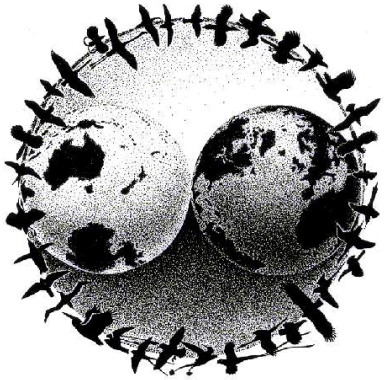

MAPS MANUAL

2018 PROTOCOL

INSTRUCTIONS FOR THE ESTABLISHMENT AND OPERATION
OF CONSTANT-EFFORT BIRD-BANDING STATIONS AS PART OF THE
MONITORING AVIAN PRODUCTIVITY AND SURVIVORSHIP (MAPS) PROGRAM

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Finally, we thank the many hundreds of station operators and all their assistants, interns, and volunteers who, year after year, contribute their data to the MAPS Program. Without their dedication and perseverance, MAPS could not exist.

This is Contribution Number 127 of The Institute for Bird Populations.

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INTRODUCTION

An Invitation

Welcome to the Monitoring Avian Productivity and Survivorship (MAPS) Program! MAPS is a cooperative effort among public agencies, private organizations, and the bird banders of the continental United States, Canada, and Mexico to provide critical, long-term data on population and demographic parameters for over 150 target landbird species at multiple spatial scales. As part of the MAPS family, you team with hundreds of private individuals, and workers from federal and state agencies and non-governmental organizations to gather important data for the conservation of birds and their habitat.

The MAPS Program utilizes standardized, constant-effort mist netting and banding during the breeding season at an extensive network of stations. The MAPS methodology provides annual indices of adult population size and post-fledging productivity from data on the numbers and proportions of young and adult birds captured; and annual estimates of adult survivorship, adult population size, proportion of resident individuals in the adult population, recruitment into the adult population, and population growth rate (lambda) from mark-recapture data on adult birds. This data is used by IBP and our collaborators to study the causes of population changes in North America's landbirds. This manual (and all the forms associated with operating a MAPS station) are available for download through the MAPS web page http://www.birdpop.org/pages/maps.php.

Any public agency, private organization, or independent bird bander currently operating or able to establish one or more banding stations operated regularly through the breeding season is encouraged to participate in the MAPS Program. All that is required is the standardized operation of a series of about ten nets at permanent sites on only one day during each of six to ten consecutive ten-day periods between May and August.

While the operation of a MAPS station is relatively simple, it is also a substantial commitment. Standardization from year to year and continuation of the study **for at least five consecutive years** at each station are necessary in order to provide reliable productivity indices and survivorship estimates ("vital rates"). Continuation of the study **for ten to twenty consecutive years** at most stations will likely be necessary to obtain reliable trend information on these critical vital rates. This manual is designed to guide you through all the steps involved in operating a MAPS station and to address any questions that may arise. Everything contained herein is important; take the manual with you on every visit to your station and, **please, read and use it.**

The Institute for Bird Populations is excited about the possibility of working with you in an effort to monitor the productivity, survivorship, and population trends of North American landbirds. We cordially invite you, therefore, to join in the MAPS Program. The methodology outlined below may seem formidable at first glance. It is, however, relatively simple: standardized mist netting and banding during the breeding season, coupled with documentation of apparent breeding status of the birds present at the station and the preparation of a simple habitat map and habitat structure assessment. In addition, IBP provides technical assistance and guidance year-round to answer your questions and guide you through the process. Furthermore, the MAPS Program requires the operation of nets on only six to ten days during the breeding season. Thus, the effort required to gather these extremely valuable data on the vital rates (productivity and survivorship) of landbirds is quite

manageable. We invite you to become an important part of this exciting, cooperative endeavor by establishing one or more MAPS stations in your area.

Bird Safety

The protocols and objectives outlined in the following pages are designed to collect data that is valuable for bird conservation. However, **protocols should never be followed at the expense of bird or human safety**. As a responsible bander, if safety is ever a concern, you should suspend protocols until the concerns are addressed. Please insure that all of the banders at your station know and practice safe banding techniques.

We encourage you to review ethical banding and safety procedures with your crews in depth at least once a year and always strive towards a safer banding experience. We recommend reviewing materials such as those provided by the North American Banding council (NABC; www.nabanding.net), The Ornithological Council (*Guidelines to the Use of Wild Birds in Research*; http://www.nmnh.si.edu/BIRDNET/guide/index.html), *The Mist Netter's Bird Safety Handbook* available from IBP and the 2013 MAPS Chat which provides bird safety suggestions for keeping your station as bird safe and smooth running as possible.

Proper Permitting

All banders applying to operate or currently operating MAPS stations must adhere to all federal and state permitting requirements. Check that you have addressed these issues before beginning banding each season, and that relevant permits are up to date. **Note:** A special addendum is required on your federal banding permit to allow you to pull feathers. If you plan to participate in the cooperative UCLA feather sampling study, or similar studies, please insure that your permits include these special permissions. Please see http://www.birdpop.org/pages/mapsDataForms.php for the latest information on feather sampling.

Background and Rationale

Earth's biosphere and its landbird populations are facing a growing number of environmental threats of ever-increasing severity, many of which, such as climate change, habitat loss, invasive species, and toxic pollution, are global in scale (Brown 1991). It is not surprising, therefore, that a number of large-scale, long-term monitoring programs for landbirds were already in place on this continent before the MAPS Program started. They include the Breeding Bird Survey (BBS), the Breeding Bird Census and Winter Bird Population Study, and the Christmas Bird Count. All of these efforts provide annual information on landbird populations, and many of the resulting trends indicate serious population declines in many species, including forest- and scrub-inhabiting Nearctic-Neotropical migrant species (Robbins *et al*. 1989, Terborgh 1989) and grassland species (Knopf 1994). These population declines, prompted the establishment of the Neotropical Migratory Bird Conservation Initiative, "Partners in Flight" (PIF), to which most federal agencies and many state and private organizations have become signatories.

The above-mentioned monitoring efforts, however, all fail to provide data on the primary demographic parameters or vital rates (productivity and survivorship) of landbirds. Without these critical data, it is difficult if not impossible to test competing hypotheses to account for observed population changes, or to determine the stage(s) in the life cycle at which these population changes are taking place; that is, whether the changes are being driven by causal agents that affect birth rates or death rates or both (DeSante 1992). Efforts that monitor only avian population trends have generally been unable to determine to what extent habitat destruction and degradation (e.g., deforestation and forest fragmentation) on the temperate breeding grounds, versus that on the tropical wintering grounds, are causes for declining populations of neotropical migratory landbirds (Wilcove 1985, Holmes and Sherry 1988, Hutto 1988, Morton and Greenberg 1989, Peterjohn *et al*. 1995).

An integrated approach to monitoring primary demographic parameters and secondary population trends of landbirds is critical for determining causes of population changes and for identifying management actions and conservation strategies to reverse population declines (Baillie 1990). Perhaps even more importantly, this approach aids in evaluating the effectiveness of the management actions and conservation strategies actually implemented (DeSante 1995). This is because environmental stressors and management actions affect primary demographic parameters directly and usually without the buffering or time lags that often occur with secondary population trends (Temple and Wiens 1989). Monitoring the vital rates of landbirds also allows models to be constructed regarding the viability of their populations. Habitat- and landscape-specific data on vital rates provide a clear index of habitat and landscape quality, and allow identification of habitat and landscape conditions that provide source populations and that influence population sinks (DeSante and Rosenberg 1998). An increase in demographic monitoring has been called for by the Monitoring Working Group of PIF since 1992 (Butcher and Droege 1992), and an argument for basing avian management on vital rates has been provided by DeSante *et al*. (2005).

In 1989, The Institute for Bird Populations (IBP) anticipated these monitoring needs and created the Monitoring Avian Productivity and Survivorship (MAPS) Program, a cooperative effort to operate a continent-wide network of constant-effort mist-netting stations to capture and band landbirds during the breeding season (DeSante 1992, DeSante *et al*. 1993, 1995). The MAPS Program was patterned on the British Constant Effort Sites (CES) Scheme which since 1981 has been one of the cornerstones of the British Trust for Ornithology's Integrated Population Monitoring Programme (Baillie *et al*. 1986, Baillie 1990, Peach *et al*. 1996) and has inspired at least 15 other European CES efforts (Robinson et al. 2009). The first three years of MAPS was an IBP-sponsored feasibility study, during which time the program grew from 16 stations in 1989 to 66 stations in 1991 and the MAPS protocol became standardized. MAPS was endorsed in 1992 by the Monitoring Working Group of PIF and a four-year pilot study was sponsored by the Migratory Bird Management Office of the U.S. Fish and Wildlife Service (sponsorship later transferred to the Biological Resources Division of the U.S.G.S.).

The number of stations grew dramatically in subsequent years to nearly 400, primarily through the involvement of the Department of Defense (Legacy Resource Management Program) and U.S.D.A. Forest Service.

In 1996, the MAPS methodology underwent an extensive peer-review. Some of the conclusions of this review were that, “MAPS is technically sound and based on the best available biological and statistical methods" and that “MAPS complements other land bird monitoring programs such as the BBS by providing useful information on land bird demographics that is not available elsewhere” (Geissler 1997). A summary and analyses of the MAPS methodology were provided by DeSante *et al*. (2004a) and Burton and DeSante (2004). MAPS has continued to expand since 1995 to some 300-500 stations operated each year during 2001-2018.

Design and Objectives of the MAPS Program

MAPS is organized around several monitoring, research, and management objectives: to provide (a) annual **estimates** of adult survival rate, adult population size, proportion of residents in the adult population, recruitment into the adult population, and population growth rate (lambda); and (b) annual **indices** of adult population size and post-fledging productivity. MAPS provides these population and demographic indices and estimates for nearly over 150 landbird species that are well-distributed among various migration-strategy, foraging-strategy, nest-location, and habitat-preference guilds. In addition, MAPS works at multiple spatial scales, from program-wide (essentially the entire Continent north of Mexico), MAPS Regions (Fig. 1), Bird Conservation Regions (BCRs), or BBS Physiographic Strata, to small scales, such as clusters of stations, on a single national forest, park, or military installation, or local landscapes surrounding single stations (e.g., four-km radius areas).

MAPS Regions have been defined by dividing the continent into eight major areas: Alaska, Boreal & Arctic Canada, Northwest, North-central, Northeast, Southwest, South-central, and Southeast (Fig. 1). These delineations generally follow the boundaries of BBS Physiographic Strata and are based on both biogeographic and meteorological considerations, including the apparent periodicity of the Jet Stream. Seasonal weather tends to be similar at many locations within a given Region, but often varies considerably among Regions. It is likely that population and demographic parameters will vary in a similar manner at many banding stations within a Region, at least to the extent to which they are influenced by weather conditions.

The achievement of the **monitoring objectives** of MAPS has been well documented in MAPS reports (DeSante *et al*. 1996, 1998, DeSante and O’Grady 2000, DeSante and Kaschube 2006, 2007, 2009) and on the VitalRatesofNorthAmericanLandbirds.org (DeSante *et al.* 2015) website in which adult population size and productivity indices and adult apparent survival rates are presented. The **research objectives** of MAPS are to identify and describe: (a) temporal and spatial patterns in the demographic indices and estimates provided by MAPS (DeSante *et al.* 2015) and (b) relationships between these temporal and spatial patterns and (1) ecological characteristics of the target species (e.g., migration strategy, nest location), (2) population trends of the target species (e.g., areas or locations with increasing or decreasing trends) (DeSante *et al.* 2015), (3) station-specific and landscape-level habitat characteristics (e.g., total forest cover, mean forest patch size), and (4) spatially-explicit weather data (e.g., mean, min, and max temperature or precipitation, extreme events).

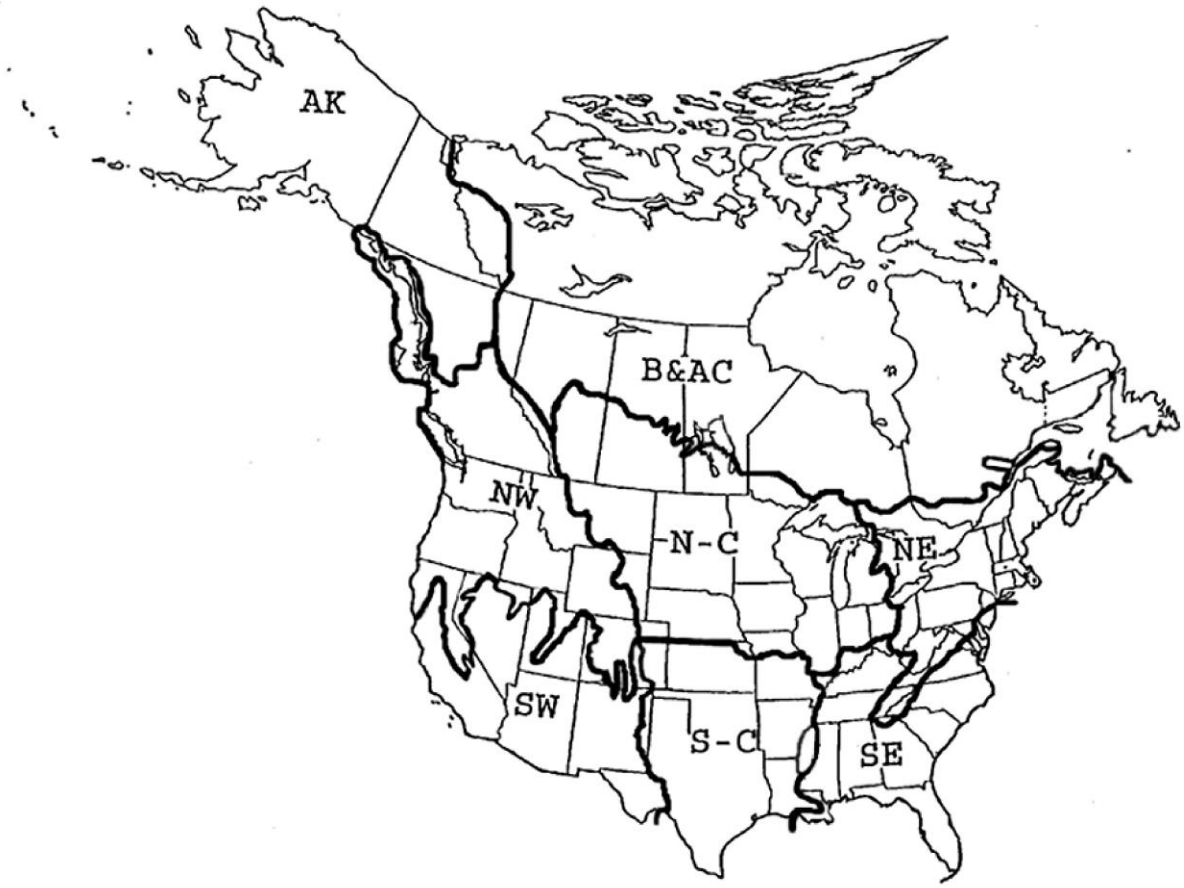

FIGURE 1. Map of the continental U.S. and Canada showing the eight MAPS regions.

MAPS allows these objectives to be met for multiple species at multiple spatial scales. Achievement of these research objectives is providing empirical information regarding life-history strategies and other topics of interest to avian ecology (DeSante *et al*. 1999, DeSante 2000), including the effects of global climate cycles on avian productivity (Nott *et al*. 2002). A future important research effort will be to integrate extensive count data (for example, from E-bird and the Avian Knowledge Network) with CMR data from MAPS and extensive remote-sensed environmental data in an effort to improve the predictive accuracy of demographic rates and abundance through space and time (Saracco et al. 2009a).

In addition, however, by analyzing the relationships between spatial variation in population trends (using for example, BBS data) and the vital rates that drive those trends, we have been able to make inferences regarding the proximate demographic cause(s) of population decline, that is, to suggest whether the decline is caused by low productivity or low survivorship (DeSante *et al*. 2001). This, in fact, is the **first management objective** of MAPS — an

objective that can be achieved by no other North American avian monitoring program (Saracco *et al*. 2008).

The **second management objective** of MAPS is to determine the ultimate (environmental) causes of population trends and to identify and formulate landscape-scale management actions and conservation strategies to reverse population declines and maintain stable or increasing populations. We do this by modeling vital rates (productivity indices and survival and recruitment estimates) as functions of landscape-scale and site-specific habitat characteristics and spatially-explicit weather and climate variables to identify habitat characteristics and weather variables that exert strong effects on the vital rates of landbird species, especially species of conservation concern. Management prescriptions developed this way for species for which productivity is critical for maintaining stable populations, involve modifying habitat characteristics from those associated with low productivity to those associated with higher productivity. Examples of these types of analyses of MAPS data, that are allowing us to achieve our second major management objective, are the focus of the management guidelines and conservation strategies that we have developed for reversing declines of landbirds of conservation concern on DOD installations in southeastern United States (Nott 2000, Nott *et al*. 2003a) and on national forests in the Pacific Northwest (Nott *et al*. 2005). We are developing decision support tools for managers, whereby they themselves can determine the effects of their proposed management actions on the vital rates of species of concern.

The **third management objective** of MAPS is to evaluate, through the adaptive management process, the effectiveness of the management actions and conservation strategies. If the goal is to manage for increased productivity (as is the implicit goal of most breeding-grounds management), it is imperative to monitor productivity.

MAPS' three management objectives can be achieved for multiple species at appropriate spatial scales.

Analysis of MAPS Data

IBP researchers have also completed a number of analyses and evaluations of the program in various geographical areas and landholdings. This effort began with a general analysis of the results of the first ten years (1992-2001) of the MAPS program in Alaska and adjacent Canada (DeSante *et al*. 2003a), followed by an analysis of the statistical power to detect temporal trends and spatial differences in survival of landbirds breeding in Alaska and adjacent Canada (DeSante *et al*. 2003b). These were followed by an evaluation of the data collected at MAPS stations operated on National Wildlife Refuges in the USFWS Pacific Region (DeSante *et al*. 2004b) which lead to an expanded evaluation of the MAPS Program on all stations in the Pacific Northwest (DeSante *et al*. 2005). Broadening our scope, we then conducted general analyses of the statistical power to detect temporal trends and spatial differences in survival from CMR models (DeSante *et al*. 2009), and applied those models to MAPS data in each MAPS region and at the continental scale in order to develop a vision for expanding MAPS and integrating it into Coordinated Bird Monitoring all across North America (Saracco *et al*. 2006, DeSante and Saracco 2009). Most recently, we built upon that continental vision and provided detailed recommendations for integrating MAPS into Coordinated Bird Monitoring in the Northeast, i.e., USFWS Region 5 (DeSante *et al*. 2008).

We are currently seeking resources to allow us to continue these latter analyses and provide analogous detailed recommendations for the remainder of the United States and Canada. This has become critically important as state and federal agencies and non-governmental organizations seek to develop bird conservation plans to deal with the huge threats posed by climate change. The assessment and monitoring of avian vital rates using MAPS may well provide one of the optimal resources with which to model and predict the effects of climate change on landbird populations, to guide adaptation and conservation efforts to mitigate those effects, and to evaluate the effectiveness of those efforts.

Annual **indices** of adult population size and post-fledging productivity (i.e., reproductive index, the ratio of young to adults in the catch) are calculated for each species from the numbers of young and adult birds captured, which are pooled over all the stations. The statistical significance is inferred from confidence intervals calculated from the standard errors of the mean percentage changes in these indices for species captured at the stations. This analytical method has been applied successfully to constant-effort mist-netting data generated by the CES and MAPS (Peach *et al*. 1996, DeSante *et al*. 1998) programs. Long-term changes in numbers of young and adult birds are assessed through application of log-linear Poisson regression models, which allow tests for temporal trends and for differences in trends for different groups of stations (Peach *et al*. 1998).

Annual **estimates** of adult survival rate, proportion of residents in the adult population, recruitment into the adult population, and population growth rate (lambda) are obtained for each species from modified Cormack-Jolly-Seber capture-mark-recapture (CMR) analyses. Major advances have been made in both the theory and application of data from CMR experiments (Pollock *et al*. 1990, Lebreton *et al*. 1992). These advances provide for increased precision in the resulting estimates and also allow spatial, age, and/or time dependence in the estimates of survival and recapture rates to be assessed, permit some parameters to be set equal to fixed *a priori* values, and allow any of the parameters to be related to external variables (Clobert *et al*. 1987). This approach was initially applied to mark-recapture data from both Great Tits and Black-headed Gulls in Europe (Clobert *et al*. 1987), and from Sedge and Reed Warblers in Britain (Peach *et al*. 1990, 1991) and has become a major analytical tool. By using reverse-time analysis of CMR data, models have been developed to permit estimation of recruitment and population growth rates (Pradel 1998). In addition, models have been developed to account for the negative bias of transient (non-resident) individuals on survival-rate estimates and to estimate the proportion of resident individuals among newly captured adult birds (Pradel *et al*. 1997, Nott and DeSante 2002, Hines *et al*. 2003). These transient models are incorporated into the capture-mark-recapture analyses of MAPS data (e.g., Rosenberg *et al*. 1999) and can be utilized through the computer programs SURVIV (White 1983), TMSURVIV (Hines *et al*. 2003), and MARK (White and Burnham 1999).

More recently, using both reverse time (Pradel 1998) and transient (Pradel *et al*. 1997, Nott and DeSante 2002, Hines *et al*. 2003) CMR models, we can examine relationships between spatial variation in MAPS trend estimates (lambda) and spatial variation in critical vital rates including adult apparent survival, recruitment, productivity, and first-year survival. As a pilot analysis, we assessed the demographic contributions of adult survival and recruitment rates to BCR-scale variation in MAPS population trends for 27 Nearctic-Neotropical migratory species using 12 years (1992-2003) of MAPS data (Saracco and DeSante 2008). We found

that recruitment tended to be about three times as important as adult survival in driving spatial variation in population trends, but that first year survival tended to be more important than productivity in driving recruitment. By looking at the overall (program-wide) MAPS population trends for these 27 species, however, we found that: first-year survival was the most important driver of spatial variation in trend for species with significant population declines, both first-year and adult survival were the most important drivers of spatial variation in trend for species with significant population increases, and productivity was most important driver of spatial variation in trend for species with non-significant (relatively stable) population trends.

Using these same methods, we examined both annual and BCR-scale spatial variation in the vital rates of 158 species of North American landbirds using 15 years (1992-2006) of MAPS data, and presented the results on the Vital Rates of North American Landbirds website (DeSante et al. 2015). For each of these 158 species, the site presents 1) estimates of population change (lambda), adult apparent survival, recruitment, and residency, along with indices of productivity, post-breeding effects, and adult population density; 2) graphs showing annual variation and maps showing spatial variation in these vital rates; and 3) the results of temporal and spatial pairwise correlations among these vital rates. The website also includes species account narratives for these 158 species that provide hypotheses regarding the proximate demographic drivers of the observed temporal and spatial variation in their population changes, as well as suggestions as to research and management efforts to reverse population declines and maintain stable or increasing populations. These results also suggest that enhancing survival of both adult and, especially, first-year birds, must be a very important conservation strategy for slowing population declines and achieving stable populations. Because both first-year and adult survival of migratory species may be driven primarily by processes acting on the wintering ranges and migration routes of these species, identifying relationships between these vital rates and both habitat characteristics and weather on the non-breeding grounds may well be critical for successful conservation of migratory landbirds. MAPS data, used in conjunction with data from the overwintering period provided by the MoSI (Monitoreo de Sobrevivencia Invernal - Monitoring Overwintering Survival) and additional information on migratory connectivity can provide insights regarding the mechanisms whereby survival throughout the year can drive populations trends of migratory birds (Saracco et al. 2009b).

