat), low productivity was the driving force for the decline, whereas for only one species, Dusky Flycatcher, did the evidence suggests that low survival is the primary contributing factor to the decline, while low but increasing productivity may also have contributed to the problem (DeSante et al. 2003a). Interestingly, it appears as though low productivity may be driving the generally negative population trends on six national forests in Forest Service Region Six (Washington and Oregon), as well. This suggests that productivity problems leading to population declines may be occurring on Flathead Reservation and thus may be correctable through habitat restoration or other proactive management strategies.

A third objective of MAPS is to evaluate the success of on-going management actions such as habitat restoration and fire-ecology management. On the Flathead Reservation, four new stations have been established in areas subject to on-going and future habitat restoration efforts in the Jocko River watershed. At two stations, Jocko River and Schall, restoration efforts commenced in 2003 and at the other two, Woodpecker Haven and Spring Creek, efforts will begin in 2004 or 2005. These efforts will be aimed at re-channeling the river to it's original banks and restoring the cottonwood/willow riparian habitat, which has been reduced during the past 100 years by grazing and development from a continuos strip to small patches. We anticipate that MAPS will be very well suited to detect increases in landbird population sizes and productivity that result from this restoration management.

We have recently initiated two additional broad-scale analyses to help us further understand the population dynamics of landbirds and formulate potential management actions to assist bird

populations. First, by modeling spatial variation in vital rates as a function of spatial variation in population trends we have demonstrated that we can determine the proximate demographic causes of population trends within a species at multiple spatial scales (DeSante et al. 2001). In a series of analyses using data from various spatial scales in eastern North America, we modeled productivity indices and time-constant annual adult survival-rate estimates from MAPS data for six target species for which BBS population trends or MAPS trends in adult captures were significantly negative in one area and positive in another. We found, in each case, that we could identify the proximate demographic cause of population decline, and showed that predicted population trends modeled from MAPS vital rates were significantly positively correlated with actual population trends. Analyses of spatial variation in productivity and survival as a function of spatial variation in population trends, therefore, appear to be very effective in determining the proximate demographic causes of population declines.

Second, we have found that patterns of landscape structure detected within a two- to four-kilometer radius area of each MAPS station are good predictors, not only of the numbers of birds of each species captured but, more importantly, of their productivity levels as well (Nott 2000). This study, based on MAPS data from military installations in the eastern United States, revealed the existence of critical threshold values of woodland/forest patch size above which productivity levels could be maximized for four forest-interior species. These types of analyses provide extremely powerful tools to identify and formulate management actions aimed at reversing declining populations and maintaining stable or increasing populations of landbirds, because they can address the particular vital rate responsible for the decline. By coupling station-specific and landscape-level information on habitat characteristics with spatially explicit weather data and estimates and indices of population trends and vital rates of target species in a GIS-based framework, we will be able to control for large-scale weather and climate effects (Nott et al. 2002) and identify the landscape-level habitat characteristics associated with both low and high productivity and low and high survival rates for each target species. Then, using these results, we will be able to identify generalized management guidelines, and formulate specific management actions, to reverse the population declines of the target landbird species (Nott et al. 2003b). By this approach, we aim to develop optimal, multi-use management strategies for reversing population declines and maintaining stable or increasing populations. At Flathead Reservation, we anticipate using habitat modeling to assess the effects of habitat restoration both at the local scale (as correlated with planned vegetation structure modeling associated with restoration efforts) and at the landscape level (as related to the sizes of continuous patches that occur along the Jocko River).

In summary, 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 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 ultimate objective of the MAPS Program is to identify generalized management guidelines and formulate specific management actions that can be implemented to reverse the population

declines of target landbird species and to maintain the populations of stable or increasing species. The identification and formulation of these management guidelines and actions is to be achieved by modeling the vital rates (productivity and survivorship) of the various landbird species as a function of landscape-level habitat characteristics and spatially explicit weather variables. Our goal is to identify relationships between productivity (and survivorship for permanent resident species) and these habitat and weather variables. These management strategies will involve efforts to modify the habitat from characteristics associated with low productivity to characteristics associated with high productivity (for species for which low productivity is driving the population decline). At Flathead Reservation, we will be integrating habitat restoration efforts into analyses of landbird population dynamics to evaluate the effectiveness of these management efforts.

The data collected at the MAPS stations at Flathead Reservation during their first eleven years have revealed that the population dynamics of the breeding birds are complex, as apparently are the causes for population changes and, for those deemed problematic, their likely solutions. This complexity, in turn, underscores the importance of standardized, long-term data. In general, the analyses of MAPS data indicate that bird populations at Flathead and in the Pacific Northwest are declining, and that these declines appear to be caused more by deficiencies in productivity on the breeding grounds than by deficiencies in survival on the winter grounds. Our next objective will be to see whether or not current habitat restoration efforts will be able to increase productivity on the Reservation, and in turn reverse current population declines.

We suggest, therefore, that the indices and estimates of primary demographic parameters produced by MAPS are extremely useful for the management and conservation of landbirds at Flathead Reservation, and we conclude that the MAPS protocol is very well-suited to provide a critical component of natural resource management and monitoring on the Reservation. Based on the above information, we recommended that the MAPS program continue to be operate on the Reservation well into the future.

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Table 1. Summary of the 2003 MAPS program on the Flathead Reservation of the Confederated Salish and Kootenai Tribes.

Station					Avg Elev. (m)	2003 operation		
Name	Code	No.	Major Habitat Type	Latitude-longitude		Total number of net-hours[1]	No. of periods	Inclusive dates
Woodpecker Haven	WOHA	11234	cottonwood-willow riparian	47˚10'19"N,-114˚04'60"W	920	403.3	7	6/05 - 8/04
Safe Harbor Marsh	SHMA	11199	Freshwater marsh, mixed conifer forest, low shrubs	47˚46'30"N,-114˚08'00"W	881	405.3 (399.5)	7	6/01 - 7/31
Schall	SCHA	11232	cottonwood-willow riparian	47˚12'57"N,-114˚08'29"W	870	408.3	7	6/03 - 8/02
Spring Creek	SPCK	11233	cottonwood-willow riparian	47˚14’03"N,-114˚09’48"W	853	383.8	7	5/31 - 7/30
Jocko River	JORI	11221	cottonwood-willow riparian, surrounded by grassland	47˚17’00"N,-114˚11’45"W	825	402.7 (374.3)	7	6/02 - 8/01
Crow Creek	CWCR	11198	Riparian, ponderosa pine woodland, grassy meadow	47˚28'10"N,-114˚16'40"W	786	408.0 (342.7)	7	6/04 - 8/03
ALL STATIONS COMBINED						2411.5 (1116.5)	7	5/31 - 8/04

[1] Total net-hours in 2003. Net-hours in 2003 that could be compared in a constant-effort manner to 2002 are shown in parentheses. Woodpecker Haven, Schall, and Spring Creek stations began operation in 2003 and therefore have no comparable hours to 2002.

Table 2. Capture summary for the six individual MAPS stations operated on the Flathead Reservation of the Confederated Salish and Kootenai Tribes in 2003. N = Newly Banded, U = Unbanded, R = Recaptures of banded birds.

	Woodpecker Haven			Safe Harbor Marsh			Schall			Spring Creek			Jocko River			Crow Creek		
Species	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
American Kestrel		1																
Mourning Dove					2													
Calliope Hummingbird		11			28			2			3			2				
Rufous Hummingbird		1			1						3			1				
Unident. Selasphorus Hum.		1																
Belted Kingfisher														2				
Red-naped Sapsucker	3			1			8	2	4	3			1					
Downy Woodpecker	3		1	2		3	7		2	3		1	3			2		
Hairy Woodpecker				1		1				1								
Northern Flicker	7		1				2			4			6					
Pileated Woodpecker											2							
Western Wood-Pewee	6			1			17		18	1			2		1	2		2
"Traill's" Flycatcher	3			8		5	8		1	29		11	9		1	4		1
Least Flycatcher	1			1			4		3	1		1	1					
Dusky Flycatcher				2		5	1									1		
"Western" Flycatcher										1						5		
Unidentified Empidonax					1			1										
Eastern Kingbird	1						1											
Cassin's Vireo				1		1				2								
Warbling Vireo	3	1					2			2								
Red-eyed Vireo	2									1			9		9			
Black-billed Magpie																	1	
Tree Swallow							1											
N. Rough-winged Swallow																2		1
Black-capped Chickadee	23		9	21		13	18	1	9	41		9	33	1	19	11		3
Mountain Chickadee				4														
Red-breasted Nuthatch				1												2		
Pygmy Nuthatch				5		1												

Table 2. (cont.) Capture summary for the six individual MAPS stations operated on the Flathead Reservation of the Confederated Salish and Kootenai Tribes in 2003. N = Newly Banded, U = Unbanded, R = Recaptures of banded birds.

