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MOSI (MONITOREO DE SOBREVIVENCIA INVERNAL) MANUAL

INSTRUCTIONS FOR ESTABLISHING AND OPERATING BIRD-BANDING STATIONS AS PART OF THE MOSI PROGRAM

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CONTENTS

1. INTRODUCTION

1.1 AN INVITATION

Welcome to the MoSI (Monitoreo de Sobrevivencia Invernal = Monitoring Overwintering Survival) Program! MoSI is a cooperative effort among public agencies, private organizations, and independent bird banders in Mexico, Central America, and the Caribbean to better understand spatial- and habitat-related variation in the overwintering physical condition and survivorship of migratory landbirds. To achieve this goal, MoSI relies on data collected between November and March at a network of standardized mist-netting and banding stations across the wintering ranges of these species. We encourage all individuals currently conducting or planning work on migratory landbirds in the northern Neotropics to become partners in the MoSI Program. By becoming a MoSI cooperator, you can help identify proximate causes of population change in these species, which can help guide efforts for their management and conservation.

Contributing to the MoSI Program is relatively easy, and we have taken a number of steps to facilitate the establishment and operation of new stations. First, we designed the program to allow a variety of variations on the basic field protocol. None of the protocol variations require more than 15 days of mist-netting per MoSI season (Nov.-Mar.). Second, we provide training and an opportunity for interaction between existing and prospective MoSI cooperators during annual workshops. Additionally, experienced bird banders are often available for short periods of time to assist with the operation of MoSI stations; contact information for these volunteers can be obtained from regional coordinators or at www.birdpop.org/MoSI/MoSIBB.asp. Finally, IBP expects to provide some level of financial assistance each year to a limited number of MoSI stations (depending on funding) to help defray costs of station operation. Each of these steps should make participation in the MoSI Program practicable and attractive to a broad range of individuals and organizations.

While we emphasize that it is relatively easy to become a MoSI cooperator, station operation does require considerable attention to detail and a commitment to the safe collection of quality data. This manual will guide prospective cooperators through each step involved in the establishment and operation of a MoSI station. Should you become a MoSI station operator, we recommend that you consult this manual frequently to ensure that your data are collected and reported in a way that will allow for the attainment of program goals.

If you are interested in establishing one or more MoSI stations in your region or would like additional information, please contact José Luis Alcántara (MoSI Mexico Coordinator; jlalcant@colpos.mx), Lety Andino (Central America MoSI Coordinator; letyandino@salvanatura.org), or James F. Saracco (MoSI Caribbean Coordinator; jsaracco@birdpop.org). You can contact The Institute for Bird Populations by phone at (415) 663-1436. Thank you for your interest in MoSI – we look forward to working with you in our efforts to better understand and conserve migratory landbird populations!

1.2 BACKGROUND AND RATIONALE

Analyses of data from the North American Breeding Bird Survey (BBS) indicate that populations of many species of Neotropical-wintering migratory birds (hereafter, NTMBs) have declined over the past three decades (Robbins et al. 1989, Terborgh 1989, Peterjohn and Sauer 1993, Pardiek and Sauer 2000). In response to these declines, major conservation efforts such as the Neotropical Migratory Bird Conservation Initiative, Partners in Flight (PIF); the North American Bird Conservation Initiative (NABCI); and the Neotropical Migratory Bird Conservation Act (NMBCA) were established and funded. Nevertheless, these conservation efforts have been hindered by a lack of information concerning the proximate (demographic) and ultimate (environmental) causes of declines (DeSante 1992, 1995, Peterjohn et al. 1995, DeSante et al. 2001). For example, although the BBS and similar monitoring programs can provide information on geographic- and habitat-related variation in bird abundance (and population trends), bird abundance may be a poor indicator of the importance of particular regions or habitats for maintaining bird populations because of source-sink dynamics (Van Horne 1983, Pulliam 1988, Donovan et al. 1995).