In cooperation with researchers at the USGS Patuxent Wildlife Research Center, we have recently begun to incorporate Bayesian hierarchical spatial autoregressive models to better describe spatial variation in adult apparent survival rates and residency probabilities. To date, we have completed such analyses for American Robin, Wood Thrush (Saracco et al. 2010), and Common Yellowthroat (Saracco et al. 2011). These spatial models represent a significant advance over approaches to investigating spatial patterns in vital rates that aggregate data at coarse spatial scales (such as the BCRs described above) and do not explicitly incorporate spatial information in the models. They tend to overcome, to some extent, difficulties caused by geographical areas (or BCRs) with sparse data and by the non-random distribution of stations, can easily accommodate missing data within the modeling framework, and permit MAPS data and results to be included in models and analyses based on any previously or subsequently established grid system. These important papers, which have appeared in *Ecology* (Saracco et al. 2010) and the *Journal of Ornithology* (Saracco et al. 2012), indicate

that residency probability is often more spatially heterogeneous than survival and not positively spatially correlated with survival. They thus illustrate the importance of understanding the role of transients in local populations.

MAPS data has also helped determine how to truly define what a "population" is for a bird species (Rushing et al. 2016). Many conservation plans and management strategies work at the level of the population so this delineation is important, but should the population be defined geographically or biologically? In cooperation with researchers at the Smithsonian Institution, an approach was developed for using Breeding Bird Survey data to quantify geographic structure in trend and abundance, and identify distinct natural populations for eight species of passerines. The researchers then used vital rates derived from MAPS data to independently validate their method of population delineation.

We hope we have conveyed to you the importance of demographic monitoring and the value of the MAPS Program. Each year, as more data accumulate from established stations and as additional stations are established in new areas and new landscapes, the power of the data for revealing spatial and temporal patterns in landbird demographic parameters, and thus their usefulness for avian conservation, increases dramatically. We hope also that we have conveyed some of the excitement and intense commitment we feel regarding the role of MAPS in North American landbird conservation. Again, we invite you to participate in this growing cooperative effort. But remember, MAPS may not be for everyone. Yet, if your heart is thrilled by holding in your hands the life of a precious warbler, thrush, or bunting, and knowing that you are providing data that will aid the survival of its species, then maybe MAPS is for you!

ESTABLISHMENT AND GENERAL OPERATION OF MAPS STATIONS

The following guidelines for the establishment and operation of MAPS stations will optimize the usefulness of data obtained from MAPS stations. These guidelines conform to those recommended for constant-effort mist netting in Ralph *et al*. (1993), and were discussed in DeSante *et al*. (2004a). Because a major objective of the program is to generate estimates of temporal variation in productivity and survivorship, standardization in station operations from year-to-year and station continuity over a number of years are critical. Continuity is also important for minimizing population-parameter fluctuations that may result from year-to-year changes in the geographic distribution of stations. We realize that, because of vagaries of weather and other uncontrollable factors, no station will be able to achieve perfect standardization. Nevertheless, every attempt should be made to follow these guidelines as closely as possible.

Although standardization and continuity are critical components of the MAPS Program, the first year of operation at a MAPS station should be considered a pilot year; nevertheless, all data from the first year should be submitted. Station boundaries and net sites may be shifted during or after the first field season if problems arise or net sites prove to be unproductive. Any such changes must be documented and reported, and no further changes ought to be made after the start of the second field season. If net sites are changed, the new net designations must differ from those of the discontinued sites.

Siting a MAPS station

It is important to keep in mind that the productivity indices generated at a MAPS station provide a landscape-level, rather than site-specific, measure of productivity. This is because the young birds captured by the MAPS protocol include many dispersing individuals from the surrounding landscape, as well as a few individuals that may have fledged from nests within the boundaries of the 20-ha MAPS study area. Data on the dispersal characteristics of young and adult birds after the breeding season but before fall migration are just now being obtained for a very few species from radio-telemetry studies (Anders *et al*. 1997, Vega Rivera *et al*. 1998). These studies suggest that the landscape from which the dispersing young originate may be on the order of several thousand hectares (perhaps about 10,000-12,000 acres). Although management actions occur on a site-specific basis, their effects on bird populations become pronounced only when the specific management actions occur over substantial portions of the landscape. The ability of MAPS to provide landscape-level information on productivity is one of the unique strengths of the program. Thus, when siting MAPS stations to investigate the effects of a particular habitat type or management action, it is important to consider the habitat type or management characteristics of the overall landscape, that is, of the area within perhaps a four-km (2.5-mile) radius of the station.

It is also important to consider site-specific habitat characteristics when siting MAPS stations as these can influence the extent to which dispersing young and adult birds concentrate there. Recent work on forest-breeding species suggests that many individuals, both young and adult, desert forest interior locations immediately after the young attain independence from their parents and disperse to edge locations to molt and stage before initiating fall migration (Anders *et al*. 1997, Vega Rivera *et al*. 1998). These edge locations are generally characterized in mid to late summer by dense cover and an abundance of food resources, often fruit. Indeed, we have found that mid-to-late-summer capture rates of both adults and young are much lower at forest-interior MAPS stations than at stations that contain forest-edge or scrub habitat (DeSante 1996). Because productivity indices are calculated from the proportion of young in the mid-to-late-summer catch, the precision of the resulting indices will tend to be lower at forest-interior stations than at stations containing edge and scrub habitats. On the other hand, because late spring and early summer capture rates of breeding adults are often high at forest-interior stations, especially for forest-interior species, such stations can provide important data for estimating adult survival rates.

As mentioned above, the goals of MAPS include identifying and describing spatial and temporal patterns in demographic parameters; relating these to species-specific population trends and life history strategies, habitat characteristics, and weather variables; and using the resulting relationships to formulate management strategies for reversing population declines. As such, MAPS stations are often sited under some hypothesis-driven sampling strategy. Although we appreciate that MAPS stations can only be sited where long-term standardized mist netting is practical and permissible, the value of the data for testing hypotheses can often be enhanced if some elements of a probability-based sampling strategy can be incorporated into the siting of stations. For example, assume you are able to establish three stations in a nearby state park or forest and are particularly interested in upland oak-hickory habitat. A promising strategy might be to lay a suitably scaled grid over a GIS layer showing the distribution of upland oak-hickory habitat within the park or forest, and randomly select 10-12 grid points that lie within landscapes comprised primarily of that habitat. Then, examine the immediate landscape around each grid point and try to identify a suitable MAPS-station site within about one km of the point. If none is available around the first point, go on to each successive point until three suitable sites have been identified. A suitable site would include an area of about 20 ha (50 acres) within which long-term mist netting is both practical and permissible and that lies at least partially in upland oak-hickory habitat, but with some edge or scrub habitat as well. Remember, most of the dispersing young and adult birds that will contribute to productivity indices will originate from the surrounding landscape rather than from within the station itself. In contrast, the breeding adults that will contribute to survivorship estimates will originate from the station itself.

With these concepts in mind, we offer the following guidelines for siting stations:

(1) If possible, try to use some elements of a probabilistic sampling strategy to site stations within the selected landscape.

(2) Within the selected landscape, stations should be established at sites that are expected to remain accessible and free of major anthropogenic disturbance for at least five (preferably ten) consecutive years. Note that there can be disturbance, even heavy disturbance,

in the surrounding landscape. If there is disturbance at the station (or in the landscape), it should be described through the Habitat Structure Assessment (see p. 17).

(3) Stations should be sited where substantial numbers of individuals of many of the common species breeding in the area, or of a particular target species, can be captured.

(4) In order to capture large numbers of dispersing young and adult birds, stations should contain some edge habitat, such as a forest edge, riparian corridor, montane meadow, or power-line right-of-way. Stations can be sited entirely in forest-interior situations, but capture rates at such stations will likely be low.

(5) The habitat types at the station should be fairly representative of those present in the surrounding landscape. Stations not representative of the landscape or at which large numbers of transient or migrating birds concentrate (such as narrow points of land jutting into large bodies of water, or isolated oases in desert or grassland habitats) should be avoided.

(6) Because the derived population and demographic parameters are likely to be highly sensitive to successional changes in the habitats sampled, stations generally should be sited in relatively mature habitats or where the habitat is held in a lower successional stage by active management. The latter type of station is particularly desirable for the long-term monitoring of scrub- and/or second-growth-inhabiting species. Stations sited in highly-successional habitats must be indicated as such so that habitat change can be factored into analyses.

(7) In order to ensure standardization, MAPS stations may not incorporate any artificial food or water sources such as feeders, compost piles, dumps, birdbaths, fountains, and livestock pens. Audio playback calls should also not be used.

If you have the resources available to establish and operate more than one station, it might be advantageous to select two (or more) sites of similar habitat within a few kilometers (but further than one kilometer) from each other. Such an arrangement would give greater precision to the population-parameter estimates for that habitat in that region and might allow us to examine the extent of local dispersal and site fidelity.

Establishing a MAPS station

MAPS terminology: A MAPS "**station**" is a discrete study area consisting of a number of net sites ("**nets**," the exact places at which nets are located). Each station is given a name and a four-character code (e.g., Copper Creek = COPP or COCR). Upon receipt of a station's first data submission, we will also assign the station a unique, five-digit station number. Each station is part of a "**location**" that may contain other stations in the same general area (e.g., on the same national forest, national park, military installation, or nature reserve) operated by the same individual or organization. Each location is identified by a four-character code (e.g., Fremont National Forest = FREM). If the location contains only a single station and is likely to remain that way, the location and station codes generally are the same.

General configuration: An idealized MAPS station is roughly square or circular in shape and encompasses an area of about 20 hectares (50 acres, about 450 meters on a side or circular with a 250-meter radius; Fig. 2). Ten 12-meter mist nets are distributed more or less uniformly but opportunistically (where birds will be caught) within a core area of about eight hectares

(20 acres, about 280 meters on a side or circular with a 160-meter radius). The station includes everything within 100 meters of any net. If nets are separated by more than 200 meters, the area between the nets (at least a 25-meter-wide corridor) should also be considered as part of the station. Note that the nets are numbered in a roughly circular arrangement; this reduces the likelihood of net numbers being recorded incorrectly as the nets are checked consecutively. We realize that many MAPS stations will not be situated in a study area that permits a square or circular configuration. Some study areas may be quite irregular in shape and others, perhaps in riparian habitats, may be long and narrow. In these cases, nets should be established as uniformly and systematically as possible in order to cover the entire core area, maintaining the recommended net density (see below). Even in these cases, the station is considered to include everything within 100 m of any net.

Mist nets (number): The number of nets utilized at a station should be the maximum number (at the appropriate density) that can be operated safely and efficiently given the personnel available to run the station. Thus, only the number of nets that can be operated in a standardized manner over the long term should be established. In most instances, ten 12-meter nets might be the optimal number that can be operated by one person or two people. With a larger number of personnel or fewer birds, this number might be increased to 15 or even 20 nets; the size of the station should be increased accordingly so as to maintain the appropriate net density. With a smaller number of personnel and more birds, this number might need to be decreased to six or seven nets over a smaller area. The number and distribution of nets should be such that all the nets can be checked within 15-20 minutes if there are no birds to extract (i.e., an empty net run). We have set five as the minimum number of nets permissible at a station, since it is unlikely that really useful data can be obtained from a station with fewer than five nets.

Mist nets (density): The density of nets is an important variable with regard to the precision of the data that can be obtained from mark-recapture analyses. Net density will affect both the number of different individuals captured ― thus the population size sampled ― and the capture probabilities of those birds. Spreading the nets as widely as possible will tend to increase the number of territories intersected, and thus the population size sampled, but will tend to decrease the capture probability for the birds on any given territory. Moving the nets closer together will do the reverse. Thus, there must be some optimal intermediate density of nets that will maximize precision by optimizing simultaneously both the capture probability and the population size sampled. This optimal density may vary from species to species and from station to station depending upon average densities and territory sizes of the various species. Analyses of MAPS data indicate that stations that produce both high capture probabilities and high capture rates operate with net densities of about one to two nets per hectare. We suggest that the optimal density of nets for most MAPS target species may be about 1.25 to 1.5 nets per hectare. Thus, ten nets could be placed effectively in a study area of about seven or eight hectares. With nets placed at this density, the distance between adjacent nets will average about 75-100 meters. In general, except in steep, rugged terrain, visiting ten nets placed 75-100 meters apart in 15-20 minutes should present no problem. The size of the netting area may need to be reduced (and the consequent net density increased) for stations established in steep, rugged terrain so that an empty net run can be completed within the allotted 15-20 minutes.

Mist nets (placement): Nets should be placed opportunistically at sites at which birds can be captured most efficiently, such as the brushy portions of wooded areas, forest breaks or edges, and in the vicinity of water. The establishment of net sites at a station should strike a balance between the conflicting needs of capturing substantial numbers of breeding adults for estimating adult survival rates and substantial numbers of dispersing young and adults for indexing productivity. This may best be achieved by placing nets in both edge and non-edge portions of the study area. To optimize both the number of birds captured and their capture probabilities, nets should be placed relatively uniformly over the available habitat at each station. Because it is not permissible to move nets after the start of the second field season, care must be taken to select optimally-efficient, permanent net sites. Care also should be taken to ensure the safety of captured birds by not placing nets low over water or at sites subject to

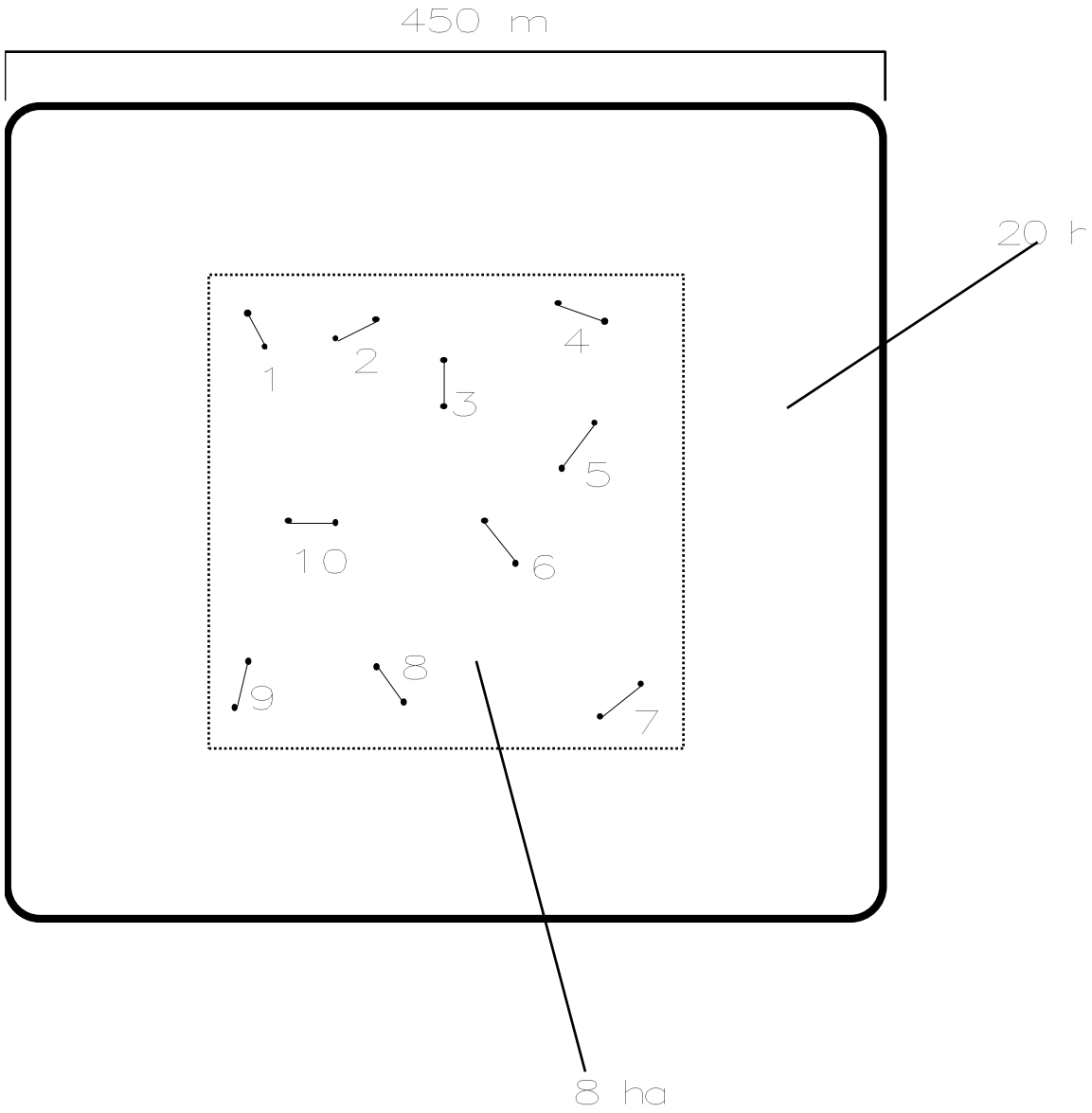

FIGURE 2. Diagram of an idealized MAPS station.

extreme wind or heat. Nets stacked two high or placed end-to-end in batteries are acceptable but not recommended, as they double the netting effort but generally don't double the number of captures. Although artificial food and water sources are not permissible within stations, they may exist adjacent to stations on property not under the control of the MAPS operator; remember that the station boundaries extend outward 100 meters from the net. Once the net sites are established, choose and flag a fixed net-run route that will minimize travel time to all nets, and number the nets sequentially along this route. Net designations should be numeric, unique within a station, and two characters long (e.g., 01, 02, 10). Remember that nets within batteries and stacked nets must be numbered individually.

Mist nets (size, type, and mesh size): We strongly recommend that all nets used in the MAPS Program be 12-meter, 30-mm mesh, four-tier, black, tethered, nylon mist nets. Other sizes, types, and meshes may be used if local conditions so warrant, but these variables must remain constant at each net site over all periods and years that the station is operated. One 12-meter net operated for one hour represents an effort of 1.0 net hour. Thus, if nets of other sizes are used, the effort reported must be adjusted accordingly. For example, a nine-meter net operated for one hour would be counted as 0.75 net hour.

Operating a MAPS station

Station registration: Before taking up station operations, a station registration form should be submitted for each station. The information on the form provides us with contact information for the station operator or operators. It also provides us with information on the station's geographic setting, critical for accessing remotely sensed data covering the station, and information on intended station operations. Once we receive a registration form for a station, the station operator or operators are added to the mailing list for the anticipated initial banding season. Refer to pages 21-24 for detailed instructions.

Banding - dates of operation: MAPS is strictly a breeding-season study. The breeding season, in general, is considered to extend from May to August and is divided into ten 10-day periods: (1) May 1-10; (2) May 11-20; (3) May 21-30; (4) May 31-June 9; (5) June 10-19; (6) June 20-29; (7) June 30-July 9; (8) July 10-19; (9) July 20-29; and (10) July 30-August 8. The strategy for the timing of operation is that each station should be operated for all ten-day periods beginning with the first period during which (a) the great majority of the breeding adults of the target species have established territories; and (b) individuals of these species migrating toward more northerly breeding grounds are no longer passing through the area. The start of operation will vary, therefore, from station to station depending on the timing of the breeding season at each station, which, in turn, is dependent primarily on latitude and altitude but also, to some extent, on longitude. Refer to Figure 3 for the recommended starting period at your location. Note that the starting period for stations at higher altitudes may have to be delayed by one (or, in years of exceptionally heavy and late-melting snowpack, even two) period(s) after the period indicated in Figure 3. In years in which late-melting snowpack do cause a delay in the initiation of breeding, the operation of periods subsequent to the starting period may also have to be delayed somewhat, more so earlier than later in the season. Nevertheless, it is extremely important that the number of periods during which the station is operated be held constant at each station for all years.

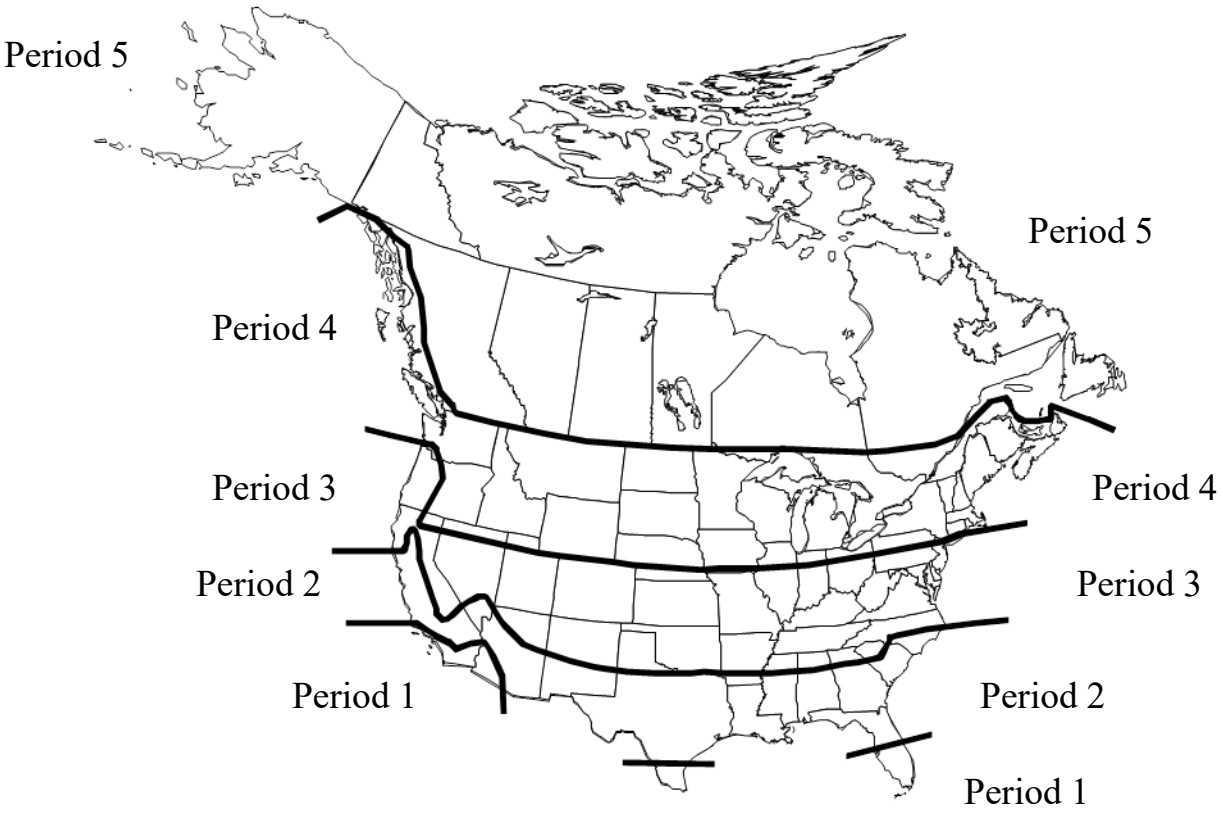

FIGURE 3. Recommended starting periods for MAPS stations. Appropriate periods for stations at high elevation stations may be later than indicated on the maps. Stations in habitats adjoining the Gulf of Mexico may start in Period 1.