	Woodpecker Haven			Safe Harbor Marsh			Schall			Spring Creek			Jocko River			Crow Creek		
Species	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Brown Creeper				1														
House Wren				1						1			1			9		4
Golden-crowned Kinglet				1			1											
Veery													1					
Swainson's Thrush				3			1			6			21		2	2		
American Robin	37		2	4		2	31	1	7	4		1	11		1	6		1
Gray Catbird	4		1	3		5	8			20		8	70	1	25	21		8
Cedar Waxwing	2			15	1	5	6		1	9			9			1		
Orange-crowned Warbler							3		3	1			2			1		
Nashville Warbler							1						2					
Yellow Warbler	11	1	3	2			66	2	12	38	1	16	28		31	15		8
Townsend's Warbler							1											
American Redstart										5								
Northern Waterthrush													1					
MacGillivray's Warbler				1		1	3		1	3	1		5		2	1		
Common Yellowthroat				3		2				5			1			1		
Wilson's Warbler																1		
Yellow-breasted Chat										2			3					
Unidentified Warbler														2				
Western Tanager				2			1						2		1			
Spotted Towhee				7		2				1			14		1	3		1
Chipping Sparrow																		1
Song Sparrow	8		5	7		6	26	2	13	33	2	13	32		9	9		6
Lincoln's Sparrow	1																	
Dark-eyed Junco				2														
Black-headed Grosbeak				3		1	1				3		14		1			
Lazuli Bunting							7			6		2	1			6		4

Table 2. (cont.) Capture summary for the six individual MAPS stations operated on the Flathead Reservation of the Confederated Salish and Kootenai Tribes in 2003. N = Newly Banded, U = Unbanded, R = Recaptures of banded birds.

	Woodpecker Haven			Safe Harbor Marsh			Schall			Spring Creek			Jocko River			Crow Creek		
Species	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Red-winged Blackbird				3			1											
Western Meadowlark	1																	
Brewer's Blackbird							2											
Brown-headed Cowbird	1		2	6			8	1	2	6		3	3					
Bullock's Oriole							3									1		
House Finch				3			3											
Red Crossbill				1														
Pine Siskin	1			2														
American Goldfinch							17		11	2			5		1	1		
House Sparrow								1										
ALL SPECIES POOLED	118	16	24	118	33	53	259	13	87	231	15	65	290	9	104	107	1	40
Total Number of Captures		158			204			359			311			403			148	
Number of species	19	5	8	32	4	15	31	8	14	28	7	10	28	5	14	23	1	12
Total Number of Species		22			35			33			32			31			25	

Table 3. 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 the Flathead Reservation of the Confederated Salish and Kootenai Tribes in 2003.

	Woodpecker Haven			Safe Harbor Marsh			Schall			Spring Creek			Jocko River			Crow Creek		
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.
Red-naped Sapsucker	4.5	0.0	0.00	1.5	0.0	0.00	7.3	4.4	0.38	3.1	1.6	0.33	1.5	0.0	0.00			
Downy Woodpecker	4.5	0.0	0.00	3.0	0.0	0.00	7.3	2.9	0.29	3.1	1.6	0.33	3.0	1.5	0.33	1.5	1.5	0.50
Hairy Woodpecker				1.5	0.0	0.00				1.6	0.0	0.00						
Northern Flicker	8.9	1.5	0.14				1.5	1.5	0.50	4.7	1.6	0.25	4.5	4.5	0.50			
Western Wood-Pewee	8.9	0.0	0.00	1.5	0.0	0.00	25.0	0.0	0.00	1.6	0.0	0.00	3.0	0.0	0.00	4.4	0.0	0.00
"Traill's" Flycatcher	4.5	0.0	0.00	10.4	0.0	0.00	8.8	0.0	0.00	43.8	0.0	0.00	13.4	0.0	0.00	5.9	0.0	0.00
Least Flycatcher	1.5	0.0	0.00	1.5	0.0	0.00	2.9	2.9	0.50	1.6	0.0	0.00	1.5	0.0	0.00			
Dusky Flycatcher				7.4	1.5	0.17	1.5	0.0	0.00							1.5	0.0	0.00
"Western" Flycatcher										1.6	0.0	0.00				5.9	1.5	0.20
Eastern Kingbird	1.5	0.0	0.00				1.5	0.0	0.00									
Cassin's Vireo				1.5	0.0	0.00				3.1	0.0	0.00						
Warbling Vireo	4.5	0.0	0.00				2.9	0.0	0.00	3.1	0.0	0.00						
Red-eyed Vireo	3.0	0.0	0.00							1.6	0.0	0.00	16.4	0.0	0.00			
Tree Swallow							1.5	0.0	0.00									
N. Rough-winged Swallow																4.4	0.0	0.00
Black-capped Chickadee	14.9	19.3	0.57	7.4	28.1	0.79	13.2	13.2	0.50	23.4	40.6	0.63	17.9	34.3	0.66	7.4	8.8	0.54
Mountain Chickadee				1.5	4.4	0.75												
Red-breasted Nuthatch				1.5	0.0	0.00										0.0	2.9	1.00
Pygmy Nuthatch				1.5	5.9	0.80												
Brown Creeper				0.0	1.5	1.00												
House Wren				0.0	1.5	1.00				0.0	1.6	1.00	0.0	1.5	1.00	8.8	5.9	0.40
Golden-crowned Kinglet				1.5	0.0	0.00	0.0	1.5	1.00									
Veery													1.5	0.0	0.00			

Table 3. (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 the Flathead Reservation of the Confederated Salish and Kootenai Tribes in 2003.

	Woodpecker Haven			Safe Harbor Marsh			Schall			Spring Creek			Jocko River			Crow Creek		
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.
Swainson's Thrush				3.0	1.5	0.33	1.5	0.0	0.00	7.8	1.6	0.17	28.3	3.0	0.09	2.9	0.0	0.00
American Robin	43.1	11.9	0.22	7.4	0.0	0.00	38.2	7.3	0.16	4.7	1.6	0.25	7.5	8.9	0.54	8.8	1.5	0.14
Gray Catbird	6.0	0.0	0.00	4.4	0.0	0.00	10.3	1.5	0.13	29.7	1.6	0.05	89.4	31.3	0.26	33.8	1.5	0.04
Cedar Waxwing	3.0	0.0	0.00	23.7	0.0	0.00	8.8	0.0	0.00	14.1	0.0	0.00	10.4	3.0	0.22	1.5	0.0	0.00
Orange-crowned Warbler							0.0	4.4	1.00	1.6	0.0	0.00	3.0	0.0	0.00	0.0	1.5	1.00
Nashville Warbler							0.0	1.5	1.00				1.5	1.5	0.50			
Yellow Warbler	11.9	4.5	0.27	3.0	0.0	0.00	19.1	80.8	0.81	45.3	14.1	0.24	35.8	19.4	0.35	17.6	10.3	0.37
Townsend's Warbler							0.0	1.5	1.00									
American Redstart										7.8	0.0	0.00						
Northern Waterthrush													0.0	1.5	1.00			
MacGillivray's Warbler				1.5	0.0	0.00	1.5	2.9	0.67	3.1	1.6	0.33	4.5	3.0	0.40	1.5	0.0	0.00
Common Yellowthroat				4.4	3.0	0.40				7.8	0.0	0.00	0.0	1.5	1.00	1.5	0.0	0.00
Wilson's Warbler																1.5	0.0	0.00
Yellow-breasted Chat										3.1	0.0	0.00	4.5	0.0	0.00			
Western Tanager				3.0	0.0	0.00	0.0	1.5	1.00				1.5	3.0	0.67			
Spotted Towhee				8.9	1.5	0.14				0.0	1.6	1.00	6.0	14.9	0.71	4.4	0.0	0.00
Chipping Sparrow																1.5	0.0	0.00
Song Sparrow	7.4	4.5	0.38	4.4	5.9	0.57	14.7	23.5	0.62	32.8	18.8	0.36	19.4	29.8	0.61	8.8	5.9	0.40
Lincoln's Sparrow	0.0	1.5	1.00															
Dark-eyed Junco				3.0	0.0	0.00												
Black-headed Grosbeak				4.4	0.0	0.00	0.0	1.5	1.00				17.9	4.5	0.20			
Lazuli Bunting							7.3	2.9	0.29	9.4	0.0	0.00	1.5	0.0	0.00	10.3	0.0	0.00
Red-winged Blackbird				4.4	0.0	0.00	1.5	0.0	0.00									

Table 3. (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 the Flathead Reservation of the Confederated Salish and Kootenai Tribes in 2003.