In contrast to abundance, vital rates (productivity, recruitment, survivorship, emigration, immigration) respond directly, and usually without substantial time lags, to environmental stressors or management actions (Temple and Wiens 1989, DeSante and George 1994). Thus, the estimation of avian vital rates provides critical information to population managers and should be an integral component of all avian monitoring and management efforts (DeSante and Rosenberg 1998). In the case of NTMBs, estimates of avian vital rates can be used to help determine whether population declines are related to low productivity on the breeding grounds, high mortality during migration or winter, or both (Sherry and Holmes 1995, 1996, DeSante et al. 2001). More generally, these estimates can be incorporated into predictive population models to assess potential effects of various land use practices on population viability (Noon and Sauer 1992) or predict effects of global climate change on bird populations (Nott et al. 2002).

The Institute for Bird Populations (IBP) initiated the first large-scale efforts to measure and monitor vital rates of NTMBs in 1989 with the creation of the Monitoring Avian Productivity and Survivorship (MAPS) Program (DeSante et al. 1995). Each summer, public agencies, private organizations, and individuals across the U.S. and Canada operate hundreds of standardized constant-effort mist-netting and bird-banding stations as part of this program. These efforts are paying off and are yielding important insights into the proximate causes of NTMB population change across North America (DeSante et al. 1999, DeSante et al. 2001). Results from the MAPS Program (DeSante et al. 2001, Nott et al. 2002) and from intensive local-scale studies (Marra et al. 1998, Sillett et al. 2000) suggest that the conditions experienced by NTMBs during the non-breeding season affect population dynamics and could limit populations.

NTMBs spend the bulk of the non-breeding season on tropical wintering grounds. Nevertheless, data on the overwintering ecology of most NTMBs is severely limited. A variety of local-scale studies have shown that many NTMBs use a wide array of habitats in the tropics; even species thought to prefer relatively mature or undisturbed primary forest can be found in substantial numbers in secondary forest, forest edge, and other disturbed habitats (e.g., Greenberg 1992). Patterns of winter abundance in different habitats, however, can be a misleading indicator of

habitat quality (Marra and Holberton 1998). In order to determine the true value of different winter habitats, estimates of sex- age- and habitat-specific overwintering survival rates and indices of late winter physical condition are needed. These parameters have only been studied for a few species on local scales (e.g., Marra et al. 1998, Sillett et al. 2000, Sillett and Holmes 2002). In order to draw inference for a larger suite of species, and to determine how these parameters vary as a function of space and habitat, a standardized spatially extensive monitoring effort is required. These data are critically needed to evaluate the quality of various winter habitats for NTMBs and to guide NTMB management and conservation efforts (Ralph and Rich in press, Latta et al. 2003).

1.3 Design and Objectives of the MoSI Program

In an effort to begin providing data on the quality of various habitats for NTMBs during the winter period, the first 29 MoSI stations were established and operated during 2002-03 as part of a five-year pilot project (DeSante et al. 2005). Funding from the Neotropical Migratory Bird Conservation Act (NMBCA) enabled expansion of the program in the second year of the pilot project (2003-04) to 63 stations. The MoSI program is patterned after, and is designed to complement, the highly successful MAPS program. Both programs (1) call for the establishment of a spatially extensive network of standardized banding stations, (2) address clear monitoring goals based on firmly established needs, and (3) use state-of-the-art analytical models for making inferences at multiple spatial and temporal scales. Also like MAPS, the MoSI Program addresses and links monitoring, research, and management objectives. **The monitoring goal** of MoSI is to provide estimates of monthly, overwintering, and annual survival and indices of late winter physical condition for a suite of about 20 land bird species for a variety of habitats and geographic regions (Table 1). **Research goals** of MoSI include (1) the statistical modeling of survival and physical condition as functions of age, sex, habitat, space, and climate, (2) the linking of winter population parameters with breeding season vital rates and population trends, and (3) the development of predictive population models. **Management goals** of MoSI are (1) to use research results to develop strategies for reversing population declines and maintaining healthy populations and (2) to evaluate management actions through an adaptive management framework. The establishment of the MoSI network will also facilitate the collection of feathers for genetic and stable isotope analyses that link breeding and wintering populations. The MoSI Program currently has a cooperative agreement with the UCLA Neotropical Migrant Conservation Genetics Project (headed by Dr. Thomas E. Smith) for the analysis and archiving of feather samples collected at MoSI stations.