It is also important not to begin the operation of a MAPS station before migrating individuals of the locally-breeding species, bound for breeding areas farther north, have finished moving through the area. These birds, if captured, will bias estimates of the proportion of residents in the adult population as well as productivity indices. The presence of such spring migrant individuals will also tend to lower the precision of all these estimates. Furthermore, the locally-breeding adults of any given species are usually the first individuals to arrive at a given location and, if captured before the start of the MAPS data-collection period, may learn to avoid the nets. Elimination from analysis of banding data collected before the official start of the season will tend to negatively bias adult survival rates, because most breeding adults are captured early in the season and net avoidance may prevent their recapture. Thus, in general, spring-migration monitoring should not be conducted at MAPS stations. If operators must run a spring-migration monitoring program and a MAPS program in the same place, they must use different net sites for the two programs.

Collection of MAPS data should be curtailed before substantial numbers of individuals (of the locally-breeding species) that are migrating south from breeding areas farther to the north

begin to pass through the station. Inclusion of these individuals in productivity analyses will produce productivity indices that will tend to be more representative of areas farther north than of the local landscape. Analyses conducted on data from the four-year (1992-1995) MAPS pilot project indicated that substantial numbers of migrating individuals (as determined from the fat contents of the banded birds) began moving through most areas, regardless of latitude, after Period 10 (July 30 - August 8) (DeSante et al. 2004a). As a result, MAPS protocol now calls for the operation of all MAPS stations through Period 10 each year, but not thereafter.

In contrast to the situation in spring, however, it is not necessary to actually curtail the operation of the station late in the season before fall migrants begin passing through the area. Rather, the station can be operated after Period 10 and data from these later periods can be removed from analysis after the fact. This is because very few, if any, breeding adults are captured for the first time late in the season and the elimination of data from these periods will not affect survival-rate estimates. Thus, a station can use the same nets for fall-migration monitoring as for MAPS monitoring without compromising the value of the MAPS data. Indeed, analyses of age ratios from successively later periods during fall-migration monitoring will provide measures of productivity from areas increasingly farther north. It is very important to note, however, that if MAPS nets are operated outside of the breeding season, such operation must be discontinued at least three months prior to the beginning of the appropriate starting period for that station. This will assure that net avoidance by breeding individuals of permanent resident species will not bias survival-rate estimates for these species.

Effort data: Effort data are critical for comparing capture rates among years and for assessing both productivity indices and population trends. Because daily activity patterns differ both by age class and species, period-by-period, net-by-net, and hour-by-hour effort data are necessary for comparing productivity levels among years and for estimating numbers of birds missed because of missing effort. These data should be summarized on the Summary of Mist-Netting Effort form. Refer to pages 25-27 for detailed instructions regarding effort at MAPS stations.

Breeding Status data: The goal of the Breeding Status List is to provide a complete assessment of the summer residency status of all species present at each station each season. In order to accomplish this, it is necessary to record observations of the nesting behavior, singing, and overall presence of each species during each visit to the station. These data should be summarized on the Breeding Status List. Refer to pages 58-66 for detailed instructions.

Habitat Structure Assessment (HSA) data: The habitat structure assessment data serve three main functions: they provide a classification for each station, permit detection of gross changes in habitat structure at the station that may explain changes in population demographics, and provide station-specific habitat data to complement remotely-sensed landscape data at a fine resolution. HSA’s should be conducted every five years, unless the habitat at your station has undergone a major change (e.g., fire, hurricane, logging, construction, brush-clearing, etc.). Please refer to the separate Habitat Structure Assessment Protocol (Nott *et al*. 2003b) for detailed instructions.

Instructions and data forms: Operators of registered stations will receive a beginning-of-season letter from The Institute for Bird Populations in early April each year. This will also direct new operators to download a copy of the MAPS Manual; the Habitat Structure Assessment Protocol; MAPSPROG, our computer data entry and verification program. Operators who have submitted data in the past will receive a printout of the overall breeding status of all species ever captured and or encountered at their stations and a MAPS Roster. All operators will be asked to download blank copies of the following data forms: the Banding, Unbanded, and Recaptures banding-data sheets, the Standard Net Opening and Closing Times form, the Summary of Mist-Netting Effort, the Summary of Mist-Netting Results, the Breeding Status List, and the forms associated with the Habitat Structure Assessment. They should also download a description of our collaboration with the Center for Tropical Research at the University of California at Los Angeles, which explains the optional feather-pulling protocol.

It is the operators' responsibility each year to make as many copies of the forms as they will need that year. Unused forms should be discarded at the end of the season because they may become obsolete the following year.

Recording data and making corrections: All data should be recorded in black ink. Please do not submit data written in pencil or other colors of ink. If you make corrections on any data sheet, use fast-drying correction fluid or correction tape. Do NOT just write over errors.

The use of MAPSPROG

MAPSPROG is a Windows-based computer program for entry/import, editing, verification, and error tracking of MAPS data (Froehlich *et al*. 2006). It offers contributors the opportunity to computerize their MAPS banding data; edit coding problems (codes that do not conform to IBP's preferred codes set forth in this manual); and address and correct, if applicable, within-record inconsistences (conflicts between codes within a record, such as juvenile birds with breeding condition or after hatching year birds with no skull pneumatization) and between-record inconsistencies (conflicts in species, age, or sex determinations in different capture records for a given band number). The verification procedures encoded in the program reflect the MAPS data-collection guidelines described in this manual and ageing and sexing criteria presented in Pyle (1997) for the months covered by the MAPS season.

By providing a data entry/editing/verification program to contributors, IBP hopes to decentralize the process of data correction, returning it to the control of those who collected the data and who should, therefore, be better situated to make necessary corrections and adjustments. As a result, we hope that the quality of MAPS data overall will improve and that contributors, by verifying their own data, will be better able to identify areas in which they can improve their data-collection techniques in future seasons. We highly recommend using MAPSPROG during the field season to enter and verify within-record consistency to improve data collection as the season progresses. MAPSPROG integrates data entry modules for Banding, Effort, Breeding Status, and Habitat Structure data.

MAPS data-use policy

Data contributed to the MAPS program will be used by IBP to further the mission and goals of the MAPS program, as detailed on pages 4-9 of the MAPS Manual. These goals include providing estimates and indices of demographic parameters, linking demographic parameters to population trends and environmental variables (e.g., habitat, climate), and providing information to land managers that will help create and maintain habitats to conserve and enhance North American landbird populations. Individual MAPS contributors will be acknowledged by name in any IBP publication or report arising from the use of MAPS data whenever their data represent more than 5% of the MAPS data used in that publication or report, and will be offered co-authorship whenever their data represent a substantial proportion (more than 30%) of the MAPS data used in that publication or report.

The MAPS database is the most extensive database on landbird demographics in North America and represents an invaluable scientific resource of immense conservation potential. As such, IBP is eager to share this resource with outside researchers, provided that the proposed research has well-defined objectives and does not impinge on current or planned IBP research projects. Requests for data should be submitted in writing and should include clearly defined objectives for the use of the MAPS data. Researchers who anticipate requesting MAPS data are encouraged to contact Danielle Kaschube, MAPS Coordinator, dkaschube@birdpop.org (609-892-0445), to discuss their request and details of the MAPS database prior to submitting their written request. All requests for MAPS data require approval by an IBP research scientist, who will also be available to provide advice on the feasibility of the proposed research. If 20% or more of the MAPS data requested by a researcher will come from any single MAPS contributor, IBP will forward the written request to that contributor for permission to use those data. IBP also requests that publications or reports using MAPS data acknowledge the MAPS Program and IBP as the source of the MAPS data, and acknowledge individual MAPS contributors by name whenever their data represent more than 5% of the MAPS data used in that publication or report. We request that researchers offer co-authorship of any publication or report using MAPS data to individuals whose data represent a substantial proportion (more than 30%) of the entire data set used in that publication or report. Finally, **we request that a copy of the final publication or report be sent to The Institute for Bird Populations** (a PDF version is fine) so that it can be archived and included on The Institute for Bird Populations publications page: http://www.birdpop.org/pages/pubsDatabase.php.

An example of some language for an acknowledgement could be:

We thank the many dedicated volunteers who have collected and donated these data to the MAPS program. We also thank The Institute for Bird Populations for developing the MAPS Program and curating the MAPS data.

STATION REGISTRATION

Joining the MAPS Program

If you are interested in establishing one or more MAPS stations and feel that you are able to meet our requirements, please contact the MAPS Coordinator, Danielle Kaschube, at The Institute for Bird Populations at dkaschube@birdpop.org or at 415-663-1436. You will be sent a registration form on which you will detail the proposed location, habitat, and operation of your station (Fig. 4). Subject to approval of your proposal, you will be added to the roster of active MAPS operators and will receive the necessary forms and instructions, as well as annual reports on the results of the program and the program's newsletter, *MAPS Chat*. Please register each MAPS station with the Institute for Bird Populations before initiating operations. This helps us plan and budget accordingly and ensures that you receive program and protocol updates.

Instructions for completing the MAPS Station Registration Form

Date: Record the date the form is completed.

Station Manager Contact Information:

Name: The name of the station manager, the person in charge of the MAPS station and responsible for seeing that changes in forms and protocol are communicated to all persons helping at the station. This will be IBP's official contact person to whom mailings and phone calls with data questions will be addressed and who will be acknowledged in publications and reports. Please keep us up-to-date concerning changes in contact information or responsibilities.

Title: The job title of the station manager within the organization, if any, with which the station is affiliated.

Affiliated Organization: The organization, if any, with which the station is affiliated.

Address and phone numbers: The mailing and e-mail addresses and phone numbers for the station manager.

Federal Banding Permit #: Provide the federal bird banding permit number under which the station will be operated. If you haven't yet received your federal permit, write "in process" in this space and provide the permit number once you have been approved.

Contact Information for an Additional Station Operator: You may provide contact information for another individual with station operation responsibilities on this form. Both operators will be included in our mailing lists and receive mailings concerning station operations. Often, secondary operators are staff biologists, technicians, students, or volunteers who play a critical role in conducting the banding station field work. If more than two individuals should be associated with this station, please provide the additional names and contact information via email at the time the registration form is submitted.

2018 MAPS STATION REGISTRATION FORM

Date: *February 20,2018*

Please refer to the instructions in the current MAPS Manual when completing this form.

THE INSTITUTE FOR BIRD POPULATIONS www.birdpop.org

Station Manager Contact Information

Name: *Joe Smith* Title: *Biologist*

Affiliated Organization: *Bird Park County Park*

Address: *Charles County Parks and Rec., 456 Main St.*

La Plata, MD 20646

Phone numbers: Work: *301-555-4444* Home or Cell : *301-556-2222*

E-mail: *Smith@svn.org* Federal Banding Permit # *12345*

You may also provide contact information for another individual with station operation responsibilities here. To add additional people, please submit a separate list of their contact information when the registration form is submitted:

Name: *Sam Jones* Title:

Affiliated Organization: *Maryland Ornithological Society*

Address: *123 State St.*

Port Tobacco, MD 20677

Phone numbers: Work: *301-654-3333* Home or Cell : *301-558-4141*

E-mail: *jones@svn.org*

Station Information

Location Code: ***BIPA*** Station Code: ***SMCR*** (pick up to 4 letters for each; location & station codes may be the same)

Name of Station: *Small Creek*

Funding Source(s): *Charles County*

Property Name: *Bird Park County Park*

Land Owner: *Charles County Parks and Recreation*

Nearest Town: *Grayton* County: *Charles* State/Province: *MD*

Latitude: *38° 26' 20"* Longitude: *-077° 10' 41"* (degrees, minutes, seconds; to the nearest sec.)

Source of lat-long coordinates: e.g. GPS, Google Earth, etc. *Google Earth*

Datum: NAD27 or (WGS84/NAD83) (circle one)

Average Altitude (in m): *11* First year of operation (expected): *2018*

General Habitat Description (e.g., "Mixed woodland in suburbia"; "cottonwood-willow riparian corridor"):

mixed deciduous forest and riparian corridor

Station Operation

Number of nets: ***10*** Number of hours of operation per day (We recommend six): ***6***

Number of days of operation per ten-day period (We recommend one): ***1***

Periods of operation: From Period ***3*** through Period ***10***.

Please include a map showing the position of the station relative to nearby towns, major roads, and other geographic features; maps that are ideal for this purpose can be produced for free using Google Earth (free at www.earth.google.com).

If you have any questions, please contact the MAPS Coordinator, Danielle Kaschube, at 415-663-1436 or via email at dkaschube@birdpop.org. To ensure receiving a timely spring packet of data sheets and information, try to **submit this form by April 1** to: Danielle Kaschube, The Institute for Bird Populations, P.O. Box 1346, Point Reyes Station, CA 94956 or email to dkaschube@birdpop.org. **Forms submitted after April 1 are still valid** but may cause a small delay in receiving season materials.

FIGURE 4. Completed MAPS Station Registration Form.

Location Code: A unique, four-character code which you may select to designate your set of stations. If the code you propose conflicts with established MAPS location codes, we will contact you to discuss an alternative.

Station Code: A unique, four-character code which you may select to designate your station. For single-station locations, this is typically identical to the location code. If the code you propose conflicts with established MAPS station codes, we will contact you to discuss an alternative.

Name of Station: The full name of your station; please try to keep it short (four words or fewer).

Funding Source(s): List government agencies, non-governmental organizations, foundations, and grants providing financial support for station operation. Use “private” if the station is self-financed or if private individuals provide funding.

Property Name: The name of the piece of land on which the station is located. Please be precise in listing the property name e.g., Wenatchee National Forest; Kittitas County Environmental Educational Center; or Starr Ranch Sanctuary. If the property is owned by an individual or family, just write “private property”.

Land Owner: The owner of the land on which the station is located. Please be precise in listing the land owner, i.e., for a station in Wenatchee National Forest, the "United States Forest Service, Wenatchee National Forest, Naches Ranger District"; for Kittitas County Environmental Education Center, "Kittitas County School District" rather than just Kittitas County; or for the Starr Ranch Sanctuary, "Audubon California" rather than just Audubon Society. If the land is owned by an individual or family, just write “private”.

Nearest Town: Indicate the nearest community, as the neotropical migrant flies, shown on **and listed in the index** of a state-level road map, such as the Rand McNally road atlas.

County: This equates to parishes in LA, boroughs in AK, etc. Western provinces have no counterpart.

Latitude and Longitude: Please provide the lat/long coordinates in degrees, minutes, and seconds **to the nearest second** for the center of the station; please convert UTM coordinates and lat/longs given in decimals (many GPS units give seconds in decimals). North American longitudes are negative (except in the outer Aleutians).

Source of lat-long coordinates: The information source from which you determined the lat/long coordinates of the center of the station (e.g., hard copy of topographic map, online topographic map, GPS unit, etc.).

Datum: The reference point around which latitude and longitude are structured. If using a topographic map created before 1983 this will be NAD27. If using a topographic map created after 1983, a GPS unit, or online mapping information, the datum will be available somewhere on the source. (Google Earth uses NAD83.)

Average Altitude: The station’s average altitude (elevation) in meters (1m=3.280833ft). Please do not give us a range.

First year of operation (expected): Please indicate the year in which you plan to begin operating your station.

General Habitat Description: Using key words, provide a brief description of the habitats at the station. Some examples: "Spruce-fir forest/meadow with willow thickets" or "Cottonwood riparian corridor/desert scrub" or "Maple-basswood forest with kettlehole marsh," etc.

Number of nets: The optimal density appears to be about one net for every two acres in the 20-acre core of the study area. The minimum number of nets permitted is five (see "Establishing a MAPS station," above). Note: a six-meter net = 0.5 net

Number of hours/day and days/period: In order to provide maximum comparability among stations, we strongly recommend six hours of operation per day (beginning at local sunrise) and only one day of operation per 10-day period.

Periods of operation: See Figure 3 for appropriate starting period. All stations should run through Period 10. High-altitude stations may start one or even two periods later as appropriate. MAPS net sites should not be used in the spring before the appropriate starting period, since spring banding activity at MAPS net sites may induce net avoidance among resident birds for the remainder of the breeding season (see "Establishing a MAPS station," above).

Please include a map on which the exact location of the station is clearly marked relative to nearby towns, roads, and other geographic features. Maps that are ideal for this purpose can be produced for free by using Google Earth (downloadable for free at www.earth.google.com).

MIST-NETTING EFFORT

Operation of nets

The importance of standardizing effort between periods and between years cannot be overemphasized. The accuracy and precision of MAPS indices and estimates depends on effort being equal, both in quantity and in timing, in all periods and all years. Thus, the number of nets operated and the timing of their operation should be standardized for all days of operation and kept constant from year to year at each station.

The first net should be opened at official local sunrise or at 0400, whichever is later; thus, starting time will change during the course of the season. The nets should be opened in the same sequence on each day of operation. If possible, they also should be checked in this same sequence on every net run. They should remain open, if possible, for exactly six hours and should be closed in the sequence in which they were opened. At stations being operated in hot climates, it may be necessary to close nets earlier than six hours after opening and to open nets earlier in the morning, but no more than 30 minutes before sunrise. Effort for a given day may be shifted up to 30 minutes early or late (relative to the standard at the station) if circumstances demand it. Nets never should be opened more than 30 minutes before sunrise nor be closed any later than 30 minutes after the standard closing time for the station. Nets should not be operated if the average wind speed exceeds ten knots or gusts exceed 20 knots (the tiers of the net will be blown into concave 'C's) or if other weather variables (e.g., precipitation or extreme heat or cold) are likely to endanger the lives of captured birds. Efforts to lure or drive birds into nets are not permitted.

Frequency of mist-netting effort

MAPS nets should be operated on only one day during each ten-day period, and the dates of operation in consecutive ten-day periods should be fairly far apart (in general, at least six days). While it is true that increasing the number of days of operation in each ten-day period will tend to increase the resulting capture probabilities, the payoff from this increase seems to fall off rapidly after two or three days of operation. Although two days per ten-day period may offer the best return on capture probability per effort spent, the two days certainly will be spent better by operating two different stations for one day each and thereby effectively doubling the total number of birds handled. Thus, if the personnel at a given station have the ability to operate on multiple days in each ten-day period, we strongly recommend the operation of multiple stations for one day each, even if the stations must be adjacent to each other (Burton and DeSante 2004). Only for certain experimental stations and other already-established stations that have a long history of operating on more than one day per ten-day period will multiple days of operation per period be accepted. In these cases, the number of days of operation during each period should, if possible, be standardized for all periods; the total effort and timing, however, must be kept constant from year to year at each station.

MAPS Periods and Intended Periods

The primary assumption of MAPS effort standardization is that banding effort at any time during a given period is equivalent to effort at any other time during the same period. Refer to pages 15-16, 'Banding ─ dates of operation' for clarifications of the MAPS Periods. Generally, banding effort in the middle of the period is likely to best approximate the proportion of young to adults prevailing for that period. However, any banding effort within the span of ten days that comprises that period is considered to be an appropriate estimator of that proportion.

Circumstances will occasionally make it impossible to conduct banding effort within the defined ten-day period. If it is impossible to put in the effort for a given period within the period itself, the station may be operated within five days before or after the period in question. For example, an operator who knows she/he will not be able to band during Period 3 due to prior engagements, may band for Period 3 as early as May 16, but no earlier. Even though the date May 16 falls in the range of Period 2, the effort is intended for Period 3. As another example, suppose your station starts operation in Period 3, but due to thunderstorms during this ten-day block, you are unable to band. You will need to make-up this effort by running the station no later than June 4. In this case, even though the date June 4 falls in Period 4, the effort is intended for Period 3.

This effectively lengthens the MAPS season by five days on either end; thus, all data collected at MAPS nets from April 26 to August 13 should be submitted.

At higher altitudes in western mountains (generally above about 2,000 m), the entire season may need to be shifted up to ten, or even 20, days later if a heavy late-lingering snowpack delays the onset of breeding. This is a rare situation, but operators at such stations may decide to delay the entire operation of their station by one or even two periods in that year, thus completing station operation in Period 11 or 12. These operators are, in effect, banding during Period 4 (or Period 5) for Intended Period 3, etc. In this case, the season may extend as late as August 23, or even September 2 (allowing for the five-day grace period at the end of the period). If you are unable to put in the effort for Periods 9 or 10 within the allowable time frame, please try to make up the effort as soon as possible, but certainly well before the end of August. Periods 9 and 10 are critical periods for calculating productivity indices, and we may be able to use data from later in August to make up the missing effort.

Alternatively, MAPS operators may decide to delay operations by one or two periods at the beginning of the season, then gradually "catch up" to normal or near normal station operation, and complete late in Period 10 or in Period 11. This is the preferred method of shifting effort, as neotropical migrants in years of phenological delay tend to speed up the breeding season by shortening the time between broods or between nesting attempts in order to leave the breeding range shortly after they would have left in a normal breeding season. In such a situation, banding should extend no later than Period 11, and the number of days between banding sessions should be decreased, and remain relatively equal, over the course of the season. For example, for a station that normally begins operation in Period 3 (May 21- 30), but instead begins in Period 5 (June 10-19 - essentially 20 days late) and plans to continue banding through Period 11 (August 9-18 - essentially 10 days late), there are only seven periods - or 70 days - in which to conduct eight sessions of banding. Thus, banding should occur approximately every 8-9 (8.75) days, rather than every 10 days, over the course of the season, ending in Period 11.

Making up missed effort

If nets are closed early or opened late (relative to the standard at the station) due to inclement weather or unforeseen circumstances, the missing hours should be recovered if possible. This may entail either ending the day late (but no more than 30 minutes) as shown in Figure 6 for Intended Period 7, or making up the missed effort on another day within the same ten-day period as shown in Figure 6 for Intended Period 5. You must make up this effort if the missing effort amounts to more than half of a normal day's operation. For example, assume a normal full day's operation is 60 net hours (ten 12-meter nets open for six hours). On one particular day, however, the nets are opened at 0600 but have to be closed at 0830 due to rain. Only 25 net hours have been accumulated. If the nets can be reopened at 0900, they should be closed at 1230 to recover the lost 30 minutes (5 net hours). If, however, it continues raining beyond 0900, the remaining 35 net hours should be made up as soon as possible during the appropriate hours (0830-1200) on another day within that period. If circumstances will prevent your return later in the intended period to make up the lost effort, then reopen the nets later in the morning, conditions permitting, to accumulate as much effort as possible (and at least half a normal day's operation) for that intended period (as shown for Intended Period 7 in Figure 6).