	Woodpecker Haven			Safe Harbor Marsh			Schall			Spring Creek			Jocko River			Crow Creek		
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.
Western Meadowlark	1.5	0.0	0.00															
Brewer's Blackbird							2.9	0.0	0.00									
Brown-headed Cowbird	0.0	1.5	1.00	8.9	0.0	0.00	11.8	0.0	0.00	9.4	0.0	0.00	3.0	1.5	0.33			
Bullock's Oriole							1.5	2.9	0.67							1.5	0.0	0.00
House Finch				1.5	3.0	0.67	1.5	2.9	0.67									
Red Crossbill				1.5	0.0	0.00												
Pine Siskin	0.0	1.5	1.00	1.5	1.5	0.50												
American Goldfinch							25.0	0.0	0.00	3.1	0.0	0.00	7.5	0.0	0.00	1.5	0.0	0.00
ALL SPECIES POOLED	129.4	46.1	0.26	130.3	59.2	0.31	218.9	161.6	0.43	272.0	87.5	0.24	304.0	168.4	0.36	136.8	41.2	0.23
Number of Species	16	8		30	12		25	19		26	12		25	18		22	10	
Total Number of Species		19			32			31			28			28			24	

Table 4. Summary of results for all six Flathead Reservation of the Confederated Salish and Kootenai Tribes MAPS stations combined in 2003.

Species	Birds captured			Birds/600 nethours		
	Newly banded	Un-banded	Recap-tured	Adults	Young	Prop. Young
American Kestrel		1				
Mourning Dove		2				
Calliope Hummingbird		46				
Rufous Hummingbird		6				
Unident. Selasphorus Hum.		1				
Belted Kingfisher		2				
Red-naped Sapsucker	16	2	4	3.0	1.0	0.25
Downy Woodpecker	20		7	3.7	1.2	0.25
Hairy Woodpecker	2		1	0.5	0.0	0.00
Northern Flicker	19		1	3.2	1.5	0.32
Pileated Woodpecker		2				
Western Wood-Pewee	29		21	7.5	0.0	0.00
"Traill's" Flycatcher	61		19	14.2	0.0	0.00
Least Flycatcher	8		4	1.5	0.5	0.25
Dusky Flycatcher	4		5	1.7	0.2	0.13
"Western" Flycatcher	6			1.2	0.2	0.17
Unidentified Empidonax		2				
Eastern Kingbird	2			0.5	0.0	0.00
Cassin's Vireo	3		1	0.7	0.0	0.00
Warbling Vireo	7	1		1.7	0.0	0.00
Red-eyed Vireo	12		9	3.5	0.0	0.00
Black-billed Magpie		1				
Tree Swallow	1			0.2	0.0	0.00
N. Rough-winged Swallow	2		1	0.7	0.0	0.00
Black-capped Chickadee	147	2	62	13.9	23.9	0.63
Mountain Chickadee	4			0.2	0.7	0.75
Red-breasted Nuthatch	3			0.2	0.5	0.67
Pygmy Nuthatch	5		1	0.2	1.0	0.80
Brown Creeper	1			0.0	0.2	1.00
House Wren	12		4	1.5	1.7	0.54
Golden-crowned Kinglet	2			0.2	0.2	0.50
Veery	1			0.2	0.0	0.00
Swainson's Thrush	33		2	7.2	1.0	0.12
American Robin	93	1	14	18.4	5.2	0.22
Gray Catbird	126	1	47	28.9	6.0	0.17
Cedar Waxwing	42	1	6	10.2	0.5	0.05
Orange-crowned Warbler	7		3	0.7	1.0	0.57

Table 4. (cont.) Summary of results for all six Flathead Reservation of the Confederated Salish and Kootenai Tribes MAPS stations combined in 2003.

Species	Birds captured			Birds/600 nethours		
	Newly banded	Un-banded	Recap-tured	Adults	Young	Prop. Young
Nashville Warbler	3			0.2	0.5	0.67
Yellow Warbler	160	4	70	21.6	21.6	0.50
Townsend's Warbler	1			0.0	0.2	1.00
American Redstart	5			1.2	0.0	0.00
Northern Waterthrush	1			0.0	0.2	1.00
MacGillivray's Warbler	13	1	4	2.0	1.2	0.39
Common Yellowthroat	10		2	2.2	0.7	0.25
Wilson's Warbler	1			0.2	0.0	0.00
Yellow-breasted Chat	5			1.2	0.0	0.00
Unidentified Warbler		2				
Western Tanager	5		1	0.7	0.7	0.50
Spotted Towhee	25		4	3.2	3.0	0.48
Chipping Sparrow			1	0.2	0.0	0.00
Song Sparrow	115	4	52	14.4	14.7	0.50
Lincoln's Sparrow	1			0.0	0.2	1.00
Dark-eyed Junco	2			0.5	0.0	0.00
Black-headed Grosbeak	18	3	2	3.7	1.0	0.21
Lazuli Bunting	20		6	4.7	0.5	0.09
Red-winged Blackbird	4			1.0	0.0	0.00
Western Meadowlark	1			0.2	0.0	0.00
Brewer's Blackbird	2			0.5	0.0	0.00
Brown-headed Cowbird	24	1	7	5.5	0.5	0.08
Bullock's Oriole	4			0.5	0.5	0.50
House Finch	6			0.5	1.0	0.67
Red Crossbill	1			0.2	0.0	0.00
Pine Siskin	3			0.2	0.5	0.67
American Goldfinch	25		12	6.2	0.0	0.00
House Sparrow		1				
ALL SPECIES POOLED	1123	87	373	197.6	94.0	0.32
Total Number of Captures		1583				
Number of Species	53	19	30	50	34	
Total Number of Species		62			54	

Table 5. Percentage changes between 2002 and 2003 in the numbers of individual ADULT birds captured at three constant-effort MAPS stations on the Flathead Reservation of the Confederated Salish and Kootenai Tribes.

Species	Safe Har. Marsh	Jocko River	Crow Creek	n[1]	All three stations combined: Number of adults 2002	Number of adults 2003	Percent change	SE[2]	
Red-naped Sapsucker	++++[3]	++++[3]		2	0	2	++++[3]		
Downy Woodpecker	++++	0.0	-100.0	3	3	4	33.3	101.8	
Hairy Woodpecker	++++			1	0	1	++++		
Northern Flicker		++++		1	0	3	++++		
Western Wood-Pewee	++++	++++	++++[3]	3	0	6	++++		
"Traill's" Flycatcher	600.0	++++	300.0	3	2	19	850.0	613.9	
Least Flycatcher	++++	++++		2	0	2	++++		
Hammond's Flycatcher	-100.0		-100.0	2	5	0	-100.0	88.9	
Dusky Flycatcher	-16.7		++++	2	6	6	0.0	33.3	
"Western" Flycatcher			++++	1	0	4	++++		
Cassin's Vireo	++++			1	0	1	++++		
Warbling Vireo	-100.0		-100.0	2	4	0	-100.0	88.9	
Red-eyed Vireo		120.0		1	5	11	120.0		
N. Rough-winged Swallow			50.0	1	2	3	50.0		
Black-capped Chickadee	-16.7	9.1	25.0	3	21	22	4.8	9.3	
Mountain Chickadee	0.0			1	1	1	0.0		
Red-breasted Nuthatch	-50.0			1	2	1	-50.0		
Pygmy Nuthatch	++++			1	0	1	++++		
Brown Creeper				0	0	0			
House Wren	-100.0		66.7	2	4	5	25.0	62.5	
Golden-crowned Kinglet	++++			1	0	1	++++		
Veery		++++		1	0	1	++++		
Swainson's Thrush	-50.0	54.5	100.0	3	16	21	31.3	32.1	
American Robin	-16.7	50.0	25.0	3	12	13	8.3	18.8	
Gray Catbird	0.0	128.0	333.3	3	31	73	135.5	29.4	**
Cedar Waxwing	-30.4	-12.5	-100.0	3	34	23	-32.4	9.4	*
Orange-crowned Warbler	-100.0	++++		2	3	2	-33.3	133.3	

Table 5. (cont.) Percentage changes between 2002 and 2003 in the numbers of individual ADULT birds captured at three constant-effort MAPS stations on the Flathead Reservation of the Confederated Salish and Kootenai Tribes.