1.4 Administration of the MoSI Program

The MoSI program is administered through three regional coordination centers. The program is administered in Mexico by José Luís Alcántara of the Colegio de Postgraduados and in Central America by Mariamar Guitierrez of SalvaNatura (El Salvador). Currently, coordination of the Caribbean region is carried out by James F. Saracco of IBP. Frequent feedback to cooperators will be provided by regional coordinators. IBP will assist with data processing and analyses and write annual reports.

1.5 MoSI Regions

We have delineated six geographic regions as organizing units for the 5-yr pilot MoSI Program: (1) Pacific Lowland Mexico, (2) Highland and Interior Mexico, (3) Atlantic Lowland Mexico (including the Atlantic lowlands of northern Central America), (4) Lowland Central America (including the Pacific slope of Chiapas), (5) Highland Central America (including the highlands of Chiapas), and (6) the Caribbean (Fig. 1). These regions are based on, and their boundaries are defined by, the ecoregion definitions of Olson et al. (2001).

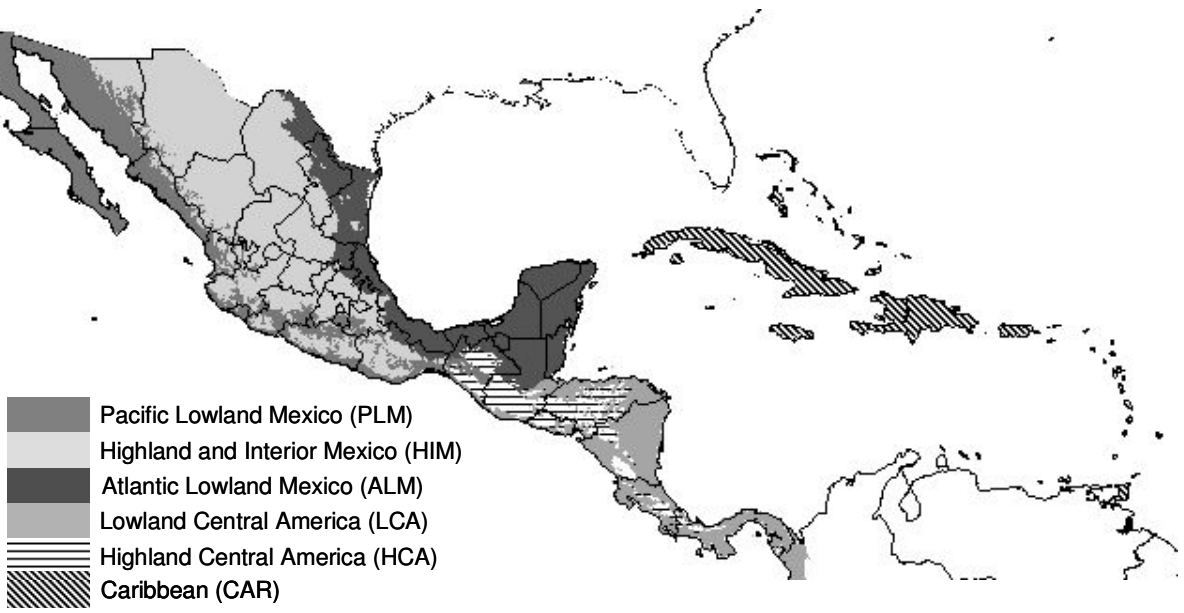

FIGURE 1. The six MoSI regions.