Minimum allowable effort

For the purposes of MAPS analyses, we divide the MAPS season into two "superperiods," an adult superperiod, during which adults usually predominate in the catch, and a young superperiod, during which young often predominate. For a given location, the dates of these superperiods depend on the recommended starting period for that location (Fig. 3). Table 1 lists the adult and young superperiods for each starting period. For data from a given station-year to be useable in MAPS analyses, the station must have been operated for a minimum of three periods during the adult superperiod and a minimum of two periods during the young superperiod. Please note that for stations having a recommended start in Periods 4 or 5, absolutely no periods may be missed during the young superperiod (Periods 9 and 10). Please also keep in mind that all stations should be run from the recommended starting period through Period 10.

Table 1. Adult and young MAPS superperiods.

Recommended start	Adult superperiod	Young superperiod
Period 1 (May 1-10)	Periods 1-6 (May 1-June 29)	Periods 7-10 (June 30-Aug. 8)
Period 2 (May 11-20)	Periods 2-7 (May 11-July 9)	Periods 8-10 (July 10-Aug. 8)
Period 3 (May 21-30)	Periods 3-7 (May 21-July 9)	Periods 8-10 (July 10-Aug. 8)
Period 4 (May 31-June 9)	Periods 4-8 (May 31-July 19)	Periods 9-10 (July 20-Aug. 8)
Period 5 (June 10-19)	Periods 5-8 (June 10-July 19)	Periods 9-10 (July 20-Aug. 8)

STANDARD NET OPENING AND CLOSING TIMES

In order to assist operators in timing the operation of their nets consistently from year to year, the Standard Net Opening and Closing Times sheet (Fig. 5) provides space for filling in local sunrise times and the net-opening and -closing schedule you intend to follow. This information is essential for analyses of effort comparability across years and for corrections for missed effort. In addition, should station operations be passed on to someone else, this information will provide the new operators and their volunteers with the times at which the nets are to be operated each period.

Typically, the standard opening time is local sunrise and the standard closing time is six hours later. Operation at some stations may deviate from this schedule consistently, year after year. In hot climates, for example, nets may need to be opened before sunrise. In cold climates, nets may need to be opened after sunrise, as shown in Periods 3 and 4 in Figure 5. In either case, the standard opening time should be no more than 30 minutes earlier or later than sunrise.

To make it easier to coordinate with banding assistants, the change from period to period in the standard opening times you designate may deviate from sunrise by 10-20 minutes, as demonstrated in Periods 8 and 10 in Figure 5. Fill out this form only once and submit a photocopy of the completed form to IBP with your data packet at the end of the season; please resubmit the form in future seasons only if you must change your standards.

Instructions for completing the Standard Net Opening and Closing Times form

Operators Name: Record the name of the MAPS Station Manager.

Location: Record your four-character location code.

Station: Record your four-character station code.

Date: Record the date the form is completed.

Sunrise: In the 'Period' field, record the sunrise time for your station for each period that you normally operate. Enter the sunrise time for the dates indicated in the period column (roughly, the mid-period dates), not the sunrise times for the dates you ran this season. U.S. sunrise tables are available free on the Web at http://aa.usno.navy.mil/data/docs/RS_OneYear.html . Once on the web-site, Form A provides sunrise times for entries of city/town and state, while Form B provides sunrise times for lat/long coordinates.

Standard Open and Standard Close: Following the guidelines given above, record the standard opening and closing times for your nets in each period. Be sure to record the standard open and standard close times you **intend** to open and close your nets each period for your station every season; these times are not necessarily the times your nets were actually operated in any given season.

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MAPS STANDARD NET OPENING AND CLOSING TIMES

Location: BIPA Station: SMCR Date: 08/13/2018
Station Manager: Joe Smith

Period		Standard Open	Standard Close
1 Sunrise 05/05:	_____		
2 Sunrise 05/15:	_____		
3 Sunrise 05/25:	0550	0550	1150
4 Sunrise 06/04:	0545	0550	1150
5 Sunrise 06/14:	0544	0540	1140
6 Sunrise 06/24:	0546	0550	1150
7 Sunrise 07/04:	0550	0550	1150
8 Sunrise 07/14:	0557	0600	1200
9 Sunrise 07/24:	0604	0600	1200
10 Sunrise 08/03:	0613	0610	1210

FIGURE 5. Completed MAPS Standard Net Opening and Closing Times form.

SUMMARY OF EFFORT

The Summary of Mist-Netting Effort is the only information available that allows us to analyze between-year changes in mist-netting data in a constant-effort manner. It is critical that this form be completed exactly as indicated. Please review this section of the manual carefully before filling out the Summary of Mist-Netting Effort forms. The most common problems that we encounter are unspecified net number(s), unspecified timing (to the nearest ten minutes) of the opening and closing of the net(s), and net-hour calculations. Remember, the opening and closing times you should record are those for the first net to be opened or closed and should be recorded in the same format as capture times. Also, please be sure to double-check all net-hour calculations. All effort at MAPS nets from Intended Period 1 through Intended Period 10 [including August data for stations at higher altitudes that were delayed by one (or, in years of exceptionally heavy and late-melting snowpacks, even two) period(s)] must be recorded on the Summary of Mist-Netting Effort forms (Fig. 6), including any effort conducted before the recommended starting period. Banding data submitted for Intended Periods 11(August 9-18) and 12 (August 19-28) must also be accompanied by effort data.

MAPSPROG incorporates a module to enter all effort data; program checks ensure that all MAPS season banding records occurred on days the nets were actually operated.

Instructions for completing the Summary of Mist-Netting Effort form

Location: Record your four-character location code.

Station: Record your four-character station code.

List net numbers of all 12-m nets: Record the net designations of all 12 meter nets.

List net numbers and lengths of all other nets: Record the net designations and lengths of all other nets. If you do not operate other length nets, please indicate by recording "N/A" or "none."

If any nets are stacked, list their net numbers and how stacked: For example, nets 02 and 03 stacked: 02-low and 03-high.

Describe net changes from last year: Indicate any previously operated nets that were not operated in the current year and any new nets added. Please note that any moved nets will require new net numbers.

MAPS season shift due to heavy snow pack at high elevation stations: See page 24 for a complete explanation of when this rare season shift may be necessary.

Intended Period: Record the **intended** period for the date operated. Remember, if it is impossible to put in the effort for a given period within the period itself, it may be done within five days before or after that period. If the date operated falls outside the standard ten-day period, include a note explaining why the operation did not occur in the standard ten-day period.

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2018 MAPS SUMMARY OF MIST-NETTING EFFORT - pg 1

LOCATION CODE: B I P A STATION CODE: UPED

List net numbers of all 12-m nets: 01- 09

List net numbers and lengths (in meters) of all other nets: Net 10 = 9 m

If any nets are stacked, list their net numbers and how stacked (i.e., nets 02 and 03 stacked: 02-low, 03-high, etc.): No stacked nets

Describe any changes in your nets or net sites since last year. **Any moved nets require new net numbers!**: No changes

MAPS PERIODS

Period One:	May 01 - May 10	Period Six:	June 20 - June 29
Period Two:	May 11 - May 20	Period Seven:	June 30 - July 09
Period Three:	May 21 - May 30	Period Eight:	July 10 - July 19
Period Four:	May 31 - June 09	Period Nine:	July 20 - July 29
Period Five:	June 10 - June 19	Period Ten:	July 30 - August 08

NOTE: Heavy snowpack in some years can cause the breeding season to be delayed in the higher elevations of the western mountains. We allow the entire MAPS season to be shifted later by one or even two periods in these instances. If your station experienced a delay in breeding this year due to heavy snowpack, please indicate the number of periods you shifted this year (1 or 2): ____

Intended Period	Date (mm/dd)	Net number(s)	Open Time (nearest 10 minute) hour	minute	Close Time (nearest 10 minute) hour	minute	Net Hours	Period Net Hours	Note No.*
e.g. 3	***05/21***	***01-06,08-10***	***06***	***0*** 0	***12***	***0*** 0	***54.00***		
<	<	***07***	***06***	***3*** 0	***12***	***0*** 0	***5.50***	***59.50***	***1***
3	*05/28*	*01-09*	*05*	*5* 0	*11*	*5* 0	*54.00*		
<	<	*10*	*06*	*2* 0	*11*	*5* 0	*4.13*	*58.13*	*1*
4	*06/05*	*01-09*	*05*	*5* 0	*07*	*5* 0	*18.00*		*2*
<	<	*10*	*05*	*5* 0	*07*	*5* 0	*1.50*		*2*
4	*06/07*	*01-09*	*07*	*5* 0	*11*	*5* 0	*36.00*		*2*
<	<	*10*	*07*	*5* 0	*11*	*5* 0	*3.00*	*58.50*	*2*
5	*06/14*	*01-09*	*05*	*4* 0	*11*	*4* 0	*54.00*		
<	<	*10*	*05*	*4* 0	*11*	*4* 0	*4.50*	*58.50*	
6	*06/24*	*01-09*	*05*	*5* 0	*07*	*3* 0	*15.00*		*3*
<	<	*10*	*05*	*5* 0	*07*	*3* 0	*1.25*		*3*
<	<	*01-09*	*08*	*5* 0	*12*	*2* 0	*31.50*		*3*
<	<	*10*	*08*	*5* 0	*12*	*2* 0	*2.63*	*50.38*	*3*

* Please write note on reverse side of this page.

FIGURE 6. Completed MAPS Summary of Mist-Netting Effort (page 1).

Date: Record the month and day of the date of operation.

Net Numbers: Record the net designations of the nets operated (not the quantity of nets opened). A single day's effort should be recorded on multiple lines if nets of different sizes are used or if the nets are open for varying periods of time. For example, if all ten nets were opened at 0600 and nets 08 and 09 were closed at 1000 due to sun or wind while the remaining eight were closed as planned at 1200, then the effort should be recorded on at least two lines. See also the example for Intended Period 3 in Figure 6.

Open Time and Close Time: These times should be recorded in the same format as capture times. That is, using the 24-hour clock, record, to the nearest 10 minutes, the opening and closing times of the first net opened or closed. Always enter three digits. Note that the ultimate zero is preprinted on the form; e.g., 6:24 a.m. = 062(0), 1:48 p.m. = 135(0).

Net Hours: Record the net hours accumulated (to the nearest 0.01 net hour) for the nets recorded on each line.

Period Net Hours: Record the total effort for all days in an intended period on the last line for the intended period.

Note No.: Record a note (with a note number) on the reverse (page 2) side of the form indicating why nets were opened or closed at times that deviate from the standard protocol. Record the note numbers for these notes in the Note No. column on the form.

Total net hours for all MAPS periods combined: Carefully sum the Period Net Hours for all MAPS periods operated during the year and enter the sum in the appropriate box on the reverse side (page 2) of the form. Please use a calculator to sum these Period Net Hours and please double-check your sum. A comparison of this sum to the sum obtained from the computerized effort file (in both IBP's verification procedures and MAPSPROG) provides an important check that all effort data have been entered.

COLLECTION AND RECORDING OF BANDING DATA

All birds captured throughout the season, including recaptures, must be identified to species and must be aged and sexed if possible (use "unknown" if necessary). Age and sex birds by the extent of skull pneumatization and/or other appropriate plumage, breeding, mensural, or molt characters (Bird Banding Offices 1991, Pyle 1997). Incorrectly-identified, -aged, and/or -sexed birds are detrimental to analyses. All birds not already banded and not excluded from the operator's banding permit (except hummingbirds, which are not included in MAPS analyses because most banders don't band them) must be banded with a numbered aluminum band issued by your country's banding office.

We consider Pyle (1997) as the authority for in-hand age, sex, and difficult species determinations of North American passerines and near-passerines. The information in this book is now accepted by the banding offices as well. MAPS banders are expected to be using this book in the field, and the validity of your determinations will be checked using it as well. Please ensure that you understand the concepts presented in Pyle (1997) and apply them appropriately. Please also ensure to correct your copy of Pyle (1997) with the latest version of the errata (http://www.slatecreekpress.com/errata.htm).

General procedures for recording banding data

Primary MAPS data: Primary MAPS data are the data upon which all analyses of productivity indices, survival-rate estimates, and population trends are based. Thus, it is crucial that complete primary MAPS data be taken on all birds captured, including recaptures. Primary MAPS data include the following data fields (see pages 36-55): capture code (e.g., newly banded, recaptured, band changed), band number, species (as given by the species alpha code), age, how aged (if age determined), sex, how sexed (if sex determined), status (as required on banding schedules submitted to the banding office), date, capture time, station, net number, disposition, and feather pull. It is important to note that the primary MAPS data fields are the only ones that may be subject to modification based on other information obtained during the capture or by comparisons with other capture records of the same band number. Date, capture time, and net number will allow us to screen out records that cannot be used for multi-year comparisons. Ageing and sexing criteria will allow us to screen out improperly-aged or -sexed birds and to evaluate the reliability of these criteria.

Supplemental data: MAPS operators are also asked to collect supplemental data on all birds captured, including recaptures: extent of skull pneumatization, breeding condition (presence or absence of a cloacal protuberance or brood patch), extent of body and flight-feather molt, extent of primary-feather wear, extent of juvenile plumage, existence of molt limits and information on feather generation for selected feather tracts or groups of feather tracts, wing chord, body mass, and fat class. These data are used in verification programs to assure the accuracy of the species, age, and sex determinations. They can also provide invaluable information regarding spatial (geographic) and temporal variation in the timing and extent of breeding and molt and the physiological condition of the bird. Because supplemental data

reflect information taken directly from the bird in the hand, supplemental data must never be modified and should mirror precisely what was recorded in the field.

Optional data: Additional data, such as exposed culmen and tail length, may also be taken but are not required, although they sometimes are useful in verifying the primary data.

Codes, scales, and forms: All data should be taken according to the standardized guidelines and utilizing the standardized codes described in these instructions and should be recorded on copies of the standardized 8 ½" by 14" MAPS banding-data sheets (Figs. 7 and 8) included in your spring MAPS package.

We realize that some contributors to the MAPS Program have long been recording many of these data according to slightly different codes and scales. The codes suggested in these guidelines are the result of thousands of hours of field work and subsequent analysis by researchers at the U.S.D.A. Forest Service, the U.S. Fish and Wildlife Service, the Point Reyes Bird Observatory, and The Institute for Bird Populations and are summarized in Ralph *et al*. 1993. In an effort to aid in the standardization of the capture and banding data now being collected in North America, we suggest that you adopt the scales and codes presented here. If you find it impossible to adopt these scales and codes, you must provide us with an explanation of how your codes correspond to MAPS codes so that they can be converted to MAPS codes. Note that codes other than MAPS codes are not accepted by the MAPS entry/verification program, MAPSPROG.

Please use the MAPS banding-data sheets for recording all MAPS banding data. We have examined well over 70 different banding-data sheets and have designed these sheets to increase the ease, logic, and accuracy of recording banding data in the field, as well as the efficiency and accuracy of entering those data into a computer for analysis and the production of banding schedules.

There are three types of MAPS banding-data sheets: the **MAPS Banding Sheet** for recording the use of new bands; the **MAPS Recaptures Sheet** for recording recaptures; and the **MAPS Unbanded Sheet** for recording birds that are captured but left unbanded.

Multiple-station locations: If more than one station is operated at a location, band strings are shared among stations, and banding is not conducted simultaneously at multiple stations, then the data from these stations should be combined on a single set of banding-data sheets to avoid gaps in the band sequences on the forms. If more than one set of banding-data sheets must be used, please use a different page-numbering sequence for each set (A1, A2,...; B1, B2...) so that each location/year/band-size/page combination is unique.

Non-MAPS data: No banding data from non-MAPS sites (e.g., nestlings, traps, feeder stations) or collected before or after the MAPS season (April 26-August 13, or through September 2 if effort for periods 9 and 10 is being made up) should be submitted to the MAPS Program. All non-MAPS data should be recorded on separate forms and, if possible, with separate band strings so as to avoid breaks in the band sequences on the MAPS Banding Sheets. However, occasionally, individual records that technically cannot be considered MAPS data are included on MAPS banding-data sheets. These records might include birds found dead on a trail or they might consist of a bird captured accidentally not in a MAPS net or at your MAPS station. These records must be identified as non-MAPS in order to avoid

including them in constant-effort analyses. **Mark these records by recording** "**NM" in the NOTE NUMBER field.**

Page headings and other notations: Be sure to fill out the headings - **Location, Year, Band Size (for new bands), and Page #** - on each banding-data sheet. Use the four-character location code determined during station registration. Number the pages sequentially for each band size, starting with page 1 every year; in other words, there will be a page 1 for each band size used each year. This is very important, as it will allow us (and you) to see at a glance that all data are submitted. Please write "End of year" at the bottom of the last page of each band size each season.

New bands: To ensure that band numbers are recorded and computerized correctly and to facilitate band inventory and scheduling, it is of the utmost importance that original banding data for only a SINGLE STRING OF BANDS be included on any single MAPS Banding Sheet and that the bands be recorded (and, as much as possible, used) in sequence. Please write "End of string" below the last record for each band string.

Lost and destroyed bands: Lost and destroyed bands should be recorded in sequence on the MAPS Banding Sheets. Record only code, band number, species name as "Band Lost" or "Band Destroyed," date, and station.

Recaptures: Every capture of a banded bird is a "recapture". Recaptures thus include returns (first captures in the current year of birds banded previously in the same place on the same permit), repeats (subsequent captures, even on the same day, of birds banded or recaptured in the same place earlier in the current year), and recoveries (first captures of birds banded in a different place or on a different permit). Birds banded outside of MAPS operation and recaptured during MAPS operation are considered recaptures. Previously-banded birds that escape or are inadvertently released before the band number is read should also be recorded as recaptures. Complete data should be taken for all recaptures and should be recorded only on MAPS Recaptures Sheets. It is crucial that new and recapture banding data NOT be entered on the same sheets. Do NOT separate recaptures by band size.

Changed bands: If a band is replaced, record the capture on both the MAPS Banding Sheet (new band) and MAPS Recaptures Sheet (recapture record). Record the old band number on the Recapture Sheet, with the new number as a note on the back. Record the new band number on the Banding Sheet, with the old number as a note on the back. The old band should be sent to the banding office with the schedule on which the new band is reported. Both records should be given capture code "C." NEVER re-use a band you have taken off a bird; it makes tracking individuals exceedingly difficult and, because the structural integrity of the band is compromised, increases the risk of injury to the bird. Importantly, a changed band should be counted only as a single recapture on the Summary of Mist-netting Results (see below), because it involves only one bird.

Added bands: Occasionally, birds wind up with a band on each leg. Usually, this is the result of a bander not realizing that the bird is a recapture and applying a band to the other leg. This can be avoided by ensuring that all banders at your location are banding on the same leg. If both bands are readable and neither is endangering the bird's welfare, it is best, because of the risk of injury to the bird, not to attempt to remove one of the bands. If the bird was captured with two bands, enter a record for each band, both with code "A" (for "Added

Band"), on the Recapture Sheet. If you have applied the second band, record it (again as code "A") on the Banding Sheet, with the original band number in a note, and record the original band on the Recapture Sheet (also with code "A") with the added band number in a note (analogous to changing a band, except that no band was removed). As with changed bands, added bands should be counted only as single recaptures on the Summary of Mist-netting Results (see below).

Unbanded birds: As much information as possible (including all primary MAPS data) must be recorded on the MAPS Unbanded Sheets for all birds that are captured but not banded (escapes, releases, and mortalities) regardless of the size of band they would have received had they been banded. Data on these birds is essential for calculating capture rates, and mortalities can be used in productivity analyses. A bird is considered an "escape" if it was touched prior to escape; a bird that bounces out of or escapes from a net before it is touched should not be recorded. "Releases" might include species that a bander is not authorized to band (gallinaceous species or hummingbirds) and birds for which the recommended band size is unavailable. See Table 2 for species alpha codes for gallinaceous birds.

Mortalities: Even if all reasonable precautions are taken, mortalities do occur occasionally in the course of mist netting. If a bird dies before it is banded, it should be recorded on the MAPS Unbanded Sheet. If a bird dies just after it is banded, remove and destroy the band. Record the bird's data on the Unbanded Sheet to account for the capture and the band number on the Banding Sheet as destroyed (code "D") to account for the destroyed band. In either case, the bird should receive "000" in the "STATUS" field and a "D" or "P" in the "DISP" field for "death due to cause other than predation" or "predator-caused mortality," respectively. If the mortality is a recapture, record the individual's band number and all normally collected data on the Recapture Sheet and then remove the band. Destroy the band unless it is a recovery, in which case you should send the band number to the banding office on form 3-1807, submit the information electronically at http://www.reportband.gov, or call the toll free band reporting number, 1-800-327-BAND). As before, enter "000" in the STATUS field and "D" or "P" in the DISP field.

Banding-data fields

The front of the banding-data sheet is broken into 36 fields each containing one or more columns. Each of these fields is described separately below. Please write out completely the first record on each sheet each day. After that, use a "greater than" (>) or "less than" (<) in the BANDER'S INITIALS, SPECIES NAME, STATUS, DATE, CAPTURE TIME, and STATION fields if the entry is repeated (on the same day only) on the next line; do not use ditto marks or vertical lines that can be mistaken for '1's and do not use these symbols in any other fields. If data for a given field are not collected, leave the field blank; do not use zeroes, nines, hyphens, slashes, or any other symbols to designate data not taken.

Please record all data taken, even if the values are "0," and do not make assumptions. For example, if you have what you believe is a female with a brood patch, please verify that there is no cloacal protuberance. Once you have done so, enter "0" in the CP field; if you leave it blank, we cannot assume that you checked to make sure there was not a CP.

BANDER'S INITIALS -- Place the initials of the bander or person taking the data in this field. Write the initials and full names of all the banders on the page in the spaces provided at the bottom of the form.

CODE -- Capture Code. Use the codes shown at the top of the banding-data sheet. Use "N" for all newly-banded birds; "L" for lost bands; "D" for destroyed bands; "U" for unbanded birds; "C" for changed bands (refer to the section on changed bands [above] for instructions on code- "C" captures); "A" for added bands (refer to the section on added bands [above]); and "R" for all other recaptures, regardless of whether they are repeats, returns, or recoveries. Please note that the only capture codes acceptable on a given sheet are those presented at the top of the sheet (e.g., "N" does not appear on the Recapture Sheet). The code for unbanded birds, "U," is already filled in on the Unbanded Sheet for these birds.

BAND NUMBER -- For new, lost, and destroyed bands, enter the complete band number for the first band on the first line of each page. Do not use a hyphen to separate the prefix from the rest of the band number. Please double-check to be sure that this first band number is completely correct. Thereafter, for all other band numbers on the page, enter only the last three digits right-justified. For all recaptures, however, be sure to enter the full band number each time. Furthermore, please double-check the band numbers on all recaptured birds before releasing them. Incorrect band numbers on recaptures are the most serious errors of all because correct band numbers on recaptured birds are the basis for all mark-recapture analyses. We strongly recommend the use of some form of optical magnification, preferably a magnification visor, to read the band numbers of recaptured birds and to examine skull pneumatization of all birds. The best one we have found is the OptiVISOR, an optical glass binocular magnifier that fits over your head, tilts up when not in use, and leaves both hands free to band and examine the bird. We recommend the DA-5 model (2.5 power at a focal length of 8"; price about $30) coupled with a 2.5 power OptiLoupe attachment (price about $5) that can be swung down in front of one of the eyepieces. It is distributed by lapidary and jewelers'-supply houses or on Amazon.