Species	Safe Har. Marsh	Jocko River	Crow Creek	n[1]	All three stations combined: Number of adults 2002	Number of adults 2003	Percent change	SE[2]	
Nashville Warbler		0.0		1	1	1	0.0		
Yellow Warbler	0.0	20.0	42.9	3	29	36	24.1	6.9	*
American Redstart		-100.0		1	3	0	-100.0		
Northern Waterthrush				0	0	0			
MacGillivray's Warbler	0.0	50.0	++++	3	3	5	66.7	50.9	
Common Yellowthroat	0.0		++++	2	3	4	33.3	66.7	
Wilson's Warbler			0.0	1	1	1	0.0		
Yellow-breasted Chat		0.0		1	3	3	0.0		
Western Tanager	-33.3	-100.0		2	4	2	-50.0	25.0	
Spotted Towhee	500.0	50.0	50.0	3	5	12	140.0	108.0	
Chipping Sparrow	-100.0	-100.0	-66.7	3	6	1	-83.3	12.7	**
Song Sparrow	-57.1	10.0	20.0	3	22	20	-9.1	23.0	
Dark-eyed Junco	0.0			1	2	2	0.0		
Black-headed Grosbeak	++++	300.0		2	3	15	400.0	200.0	
Lazuli Bunting		-100.0	200.0	2	5	6	20.0	144.0	
Red-winged Blackbird	++++			1	0	3	++++		
Brown-headed Cowbird	500.0	++++		2	1	8	700.0	400.0	
Bullock's Oriole				0	0	0			
House Finch	++++			1	0	1	++++		
Red Crossbill	++++			1	0	1	++++		
Pine Siskin	++++			1	0	1	++++		
American Goldfinch		150.0	++++	2	2	6	200.0	100.0	
ALL SPECIES POOLED	6.0	66.1	63.0	3	244	354	45.1	20.7	

Table 5. (cont.) Percentage changes between 2002 and 2003 in the numbers of individual ADULT birds captured at three constant-effort MAPS stations on the Flathead Reservation of the Confederated Salish and Kootenai Tribes.

Species	Safe Har. Marsh	Jocko River	Crow Creek	All three stations combined
No. species that increased[4]	16(13)	19(8)	17(6)	31(14)
No. species that decreased[5]	13(5)	5(4)	5(4)	9(3)
No. species remained same	6	3	1	6
Total Number of Species	35	27	23	46
Proportion of increasing (decreasing) species	0.457	0.704	0.739	0.674
Sig. of increase (decrease)[6]	0.750	0.026	0.017	0.013
		**	**	**

[1] Number of stations at which at least one adult bird was captured in either year.
[2] Standard error of the % change in the number of adult birds captured.
[3] Increase indeterminate (infinite) because no adult was captured during 2002.
[4] No. of species for which adults were captured in 2003 but not in 2002 are in parentheses.
[5] No. of species for which adults were captured in 2002 but not in 2003 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. Percentage changes between 2002 and 2003 in the numbers of individual YOUNG birds captured at three constant-effort MAPS stations on the Flathead Reservation of the Confederated Salish and Kootenai Tribes.

Species	Safe Har. Marsh	Jocko River	Crow Creek	n[1]	All three stations combined: Number of young 2002	All three stations combined: Number of young 2003	All three stations combined: Percent change	All three stations combined: SE[2]
Red-naped Sapsucker				0	0	0		
Downy Woodpecker		++++[3]	++++[3]	2	0	2	++++[3]	
Hairy Woodpecker				0	0	0		
Northern Flicker		50.0		1	2	3	50.0	
Western Wood-Pewee				0	0	0		
"Traill's" Flycatcher				0	0	0		
Least Flycatcher				0	0	0		
Hammond's Flycatcher				0	0	0		
Dusky Flycatcher	-50.0			1	2	1	-50.0	
"Western" Flycatcher			++++	1	0	1	++++	
Cassin's Vireo				0	0	0		
Warbling Vireo				0	0	0		
Red-eyed Vireo				0	0	0		
N. Rough-winged Swallow				0	0	0		
Black-capped Chickadee	137.5	300.0	-25.0	3	21	45	114.3	85.3
Mountain Chickadee	++++[3]			1	0	3	++++	
Red-breasted Nuthatch	-100.0		++++	2	2	2	0.0	200.0
Pygmy Nuthatch	300.0			1	1	4	300.0	
Brown Creeper	++++			1	0	1	++++	
House Wren	++++	++++	++++	3	0	4	++++	
Golden-crowned Kinglet				0	0	0		
Veery				0	0	0		
Swainson's Thrush	0.0	0.0		2	3	3	0.0	88.9
American Robin		++++	++++	2	0	5	++++	
Gray Catbird		20.0	0.0	2	16	19	18.8	2.3
Cedar Waxwing		++++		1	0	2	++++	
Orange-crowned Warbler			++++	1	0	1	++++	

Table 6. (cont.) Percentage changes between 2002 and 2003 in the numbers of individual YOUNG birds captured at three constant-effort MAPS stations on the Flathead Reservation of the Confederated Salish and Kootenai Tribes.

Species	Safe Har. Marsh	Jocko River	Crow Creek	n[1]	All three stations combined: Number of young 2002	All three stations combined: Number of young 2003	All three stations combined: Percent change	All three stations combined: SE[2]	
Nashville Warbler		++++		1	0	1	++++		
Yellow Warbler		120.0	++++	2	5	18	260.0	280.0	
American Redstart				0	0	0			
Northern Waterthrush		++++		1	0	1	++++		
MacGillivray's Warbler		++++		1	0	2	++++		
Common Yellowthroat	0.0	-66.7		2	5	3	-40.0	32.0	
Wilson's Warbler				0	0	0			
Yellow-breasted Chat				0	0	0			
Western Tanager				0	0	0			
Spotted Towhee	++++	++++		2	0	9	++++		
Chipping Sparrow	-100.0			1	1	0	-100.0		
Song Sparrow	33.3	122.2	-33.3	3	15	26	73.3	45.5	
Dark-eyed Junco	-100.0			1	1	0	-100.0		
Black-headed Grosbeak		++++		1	0	3	++++		
Lazuli Bunting				0	0	0			
Red-winged Blackbird				0	0	0			
Brown-headed Cowbird		++++		1	0	1	++++		
Bullock's Oriole		-100.0		1	2	0	-100.0		
House Finch	++++			1	0	2	++++		
Red Crossbill				0	0	0			
Pine Siskin	++++			1	0	1	++++		
American Goldfinch				0	0	0			
ALL SPECIES POOLED	90.5	130.2	100.0	3	76	163	114.5	13.9	**

Table 6. (cont.) Percentage changes between 2002 and 2003 in the numbers of individual YOUNG birds captured at three constant-effort MAPS stations on the Flathead Reservation of the Confederated Salish and Kootenai Tribes.

Species	Safe Har. Marsh	Jocko River	Crow Creek	All three stations combined
No. species that increased[4]	9(6)	15(10)	7(7)	22(16)
No. species that decreased[5]	4(3)	2(1)	2(0)	5(3)
No. species remained same	2	1	1	2
Total Number of Species	15	18	10	29
Proportion of increasing (decreasing) species	0.600	0.833	0.700	0.759
Sig. of increase (decrease)[6]	0.304	0.004 ***	0.172	0.004 ***

[1] Number of stations at which at least one young bird was captured in either year.
[2] Standard error of the % change in the number of young birds captured.
[3] Increase indeterminate (infinite) because no young bird was captured during 2002.
[4] No. of species for which young birds were captured in 2003 but not in 2002 are in parentheses.
[5] No. of species for which young birds were captured in 2002 but not in 2002 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 7. Percentage changes between 2002 and 2003 in the PROPORTION OF YOUNG in the catch at three constant-effort MAPS stations on the Flathead Reservation of the Confederated Salish and Kootenai Tribes.