The Pacific Lowland Mexico (PLM) region includes the Sonoran and Baja California Deserts, dry broadleaf forests that extend from eastern Sonora south to Chiapas, and scattered xeric scrub, pine-oak, wetland, and mangrove habitats. The PLM region is bounded in the east by three major mountain ranges: the Sierra Madre Occidental, the Transverse Volcanic Belt, and the Sierra Madre del Sur. Major inland intrusions of the PLM region include the Balsas River Valley and the interior valleys of Oaxaca and Chiapas.

The Highland and Interior Mexico (HIM) region is comprised primarily of inland desert, mattoral, high elevation grassland, oak, pine-oak, pine, and pine-fir forest habitats. It extends from the Chihuahuan Desert in the north to the southern extensions of the Sierra Madre del Sur and the Sierra de Oaxaca in the south. This region is bounded on the west by the dry forests of the Pacific slope and extends eastward through the mountains of the Sierra Madre Oriental.

The Atlantic Lowland Mexico (ALM) region includes the Atlantic lowlands of northern Central America and is dominated by the moist broadleaf forests of southeastern Mexico and the Petén of Guatemala and Belize. Other important habitats include various dry broadleaf forests (in Yucatan), mangroves, brushlands and thorn scrub (in Northeast Mexico), and pine forests (in Belize). The MAL region extends from the eastern slopes of the Sierra Madre Oriental and

Sierra de Oaxaca and northeastern slopes of the mountains of Chiapas and northern Central America east and north to the Gulf and Caribbean coasts.

The Lowland Central America (LCA) region includes the Pacific slope lowlands of Chiapas and consists of the low lying areas of both the Atlantic and Pacific slopes of Central America. On the Atlantic side, the region extends as far north as the southern border of Belize; on the Pacific, it extends north into coastal Chiapas. The southern extension of the region lies at the Darién of Panama. Dry broadleaf forests predominate in the Pacific lowlands of Chiapas, Guatemala, El Salvador, Nicaragua, and northwest Costa Rica. The Caribbean and Southern portions of the LCA region are dominated by moist broadleaf forests (although pine stands are also found in the Caribbean lowlands of Honduras and northern Nicaragua). Mangroves are fairly common along both coasts.

The Highland Central America (HCA) region includes the highlands of Chiapas and is comprised of three relatively distinct subregions. The northern subregion, which extends from the Sierra de Chiapas through northern Nicaragua, is comprised primarily of montane pine-oak and other mixed conifer-broadleaf forests. The middle subregion consists of the moist broadleaf and cloud forests of the Talamanca Mountains, extending from Costa Rica through western Panama. The last subregion consists of cloud forests and other montane habitats of the Darien region of southeastern Panama.

The Caribbean (CAR) region includes the Bahamas, Turks and Caicos, and all islands of the Greater and Lesser Antilles. This geographically extensive area contains a variety of montane and lowland habitats including both moist and dry broadleaf forests, Caribbean pine forests, thorn scrub, and mangroves.

1.6 MoSI Target Species

We have identified sets of 7-19 target NTMB species for each MoSI region to comprise a total of 25 target species for the pilot MoSI Program (Table 1; note: four species were added following the 2003-04 season). Target species were selected according to three criteria: (1) MAPS data show that they can be captured with ground-level mist nets in sufficient numbers to provide adequately precise estimates of survival rates; (2) they are classified as priority species in one or more Bird Conservation Regions (and typically have declining 23-yr BBS population trends), **or** they are non-declining species for which survival rates can be compared to those for the declining species; and (3) they provide for an adequate representation of declining and non-declining species over each of the six regions defined above.

TABLE 1. Twenty-five target species and 23-yr population trends for the five-year MoSI pilot project (✓ ♭ regular and relatively common, × ♭ irregular or uncommon). See www.birdpop.org/alpha_codes for English names, scientific names, and 4- and 6-letter species codes.