It is extremely important that **all band numbers be nine characters long**. Three-digit prefixes must be recorded prefaced with a "0" (e.g., 972 becomes 0972). Two-digit prefixes must be recorded prefaced and followed by '0's (e.g., 81 becomes 0810). For unbanded birds, leave BAND NUMBER blank.

SPECIES NAME -- Enter at least an abbreviation of the species name (e.g., "Blk-cap Chick" for Black-capped Chickadee). This abbreviation will not be entered in the MAPS database but will serve as a check against the error-prone SPECIES ALPHA CODE (below), such as Barn Swallow ("BARS") and Bank Swallow ("BANS"), both of which are often written incorrectly as "BASW". Write "Band Lost" or "Band Destroyed" in this space where appropriate.

SPECIES ALPHA CODE -- Enter the four-letter code for the species (e.g., "BCCH" for Black-capped Chickadee) from *Four-letter and six-letter alpha codes for birds recorded from the American Ornithologists' Union check-list area* (Pyle and DeSante 2003). This list (further updated in Pyle and DeSante [up through 2015]) can be downloaded from The Institute for Bird Populations' website at http://www.birdpop.org/AlphaCodes.htm . Very few discrepancies that are likely to be encountered by banders exist between this list and the

current BBL codes; the most notable is the use of "TUTI" by Pyle and DeSante (2003) instead of "ETTI" by the BBL for Tufted Titmouse (formerly Eastern Tufted Titmouse). All discrepancies are listed in Appendix 1 of Pyle and DeSante (2003, 2005, 2006). In the very few cases where the species codes differ, and until the BBL is able to update their codes, MAPSPROG will convert the alpha codes provided by Pyle and DeSante (2003, 2005, 2006) to current BBL codes when producing the export file for Band Manager. Species codes for gallinaceous birds are given in Table 2; these species do not fall under the jurisdiction of the federal banding offices, which consequently do not provide alpha codes for them.

Table 2. Species alpha codes for gallinaceous birds.

Species	Alpha codes	Species	Alpha Codes
Plain Chachalaca	PLCH	Dusky Grouse	DUGR
Chukar	CHUK	Sooty Grouse	SOGR
Himalayan Snowcock	HISN	Sharp-tailed Grouse	STGR
Gray Partridge	GRAP	Greater Prairie-Chicken	GRPC
Ring-necked Pheasant	RNEP	Lesser Prairie-Chicken	LEPC
Common Peafowl	CPEA	Wild Turkey	WITU
Ruffed Grouse	RUGR	Mountain Quail	MOUQ
Greater Sage-Grouse	GRSG	Scaled Quail	SCQU
Gunnison Sage-Grouse	GUSG	California Quail	CAQU
Spruce Grouse	SPGR	Gamble's Quail	GAQU
Willow Ptarmigan	WIPT	Northern Bobwhite	NOBO
Rock Ptarmigan	ROPT	Montezuma Quail	MONQ
White-tailed Ptarmigan	WTPT		

Occasionally, notes associated with a record indicate that the species determination for a recapture or an unbanded bird was uncertain. **Mark these records by recording** "**QS" in the NOTE NUMBER field.**

AGE -- Enter a single-digit numeric code for the age class of the bird, as shown at the top of the banding-data sheets. Alternate, single-character, alpha codes for each age class also are presented below. We strongly recommend using the numeric codes, however, because of the difficulty we have experienced in distinguishing between a printed 'H' and a printed 'A', which together comprise the vast majority of the age classes. These codes are:

4 - Local (L): A young bird incapable of sustained flight. (These birds always should be banded, processed, and released near the capture net as quickly as possible.)

2 - Hatching Year (H): A bird capable of sustained flight and known to have hatched during the calendar year in which it is captured.

1 - After Hatching Year (A): A bird known to have hatched before the calendar year in which it is captured; year of hatching otherwise unknown.

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MAPS BANDING Sheet

Location B I P A **Band Size** 0 **Year** 2018 **Page #** 1

CODE		AGE		HOW AGED AND HOW SEXED				SKULL		CL. PROT.		BR. PATCH		FAT		BODY MLT		FF MOLT		FF WEAR		MOLT LIMITS & PLUMAGE		DISP	
New Band	N	Local	4	Skull	S	Feather Wear	F	None	0	None	0	None	0	None	0	None	0	None	N	None	0	Juvenal	J	Malformed	M
Band Destroyed	D	Hatching Year	2	Cloacal Pr.	C	Mouth/Bill	I	Trace	1	Small	1	Smooth	1	Trace	1	Trace	1	Adventitious	A	Slight	1	Formative	F	Old (healed) Injury	O
Band Lost	L	After Hatching Year	1	Brood Patch	B	Eye Color	E	< 1/3	2	Medium	2	Vascular.	2	Light	2	Light	2	Symmetric	S	Light	2	Juv. & Form.	L	Illness/Disease	I
Band Changed*	C	Second Year	5	Juv. Plumage	J	Wing Length	W	Half	3	Large	3	Heavy	3	Half	3	Medium	3	Juv. growth	J	Moderate	3	Basic	B	Stress/Shock	S
Band Added*	A	After Second Year	6	Molt Limit	L	Tail Length	T	> 2/3	4			Wrinkled	4	Filled	4	Heavy	4	JUV. PL.		Heavy	4	Alternate	A	Eye Injury	E
*Old Band No. in note		Third Year	7	Plumage	P	Other (Note)	O	Almst Com.	5			Molting	5	Bulging	5			Full	3	Excessive	5	Juv. & Basic	R	Tongue Injury	T
SEX		After Third Year	8	Molt	M			Fully Comp.	6					Gr. Bulging	6			>1/2	2			Mixed Basic	M	Wing Injury	W
Male	M	Indeterminable	0					Invisible	8					V. Excess.	7			< 1/2	1			Unknown	U	Body Injury	B
Female	F	Not attempted	9															None	0					Leg Injury	L
Indeterm.	U																							Predation	P
Not attempt	X																							Dead	D

BANDER'S INITIALS		CODE	BAND NUMBER								SPECIES NAME	SPECIES ALPHA CODE				AGE	HOW AGED		SEX	HOW SEXED		SKULL	CL. PROT.	BR. PATCH	FAT	BODY MLT	FF MOLT	FF WEAR	JUV. PL.	MOLT LIMITS & PLUMAGE: PRI. COVS	SEC. COVS	PRIMARIES	SECONDS	TERTIALS	RECTRICES	BODY PLUM	NON-FEATH	WING	BODY MASS	STATUS	DATE: MO	DAY	CAPTURE TIME	STATION	NET	DISP	NOTE	NUMBER	FTHR. PULL	SWAB
C	C	C	1	9	3	0	3	8	3	8	8	Carolina Chickadee	C	A	C	H	6	S	P	M	C		6	2	0	0	0	N	2		B	B			B	B			6 3	9.7	3 0 0	0 7	0 6	0 6 5 0	U P E D	0 5			1		
P	B	N							3	8	9	Acadian Flycatch	A	C	F	L	5	S	L	F	B		6	0	4	0	0	N	2		J	L	U		U	J		3	6 8	1 2.9	>	>		0 7 2 0	>	0 4			2		
C	C	N							3	9	0	Chipping Sparrow	C	H	S	P	1	P		U											U	U						N		.	>	>		0 8 0 0	>	0 9			3		
C	C	N							3	9		C. Yellowthroat	C	O	Y	E	2	S	J	U			1	0	0	0	1	N	1	2										5 4	1 0.1	5 0 0	>		1 0 4 0	>	0 1	W		4		
A	B	N							3	9	2	White-eyed Vireo	W	E	V	I	6	E	P	U			6	0	0	0	1	N	3		B	B	B	U	U	B			6 0	1 2.7	3 0 0	0 7	0 8	1 0 0 0	S M C R	0 1			5		
C	C	N							3	9	3	Black & white warb.	B	A	W	W	5	M	L	M	P		8	0	0	0	4	S	3		J	F				J			7 0	1 0.5	5 0 0	>		1 1 5 0	>	1 0 I			6	O	1
A	B	N							3	9	4	C. Yellowthroat	C	O	Y	E	1	S	B	F	P	B	6	0	3	0	0	N	4		J		U	U	U	B			5 3	9.8	3 0 0	0 7	1 3	0 8 4 0	U P E D	0 7			7	O	1
P	B	N							3	9	5	N.Rough-wng Swal.	N	R	W	S	1	S	P	M	P		5	0	0	0	0	N	2		N	N	N		N		N		1 1 6	1 4.9	3 0 0	0 7	1 6	0 8 4 0	S M C R	0 3					
P	B	N							3	9	6	Proth. Warbler	P	R	O	W	6	S	P	M	P		6	0	0	0	4	S	3		B					B	U		7 1	1 5.5	>	>		1 0 0 0	>	0 1			8	O	1
C	C	N							3	9	7	American Restart	A	M	R	E	2	S	J	U			2	0	0	0	3	N	1	1									6 3	8.2	3 0 0	0 7	2 5	0 7 3 0	U P E D	0 5					
A	B	N							3	9	8	Yellow Warbler	Y	E	W	A	5	S	L	M	P	C	6	2	0	0	0	N	3		J	L			F	J	A		6 2	9.6	>	>		0 9 3 0	>	0 8			9	O	1
A	B	N							3	9	9	Carolina Chickadee	C	A	C	H	1	M	F	U			8	0	5	0	4	S	3		U	U			U	U			6 5	1 0.2	3 0 0	0 7	2 7	0 8 4 0	S M C R	0 4		1	0		
P	B	N							4	0	0	Hooded Warbler	H	O	W	A	2	S	L	M	P		2	0	0	0	2	N	1	1	J	F				J			6 4	1 0.8	3 0 0	0 8	0 5	0 7 1 0	S M C R	0 6		1	1	O	1
																							E	N	D		O	F		S	T	R	I	N	G															

Bander: C C Chris Countersong Bander: P B Peter Bridgestone Bander: A B Andrea Bassethound Bander:

Figure 7. Completed MAPS banding-data sheet for Band Size '0' (front). Associated notes are shown in Figure 8.

NOTE NO.	NOTE
1	band changed, original band number = 122045678
2	molt limit within lesser and med covs
3	aged by adult plumage; escaped before fully processed
4	Unable to fly on release but couldn't recapture
5	couldn't see molt limit betw/ terts and middle ss (but Pyle says can be hard to see)
6	pox on legs; pp 1-2 growing; swab vial # 000013107
7	male seen near net during extraction. Rects looked ~truncate but pp covs looked ~tapered - unsure of SY/ASY, aged AHY; swab vial # 000013062
8	molting pp 3-4. unreplaced outer pp covs & rects truncate; swab vial # 000010679
9	gr covs w/ 3 feather gens - 3 alternate coverts; rects with limited yellow (like Fig. 263 B); swab vial # 000013104
10	molting pp 2-3, ss 8-9, & pp covs, L & R r 1, unsure of brood patch 5
11	preformative nearly complete; head & upper breast feathers black w/ yellow edging; swab vial # 000016111

Figure 8: Completed MAPS banding sheet (back). These notes refer to captures in figure 7.

5 - Second Year (S): A bird known to have hatched in the calendar year preceding the year in which it is captured (known to be in its second calendar year of life).

6 - After Second Year (O): A bird known to have hatched earlier than the calendar year preceding the year in which it is captured (known to be at least in its third calendar year); year of hatching otherwise unknown.

7 - Third Year (T): A bird known to have hatched two calendar years prior to the year in which it is captured (known to be in its third calendar year).

8 - After Third Year (Z): A bird known to have hatched more than two calendar years prior to the year in which it is captured (known to be at least in its fourth calendar year); year of hatching otherwise unknown.

0 - Indeterminable (U): Age unknown because age indeterminable; i.e., age determination attempted but not possible with confidence.

9 - Not attempted (X): Age unknown because age determination not attempted.

Please attempt (without relying on previous capture data) to age adult birds as second year (SY) or after second year (ASY). It should be possible to reach this level of precision with at least some individuals of roughly 95% of North American passerine and near-passerine species. In addition, many near-passerines (including woodpeckers) and a few passerines may be aged to third year (TY) and after third year (ATY). Our ability to index juvenile survival rates and estimate recruitment rates of young and immigration rates of adults hinges on your ability to discriminate between SY and ASY age classes. Since the presence of juvenile or first-alternate feathers indicates SY, whereas the lack of such feathers often is not definitive, it is likely that more SYs than ASYs will be identified.

HOW AGED -- The how-aged codes indicate the criteria that you used to determine the age of the bird. Use only the appropriate code(s) shown at the top of the banding-data sheets. Use two codes if possible and enter them from left to right in order of importance for your age determination. If you use only one code, enter it left-justified. You must record at least one criterion unless the age is unknown (i.e., unless AGE = 0 or 9). The how-aged codes are as follows:

S - Skull: The degree of skull pneumatization.

C - Cloacal Protuberance: The presence of a cloacal protuberance on adults.

B - Brood Patch: The presence of a brood patch on adults.

J - Juvenile Plumage: The presence of juvenile body plumage on juveniles.

L - Molt Limit: The presence of two generations of feathers **within** a feather tract (e.g., within the greater coverts) **or between** two adjacent feather tracts (e.g., between the primary coverts and greater coverts). If the Molt Limit code is used, at least one of the first seven MOLT LIMITS & PLUMAGE fields (see below) must be filled in.

P -Plumage: The appearance, if reliable for ageing, of plumages other than juvenile body plumage. Feather color, shape, quality, and wear are plumage characteristics; measurements are not. Contrasts in color, shape, quality, or wear between two generations of feathers or groups of feathers should generally be treated as a molt limit characteristic (L), not a plumage characteristic (P). If the Plumage code is used, at least one of the first seven MOLT LIMITS & PLUMAGE fields (see below) must be filled in.

M - Molt: The presence and characteristics, if reliable, of **active molt**, indicated by pinfeathers and/or missing flight feathers in a symmetric pattern.

F - Feather Wear: The degree, if reliable, of flight-feather wear.

I - Mouth/Bill: The external and/or internal appearance, if reliable, of the bill or the presence of a fleshy gape on very young birds.

E - Eye color: The color of the iris, if reliable. This does not include the eye ring.

O - Other: Any criterion not listed above (e.g., date, orbital apterium, talon-flange serration, tail fork, etc.). If you use this code, you must explain how the bird was aged in a note on the back of the sheet.

Note that W (Wing Length) and T (Tail Length) are not valid how-aged codes. If tail length (or tail fork) are used to age Barn Swallows or Great-tailed Grackles use "O" and provide a note to that effect.

Please do not age recaptures based upon previous captures. Each capture should be treated in the field as if it were a new bird in order to avoid perpetuating previous errors and to enable us to see what is possible at that time of year.

Please remember that you must record at least one ageing criterion unless the age is unknown (indeterminable or unattempted). In many cases, especially with adults, more than one criterion is available; RECORD TWO! Try to look at and indicate features such as plumage, eye color, and bill/mouth that are not recorded elsewhere on the form. Don't forget that CPs and BPs can be used for ageing adults, since HY birds don't get them. Please study the sample banding sheet (Fig. 7) to better understand how this field should be used.

You must record data in at least one of the first seven MOLT LIMITS & PLUMAGE fields whenever "L" or "P" is used as a how-aged code. You also must record data in at least one of the MOLT LIMITS & PLUMAGE fields whenever you age an adult bird more specifically than AHY (i.e., SY, ASY, TY, or ATY). Remember, however, that when you age an adult bird as SY by Molt Limit, you must also indicate, with an additional how-aged code, what you used to determine that it was **not** a HY bird (e.g., skull, cloacal protuberance, brood patch, plumage, molt, feather wear, mouth/bill, eye color, or other). This additional how-aged code should generally be recorded as the left-justified one.

SEX -- Enter "M" for male, "F" for female, "U" for indeterminable (sex unknown because sex indeterminable, i.e., sex determination attempted but not possible with certainty), or "X" for not attempted (sex unknown because sex determination not attempted). If you must use numeric codes (we strongly recommend against them), use "4" for male, "5" for female, "0" for indeterminable, and "9" for not attempted.

HOW SEXED -- Use the codes below as in HOW AGED above. As with age, do not sex recaptures in the field based on previous captures. Note that S (skull), L (molt limit), M (molt), and F (feather wear) are not valid how-sexed codes.

C - Cloacal Protuberance: The presence of a cloacal protuberance, if reliable, on adult males.

B - Brood Patch: The presence or degree of a brood patch, if reliable, on adult females.

J - Juvenile Plumage: The appearance of juvenile body plumage, if reliable, on juveniles.

P - Plumage: The appearance, if reliable, of all plumages other than juvenile plumage. Does not include measurements.

I - Mouth/Bill: The appearance, if reliable, of the bill.

E - Eye Color: The color, if reliable, of the iris.

W - Wing Length: The wing chord, if reliable.

T - Tail Length: The length, if reliable, of the tail.

O - Other: Any criterion not listed above (e.g., singing, tail fork, etc.). Use of this code requires an explanatory note.

We commonly see data for species that cannot be sexed by plumage with "CP" or "BP" in the HOW SEXED field. This invariably is the result of a bander instructing a recorder to enter "male by CP" or "female by BP" and the recorder not realizing that "P" in this case stands for plumage. It is much safer (and faster) to say the codes (e.g., "M by C") rather than the words.

SKULL -- Skull Pneumatization. In order to determine the degree of skull pneumatization, it is necessary to part the feathers of the head to get them out of the way (wetting them slightly may help), then gently rock the skin back and forth over the skull while looking through the skin to the skull. The best procedure is to start at the back of the skull and proceed toward the front looking for the pattern of the line that separates the pneumatized area from the area that is not pneumatized. A pneumatized skull consists of two layers of bone connected by tiny "struts" and filled with air, much like the wing of a plane. A pneumatized skull appears opaque and grayish with tiny whitish dots. In contrast, an un-pneumatized skull, consisting of a single, thin layer of bone, appears pinkish and somewhat translucent and never shows the minute dots characteristic of a pneumatized skull. We very strongly recommend the use of a binocular magnifier such as the OptiVISOR for determining the degree of skull pneumatization (see above under BAND NUMBER). See Yunick 1979, Ralph *et al*. 1993, and Pyle 1997 for more complete information (including diagrams) on the determination of age by skull pneumatization.

Skull pneumatization should be recorded by means of the scale shown below. We strongly recommend using the numeric codes, although corresponding alpha codes that were developed by Ralph *et al*. (1993) also are shown below; these alpha codes may be used in the field if necessary, but we request that they be converted to numeric codes prior to submission.

0 - (N = none): Skull not pneumatized; that is, only a single thin layer of bone covers the entire brain, which shows through the thin covering of bone and appears as an unmarked, pinkish color. Beware of thick-skinned species such as corvids and parids, whose skull can be very difficult to see because the skin itself tends to be rather opaque; and heavily-muscled species such as grosbeaks and cardinals, whose jaw muscles can obscure the rear of the skull.

1 - (T = trace): A trace of skull pneumatization can be seen at the very back of the skull, usually appearing as an opaque, grayish crescent or a very-small, triangular area. Somewhere from 1 to 5% of the skull is pneumatized.

2 - (L = less than 1/3): Skull less than 1/3 pneumatized but some pneumatization is obvious. Thus, somewhere from 6 to 33% of the skull is pneumatized. Generally, the posterior part of the cranium has an inverted 'u'- or 'v'-shaped area of pneumatization that is usually distinctly grayish and contrasts with the unpneumatized area. The grayish area typically shows the characteristic, small, whitish dots of a pneumatized skull.

3 - (H = half): Skull greater than 1/3 but less than 2/3 pneumatized. In typical birds, most of the rear half of the skull is pneumatized, as is a small portion of the front part extending back around the eyes. This front part of the skull is usually very difficult to see because the feathers of the forehead are dense and short and difficult to move out of the way. In most cases, a bird given a "3" skull will show a pneumatized area extending up the midline or sides of the skull.

4 - (G = greater than 2/3): Skull at least 2/3 pneumatized but at least small areas of skull not pneumatized. Thus, somewhere from 67 to 94% of the skull is pneumatized. The un-pneumatized areas generally show either as two oval, pinkish spots on either side of the cranium or (rarely) as a single spot in the center of the skull.

5 - (A = almost complete): Somewhere from 95 to 99% of the skull is pneumatized. These birds have virtually a fully-pneumatized skull that shows one or two tiny, dull-pinkish areas where the pneumatization is incomplete. It should be noted that some birds, including many flycatchers, thrushes, and vireos, never develop a fully pneumatized skull, even when adult, but retain a "5" skull throughout life. Thus, a "5"-skull bird cannot necessarily be called a HY/SY bird because it could be an AHY/ASY bird whose skull never completely pneumatized.

6 - (F = fully complete): Skull fully pneumatized.

8 - (I = invisible): Skull examined but extent of pneumatization not visible. Do not use this code if you have determined that pneumatization is incomplete but are unsure of the appropriate score; in this case, make your best guess!

CL. PROT. -- Cloacal Protuberance. As the breeding season approaches, the cloaca of most male birds (and female Wrentits) begins to enlarge and forms an obvious protuberance which serves a role in sperm storage. The development of the cloacal protuberance is recorded according to the system shown below. Again, we strongly recommend using the numeric codes, although corresponding alpha codes are also given.

0 - (N= none): Cloaca not enlarged.

1 - (S= small): Cloaca somewhat enlarged and noticeably swollen. The shape of the protuberance is generally such that it is widest at the base and narrowest near the tip (conical). Since small cloacal protuberances (CPs) can be hard to discern, caution should be used in ageing or sexing birds on the basis of a CP of 1 alone. A CP of 1 can **not** be used to age or sex the thrushes of the genera *Catharus*, *Hylocichla*, *Turdus*, or *Ixoreus*. We have found that unenlarged cloacas in these species have often been designated CP = 1, which regularly has led to incorrect age or sex determinations.

2 - (M = medium): Cloacal protuberance large, with a diameter fully as large near the tip as at the base (cylindrical).

3 - (L = large): Cloacal protuberance very large and with a diameter considerably larger in the middle than at the base (bulbous).

Unlike a brood patch (see below), a regressing CP simply goes back down the scale: 3-2-1-0. CPs vary greatly in size and shape among species, being largest and most prominent in sparrows and thrushes and much less prominent in jays and Wrentits. It may be possible to sex species that rarely show prominent CPs by examining the angle of the CP with respect to the body axis. In males, the CP seems to point straight out, more or less perpendicular to the body axis. In females, the cloaca seems to point toward the rear of the bird, somewhat more parallel to the axis of the body. This same tendency can be used with caution to distinguish the occasionally slightly enlarged cloacal region of a female from a true class- 1 CP of a male. Class- 2 and - 3 CPs of males, of course, cannot be confused with those of females in any species except, possibly, in Wrentits.

Please note that all cloacas, whether enlarged or not, stick out. A true CP is characterized by firmness and lateral swelling. Note also that immature birds DO NOT get CPs.