Species	Safe Har. Marsh	Jocko River	Crow Creek	n[1]	All three stations combined: Proportion young 2002	All three stations combined: Proportion young 2003	All three stations combined: Absol. change	SE[2]
Red-naped Sapsucker	+-+-+[3]	+-+-+[3]		2	------[4]	0.000	+-+-+[3]	
Downy Woodpecker	+-+-+	0.333	1.000	3	0.000	0.333	0.333	0.192
Hairy Woodpecker	+-+-+			1	------	0.000	+-+-+	
Northern Flicker		-0.500		1	1.000	0.500	-0.500	
Western Wood-Pewee	+-+-+	+-+-+	+-+-+[3]	3	------	0.000	+-+-+	
"Traill's" Flycatcher	0.000	+-+-+	0.000	3	0.000	0.000	0.000	0.000
Least Flycatcher	+-+-+	+-+-+		2	------	0.000	+-+-+	
Hammond's Flycatcher	+-+-+		+-+-+	2	0.000	------[4]	+-+-+	
Dusky Flycatcher	-0.083		+-+-+	2	0.250	0.143	-0.107	0.041
"Western" Flycatcher			+-+-+	1	------	0.200	+-+-+	
Cassin's Vireo	+-+-+			1	------	0.000	+-+-+	
Warbling Vireo	+-+-+		+-+-+	2	0.000	------	+-+-+	
Red-eyed Vireo		0.000		1	0.000	0.000	0.000	
N. Rough-winged Swallow			0.000	1	0.000	0.000	0.000	
Black-capped Chickadee	0.220	0.313	-0.121	3	0.500	0.672	0.172	0.127
Mountain Chickadee	0.750			1	0.000	0.750	0.750	
Red-breasted Nuthatch	-0.500		+-+-+	2	0.500	0.667	0.167	0.444
Pygmy Nuthatch	-0.200			1	1.000	0.800	-0.200	
Brown Creeper	+-+-+			1	------	1.000	+-+-+	
House Wren	1.000	+-+-+	0.286	3	0.000	0.444	0.444	0.185
Golden-crowned Kinglet	+-+-+			1	------	0.000	+-+-+	
Veery		+-+-+		1	------	0.000	+-+-+	
Swainson's Thrush	0.133	-0.049	0.000	3	0.158	0.125	-0.033	0.043
American Robin	0.000	0.571	0.167	3	0.000	0.278	0.278	0.175
Gray Catbird	0.000	-0.135	-0.179	3	0.340	0.207	-0.134	0.063
Cedar Waxwing	0.000	0.222	+-+-+	3	0.000	0.080	0.080	0.089
Orange-crowned Warbler	+-+-+	+-+-+	+-+-+	3	0.000	0.333	0.333	0.385

Table 7. (cont.) Percentage changes between 2002 and 2003 in the PROPORTION OF YOUNG in the catch at three constant-effort MAPS stations on the Flathead Reservation of the Confederated Salish and Kootenai Tribes.

Species	Safe Har. Marsh	Jocko River	Crow Creek	n[1]	All three stations combined: Proportion young 2002	Proportion young 2003	Absol. change	SE[2]
Nashville Warbler		0.500		1	0.000	0.500	0.500	
Yellow Warbler	0.000	0.114	0.412	3	0.147	0.333	0.186	0.072
American Redstart		+-+-+		1	0.000	------	+-+-+	
Northern Waterthrush		+-+-+		1	------	1.000	+-+-+	
MacGillivray's Warbler	0.000	0.400	+-+-+	3	0.000	0.286	0.286	0.122
Common Yellowthroat	0.000	0.000	+-+-+	3	0.625	0.429	-0.196	0.275
Wilson's Warbler			0.000	1	0.000	0.000	0.000	
Yellow-breasted Chat		0.000		1	0.000	0.000	0.000	
Western Tanager	0.000	+-+-+		2	0.000	0.000	0.000	0.000
Spotted Towhee	0.143	0.727	0.000	3	0.000	0.429	0.429	0.237
Chipping Sparrow	+-+-+	+-+-+	0.000	3	0.143	0.000	-0.143	0.127
Song Sparrow	0.271	0.172	-0.125	3	0.405	0.565	0.160	0.109
Dark-eyed Junco	-0.333			1	0.333	0.000	-0.333	
Black-headed Grosbeak	+-+-+	0.200		2	0.000	0.167	0.167	0.056
Lazuli Bunting		+-+-+	0.000	2	0.000	0.000	0.000	0.000
Red-winged Blackbird	+-+-+			1	------	0.000	+-+-+	
Brown-headed Cowbird	0.000	+-+-+		2	0.000	0.111	0.111	0.148
Bullock's Oriole		+-+-+		1	1.000	------	+-+-+	
House Finch	+-+-+			1	------	0.667	+-+-+	
Red Crossbill	+-+-+			1	------	0.000	+-+-+	
Pine Siskin	+-+-+			1	------	0.500	+-+-+	
American Goldfinch		0.000	+-+-+	2	0.000	0.000	0.000	0.000
ALL SPECIES POOLED	0.111	0.069	0.036	3	0.238	0.315	0.078	0.036

Table 7. (cont.) Percentage changes between 2002 and 2003 in the PROPORTION OF YOUNG in the catch at three constant-effort MAPS stations on the Flathead Reservation of the Confederated Salish and Kootenai Tribes.

Species	Safe Har. Marsh	Jocko River	Crow Creek	All three stations combined
No. species that increased	6	10	4	15
No. species that decreased	4	3	3	8
No. species remained same	9	4	7	8
Total Number of Species[5]	19	17	14	31
Proportion of increasing (decreasing) species	0.316	0.588	0.286	0.484
Sig. of increase (decrease)[6]	0.968	0.315	0.971	0.640

[1] Number of stations at which at least one aged bird was captured in either year.
[2] Standard error of the change in the proportion of young.
[3] The change in the proportion of young is undefined at this station because no aged individual of the species was captured in one of the two years.
[4] Proportion of young not given because no aged individual of the species was captured in the year shown.
[5] Species for which the change in the proportion of young 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 8. Mean numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the two individual MAPS stations operated from 1993-2003 (Safe Harbor Marsh and Crow Creek) on the Flathead Reservation of the Confederated Salish and Kootenai Tribes averaged over the 11 years, 1993-2003. Data for each species are included only from stations that lie within the breeding range of the species.

	Safe Harbor Marsh			Crow Creek			Both stations pooled		
Species	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]
American Kestrel				0.2	0.0	0.00	0.1	0.0	0.00
Red-naped Sapsucker	0.1	0.0	0.00				0.1	0.0	0.00
Downy Woodpecker	0.6	0.0	0.00	1.1	0.1	0.07	0.9	0.1	0.04
Hairy Woodpecker	0.1	0.0	0.00	0.0	0.2	1.00	0.1	0.1	0.50
Northern Flicker	0.1	0.0	0.00	0.3	0.2	0.33	0.2	0.1	0.33
Western Wood-Pewee	1.2	0.2	0.08	3.1	0.1	0.02	2.1	0.2	0.05
"Traill's" Flycatcher	5.7	0.2	0.05	7.5	0.3	0.03	6.6	0.2	0.03
Least Flycatcher	0.3	0.0	0.00				0.2	0.0	0.00
Hammond's Flycatcher	1.5	0.0	0.00	0.8	0.0	0.00	1.1	0.0	0.00
Dusky Flycatcher	3.3	0.5	0.08	0.6	0.0	0.00	2.0	0.3	0.06
"Western" Flycatcher	0.4	0.0	0.00	1.3	0.3	0.18	0.9	0.2	0.18
Western Kingbird				0.1	0.0	0.00	0.1	0.0	0.00
Eastern Kingbird	0.1	0.0	0.00	0.9	0.0	0.00	0.5	0.0	0.00
Cassin's Vireo	0.8	0.0	0.00	0.3	0.2	0.33	0.6	0.1	0.08
Warbling Vireo	3.0	0.0	0.00	0.3	0.0	0.00	1.7	0.0	0.00
Red-eyed Vireo				0.2	0.0	0.00	0.1	0.0	0.00
Tree Swallow	0.1	0.0	0.00				0.1	0.0	0.00
Violet-green Swallow	0.6	0.0	0.00				0.3	0.0	0.00
N. Rough-winged Swallow				2.1	0.4	0.08	1.0	0.2	0.08
Bank Swallow				0.8	0.0	0.00	0.4	0.0	0.00
Black-capped Chickadee	6.6	14.4	0.67	17.1	12.6	0.41	11.8	13.5	0.52
Mountain Chickadee	0.7	1.6	0.69				0.4	0.8	0.69
Red-breasted Nuthatch	3.2	1.3	0.27	1.8	1.0	0.35	2.5	1.1	0.28
Pygmy Nuthatch	0.7	0.7	0.36				0.3	0.3	0.36
Brown Creeper	0.0	0.1	1.00				0.0	0.1	1.00
House Wren	0.1	0.3	0.67	11.3	4.2	0.25	5.7	2.3	0.27
Marsh Wren	1.1	4.1	0.81				0.5	2.1	0.81
Golden-crowned Kinglet	0.1	0.2	0.50	0.0	0.2	1.00	0.1	0.2	0.67
Townsend's Solitaire	0.1	0.1	0.50				0.1	0.1	0.50
Swainson's Thrush	5.9	1.0	0.15	2.9	0.3	0.15	4.5	0.7	0.12
American Robin	9.8	1.1	0.09	5.3	0.7	0.09	7.6	0.9	0.10
Gray Catbird	1.3	0.0	0.00	14.7	1.1	0.07	8.0	0.5	0.06
Cedar Waxwing	26.2	0.2	0.01	4.0	0.5	0.07	15.2	0.3	0.03
Tennessee Warbler	0.2	0.0	0.00				0.1	0.0	0.00
Orange-crowned Warbler	1.2	0.4	0.33	0.8	0.3	0.50	1.0	0.3	0.44
Nashville Warbler	0.2	0.0	0.00	0.0	0.2	1.00	0.1	0.1	0.50
Yellow Warbler	1.3	0.0	0.00	14.0	2.6	0.13	7.5	1.3	0.12
Yellow-rumped Warbler	0.2	0.2	0.50	0.0	0.2	1.00	0.1	0.2	0.67
Townsend's Warbler	0.0	0.2	1.00	0.4	0.0	0.00	0.2	0.1	0.25
Northern Waterthrush	0.0	0.1	1.00	0.2	0.0	0.00	0.1	0.1	0.50
MacGillivray's Warbler	2.1	0.3	0.13	0.9	0.0	0.00	1.6	0.2	0.08
Common Yellowthroat	15.2	5.7	0.26	1.6	0.2	0.04	8.5	3.0	0.25
Wilson's Warbler	0.2	0.0	0.00	0.6	0.0	0.00	0.4	0.0	0.00