Species [1]	1980-2002 BBS population trend [2]		Region [3]					
			PLM	HIM	ALM	LCA	HCA	CAR
Empidonax traillii	Neg.**		✓			✓		
E. minimus	Neg.**		✓	×	✓	✓	×	
E. oberholseri	Neg.**		✓	✓				
Vireo griseus		Pos.*			✓	✓		
V. gilvus		Pos.**	✓	✓	×	✓	✓	
Catharus ustulatus	Neg.**		✓	✓	✓	✓	✓	
Hylocichla mustelina	Neg.**				✓	✓		
Dumetella carolinensis		Pos.			✓	✓		×
Vermivora celata	Neg.**		✓	✓	×			
Dendroica magnolia		Pos.	✓		✓	✓		
D. tigrina	Neg.							✓
D. caerulescens		Pos.**						✓
D. discolor	Neg.**							✓
Setophaga ruticilla	Neg.		✓		✓	✓		✓
Protonotaria citrea	Neg.**				✓	✓		×
Helmitheros vermivorus		Pos.			✓	✓		✓
Seiurus aurocapilla		Pos.	✓		✓	✓		✓
Seiurus noveboracensis	Neg.		✓	×	✓	✓	×	✓
Oporornis formosus	Neg.**				✓	✓		
O. Philadelphia	Neg.**					✓	✓	
O. tolmiei	Neg.			✓			✓	
Wilsonia citrina		Pos.			✓	✓		
W. pusilla	Neg.**		✓	✓	×	✓	✓	
Passerina cyanea	Neg.**		✓		✓	✓		✓
P. ciris		Pos.	✓		✓	✓		×

[1] Additional potential target species of a fully realized MoSI Program: *E. flaviventris*, *E. difficilis/occidentalis*, *V. bellii*, *Troglodytes aedon*, *Regulus calendula*, *Polioptila caerulea*, *V. peregrina*, *V. ruficapilla*, *D. petechia*, *D. pensylvanica*, *D. coronata*, *D. palmarum*, *Mniotilta varia*, *Geothlypis trichis*, *Icteria virens*, and *Spizella breweri*.

[2] Trends and significance from Sauer et al. (2003); ** $P \leq 0.05$, ** $P \leq 0.01$

[3] PLM = Pacific Lowland Mexico; HIM = Highland and Interior Mexico; ALM = Atlantic Lowland Mexico; LCA = Lowland Central America; HCA = Highland Central America; CAR = Caribbean

2. ESTABLISHING A MoSI STATION

2.1 WHAT IS A MOSI STATION?

A MoSI "**station"** is a discrete study site with a core netting area of approximately 12 ha and a buffer extending 50 m beyond the core area. An idealized MoSI station is a 20 ha square (~ 450 m on a side) with a core area measuring ~350 m on a side and containing 16 mist nets (Fig. 2). MoSI stations can, however, be a variety shapes (e.g., linear stations along riparian corridors), as long as the core netting area (12 ha) and net density (~1.33 nets/ha) remain similar to that of the idealized station. In some cases, two stations can be located nearby to one another (< 1 km) to create one 40 ha "superstition".

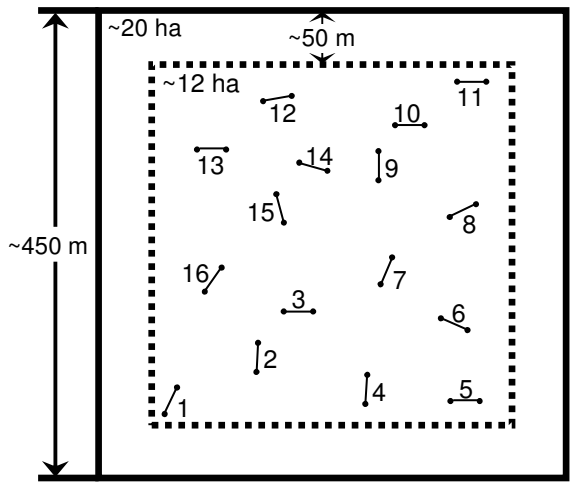

FIGURE 2. Idealized MoSI station.