BR. PATCH -- Brood Patch. Just prior to and during the time that the female (and in some species, the male as well) is incubating eggs in a nest, the feathers of the lower breast and abdomen are lost, vascularization increases just below the skin, and considerable fluid collects below the skin. The purpose of these changes is, of course, to facilitate the transfer of heat from the incubating bird's body to the eggs. The scale shown below should be used to record the sequence of events in the development and regression of a brood patch. Again, we strongly recommend using the numeric codes, although corresponding alpha codes are also given.

NOTE: In hummingbirds and in juveniles of most species, the lower breast and abdomen are normally unfeathered. This can cause it to look like a brood patch of 1 or 4, but the area is darker red and unwrinkled and usually has a less distinct margin.

0 - (N = none): No brood patch is present. The lower breast and abdomen are more-or-less feathered. Unfeathered areas of the breast and abdomen are smooth, without evident vascularization.

1 - (S = smooth): The lower breast and abdomen feathers are dropped and some vascularization can be seen, but most of the area is still rather smooth and dark red.

2 - (V = vascularized): Vascularization is evident, some wrinkles are present, and some fluid is present under the skin, giving the area a pale, opaque, pinkish color as opposed to the normal, dark-red muscle color.

3 - (H = heavy): The vascularization is extreme, the brood patch becomes thickly wrinkled, and much fluid is present under the skin. This is the maximum extent of the brood patch and corresponds closely to the time during which the bird is incubating eggs.

4 - (W = wrinkled): The vascularization mostly has disappeared and the fluid under the skin is mostly gone. The skin, however, retains many thin, dry-looking, contracted wrinkles.

5 - (M = molting): The vascularization and fluid and most of the wrinkles are gone. New pinfeathers are present as the area begins to become re-feathered. Most birds do not reach class 5 BPs until the nesting season is over and the prebasic molt has begun.

The sequence of 0 to 5 is rather symmetric. Classes 1 and 5 resemble each other, class 5 being distinguished most easily by the growth of new feathers. Similarly, classes 2 and 4 resemble each other but class 4 can be distinguished by its dry, thin wrinkles, as opposed to the thick, fluid-filled wrinkles of class 2.

FAT -- Fat Content. Subcutaneous fat is a yellow or orange substance that is stored just under the skin and is used as fuel for migratory flights and for maintenance during the colder winter months. Fat generally is stored in three discrete areas that usually begin filling in the following order: (1) the hollow in the furculum (wishbone) just below the throat at the top of the breast muscles; (2) the hollow directly under the wing, essentially in the “wingpit”; and (3) the lower abdomen just anterior to the vent area. The stored fat can be seen clearly through the nearly- transparent skin and contrasts with the dull, dark-reddish color of the breast muscles. It is seen most easily by holding the bird on its back while placing the index and middle fingers on the front and back of the bird’s neck, stretching the head slightly forward along a line parallel to the body, and gently blowing the feathers away from the upper breast to expose the furculum. Then check under the wing and on the abdomen, again by blowing the feathers gently out of the way. Fat content generally can be assessed quite easily while checking for breeding condition and body molt. The placement of the field on the banding-data sheets reflects this fact. The codes shown below should be used to record fat content. Again, the use of the numeric codes is strongly recommended.

0 - (N = none): No fat in the furculum or anywhere on the body.

1 - (T = trace): A very small amount of fat in the furcular hollow (< 5% filled) but not enough to cover the bottom of the furculum, and no fat or just a trace of fat is present under the wing, on the abdomen, or anywhere else on the body; **or**, if there is no fat in the furcular hollow, at least a trace of fat is present under the wing, on the abdomen, or both.

2 - (L = light): The bottom of the furculum is completely covered but the furcular hollow is less than 1/3 filled, and a small amount of fat may be present under the wing, on the abdomen, or both; **or**, if there is no fat in the furcular hollow, a

covering pad of fat is definitely present under the wingpit and, usually, on the abdomen.

3 - (H = half): The furcular hollow is about half full (actually anywhere from 1/3 to 2/3 filled), and a covering pad of fat is definitely present under the wingpit and, usually, on the abdomen; **or**, if there is no fat in the furcular hollow, a thick layer of fat occurs under the wing and on the abdomen.

4 - (F = filled): The furcular hollow is full (actually anywhere from 2/3 full to level with the clavicles) and a thick layer of fat also occurs under the wing and on the abdomen; **or**, if the fat in the furcular hollow is not full, the fat under the wing as well as on the abdomen is well mounded.

5 - (B = bulging): The furcular hollow is more than full; that is, the fat is bulging slightly above the furculum. The fat under the wing as well as that on the abdomen is also well mounded.

6 - (G = greatly bulging): Fat is bulging greatly above the furculum. Large mounds of fat occur under the wings and on the abdomen.

7 - (V = very excessive): The fat pads of the furculum, "wingpit," and abdomen are bulging to such an extent that they join. Nearly the entire ventral surface of the body is thus covered with fat, and fat even extends onto the neck and head. Such birds are nicknamed “butterballs.”

NOTE: The upper fat classes (5-7) are seen most often just prior to and during migration.

BODY MLT -- Body Molt. Body molt should be determined by examining the bases of all the contour feathers on the bird’s body, including all the body feathers as well as the upper- and underwing coverts (both secondary coverts and primary coverts) and the upper- and undertail coverts. The bases of the feathers can be exposed by blowing lightly but continuously over the body. The presence of pinfeathers is a sure sign of the early stages of molt. Later stages can be recognized by a remnant, scaly sheath at the base of each growing feather. These sheaths persist until the feathers are fully grown. You should integrate several factors in making your rating, including the number of feather tracts in molt and the proportion of feathers in molt in each feather tract. Body molt should be rated according to the scale shown below. Again, numeric codes are preferred.

0 - (N = none): No body molt. No feathers in sheath or growing.

1 - (T = trace): Only a very few feathers molting anywhere on the bird’s body, usually in no discernible pattern.

2 - (L = light): A few feathers are molting from a few feather tracts, or some feathers (fewer than ½) are molting from only one tract. In general, fewer than 1/3 of the contour feathers on the bird are molting.

3 - (M = medium): Some feathers (generally fewer than ½) are molting from most tracts, or many feathers (generally more than ½) are molting from one tract or a few tracts. In general, from 1/3 to 2/3 of a bird’s contour feathers are in molt. This class also should be used for a bird in spring whose pre-alternate molt normally includes only the head but that has nearly all head feathers in molt. Such a bird

would be given a class "3" even though fewer than ⅓ of all its contour feathers are molting.

4 - (H = heavy): Many feathers (generally more than 1/2) are molting from many or most tracts. In general, more than 2/3 of the contour feathers on the bird are in molt.

FF MOLT -- Flight-feather Molt. Flight feathers are collective for primaries, secondaries, and rectrices.

Most adult passerines in North America undergo a complete molt following the breeding season. This molt usually occurs from July to September and most often occurs on the breeding grounds, although there are some notable exceptions (see Pyle 1997). We refer to this complete molt in adults as the "**prebasic molt**" (= "adult prebasic molt" in Pyle 1997). At the same time of year (July to September), juvenile birds also undergo a molt which, following the new terminology of Howell *et al*. (2003), we refer to as the "**preformative molt**" (= "first prebasic molt" in Pyle 1997). In contrast to the complete prebasic molt of adults, the preformative molt in juveniles of most passerine species is "partial"; that is, it includes the body feathers but not the flight feathers, except sometimes the innermost rectrices (the "decks") and the innermost secondaries (the "tertials"). Thus, the presence or absence of symmetric flight-feather replacement in a bird undergoing molt in the late summer and early fall often provides another good indicator of the age of the bird. First, be sure to check Pyle (1997) to make sure that the species does not replace flight-feathers during the preformative molt (termed "first prebasic molt" in Pyle). Then, examine all the primaries, secondaries, and rectrices for the presence or absence of flight-feather molt; and examine both the left and right sides to be sure that the replacement is symmetric and not adventitious (the accidental, generally asymmetric, loss of flight feathers or body feathers anywhere on a bird). Record flight-feather molt with the codes shown below. In this case, we recommend using alpha codes since the codes are categorical and do not represent a sequence that can be expressed numerically.

N - (0 = none): No flight-feather molt.

A - (1 = adventitious): Accidental, adventitious, usually asymmetric flight-feather molt.

S - (2 = symmetric): Normal, essentially symmetric flight-feather molt, indicative of prebasic molt in adult birds and preformative molt in some young birds. A few species also exhibit prealternate flight-feather molt (see Pyle 1997).

J - (3 = juvenile growth): Growth of juvenile flight feathers in fledgling birds (only to be used for very young birds, just out of the nest, growing their first flight feathers).

IMPORTANT NOTE: If a bird is exhibiting flight-feather molt, record, as a note, the particular group(s) of feathers (primaries, secondaries, and/or rectrices) in which molt is occurring. If possible, record the highest-numbered growing feather in each molting group. This information will aid greatly in the verification of age data.

FF WEAR -- Flight-feather Wear. The juvenile generation of flight feathers (primaries, secondaries, and rectrices) is structurally weaker than later (adult) generations of feathers and thus may wear and fade at a faster rate. Furthermore, because young birds grow their juvenile flight feathers considerably before adults molt their flight feathers, at any given time during

the following 12 months, juvenile flight feathers are older than the new generation of adult flight feathers. The result is that juvenile feathers in the following spring are likely to show greater degrees of feather wear than do adult feathers at that time. If so, these data may help to determine the age of birds first captured in the spring. In addition, hatching year birds in the summer have very fresh, new flight feathers, while adult flight feathers, before they are molted, are very old and worn. This also helps facilitate the determination of age in mid-summer birds. Examine only the outer 4-5 primaries to determine wear. Flight-feather wear should be classified according to the scale shown below. Again, numeric codes are preferred.

0 - (N = none): No wear at all. The feather edges are perfect. A light-colored edge exists all the way around the feathers, including the tips.

1 - (S = slight): Very little wear. Feather edges are only slightly worn and no actual fraying or nicks have occurred. Often, a light-colored edge exists around the sides of the feathers but not at the tips.

2 - (L = light): Relatively light wear. The feathers are definitely worn but with very little fraying and very few actual nicks.

3 - (M = moderate): The feathers show considerable wear and some very definite fraying. Nicks and chips are obvious along the vanes.

4 - (H = heavy): The feathers are very heavily worn and frayed. The tips are often worn completely off.

5 - (X = excessive): The feathers are extremely ragged and torn up, and the shafts are usually exposed well beyond the vanes. All the tips are usually completely worn or broken off.

JUV. PL. -- Extent of Juvenile Body Plumage. Most fledgling birds wear a juvenile plumage that is distinct, at least in texture, from any other plumage of the species. Juvenile plumage is generally distinguished from adult plumages by loosely-textured ("fluffy") contour feathers, often with streaks or spots not found on corresponding adult feathers. It is important to examine individual feathers in assessing the extent of juvenile plumage. This plumage may be worn from only a few days to several months, depending on species and fledging date, until the **preformative molt**, at which time it is molted into "**formative plumage**" (= "first prebasic plumage" in Pyle 1997, which see for descriptions and timing of juvenile plumage and an extensive discussion of molt). The extent of juvenile body plumage on a young bird, therefore, is often a good indicator of how long the individual has been out of its nest. Note that flight feathers (primaries, secondaries, and rectrices) are generally not replaced during the preformative molt and should not be considered when assessing the extent of juvenile plumage. The extent of juvenile body plumage should be recorded according to the scale shown below. Again, we recommend using the numeric codes rather than the alpha codes. For the purpose of this field, only juvenile birds have juvenile body plumage! Most birds do retain some juvenile wing coverts through the first breeding season, but these second-year birds are considered to have no juvenile body plumage because they have completed the preformative (and in some cases prealternate) body molt.

3 - (F = full): Full juvenile body plumage. The bird has not yet begun its preformative (= "first prebasic") molt.

2 - (G = greater): More than half of the juvenile body plumage remains, although the bird already has begun its preformative molt. The individual looks mostly like a juvenile, but some formative (= "first basic") body plumage is evident.

1 - (L = less): Less than half of the juvenile body plumage remains. The bird has molted primarily into formative body plumage, but some juvenile body plumage remains.

0 - (N = none): No juvenile body plumage. The individual has molted already into full formative body plumage. All adult birds, including SYs, therefore, have "0" juvenile plumage, even if they have some retained juvenile coverts or flight feathers.

In summary, a bird is in full (3) juvenile plumage from fledging until the onset of the preformative (= "first basic" in Pyle 1977) molt. During this molt, juvenile plumage is replaced by formative (= "first basic" in Pyle 1977) body plumage. Thus, birds in partial (2 or 1) juvenile plumage must be in molt. Recently-fledged birds still may be growing their juvenile feathers but should be classed as "3" juvenile plumage. Similarly, birds in the final stages of the preformative molt may have shed all of their juvenile body feathers but still be growing their formative feathers; such birds have "0" juvenile plumage.

MOLT LIMITS & PLUMAGE - These fields are to be used for adult birds aged more specifically than AHY (i.e., SY, ASY, TY, or ATY), as well as for any birds (including those aged HY or AHY) aged by molt limit or plumage (i.e., any time "L" or "P" is used as a how-aged code). Up to eight fields, which describe individual (or multiple) feather tracts or non-feathered body parts, may be considered for any individual bird. At least one of the first seven fields must be filled in if the bird is aged by molt limit or plumage, and at least one of the fields must be filled in if the bird is aged SY, ASY, TY, or ATY. Refer to Pyle (1997), Froehlich (2003), and Saracco (2004) for additional discussion and examples of the use of molt limits and plumage criteria for ageing landbirds. Note that in Saracco (2004) and in the material that follows, we use the new molt terminology of Howell *et al*. (2003) as discussed by Pyle (2004). In particular, as compared to molt terminology in Pyle (1997), we use "**formative feathers**" instead of "first basic feathers," "**preformative molt**" instead of "first prebasic molt," "**basic feathers**" to mean "adult basic feathers," and "**prebasic molt**" to mean "adult prebasic molt." The eight MOLT LIMITS & PLUMAGE fields are:

PRI. COVS - Primary coverts.

SEC. COVS - Secondary coverts (i.e., greater, median, lesser, carpal, and alula coverts and alula).

PRIMARIES - Primaries.

SECONDS - Secondaries, not including the tertials.

TERTIALS - Tertials.

RECTRICES - Rectrices.

BODY PLUM. - Includes all feather tracts of the head, upperparts and underparts (including the underwing coverts).

NON-FEATH - Includes all non-feather parts including bill, mouth, eye, legs, and feet. A note is required if this field is used.

The codes entered in these fields should reflect the ***feather generation(s)*** present within the particular feather tract (or multiple feather tracts in the case of body plumage). Adventitiously (accidentally) replaced feathers should be ignored (except to provide context to the other feathers in the tract) because recognizing them as a separate feather generation will lead to mis-aging birds. Similarly, brand new or actively molting feathers should be ignored when coding tracts containing actively molting feathers.

The use of any of the following three codes during the MAPS season on an adult bird prior to completion of its prebasic molt indicates that it is a SY bird; the use of any of these codes on a young bird after its preformative molt (= "first prebasic molt" in Pyle 1997) confirms that it is a HY bird.

J - Juvenile: Feather tract comprised entirely of retained juvenile (or a mix of juvenile and alternate) feathers, but no formative (= "first basic" in Pyle 1997) feathers. This code should also be used for NON-FEATH if non-feathered body parts show characteristics indicative of a young bird.

L - Molt limit: Molt limit between juvenile and formative feathers exists **within** the feather tract, regardless of whether or not alternate feathers are also present in the tract.

F - Formative: Feather tract comprised entirely of formative (or a mix of formative and alternate) feathers, but no juvenile feathers.

The use of any of the following three codes during the MAPS season indicates that the bird is <u>not</u> a SY or HY bird:

B - Basic: Feather tract comprised entirely of basic (or a mix of basic and alternate) feathers (note that basic feathers = "adult basic feathers" in Pyle 1997), but no juvenile or formative feathers. The use of this code during the MAPS season on an adult bird prior to its prebasic molt indicates that it is an ASY bird; the use of this code during the MAPS season to describe feather tracts on an adult bird after its prebasic molt indicates only that it is an AHY bird.

Individuals of some near-passerine species (e.g., woodpeckers) can be aged to TY or ATY during the MAPS season (see discussion in Pyle 1997, pp. 39-40) due to incomplete molts, which result in feathers that are retained through the next prebasic (not preformative) molt. Such individuals can have up to three generations of juvenile and basic feathers present within the same feather tract (these species do not acquire alternate feathers). Two codes are to be used to distinguish cases in which juvenile and basic (rather than juvenile and formative) feathers are present, from situations in which two generations of basic (rather than formative and basic) feathers are present:

R - Retained: Both juvenile and basic (rather than juvenile and formative) feathers are present within the tract (e.g., see Figs. 25 and 26 in Froehlich 2003). The use of this code during the MAPS season on an adult bird prior to its prebasic molt indicates that it is a TY bird; the use of this code during the MAPS season to describe feather

tracts on an adult bird after its prebasic molt indicates that it is a SY bird. **Typically, only used for woodpeckers.**

M - Mixed: Multiple generations of basic feathers are present in the tract (e.g., see Fig. 27 in Froehlich 2003). The use of this code during the MAPS season on an adult bird prior to its prebasic molt indicates that it is an ATY bird; the use of this code during the MAPS season to describe feather tracts on an adult bird after its prebasic molt indicates only that it is an ASY bird. **Typically, only used for woodpeckers.**

The following two codes, which can be used during the MAPS season (prior to the prebasic molt) to distinguish adult (AHY) from young (HY) birds, are generally not useful for ageing adult birds to more specific age classes (i.e., SY, ASY, TY, ATY):

A - Alternate: **ALL** feathers in the feather tract are of alternate plumage; if **ANY** juvenile, formative, or basic feathers are present, the alternate feathers should be ignored and the code for the feather tract should be based on the other feathers, that is "J", "L", "F", or "B".

N - Non-juvenile: Feathers in this tract are definitely not juvenile feathers (or the non-feathered body part is not characteristic of a young bird), but whether or not they are formative or basic feathers cannot be determined with confidence. Note that if primary coverts are coded "J" and a molt limit exists between the primary coverts and the secondary coverts, the secondary coverts must be formative feathers and, thus, must be coded "F", not "N", even though formative and basic secondary coverts might be indistinguishable from each other. The code "N" should only be used as a last resort; every effort should be made to identify appropriate feather tracts to formative or basic. Often, this is best accomplished by considering the tract in the context of other tracts which, for example, have perhaps been reliably aged juvenile. This code should also be used for NON-FEATH if non-feathered body parts show characteristics indicative of an adult bird.

The following code should be used for feather tracts examined, but not meeting any of the above criteria:

U - Unknown: This code should be used for any feather tract or non-feathered body part that is examined, but that shows ambiguous characteristics or that cannot be coded with confidence.

Finally, LEAVE BLANK any field representing a feather tract or non-feathered body part that was not examined for any reason, including cases where that feather tract provides no useful information for ageing the bird.

As an example of the use of these fields, consider the age determination of a SY bird (i.e., AGE = 5) prior to its prebasic molt. The age of SY birds can be determined by the retention of juvenile feathers, which will be evident in some feather tracts but not others (depending on the extent of the preformative molt). Any feather tract for which retained juvenile feathers are evident will have either a "J" or "L" entered in its field, depending on whether molt limits are between or within feather tracts, respectively. If the molt limit is between feather tracts, the tract with juvenile feathers would be coded "J" and the tract with formative feathers would be coded "F." If the molt limit is within the feather tract, the tract would be coded "L."

In each of these cases where a molt limit between juvenile and formative feathers can be discerned, the bird should be aged by molt limit (HOW AGED = L). If, however, a molt limit cannot be discerned, but the juvenile feathers present can be distinguished as juvenile (as opposed to basic) feathers by their appearance alone (i.e., color, shape, quality, or wear), the bird would be aged by plumage (HOW AGED = P). Remember, any feather tract or non-feathered body part that was examined, but for which a code could not be determined, should have a "U" entered in its field.

As another example, consider an ASY bird (i.e., AGE = 6) prior to its prebasic molt. Birds of this age are typically distinguished by having undergone a complete prebasic molt – adjacent feather tracts generally show little if any contrast in quality or wear. Such birds should have a "B" entered in all fields for which the basic feathers present can be distinguished as basic (as opposed to juvenile) feathers by their appearance alone (i.e., color, shape, quality, or wear), and should be aged by plumage (HOW AGED = P). They should not be aged by molt limit (HOW AGED = L) because there is no molt limit. Note that any alternate feathers present provide no information as to whether the individual is a SY or ASY bird.

As a third example, consider a species that can undergo a complete preformative molt (e.g., a Northern Cardinal). When examining an adult of these species during the breeding season, you may find that all of the feathers are of a single generation (i.e., no molt limits). Because formative and basic feathers appear identical in this species, you will not be able to age the bird specifically to SY or ASY and so the bird must be aged AHY (i.e., AGE = 1). Such birds should have "N" entered in all fields for which the formative or basic feathers present can be distinguished as non-juvenile feathers by their appearance alone (i.e., color, shape, quality, or wear), and should be aged by plumage (HOW AGED = P). If a molt limit is present in these species, the limit must be between juvenile and formative feathers and "N" should not be used in any field because evidence for the existence of formative feathers is provided in context by the presence of juvenile feathers. Therefore, the bird must be aged SY (AGE = 5). Birds of these species can never be aged ASY (AGE = 6) in the field.

Finally, it is possible that various feather tracts in an individual bird will show conflicting characteristics (i.e., characteristics that indicate different age classes). When making an age determination for such a bird, give more weight to tracts that are more reliable or have the most obvious reliable features. Although it is not necessary that all tracts in a record agree, you should be confident in your ultimate age designation. During the MAPS season, a bird with no reliable feather tracts or a bird for which conflicting characteristics make age determination difficult should be aged as AHY (AGE = 1) prior to the prebasic molt and as indeterminable (AGE = 0) after the prebasic (or preformative) molt.

WING -- Wing Chord. Record wing chord (the length of the unflattened wing) to the nearest mm. See Pyle (1997) or Ralph *et al*. (1993) for an explanation of the technique. Unless there is little or no overlap in wing lengths between sexes (e.g., icterids), DO NOT sex birds by wing length alone in the absence of population-specific wing-chord data.

BODY MASS -- Using an electronic balance, record the mass of the bird to the nearest tenth of a gram. If an electronic balance is not available, record the weight of the bird to the nearest 0.5 gram using a Pesola (or other spring-operated) scale.

STATUS -- Record status as a single, three-digit code as shown in Bird Banding Offices 1991 (revised 1992); http://www.pwrc.usgs.gov/bbl/manual/status.cfm. The most-frequent codes are "300" - normal wild bird captured, banded, and released; "301" - normal wild bird captured, banded and color-banded, and released; and "500" - injured bird (see DISP). In addition to these standard status codes, please use code "000" for all birds that were not banded or that died prior to release. Please note that status "000" birds are now requested to be included in schedules submitted to the banding offices if they are mortalities. Live released unbanded birds with status "000" are not to be included on schedules.