Table 8. (cont.) Mean numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the two individual MAPS stations operated from 1993-2003 (Safe Harbor Marsh and Crow Creek) on the Flathead Reservation of the Confederated Salish and Kootenai Tribes averaged over the 11 years, 1993-2003. Data for each species are included only from stations that lie within the breeding range of the species.

	Safe Harbor Marsh			Crow Creek			Both stations pooled		
Species	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]	Ad.	Yg.	Prop. Yg.[1]
Western Tanager	3.3	0.3	0.07				1.7	0.2	0.07
Spotted Towhee	2.0	1.6	0.37	2.3	0.8	0.23	2.1	1.2	0.35
Chipping Sparrow	3.3	0.5	0.19	3.1	0.6	0.33	3.2	0.5	0.14
Vesper Sparrow	0.3	0.0	0.00	0.2	0.0	0.00	0.2	0.0	0.00
Song Sparrow	9.7	6.3	0.39	7.6	3.5	0.32	8.7	4.9	0.36
Dark-eyed Junco	2.3	2.6	0.50	0.0	0.2	1.00	1.2	1.4	0.55
Black-headed Grosbeak	0.6	0.0	0.00	0.8	0.0	0.00	0.7	0.0	0.00
Lazuli Bunting				7.8	0.2	0.02	3.9	0.1	0.02
Red-winged Blackbird	1.8	0.2	0.06				0.9	0.1	0.06
Yellow-headed Blackbird	0.3	0.0	0.00				0.1	0.0	0.00
Brown-headed Cowbird	3.8	0.4	0.18	1.1	0.2	0.10	2.5	0.3	0.11
Bullock's Oriole				1.3	0.7	0.26	0.6	0.3	0.26
Cassin's Finch	1.3	0.0	0.00				0.6	0.0	0.00
House Finch	0.1	0.3	0.67				0.1	0.1	0.67
Red Crossbill	0.6	0.5	0.25				0.3	0.3	0.25
Pine Siskin	7.3	0.6	0.24	0.3	0.0	0.00	3.8	0.3	0.24
American Goldfinch				0.8	0.0	0.00	0.4	0.0	0.00
Evening Grosbeak	0.4	0.0	0.00				0.2	0.0	0.00
ALL SPECIES POOLED	131.9	46.0	0.25	120.5	32.0	0.20	126.3	39.0	0.23
Number of Species	50	31		39	28		60	42	
Total Number of Species		53			44			61	

[1] Years for which the proportion of young was undefined (no aged birds were captured in the year) are not included in the mean proportion of young.

Table 9. Summary statistics for survival analyses with temporally variable survival and recapture probabilities and proportion of residents in transient models using 11 years (1992-2003) of mark-recapture data from the two long running MAPS stations (Safe Harbor Marsh and Crow Creek) on the Flathead Reservation of the Confederated Salish and Kootenai Tribes. $QAIC_C$[1] and (GOF)[2] are presented for all models.

	Transient Models								
Species	$\phi p \tau$ [3]	$\phi_t p \tau$ [4]	$\phi p_t \tau$ [5]	$\phi p \tau_t$ [6]	$\phi_t p_t \tau$ [7]	$\phi_t p \tau_t$ [8]	$\phi p_t \tau_t$ [9]	$\phi_t p_t \tau_t$ [10]	$\Delta QAIC_C$
"Traill's" Flycatcher	32.5* (1.000)	46.3 (1.000)	50.0 (1.000)	50.5 (1.000)	71.9 (1.000)	73.6 (1.000)	77.0 (1.000)	104.7 (1.000)	13.8
Black-capped Chickadee	107.6* (1.000)	109.9 (1.000)	113.0 (1.000)	117.7 (1.000)	118.5 (1.000)	127.9 (1.000)	127.7 (1.000)	136.0 (1.000)	2.3
House Wren	35.5* (1.000)	47.9 (1.000)	45.4 (1.000)	53.2 (1.000)	71.1 (1.000)	79.7 (1.000)	77.4 (1.000)	111.4 (1.000)	12.4
American Robin	58.0* (1.000)	69.8 (1.000)	69.7 (1.000)	68.2 (1.000)	88.1 (1.000)	88.7 (1.000)	85.0 (1.000)	108.7 (1.000)	11.9
Gray Catbird	57.6* (1.000)	67.7 (1.000)	64.6 (1.000)	69.2 (1.000)	82.5 (1.000)	89.4 (1.000)	88.7 (1.000)	113.9 (1.000)	10.1
Yellow Warbler	68.8* (1.000)	71.1 (1.000)	77.9 (1.000)	81.5 (1.000)	93.7 (1.000)	95.9 (1.000)	99.9 (1.000)	125.2 (1.000)	2.3
Common Yellowthroat	87.0* (1.000)	102.9 (1.000)	104.9 (1.000)	100.1 (1.000)	123.7 (1.000)	121.5 (1.000)	123.1 (1.000)	145.8 (1.000)	16.0
Song Sparrow	68.7* (1.000)	84.8 (1.000)	78.7 (1.000)	84.3 (1.000)	97.3 (1.000)	104.9 (1.000)	99.5 (1.000)	121.0 (1.000)	16.1

1 Akaike Information Criterion ($QAIC_C$) given as -2(log-likelihood) + 2(number of estimable parameters) with corrections for small sample sizes and overdispersion of data.

[2] Goodness-of-fit is a measure of how well the actual distribution of data fits the theoretical distribution calculated using the estimates provided by the model. The larger the value provided by the GOF test the better the model describes the data.

Table 9. (cont.) Summary statistics for survival analyses with temporally variable survival and recapture probabilities and proportion of residents in transient models using 11 years (1992-2003) of mark-recapture data from the two long running MAPS stations (Safe Harbor Marsh and Crow Creek) on the Flathead Reservation of the Confederated Salish and Kootenai Tribes. $QAIC_C$[1] and $(GOF)^2$ are presented for all models.

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[3] $\phi p \tau$ Model: Transient model with temporally-constant survival probability, recapture probability, and proportion of residents (invariable from year to year).

[4] $\phi_t p \tau$ Model: Transient model with temporally-variable survival probability; and temporally-constant recapture probability and proportion of residents.

[5] $\phi p_t \tau$ Model: Transient model with temporally-variable recapture probability; and temporally-constant survival probability and proportion of residents.

[6] $\phi p \tau_t$ Model: Transient model with temporally-variable proportion of residents; and temporally-constant survival and recapture probabilities.

[7] $\phi_t p_t \tau$ Model: Transient model with temporally-variable survival and recapture probabilities; and temporally-constant proportion of residents.

[8] $\phi_t p \tau_t$ Model: Transient model with temporally-variable survival probability and proportion of residents; and temporally-constant recapture probability.

[9] $\phi p_t \tau_t$ Model: Transient model with temporally-variable recapture probability and proportion of residents; and temporally-constant survival probability.

[10] $\phi_t p_t \tau_t$ Model: Transient model with temporally-variable survival probability, recapture probability, and proportion of residents.

[11] $\Delta QAIC_C$ is defined as the difference in $\Delta QAIC_C$ between the $\phi p \tau$ model and the $\phi_t p \tau$ model.

Table 10. Estimates of adult survival and recapture probabilities and proportion of residents using both temporally variable and time-constant models for eight species breeding at the two long running MAPS stations (Safe Harbor Marsh and Crow Creek) on the Flathead Reservation of the Confederated Salish and Kootenai Tribes obtained from 11 years (1993-2003) of mark-recapture data.