Each MoSI station is identified by a unique name and 4-character code (e.g., Cafetál de Sombra = CAFE or CASO). Numbers are typically used to distinguish contiguous or nearby stations that together make up a "superstation" [e.g., Cafetál 1 (CAF1) and Cafetál 2 (CAF2)]. Each MoSI station is also identified by a **"location"** name and code that reflects the larger landscape or landholding (e.g., national park or nature reserve) within which the station is located (e.g., Reserva Natural de Mombacho = MOMB). A particular location may contain multiple stations operated by the same individual or organization.

2.2 SITING THE MOSI STATION

The ability of large scale monitoring efforts, such as the MoSI Program, to provide unbiased measures of population parameters depends, to some extent, on how study sites are selected. Ideally, all stations should be sited according to some randomization scheme. For example, a researcher interested in cloud forest habitat might randomly select coordinates from a map and site their station as near as possible to that random point. In reality, such a sampling strategy will be constrained by a number of issues including land ownership, accessibility, and likelihood of future disturbance. Target species could also be rare at randomly selected sites, limiting their utility as monitoring sites. We ask that cooperators attempt to meet as many as the following site selection criteria as possible:

(1) Select sites according to some probabilistic sampling scheme.

(2) Choose sites likely to catch substantial numbers of individuals of target species.

(3) Select sites with habitat types representative of those present in the surrounding landscape.

(4) Avoid sites that concentrate large numbers of transient or migrating birds (e.g., narrow points of land jutting into large bodies of water or isolated oases in desert or grassland habitats).

(5) Choose sites containing at least some edge habitat (e.g., forest gaps, trails, roadsides, or early successional areas). Sites dominated by forest interior should have areas with a well-developed understory that is utilized by target species.

(6) Choose sites likely to remain accessible and free of major anthropogenic disturbance for at least five years (major anthropogenic disturbance may, however, occur in the larger landscape).

(7) Do not site MoSI stations in areas with artificial food or water sources (e.g., feeders, compost piles, dumps, birdbaths, fountains, livestock pens).

(8) Avoid siting stations < 1 km from one another (to minimize the likelihood of having multiple capture histories of the same individual birds at multiple stations).

2.3 SETTING UP THE MOSI STATION: MIST NETS

Once a suitable site has been found for the MoSI station, operators must determine the size, number, and placement of mist nets.

2.3.1. NET SIZE.—We recommend that all mist nets used in the MoSI Program be 12-m, four-tiered, black, tethered, nylon nets. Shorter nets can be used (e.g., 6- or 9-m nets); however, care should be taken to record these as partial nets when calculating effort (see section 5.1). The mesh size of nets should be 30 mm unless the major target species is *Catharus* thrush-sized or larger, in which case the mesh size should be 36 mm.

2.3.2. NET NUMBER.—Operators should run the maximum number of nets that can be safely and efficiently operated on a regular basis. Ideally, this will be 16 nets (or a net density in the core area of approx. 1.33 nets/ha; Fig. 1); however, stations with high capture rates or few personnel may run fewer. Operators should always place the welfare of the birds as their primary concern when deciding how many nets to run.

2.3.3. NET PLACEMENT.—A good strategy for placing the nets is to scatter them singly and relatively uniformly over the core netting area (i.e., > 50 m from the station boundary; Fig. 1). Within this general strategy, however, nets should be placed opportunistically in areas likely to catch substantial numbers of birds (e.g., in brushy portions of wooded areas, forest breaks or edges, or in the vicinity of water). An alternate acceptable net placement strategy is to place nets along two or more transects that traverse the station and are separated by at least 150 m. Each net site should be uniquely identified by a number (2-digit maximum).

3. MoSI STATION REGISTRATION

All MoSI cooperators must complete a MoSI Station Registration Form for each station operated and submit it (via e-mail) to the appropriate regional MoSI coordinator. Registration forms must be received before any funds can be transferred from IBP and before any data are submitted. The information on this form provides contact information for station operators and information on the station's location, habitat, and intended operations. Once registration forms are received, operators are added to the mailing list for the anticipated banding season. Registration forms can be obtained from regional MoSI coordinators or downloaded at www.birdpop.org/MoSI/MoSI.htm.