DATE (MO/DAY) -- Month/day. Record the date of capture as month and day, all in numbers. The year is entered once on the top of the form. Record all months and days as two-digit numbers (i.e., June is written "06"). The first entry on a page for each date must be written out completely; subsequent entries for that date may be entered as ">."

CAPTURE TIME -- Using the 24-hour clock, record, to the nearest 10 minutes, the starting time of the net run on which the bird was extracted. Thus, all birds extracted (or escaping) on a given net run will have the same capture time. This is necessary for standardizing effort between years. Do not enter the time at which the bird was extracted, processed, or released. Always enter three digits. Note that the ultimate zero is preprinted on the form; e.g., 6:24 a.m. = 062(0), 1:48 p.m. = 135(0).

STATION -- Record the four-character code for the MAPS station as determined during station registration.

NET -- Enter a two-digit, numeric code (e.g., "06") for the net site at which the bird was captured. It is important that net codes not include alpha characters nor be more than two characters long. Please enter "?" into this field if the net number is unknown.

DISP -- Disposition. Enter a code from the list below indicating the final disposition of any injured or dead bird. A bird is considered "injured" if its survival probability is thought to be compromised, or for healed injuries, could previously been compromised; thus, a minor flesh wound or loss of a few feathers is generally not worthy of note. Any injured or dead bird also should have a status code of "500" or "000," respectively.

- M - Malformed (deformity such as crossed mandibles)
- O - Old (healed) injury.
- I - Ill or diseased.
- S - Stress or shock.
- E - Eye injury.
- T - Tongue injury.
- W - Wing injury (unable to fly).
- B - Body injury.
- L - Leg injury.
- P - Predator-caused mortality.

D - Death due to a cause other than predation.

R - Band removed from bird and then bird released bandless. Only should occur for leg injuries where other leg cannot be banded.

NOTE NUMBER -- Enter a number (starting with "1" on each page) if additional information needs to be recorded, and record this information with the corresponding note number in the NOTE field on the back of the banding-data sheet. Occasionally, individual records that technically cannot be considered MAPS data are included on MAPS banding-data sheets. These records must be identified as non-MAPS in order to avoid including them in constant-effort analyses. **Mark these records by recording** "**NM" in the NOTE NUMBER field.** Occasionally notes associated with a record indicate that the species determination for a recapture or an unbanded bird was uncertain. **Mark these records by recording** "**QS" in the NOTE NUMBER field.**

FTHR. PULL -- Enter a code from the list below indicating which feathers were pulled during this capture event. Only record this information when the feathers are actually pulled, not on a recaptured bird that has previously had feathers pulled. If no feathers were pulled, leave the field blank.

O - Outer two rectrices were pulled (i.e., rectrix 6 from both the left and right side of the tail). Previously, this was indicated by FTHR. PULL = P.

I - An inner and an outer rectrix were pulled (i.e., rectrix 1 from one side and rectrix 6 from the other side were pulled).

SWAB -- Enter the size of the swab used to collect the cloacal swab sample into the SWAB field on the banding data sheet for any bird that had a cloacal swab sample taken from within the cloacal cavity (note: only record this information when the swab is actually taken, not on a recaptured bird that has previously been swabbed). We recommend that you record the barcode number of the vial into which the swab was placed in the note field on the reverse of the banding sheet in addition to recording the barcode number on the separate swab datasheet. If no swab sample was taken, leave the field blank.

1 - 1mm wide swab used to collect the sample from within the cloacal cavity

2 - 2mm wide swab used to collect the sample from within the cloacal cavity

NOTE -- Record notes on the back of the banding-data sheet. These include characterizations of examined feather tracts in adult birds (see AHY/SY/ASY/TY/ATY above). Other examples of notes include measurements of difficult-to-identify species such as *Empidonax* flycatchers; documentation of rarities or extralimital species; suspected age or sex determinations of birds given age code "0" or "9" or sex code "U" or "X"; details of any "O" (other) code for HOW AGED or HOW SEXED; explanations for injured, dead, and unbanded birds; and sequence of color bands, if present. Please be liberal in your note-taking, especially to indicate which, if any, flight feathers are missing, erupting, or growing.

A strategy for ageing and sexing birds

A useful strategy for ageing and sexing is to complete the skull, cloacal protuberance, brood patch, molt, wear, and juvenile plumage fields first (that is, after identifying the bird and banding it or, if a recapture, reading the band number). In most cases, ageing and sexing should be straightforward if you keep the following breeding-season "rules" in mind:

- A skull of 0 to 4 indicates a hatching year bird (except in a few species such as cuckoos that may never progress beyond 4); a skull of 5 or 6 indicates an adult.
- Presence of a CP indicates an adult male (except in Wrentits).
- Presence of a BP indicates an adult and, in most species, a female (for exceptions see "Sex" in individual species accounts (Pyle 1997) or "List of species in which males can develop brood patches" at http://www.birdpop.org/pages/mapsDataForms.php) on the IBP website. A full (class 3) BP indicates a female (except in cuckoos, kingfishers, woodpeckers, Clark's Nutcracker, and Wrentit, in which males develop full brood patches).
- Heavy body molt in the absence of symmetric flight-feather molt generally indicates a hatching year bird. Conversely, symmetric flight-feather molt, especially of the primaries, indicates an adult in most species (see "Molt" in individual species accounts (Pyle 1997) for exceptions).
- Flight-feather wear of 3 or greater generally indicates an adult.
- Presence of juvenile body plumage indicates a hatching year bird.

If your data conflict with one another, look again! And remember that the absence of CP, BP, molt, or wear is not, by itself, conclusive evidence of anything!

Remember, if you use how-aged codes of "L" or "P", you must fill in at least one of the first seven MOLT LIMITS & PLUMAGE fields. Also, if you have an adult bird prior to its prebasic molt, please go on and attempt to age it more specifically to SY, ASY, etc., by recording the feather generations of the relevant feather groups (or soft-part features) in the appropriate MOLT LIMITS & PLUMAGE fields.

SUMMARY OF MIST-NETTING RESULTS

This summary serves as a check to ensure that all of your capture records ― for newly banded, unbanded, and recaptured birds ― have been submitted and that the dates and station are correct for each capture. Please complete this form using your raw banding-data sheets at the end of each banding day. Please do not fill out this sheet from your computer file! Remember to count replaced and added bands only once (as recaptures) and to omit lost and destroyed bands. Refer to Figure 9 for an example.

Instructions for completing the Summary of Mist-Netting Results form

Location: Record your four-character location code.

Station: Record your four-character station code.

Intended Period: Record the intended period for the date operated.

Date: Record the month and day of the date operated.

New: Record the number of new individuals banded. Remember, if a bird dies before processing, this individual should be recorded on the data sheet as an unbanded bird. The band that was applied to the individual should be taken off the bird and be recorded as destroyed.

Unbanded: Record the number of birds captured but not banded.

Recaps: Record the number of recaptures. Remember that previously-banded birds that escape or are inadvertently released before the band number is read should be recorded and counted as recaptures (BAND NUMBER remains blank).

Total: Tally the number of new, unbanded, and recaptured birds for each day of operation. At the end of the season, record the totals of these three categories at the bottom of the form.

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2018 MAPS SUMMARY OF MIST-NETTING RESULTS

LOCATION CODE: BIPA STATION CODE: UPED

MAPS PERIODS

Period One:	May 01 - May 10	Period Six:	June 20 - June 29
Period Two:	May 11 - May 20	Period Seven:	June 30 - July 09
Period Three:	May 21 - May 30	Period Eight:	July 10 - July 19
Period Four:	May 31 - June 09	Period Nine:	July 20 - July 29
Period Five:	June 10 - June 19	Period Ten:	July 30 - August 08

For each banding date, fill in the number of captures on your Banding, Unbanded and Recaptures banding-data sheets. Assign each date to the period for which your banding effort was intended, following the guidelines in the Manual.

Intended Period	Date	New	Un-banded	Recaps	Total
E.g. 3	05/21	12	1	4	17
4	05/30	15	0	6	21
3	05/28	14	2	1	17
4	06/05	21	0	3	24
<	06/07	12	0	5	17
5	06/14	30	2	11	43
6	06/24	17	0	9	26
7	07/06	16	0	8	24
8	07/13	18	1	5	24
9	07/25	26	0	6	32
10	08/04	15	2	3	20
Total		169	7	51	227

Intended Period	Date	New	Un-banded	Recaps	Total
Total					

FIGURE 9. Completed MAPS Summary of Mist-Netting Results form.

BREEDING STATUS LIST

Many of the individual adult birds captured in the MAPS program are transients that do not breed at the MAPS station. They include floaters that have not yet acquired a breeding territory, failed breeders searching for a new mate or new breeding territory, and post-breeding individuals dispersing from breeding territories to molting and pre-migration staging areas. Because the presence of such transient individuals negatively biases adult survival rates, we use a transient modification (Pradel *et al*. 1997) of Cormack-Jolly-Seber mark-recapture models (Pollock *et al*. 1990) to estimate the survival rate of resident individuals and the proportion of residents among newly captured birds. We suggest, however, that the proportion of residents in the adult population may be more than a simple nuisance parameter. Rather, we suggest that this proportion may vary in a predictable manner as a function of population change and, thus, may be of fundamental importance to avian population dynamics. In order to obtain the most useful measure of the proportion of residents, we pool data for a given species only from those stations at which the species is a regular or usual breeder, that is, only from those stations where at least one individual of the species was known to be a summer resident attempting to breed during more than half of the years the station has been operating.

As part of MAPS protocol, therefore, we ask MAPS operators to record breeding status information on all species seen or heard during each visit to each station. We ask operators to record anecdotal observations of active nests; birds carrying nesting material, food, or fecal sacs; distraction displays; courtship; copulation; and territorial singing or drumming using a protocol similar to that employed in Breeding Bird Atlas projects. These observations are recorded on the stations' Breeding Status List. Using these data, coupled with capture data, MAPS operators are asked to determine the breeding (summer residency) status of all species at each station each year.

In addition to providing unbiased data on the proportion of residents in the population, this protocol provides a unique and extremely valuable database, one which allows the construction of temporally and spatially explicit species-habitat relationships based on actual breeding status at each of the hundreds of MAPS stations. This database can overcome many of the limitations of traditional species-habitat relationships derived from point-count data. Such limitations are caused by including species as breeders that are in fact only transients at the location in question; and by excluding actual breeding species at the location in question because they are not encountered within the short duration of most point counts.

It is important to understand that what we are asking you to determine by asking for breeding status is **whether or not any portion of at least one breeding territory or home range of a given species includes any portion of the area of your MAPS station.** Remember, breeding status is determined only for the area contained within the boundaries of your MAPS station, NOT the preserve, county, or any other area in which your station is located. Remember also that the boundaries of your station include all of the area extending outward for 100 m from your outermost nets. In general, typical MAPS stations include an area of about 20 ha (50 acres).

Station-specific Breeding Status Lists (Fig.10) are included with the Spring Packet sent to MAPS operators in mid-April. Operators of stations from which no previous data have been received by IBP will receive a blank Breeding Status List with the four-letter alpha location code, four-letter alpha station code, unique five-number numerical station code assigned by IBP ("Sta"), and the current year preprinted on the form. Before the season begins, such operators should list in the SPECIES CODE field, in A.O.U. checklist order (A.O.U. 1998), the species alpha codes of all species that are anticipated to be encountered at the station. Operators of stations from which previous MAPS data have been received by IBP will receive a preprinted Breeding Status List that lists all species ever encountered at the station in A.O.U. checklist order. (If data were not submitted using MAPSPROG, species recently added to the list by the operator may not be included on the preprinted list because of a backlog in data entry and processing at IBP). Species that are encountered at the station during the MAPS season, but that are not on the preprinted (or anticipated) list, should be added to the end of the list. At the end of the season, the completed Breeding Status List will thus include all species **detected** at the station during **all** breeding seasons that the station has been operated, not just those species detected during the current year or only those species for which individuals have been captured.

Breeding Status Lists for stations from which previous MAPS data has been received will also contain filled-in BRSTAT codes for each species. The BRSTAT code is the cumulative breeding status at the station for all previous years of operation, a kind of breeding status summary. First time operators' Breeding Status Lists will have a dash preprinted in BRSTAT. For each species, the BRSTAT code represents a summary of all of the yearly breeding status codes. The following BRSTAT codes are in use:

B - Regular breeder. Summer resident or suspected summer resident during all years the station was operated.

U - Usual breeder. Summer resident or suspected summer resident for more than ½ of the years the station was operated, but not all years.

O - Occasional breeder. Summer resident or suspected summer resident for ½ or fewer of the years the station was operated.

T - Transient. The station lies within the species' breeding range, but no individual of the species was a summer resident at that station during any year.

A - Altitudinal disperser. A species which breeds only at lower elevations than that of the station, and which disperses to higher elevations after breeding.

M - Migrant. The station falls outside of the species' normal breeding range.

? - Unidentified. Individuals of the taxon were not identified to species; no breeding status was assigned.

These codes are provided to inform you of the overall breeding status for each species. It is important that you **determine each new year's breeding status independently of the BRSTAT.**

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2018 MAPS BREEDING STATUS LIST

List all species ever encountered at the station!

Location: B I P A Station: U P E D Sta: 1 6 6 9 8

Period Status Codes: Please record only the highest hierarchical breeding status observed during each period C supercedes P and O; P supercedes O), and the appropriate daily sub-codes (hierarchically listed) describing the behavior or observation indicating that status (e.g., Cn, Pc, or Ob). If a species wasn't observed, use a '-'. If a station was operated two or more days in a period, record only the highest breeding status observed.

C = Confirmed Breeder	**P = Probable Breeder**	**O = Observed**	**-- = Absent**
n = current year's nest found **m** = carrying nest material **f** = carrying food or fecal sac **d** = distraction display **l** = local bird present	**c** = courtship/copulation **t** = other territorial behavior **s** = song/drumming	**b** = banded/captured **e** = encountered **o** = flyover	

ENTER DATE (mm/dd) FOR INTENDED PERIOD BELOW

SPECIES CODE	BRSTAT	/	/	05/28	06/05	06/14	06/24	07/06	07/13	07/25	08/04	2018 YEAR STATUS
HAWO	T			—	—	Ps	Ps	—	—	—	—	L
ACFL	U			Ps	Ps	Ps	Ps	Ob	—	—	Oe	B
YTVI	O			—	—	—	Ps	Ps	—	—	—	L
REVI	B			Ps	Ps	Ps	Cn	Cnf	Ps	Ob	—	B
TRES	T			—	—	Oo	—	—	—	—	Oo	T
CACH	U			Ps	Ps	Ps	Ps	Ps	Ps	Ps	Ps	B
WOTH	B			Ps	Ps	Ps	Ps	Ps	Ps	Oe	Oe	B
GCTH	M			Ob	—	—	—	—	—	—	—	M
AMRO	B			—	Ps	Ps	—	—	Oe	—	—	L
GRCA	B			Ps	Ps	Ps	Ps	Ps	Oe	Oe	—	B
NOPA	O			Oe	Ps	Ps	Ps	Oe	Ps	Ob	Obe	B
YWAR	T			—	—	—	—	—	—	Ob	Obe	T
AMRE	O			—	—	—	—	—	—	Ob	Oe	T
OBSERVER'S INITIALS				CC	CC/ PB	CC	CC/ AB	CC	CC	CC	CC/ AB	

BRSTAT: Cumulative breeding status for all previous years of operation
B = Regular Breeder (all years) **A=** Altitudinal Disperser
U = Usual Breeder (>1/2, not all, years) **M** = Migrant
O = Occasional Breeder (<1/2 years) **?** = Uncertain Species ID
T = Transient

2018 YEAR STATUS: Current year breeding status
B = Breeder **M** = Migrant
L = Likely Breeder **E** = Extralimital Breeder
T = Transient **?** = Uncertain Species ID
A = Altitudinal Disperser **--** = Absent
H = Higher Altitude (than usual) Breeder

FIGURE 10. Completed MAPS Breeding Status List

Instructions for completing the Breeding Status List

DATE (mm/dd) FOR INTENDED PERIOD: Record the date the station was operated during each intended period. If the station was operated outside the standard ten days of the period, be sure to enter the date above the period for which the effort was actually intended. Note on Figure 10 that the date 5/30, normally a Period 3 date, was placed above Period 4 because the effort on 5/30 was intended for Period 4. If the station was operated more than one day in a period, summarize the data for that period by recording the highest hierarchical Period Status Code (Table 3) for each species that period.

PERIOD STATUS: The Period Breeding Status (i.e., Confirmed - C; Probable - P, Observed - O) of each species encountered during each period of operation at each station must be recorded on the list for that station, either during the day as the birds are detected or at the end of the day before leaving the field. Record, using upper case letters, the highest hierarchical Period Breeding Status (Table 3 or Fig. 10) detected for each species that period; and, using lower case letters, the appropriate Daily Behavior Sub-Codes (Table 3 or Fig. 10)

Table 3. Hierarchical categories of Period Breeding Status (upper case) and associated Daily Behavior Sub-Codes (lower case) for MAPS Breeding Status List

The criteria used to designate Period Breeding Status are as follows:

Confirmed (C): The following criteria confirm a species as a breeder:

- (n) current year's nest found in the study area with eggs or young, in the process of being built, or already depredated or abandoned;
- (m) adult seen gathering or carrying nesting material to a likely nest site in the study area;
- (f) adult seen carrying food or fecal sac to or from a likely nest site in the study area;
- (d) distraction display or injury feigning by an adult bird;
- (l) capture of a young bird incapable of sustained flight (a "local"), or very young (stub-tailed) fledglings being fed by parents in the study area.

Probable (P): The following criteria suggest, but do not confirm a species as a breeder:

- (c) copulation or courtship observed of a species within its breeding range;
- (t) other territorial behavior observed in the study area;
- (s) territorial song or drumming heard.

Observed (O): The following criteria indicate the species was detected, but with no evidence of local breeding:

- (b) bird captured or banded. NOTE: The presence of a brood patch or cloacal protuberance on a single individual is not valid evidence of local breeding;
- (e) bird encountered (seen or heard) in the study area but with no territorial behavior;
- (o) bird encountered flying over the study area.

Absent (--): The species was not encountered during that period.

Associated with that Period Breeding Status. Note that sub-codes can only be combined with other sub-codes at the same breeding status level. For example, 'Cf' and 'Obe' are acceptable combinations; 'Cs' and 'Obs' are not. Use a '-' to indicate that a species was not observed in a given period. Finally, note that the certainty of Period Breeding Status codes likely will decrease for most species as the season progresses and breeding behavior diminishes. For example, a species recorded as a probable breeder in May and confirmed as a breeder in June may drop back to a probable breeder in July and show no signs of breeding (or disappear altogether) by August.

YEAR STATUS: The current year breeding status. At the end of the season, review your period status codes and enter the apparent breeding status for the current year for each species in the right-hand column, using one of the following nine categories:

Breeder (B): Summer resident. A Breeder is a species within its normal breeding range that is confirmed or determined to be a breeder or summer resident within the station (i.e., at least one individual was determined to reside at least partly within the station boundary during the breeding season of the year under consideration). It needn't be proven that the species actually bred, or even found a mate. Summer residents outside their normal breeding range should be given the code "E" (see below).

A species automatically qualifies for a Breeder ("B") Year Status if it was given a Confirmed ("C") Period Breeding Status in one or more periods. Thus, a current year's nest found in the study area with eggs or young, in the process of being built, or already abandoned or depredated qualifies the species for a "B" Year Code, as does the sighting of an adult carrying nesting material, food, or a fecal sac to or from a likely nesting site, or doing a distraction display or feigning injury within the station. The sighting of very young (stub-tailed) fledglings being fed by parents within the study area also qualifies the species for a "B" Year Code. Probably the most common means of classifying a species as a Breeder is by the presence of at least one territorial (singing or drumming) male in the study area throughout the breeding season. Note that such territorial behavior is coded "Ps" (probable breeder) for individual periods, but if it occurs over much of the season, the species should be considered a Breeder' ("B") rather than a Likely Breeder ("L"). Multi-period observations of courtship, copulation, or other territorial or mating behaviors also qualifies the species as a Breeder, especially if coupled with song or drumming in other periods. In summary, note that it is acceptable to assign a year status of "B" to a species that exhibits persistent territorial singing during the height of the breeding season, as well as to those confirmed by nest sightings, fledglings or other "hard evidence" of breeding activity.

Banding data are also useful for determining breeding (summer residency) status. Within-year recaptures or resightings of an adult, at least seven days apart and with at least one occurrence during the height of the breeding season, indicates a summer resident, as does the recapture of an adult during the height of the breeding season over two or more years. Note that the species is given a "B" code for the first and last year that it was captured during the height of the breeding season and for all intervening years. The capture of a single adult in breeding condition (i.e., with a greatly enlarged cloacal protuberance or a heavily vascularized brood patch) is not sufficient evidence to classify the species as a breeder because failed breeders often wander widely before losing their BPs and CPs. However,

several individuals showing breeding characteristics at various times during the season could warrant a "B" designation for the species for the year.

Likely Breeder (L): Probable summer resident. A species within its normal breeding range that was suspected to be a breeder or summer resident but was encountered somewhat infrequently during the breeding season of the year under consideration is classified as a Likely Breeder. This code permits a degree of uncertainty when determining single-year breeding status and need be used only for species that were suspected summer residents *but were encountered infrequently* during the field season. We suspect this may happen with species that reside on the fringes of the station or are difficult to detect. To avoid the uncertainty associated with the status "L," all efforts should be made to assign one of the more definitive status codes to each species whenever possible.

Please note that while continual territorial singing throughout the breeding season would merit a "B" status, singing on only two or three different days may indicate an "L," or even a "T." In such cases, one should consider the likelihood of summer residency in terms of habitat suitability for that species, the dates on which the singing occurs, and any behavioral knowledge of that species. As shown in Figure 10, two instances of a Hairy Woodpecker drumming in June at a station within its breeding range (and with no additional records) likely (but not definitively) indicates summer residency, and thus merits a year status of "L." However, two instances of Swainson's Thrushes singing in May within their breeding range, again with no additional records, would *not* suggest a single-year status of "L," as this species is known to sing during migration and to sing well into the season if a summer resident. The year status, in this latter case, should be "T." When the cumulative breeding status (BRSTAT) is calculated, years coded "L" are treated as if they were coded "B."

Transient (T): A species that breeds in the general area of the station (perhaps even less than a kilometer away) but, because of habitat or patchy distribution, does not breed at the station is classified as a Transient. In order to qualify as a Transient, the station must lie within the breeding range of the species, but no individuals of the species can be thought to be breeders or summer residents within the station (see above definition of "Breeder"). Transient individuals may be adults within their normal breeding range that move through the station during the breeding season but do not establish a territory or home range within the station boundaries. Early in the season, such adult individuals could be birds still in migration, birds that have completed migration but not yet established territories, or birds that might never establish territories that year (floaters). For example, capturing one or two individuals of a rarely observed species in June with well-developed CPs or BPs would not permit categorizing that species as anything other than a transient. Mid-season transients could be failed breeders from beyond the station boundary that are simply moving through the station. Later in the season, transient individuals could be adults or young in post-breeding dispersal, or even very early individuals in fall migration. A species may be a Transient at one station within a location and a Breeder at another station.