Species	Num. sta2.[1]	Num. ind.[2]	Num. caps.[3]	Num. ret.[4]	Model[5]	$QAIC_C$[6]	Survival probability[7]	Surv. C.V.[8]	Recapture probability[9]	Proportion of residents[10]
"Traill's" Flycatcher	2	78	111	5	$\phi p \tau$	32.5	0.389 (0.162)	41.7	0.538 (0.298)	0.132 (0.113)
Black-capped Chickadee	2	105	195	41	$\phi p \tau$	107.6	0.606 (0.064)	10.5	0.445 (0.082)	0.645 (0.165)
House Wren	1	65	96	5	$\phi p \tau$	35.5	0.364 (0.178)	49.0	0.155 (0.160)	1.000 (1.007)
American Robin	2	88	110	10	$\phi p \tau$	58.0	0.732 (0.134)	18.4	0.192 (0.099)	0.289 (0.165)
Gray Catbird	2	93	127	11	$\phi p \tau$	57.6	0.456 (0.139)	30.4	0.236 (0.152)	0.872 (0.637)
Yellow Warbler	1	75	115	13	$\phi p \tau$	68.8	0.580 (0.113)	19.5	0.303 (0.125)	0.470 (0.233)
Common Yellowthroat	1	72	126	22	$\phi p \tau$	87.0	0.574 (0.084)	14.6	0.347 (0.104)	0.710 (0.262)
Song Sparrow	2	84	165	25	$\phi p \tau$	68.7	0.517 (0.081)	15.6	0.628 (0.122)	0.406 (0.147)

[1] Number of super-stations where the species was a regular or usual breeder at which adults of the species were captured.
[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] Models included are those chosen by $QAIC_C$ (those models marked with * in Table 9) plus the $\phi p \tau$ model in all cases. See Table 9 for definitions of the models.
[6] Akaike Information Criterion ($QAIC_C$) given as -2(log-likelihood) + 2(number of estimable parameters) with corrections for small sample size and over dispersion of data.
[7] Survival probability presented as the maximum likelihood estimate (standard error of the estimate).
[8] The coefficient of variation for survival probability.
[9] Recapture probability presented as the maximum likelihood estimate (standard error of the estimate).
[10] The proportion of residents among newly captured adults presented as the maximum likelihood estimate (standard error of the estimate).

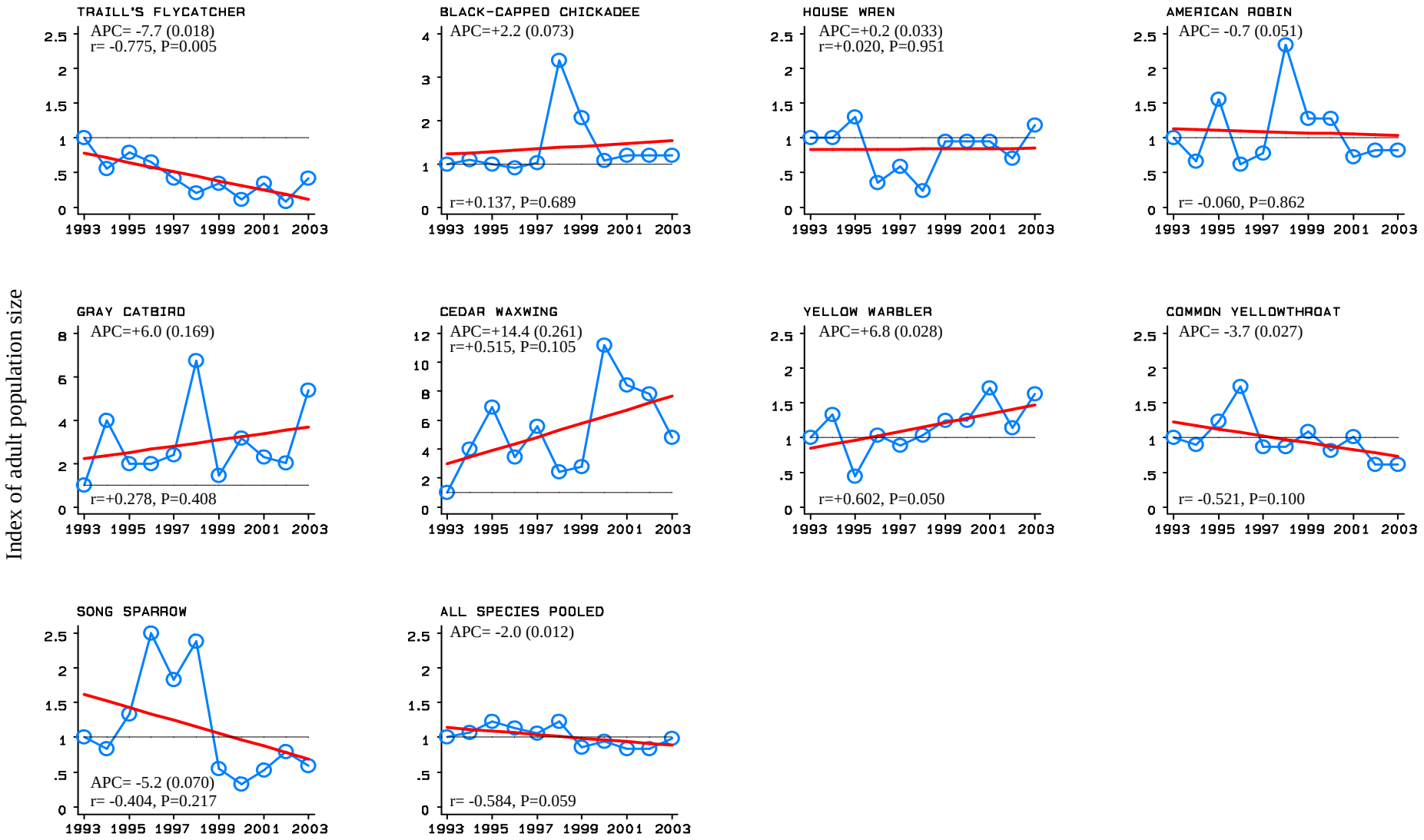

Figure 1. Population trends for nine species and all species pooled at the two long running MAPS stations (Safe Harbor Marsh and Crow Creek) on the Flathead Reservation of the Confederated Salish and Kootenai Tribes over the 11 years 1993-2003. The index of population size was arbitrarily defined as 1.0 in 1993. Indices for subsequent years were determined from constant-effort between-year changes in the number of adult birds captured from stations where the species was a regular or usual breeder and summer resident. The annual percentage change in the index of adult population size was used as the measure of the population trend (APC), and it and the standard error of the slope (in parentheses) are presented on each graph. The correlation coefficient (r) and significance of the correlation coefficient (P) are also shown on each graph.

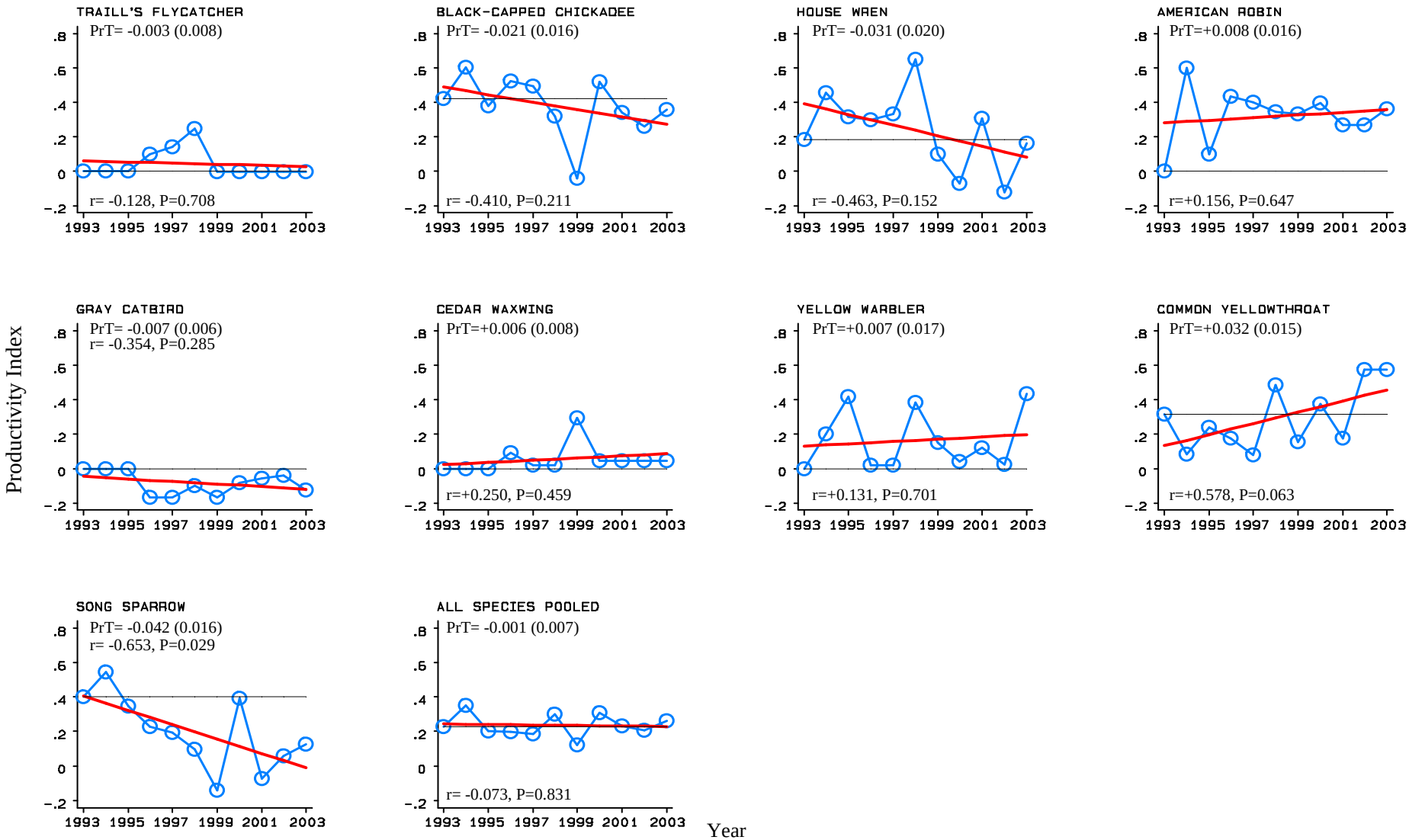

Figure 2. Trend in productivity for nine species and all species pooled at the two long running MAPS stations (Safe Harbor Marsh and Crow Creek) on the Flathead Reservation of the Confederated Salish and Kootenai Tribes over the 11 years 1993-2003. The productivity index was defined as the actual productivity value in 1993. Indices for subsequent years were determined from constant-effort between-year changes in proportion of young in the catch from stations where the species was a regular or usual breeder and summer resident. The slope of the regression line for annual change in the index of productivity was used as the measure of the productivity trend (PrT), and it and the standard error of the slope (in parentheses) are presented on each graph. The correlation coefficient (r) and significance of the correlation coefficient (P) are also shown on each graph.

Appendix I. Numerical listing (in AOU checklist order) of all the species sequence numbers, species alpha codes, and species names for all species banded or encountered during the 11 years, 1993-2003, of the MAPS Program on the six stations on the Flathead Reservation of the Confederated Salish and Kootenai Tribes .

NUMB	SPEC	SPECIES NAME
00130	PBGR	Pied-billed Grebe
00860	DCCO	Double-crested Cormorant
01010	GBHE	Great Blue Heron
01300	TUVU	Turkey Vulture
01460	CAGO	Canada Goose
01570	WODU	Wood Duck
01580	GADW	Gadwall
01630	MALL	Mallard
01930	BUFF	Bufflehead
01980	COME	Common Merganser
02020	OSPR	Osprey
02130	BAEA	Bald Eagle
02170	NOHA	Northern Harrier
02200	SSHA	Sharp-shinned Hawk
02210	COHA	Cooper's Hawk
02460	RTHA	Red-tailed Hawk
02630	AMKE	American Kestrel
02710	PRFA	Prairie Falcon
02940	RUGR	Ruffed Grouse
03780	KILL	Killdeer
04020	SPSA	Spotted Sandpiper
04461	COSN	Common Snipe
04510	RNPH	Red-necked Phalarope
04690	RBGU	Ring-billed Gull
04700	CAGU	California Gull
05370	RODO	Rock Dove
05570	MODO	Mourning Dove
06800	GHOW	Great Horned Owl
06830	NOPO	Northern Pygmy-Owl
07010	SEOW	Short-eared Owl
07080	CONI	Common Nighthawk
08690	CAHU	Calliope Hummingbird
08730	RUHU	Rufous Hummingbird
08774	USHU	Unidentified Selasphorus Hummingbird
08775	UNHU	Unidentified Hummingbird
09110	BEKI	Belted Kingfisher
09390	LEWO	Lewis's Woodpecker
09570	WISA	Williamson's Sapsucker
09590	RNSA	Red-naped Sapsucker
09650	DOWO	Downy Woodpecker
09660	HAWO	Hairy Woodpecker
09800	RSFL	Red-shafted Flicker
09800	YSFL	Yellow-shafted Flicker

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 11 years, 1993-2003, of the MAPS Program on the six stations on the Flathead Reservation of the Confederated Salish and Kootenai Tribes .

NUMB	SPEC	SPECIES NAME
09860	PIWO	Pileated Woodpecker
11340	OSFL	Olive-sided Flycatcher
11380	WEWP	Western Wood-Pewee
11475	TRFL	"Traill's" Flycatcher
11475	WIFL	Willow Flycatcher
11500	LEFL	Least Flycatcher
11510	HAFL	Hammond's Flycatcher
11530	DUFL	Dusky Flycatcher
11555	COFL	Cordilleran Flycatcher
11555	WEFL	"Western" Flycatcher
11595	UEFL	Unidentified Empidonax Flycatcher
12020	WEKI	Western Kingbird
12030	EAKI	Eastern Kingbird
12710	CAVI	Cassin's Vireo
12760	WAVI	Warbling Vireo
12790	REVI	Red-eyed Vireo
13150	CLNU	Clark's Nutcracker
13160	BBMA	Black-billed Magpie
13190	AMCR	American Crow
13300	CORA	Common Raven
13410	TRES	Tree Swallow
13440	VGSW	Violet-green Swallow
13490	NRWS	Northern Rough-winged Swallow
13510	BANS	Bank Swallow
13520	CLSW	Cliff Swallow
13540	BARS	Barn Swallow
13570	BCCH	Black-capped Chickadee
13580	MOCH	Mountain Chickadee
13690	RBNU	Red-breasted Nuthatch
13710	PYNU	Pygmy Nuthatch
13730	BRCR	Brown Creeper
13850	CANW	Canyon Wren
14070	HOWR	House Wren
14110	WIWR	Winter Wren
14130	MAWR	Marsh Wren
14210	AMDI	American Dipper
14240	GCKI	Golden-crowned Kinglet
14250	RCKI	Ruby-crowned Kinglet
14590	TOSO	Townsend's Solitaire
14780	VEER	Veery
14810	SWTH	Swainson's Thrush
15000	AMRO	American Robin
15130	GRCA	Gray Catbird

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 11 years, 1993-2003, of the MAPS Program on the six stations on the Flathead Reservation of the Confederated Salish and Kootenai Tribes .

NUMB	SPEC	SPECIES NAME
15370	EUST	European Starling
15550	CEDW	Cedar Waxwing
15650	TEWA	Tennessee Warbler
15660	OCWA	Orange-crowned Warbler
15670	NAWA	Nashville Warbler
15750	YWAR	Yellow Warbler
15800	AUWA	Audubon's Warbler
15840	TOWA	Townsend's Warbler
16040	AMRE	American Redstart
16090	NOWA	Northern Waterthrush
16140	MGWA	MacGillivray's Warbler
16150	COYE	Common Yellowthroat
16290	WIWA	Wilson's Warbler
16460	YBCH	Yellow-breasted Chat
16495	UNWA	Unidentified Warbler
16840	WETA	Western Tanager
17810	SPTO	Spotted Towhee
18020	CHSP	Chipping Sparrow
18080	VESP	Vesper Sparrow
18230	SOSP	Song Sparrow
18240	LISP	Lincoln's Sparrow
18320	ORJU	Oregon Junco
18610	BHGR	Black-headed Grosbeak
18660	LAZB	Lazuli Bunting
18730	RWBL	Red-winged Blackbird
18810	WEME	Western Meadowlark
18820	YHBL	Yellow-headed Blackbird
18860	BRBL	Brewer's Blackbird
18960	BHCO	Brown-headed Cowbird
19105	BUOR	Bullock's Oriole
19350	PUFI	Purple Finch
19360	CAFI	Cassin's Finch
19370	HOFI	House Finch
19380	RECR	Red Crossbill
19430	PISI	Pine Siskin
19510	AMGO	American Goldfinch
19580	EVGR	Evening Grosbeak
19920	HOSP	House Sparrow