Altitudinal Disperser (A): A species which breeds only at lower elevations than that of the station and which disperses to higher elevations after breeding. In the Sierra and, to a lesser extent, the Cascades and other western montane areas, this is a common phenomenon for Orange-crowned Warblers, Nashville Warblers, and House Wrens. In order to qualify as an altitudinal disperser, the station must lie upslope from the breeding range of the species.

Higher Altitude (than normal) Breeder (H): An altitudinal disperser that has resided during the height of the breeding season (not just during the post-breeding period) in a given year above its normal breeding elevation. When the cumulative breeding status (BRSTAT) is calculated, years coded "H" are treated as if they were coded "A."

Migrant (M): The station does not lie within the breeding range of the species, and the species did not reside at the station during the breeding season. Migrant species may pass through the station on migration, or reside through the winter. Specifically, the species' breeding range, as delineated by range maps and descriptions, does not include the specific geographic location of the station. (The primary references we use are the range maps in *The Sibley Field Guide to Birds of Eastern North America* and *The Sibley Field Guide to Birds of Western North America*. We also use National Geographic's *Field Guide to the Birds of North America*, Peterson's *Field Guide to Western Birds* and *Field Guide to Eastern Birds*, Birds of North America Online (Rodewald 2015) and range descriptions in the A.O.U. *Checklist of North American Birds* [1957 for subspecies, 1983, and 1998]; and status codes in DeSante and Pyle's *Distributional Checklist of North American Birds*, 1986).

There is one important exception to the above definition of Migrant. If a station lies within a mountain range at a higher elevation than a given species breeding range, but adults and young of the species habitually move through it during post-breeding and juvenile dispersal, respectively (as in a foothill species that disperses upslope), the species should be classified as an Altitudinal Disperser (A; see above) at the station rather than a Migrant (M). The inclusion of capture data for such species from such stations can provide important information for regional productivity indices. A Migrant status for such a species would cause it to be overlooked during productivity analyses. Finally, do not confuse the terms "Migrant" and "migratory"; migratory species can be classified as Migrants, Altitudinal Dispersers, Transients, Likely Breeders, or Breeders.

Extralimital Breeder (E): A summer-resident species that is outside of its normal breeding range. As with species given a code of "B," it need not be proven that the species actually bred, or even found a mate; merely residing at the station during the breeding season is sufficient to warrant a code of "E." These vagrant individuals are not given a code of "B," as they are unlikely to return in subsequent years; in pooled analyses, a "B" code could bias survivorship estimates for the species. When the cumulative breeding status (BRSTAT) is calculated, years coded "E" are treated as if they were coded "M."

Unidentified (?): This code is used primarily for observed (non-captured) individuals that were not identified to species. Examples include UNGU, UNCR, UNSW. This code is also used if an unidentified individual was captured but not banded, for example UNHU or an unbanded UEFL. A species that has been banded would receive a breeding status of "?" if, during verification, the species identification of an individual became uncertain and no other individuals of that species were encountered in that year.

Absent (--): No individual of the species was detected at the station ― neither captured, heard nor seen ― for the duration of the MAPS field season in the year under consideration. This code applies both to species previously captured/encountered at the station in a past field season and to those anticipated but not yet encountered.

OBSERVER'S INITIALS: Record the initials of the people involved with collecting breeding status data for each intended period.

Please note that it is very important to classify each species correctly, to the best of your ability, within the boundaries of your station (i.e., within 100 m of nets). Inclusion of data for a species in mark-recapture analyses from stations where it does not regularly or usually breed will deflate estimates of proportion of residents and lower the precision of survival-rate estimates as well. However, transients can be included in the calculation of productivity indices. Bear in mind that the Breeding Status List is annual in nature (i.e., you will consider breeding status of each species on a year-by-year basis) and that a species' year status may change from one year to the next. Generally, such changes will be a species changing from Breeder to Likely Breeder or Transient or vice versa, but occasionally a species can change from an Extralimital Breeder or Migrant to a Breeder or Transient (or vice versa) as its breeding range changes.

It is important to remember to assign a breeding status *each year* to all species *ever captured or encountered* at the station, and not just to those that were captured during the most recent field season.

Occasionally, during the verification process, recapture data or other information come to light that require re-determination of Breeding Status Codes for various species at a station. IBP biologists may change some Year Codes and will want you to examine their changes. Each year during the verification process, therefore, you may receive from IBP a printout of the overall breeding status of all species ever captured and or encountered at your station (Fig. 11). IBP biologists want you to check over the list to see if you agree with all of the codes. The following three additional codes may occur on these printouts that are sent out for your review:

D = The species was only encountered at the station outside of the MAPS season, but the station lies *within* breeding range of the species.

W = The species was only encountered at the station outside of the MAPS season, and the station lies *outside* of the breeding range of species.

@ = The Breeding Status List is missing or incomplete for this species this year.

Printout of Breeding Status Year Codes for Operator Review

```
      FILE: 16698s17
      LOCATION: BIPA
      STATION: UPED

B = Breeder (Summer Resident)  L = Likely Breeder  T = Transient
A = Altitudinal Disperser      H = Higher Altitude (than normal) Breeder
M = Migrant       E = Extralimital Breeder         ? = Uncertain Species
                                                   ID
D = Species only encountered outside MAPS season, but station lies within
    breeding range of species
W = Species only encountered outside MAPS season, but station lies outside
    breeding range of species
@ = Breeding Status List missing or incomplete     - = Absent
```

Record#	spec	bs09	bs10	bs11	bs12	bs13	bs14	bs15	bs16	bs17
1	GBHE	-	--	-	-	-	-	T	T	-
2	TUVU	@	T	T	T	-	T	-	T	T
3	WODU	@	B	L	-	T	B	B	L	B
4	SSHA	-	-	W	-	-	M	-	-	M
5	RSHA	@	D	-	-	-	-	-	-	-
6	NOBO	B	B	B	B	B	B	B	L	B
7	MODO	B	B	B	B	T	B	B	B	B
8	YBCU	B	L	T	B	-	L	L	L	L
9	EASO	T	T	T	T	T	-	-	-	-
10	CHSW	@	T	T	T	-	T	T	L	T
11	RTHU	T	T	T	B	B	B	B	B	T
12	RBWO	B	B	B	B	B	B	B	B	B
13	HAWO	T	-	T	-	T	-	-	T	T
14	ACFL	T	T	L	B	L	T	B	T	L
15	YTVI	T	T	L	T	L	T	T	T	L
16	REVI	B	B	B	B	B	B	B	B	B
17	TRES	T	T	-	T	T	T	-	T	T
18	CACH	L	L	-	B	B	-	L	B	L
19	WOTH	L	L	B	B	B	B	B	B	B
20	SWTH	-	-	M	-	-	-	-	-	M
21	AMRO	B	B	L	B	L	L	B	B	B
22	GRCA	B	B	L	B	B	B	B	B	B
23	NOPA	-	L	-	B	T	T	L	T	L
24	YWAR	-	-	T	-	-	-	T	T	-
25	AMRE	-	-	-	T	T	L	T	T	T
26	NOWA	-	-	-	-	E	-	-	-	-
27	COYE	B	B	B	B	B	B	B	B	B
28	HOWA	B	B	T	T	B	T	-	T	-
29	YBCH	B	T	-	T	-	B	-	-	T
30	EATO	B	B	B	B	B	B	B	B	B
31	CHSP	@	T	T	T	-	B	B	B	B
32	UNSP	-	-	-	?	-	-	-	?	-
33	NOCA	B	B	B	L	L	B	B	B	B
34	INBU	T	T	B	T	L	T	L	B	L
35	BHCO	-	L	T	L	-	L	B	L	L
36	AMGO	B	B	B	B	B	B	B	B	L

FIGURE 11. Species breeding status history for a MAPS station.

DATA SUBMISSION

Making sure the required data from each station become a part of the compiled MAPS database is the final ― and crucial ― step in operating a MAPS station. To maximize the use that can be made of the data, all elements listed below must be included. It is also important to ensure that data submission occurs within a reasonable amount of time; delays hold up analyses, prevent us from providing you with timely feedback, and require us to spend time rounding up outstanding data.

What data to submit

Each year, for each location, MAPS operators must submit the following data:

- Banding data for newly banded birds
- Banding data for recaptured birds
- Banding data for unbanded birds
- Summary of mist-netting effort data for each station
- Summary of mist-netting results data for each station (if not using MAPSPROG)
- Breeding status data for each station

Habitat Structure Assessment (HSA) data (including the station map) must also be submitted for each station during its first year of operation and every five years following (i.e., sixth year, eleventh year, etc.). However, if substantial habitat change has occurred within five years as a result rapid succession or catastrophic events (anthropogenic or natural), a revised HSA, along with the creation of a revised station map, should be completed. A revised station map should also be submitted anytime that nets are moved. Be sure to show the locations of the old, as well as the new, nets. Refer to the HSA Protocol (Nott *et al*. 2003; which can be downloaded from the IBP website) for directions on how to create the station map.

In addition, submit a completed Standard Net Opening and Closing Times sheet for each station at the end of the first season of operation and after any season in which any of the standard operating times are changed, that is, whenever you have changed any of the times at which you plan to operate your station in the future.

How to submit MAPS data

Currently, data may be submitted to the MAPS program in three ways: electronically using MAPSPROG, electronically not using MAPSPROG, or non-electronically by submitting hard (paper) copies of all data.

Submitting data through MAPSPROG: Coinciding with the Bird Banding Offices' effort to institute electronic data submission for banding schedules, IBP has developed a Windows-based data entry/import, verification/editing, and error-tracking program called MAPSPROG for submitting MAPS data to IBP. We strongly encourage all operators to submit their 2018

data using MAPSPROG, which was introduced on p. 17. MAPSPROG includes modules to enter and verify your banding, effort, breeding status, and habitat structure assessment data collected during the 2018 MAPS season. MAPSPROG is designed to mimic the data verification procedures that have been developed by IBP over more than 25 years and have been applied to every set of MAPS data contributed to the MAPS program. The checks embedded in the program will allow you to see and correct any errors or inconsistencies that occur in your own data and will help you to improve your data collection. Moreover, submission of data through MAPSPROG will, in the long run, reduce the amount of time IBP biologists must spend in verifying data from the over 300 MAPS stations operated each year, thus allowing them more time and resources to focus on analyses aimed at understanding the causes of population declines in landbirds and at formulating management and conservation strategies for them.

The most current version of **MAPSPROG, Version 4.4.x**, is available for download from the MAPSPROG web page http://www.birdpop.org/pages/mapsMAPSPROG.php. **Do NOT use any MAPSPROG version prior to 4.2.1 with your 2018 data. Please check the IBP website to ensure you have the latest version. To ensure that you have the latest version of the program, open the program and click on the "Utilities" drop down menu header. You will see "Version 4.4.x" below the "Utilities" header if you have updated the program to 4.4.x.**

For stations that have run for more than one year, proper use of MAPSPROG requires that recapture records from the current year be checked against banding data from previous years in order to correct discrepancies among recaptures and to screen recaptures for possible misread band numbers. Follow the instructions in "**MAPSPROG Version 4.1: User's Guide and Manual**" (Froehlich *et al*. 2006), which is also available for download from the MAPSPROG web page, to append the data from previous years to your NEWMAPS file at the appropriate stage in the process (between-record verification). All operators who ran station(s) in 2017 should append their <LOCA>17 file to NEWMAPS. Those who used MAPSPROG in 2017 should use their MAPSPROG-created <LOCA>17 file unless they have been sent an updated file from IBP. Operators whose station(s) ran in 2017 and who did not use MAPSPROG should contact IBP for a file containing their previous years' data.

To ensure that first-time MAPSPROG users are using the program appropriately, IBP will compare their MAPSPROG output files against output verified by IBP biologist using IBP's traditional verification procedures. Once this comparison is completed, IBP will provide feedback on the results by certifying those operators whose results closely match ours and by providing recommendations to those whose results suggest that they encountered considerable difficulties with the program. To undertake these comparisons, we require paper copies of all data sheets and a copy of RAWMAPS, the initial raw data file produced by MAPSPROG, regardless of whether the data were entered or imported into it. To make sure we receive RAWMAPS, follow the instructions in the "Submitting Verified Data Files to IBP" section in the MAPSPROG Version 4.1 User's Guide when submitting data files. **It is extremely important to proof your RAWMAPS file against your raw data before using MAPSPROG to verify it. MAPSPROG will facilitate this proofing by allowing you to print out your RAWMAPS file.** Thus, all first time MAPSPROG users, and those who have not yet been certified, must submit paper copies (we prefer originals, but clear photocopies, including notes, are acceptable) of all their MAPS data for the year being submitted (including their Summary of Results form). Once a MAPSPROG user is certified, we anticipate that the user will continue to submit her/his MAPS data using MAPSPROG and that her/his MAPSPROG output files will be reliable. Certified MAPSPROG users need not submit paper copies of any MAPS data (except any revised Standard Net Opening and Closing Forms or revised stations maps). Please contact Ron Taylor at rtaylor@birdpop.org or 415-663-1436 or Danielle Kaschube at dkaschube@birdpop.org or 609-892-0445 if you have questions regarding the use of MAPSPROG.

Once the Bird Banding Offices require banding schedules be submitted electronically, IBP will require MAPS data to be submitted using MAPSPROG. The Bird Banding Offices is now requiring the use of BANDIT by all banders. As of the release of this manual (April 2018), BANDIT easily imports the file created by MAPSPROG. MAPSPROG will no longer support creating a banding file for import into BAND MANAGER. Documentation is available on our website on how to import your MAPSPROG file into BANDIT. If you get frustrated, please contact us for assistance. We don't want you to have to enter your data twice (once into MAPSRPOG and once for BBL submission) and think it is useful for you to submit MAPSPROG-verified data to the Bird Banding Offices.

MAPSPROG version 4.2.x and later will create an output file, export<yr>.dbf (e.g. export15.dbf) for import into Bandit 3.1. MAPSPROG version 4.4.x can create both an export file for Bandit 3.1, export<yr> or for Bandit 4.0, expt4<yr>.dbf (e.g. expt415.dbf). The export file will contain all added, changed, lost, destroyed, and new records for the current year only. Additionally, in those very few cases where the species alpha codes in Pyle and DeSante (2003, 2005, 2006) differ from those used by the BBL (e.g., "TUTI" instead of "ETTI"), the alpha codes will be converted to BBL codes in the export.dbf file. **Please use the export<yr>.dbf or expt4<yr>.dbf file instead of the <loca><yr> file when importing data into BANDIT, to avoid importing a file with alpha codes not recognized by the BBL**. We strongly encourage all MAPS operators to use MAPSPROG for their data.

Submitting banding data in electronic format other than through MAPSPROG: IBP can also accept electronic banding data as an e-mail attachment or on a CD in any of three formats: dBase, Excel, or ASCII. Data for all stations and for all band sizes and capture

codes should be merged into a single file. Please use the template we provide online for entering banding, effort and breeding status data into Excel. It can be downloaded at http://www.birdpop.org/docs/misc/MAPS-Materials-Template.xls. Using this template will allow us to more easily import your data into our databases.

If you are entering your data using Access, please export each table within the database as a separate Excel spreadsheet. If you are entering your data using some other program, such as Paradox, Quattro Pro, or a word-processing program, please convert the file to dBase or ASCII. It is often safer to convert to ASCII rather than directly to dBase, especially from Paradox or Quattro Pro. Refer to your program's documentation for instructions on making this conversion.
Table 4 shows the file structure that must be used when submitting electronic banding data not entered using MAPSPROG. Following are explanations of the fields listed in Table 4; for further details on the codes used, consult the "Collection and Recording of Banding Data" section of this manual. All character fields should be entered left-justified and numeric fields right-justified.

LOC	-	Location. Enter your four-character location code.
BI	-	Bander's Initials. Enter the two-character bander's initials.
BS	-	Band size. The purpose of this and the following field is to enable us to find original data easily. Records on 'Unbanded' and 'Recapture' sheets should be entered with band sizes 'U' and 'R', respectively. Unbanded birds on new-band sheets should be given the band size for the sheet
PG	-	Page number.
C	-	Capture code.
BAND	-	Band number (always nine digits long).
SPEC	-	Four-letter species alpha code.
SPEC6	-	Six-letter species alpha code (this field is not used for MAPS data).
AGE	-	Age.
HA	-	How aged.
WRP	-	Wolfe-Ryder-Pyle plumage and molt code (this field is not used for MAPS data).
SEX	-	Sex.
HS	-	How sexed.
SK	-	Skull.
CP	-	Cloacal protuberance.
BP	-	Brood patch.
F	-	Fat.
BM	-	Body molt.
FM	-	Flight-feather molt.
FW	-	Flight-feather wear.
JP	-	Juvenile plumage.
WNG	-	Wing chord.
WEIGHT	-	Body mass.
STATUS	-	Status.
DATE	-	In dBase, enter as MM/DD/YYYY. In a text file, enter as YYYYMMDD.
TIME	-	Omit the final '0'.

STATION - Station code.
NET - Original net designation. Enter your net number (preferably two digits) or "?" if net number is unknown, left justified
DISP - Disposition.
NOTE - Enter the note number if the record has a note. Otherwise, leave blank.
PPC - Primary coverts.
SSC - Secondary coverts.
PPF - Primaries.
SSF - Secondaries.
TT - Tertials.
RR - Rectrices.
HD - forehead; crown; nape; supercilium; eye ring; eyeline; auricular, subauricular, submoustachial, and malar stripes; and lores (this field was only used for MAPS data from 1998 through 2003).
UPP - back, scapulars, rump, and uppertail coverts (this field was only used for MAPS data from 1998 through 2003).
UNP - chin, throat, breast, belly, sides, flanks, and undertail coverts (this field was only used for MAPS data from 1998 through 2003).
BPL - Includes all feather tracts of the head, upperparts and underparts (this field is to be used for MAPS data in and subsequent to 2004).
NF - all non-feather parts including bill, mouth, eye, legs, and feet. A note is required if this column is used.
FTHR. PULL - Enter 'O' if the outer two rectrices were pulled or 'I' if an inner and outer rectrix were pulled. If no feathers were pulled, leave this field blank.
SWAB - Enter the size of the cloacal swab with which the sample was collected. If no sample was collected, leave this field blank.
COLOR - Color band sequence (this field is not used for MAPS data).

It is imperative that character fields be entered as character fields. dBase will put '0' into a blank numeric field by default, and there is a big difference between blank and zero! Before submitting electronic banding data, it is extremely important that you proof your electronic file against the banding-data sheets for data-entry errors. When submitting electronic data **not** using MAPSPROG, **please remember to send paper copies of all data sheets not included in your electronic file, e.g., paper copies of your Summary of Effort, Summary of Results, and Breeding Status List for each station.** PDF scans of the non-entered data sheets can be emailed if you prefer not to send hard copies.

Submitting paper copies of banding data: Operators who are unable to use MAPSPROG and are unable to submit electronic data must submit paper copies (hard copy originals, or photocopies or PDF scans, including notes, are acceptable) of all of the forms mentioned above, **including completed Banding Data Sheets for newly banded birds, unbanded birds, and recaptured birds; completed Summary of Mist-Netting Effort forms for each station, completed Summary of Mist-Netting Results forms for each station, and completed Breeding Status Lists for each station each year**. In addition, such operators must submit paper copies of their completed HSA forms and the associated station map for each station (once every five years or more often if substantial habitat change has occurred), and their Standard Net Opening and Closing Times form (after the first season and whenever

they change their standard operation). Please do not staple data sheets together or put them in binders when submitting data.

Due date

MAPS operators are requested to return their completed data sheets and map(s) to The Institute for Bird Populations as soon as possible after the completion of the season. In general, the due date is September 15. The due date for operators using MAPSPROG is October 15. Data will be accepted after these dates, but late data, especially from long-standing stations, compromise our ability to conduct analyses and prepare reports on schedule. However, we would rather receive complete, proofed, carefully-compiled data packets a little late than incomplete or sloppy packets submitted on schedule.

Where to send data

MAPSPROG files or other electronic files can be e-mailed to our data manager Ron Taylor at rtaylor@birdpop.org or the MAPS Coordinator, Danielle Kaschube, at dkaschube@birdpop.org.

Hard copy data packets should be addressed to: MAPS Data Manager, The Institute for Bird Populations. Our mailing address is P.O. Box 1346, Point Reyes Station, CA 94956-1346 USA. Our shipping address is 11435 State Route 1, Suite 23, Point Reyes Station, CA 94956 USA.

We will acknowledge receipt of your data; if you do not hear from us within a month of sending your data, chances are we did not receive them!

Table 4. MAPS Banding-data file structure for 2018 data

Field	Field Name	Type	Width	Dec	Description
1	LOC	Character	4		Location code
2	BI	Character	2		Bander's initials
3	BS	Character	2		Band size
4	PG	Character	3		Data page number
5	C	Character	1		Capture code
6	BAND	Character	9		Band number
7	SPEC	Character	4		Four-letter species alpha code
8	SPEC6	Character	6		*Six-letter species alpha code
9	AGE	Character	1		Age
10	HA	Character	2		How aged
11	WRP	Character	3		*Wolfe-Ryder-Pyle plumage code
12	SEX	Character	1		Sex
13	HS	Character	2		How sexed
14	SK	Character	1		Skull pneumatization
15	CP	Character	1		Cloacal protuberance score
16	BP	Character	1		Brood patch score
17	F	Character	1		Fat content score
18	BM	Character	1		Body molt score
19	FM	Character	1		Flight feather molt score
20	FW	Character	1		Flight feather wear score
21	JP	Character	1		Juvenile plumage score
22	WNG	Numeric	3	0	Wing chord
23	WEIGHT	Numeric	5	1	Body mass
24	STATUS	Character	3		Status upon release
25	DATE	Date	8		Capture date
26	TIME	Character	3		Time of capture
27	STATION	Character	4		Station code
28	NET	Character	4		Net
29	DISP	Character	1		Disposition on release
30	NOTE	Character	2		Notes on data sheet
31	PPC	Character	1		Feather generations in primary coverts
32	SSC	Character	1		Feather generations in secondary coverts
33	PPF	Character	1		Feather generations in primaries
34	SSF	Character	1		Feather generations in secondaries
35	TT	Character	1		Feather generations in tertials
36	RR	Character	1		Feather generations in rectrices
37	HD	Character	1		**Age class of head feathers
38	UPP	Character	1		**Age class of upperpart feathers
39	UNP	Character	1		**Age class of underpart feathers
40	BPL	Character	1		***Feather generations in body plumage
41	NF	Character	1		Generation indicated by non-feather parts
42	FP	Character	1		Feather pull status
43	SW	Character	1		Cloacal swab status
44	COLOR	Character	5		*Color band sequence

* - These fields (SPEC6, WRP, and COLOR) are not usually used for MAPS data.

** - These fields (HD, UPP, UNP) were only used for MAPS data from 1998 through 2003.

*** - This field (BPL) is to be used for MAPS data in and subsequent to 2004.

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