3.1 COMPLETING THE MOSI STATION REGISTRATION FORM

Below, we provide instructions for filling out each major section or field contained on the MoSI Station Registration form.

Station Manager Contact Information
The station manager is the official contact person for the MoSI Program Coordinator and regional coordinators, to whom all mailings (including updates in forms and protocols), phone calls, and emails are addressed. Station managers will be acknowledged in MoSI Program publications and reports. Please notify MoSI regional coordinators of changes in contact information for the Station Manager.

Additional Station Operator Contact Information
You may provide contact Information for a second individual with station operation responsibilities. Often, secondary operators are staff biologists, technicians, students, or volunteers who play a critical role in conducting the banding station field work. Both the Station Manager and secondary operators can be included on regional MoSI mailing lists.

Station Information
Location code: A unique, four-character code that you select to designate your station or set of stations. If the code you propose conflicts with established MoSI location codes, the MoSI Program Coordinator will contact you to discuss an alternative.

Station code: A unique, four-character code that you select to designate your station. For single-station locations, this is typically the same as the location code. Use numbers to distinguish adjacent stations that, together, make up a 40 ha "superstation" (e.g., CAF1 and CAF2) if you are using the 2-pulse protocol. If the station codes you propose conflict with established MoSI station codes, the MoSI Program Coordinator will contact you to discuss an alternative.

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

Funding source(s): This will likely include IBP but may also include other sources. List all government agencies, non-governmental organizations, foundations and grants providing financial support for station operation. Use "private" if the station is self-financed.

Land ownership: The organization that owns the property on which the station is located. If it is government owned, please indicate the federal agency, state, or city that owns the land. If the land is privately owned by an individual, please list the ownership as "private".

Nearest town: Indicate the nearest community, as the Neotropical migrant flies, shown on *and listed in the index* of a state- or province-level road map.

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).

Mean elevation: The station's mean elevation in meters. Please do not report a range.

Approximate size of study area: Ideally, stations should be 20 ha with a core area of 12 ha.

Habitat description: Provide a brief description of the station's vegetation. Some examples: "mature lowland rain forest", "cloud forest", "deciduous second-growth woodland", "rustic shade coffee plantation", etc.

Target species (expected): Consult Table 1 for a list of target species for each region.

First pulse of operation: Please indicate the month and year in which you plan to begin operating your station. For pre-existing stations, indicate the first pulse the station was operated.

Station operation

Number of 12-m mist nets: We recommend an approximate net density of 1.33 nets/ha.

Number of pulses station is expected to be operated: Should be five, but can be as few as three. If fewer than five pulses are operated, indicate which pulses the station will be operated (see section 4, Table 2). Two pulse stations were permitted in the past, but do not provide enough data to be generally useful. Three pulse stations provide much more useful data with little extra effort.

Number of days of operation per pulse: Should be three days. Can be two days for 5-pulse or 4-pulse stations.

Is part of a "superstation"? In other words, is there another contiguous or nearby (boundaries separated by < 1 km) station? (Superstations were advocated by the MoSI Program prior to the 2003-04 season, but are not recommended now.)

In addition to the above information, station operators should submit an accompanying letter describing special circumstances, anticipated difficulties, or proposed deviations from protocols outlined in the MoSI manual. As indicated on the registration form, a map showing the geographic location of the station should also be submitted.

4. OPERATING A MoSI STATION

The MoSI program is designed to be as inclusive as possible, and its overall goal – to maximize the numbers of captures of target species – is broad enough that it can accommodate several protocol variations. For all protocol variations, we suggest that every effort be made to run nets in a constant-effort manner and to apply the same protocol in all years of operation. Consistency of operation, although not required for mark-recapture analyses, can aid in modeling of survival rates. We appreciate, however, that changes can often be necessary as funding levels or research objectives change. Operators running fewer than five pulses are particularly encouraged to increase their effort if at all possible.

4.1 GENERAL STATION OPERATION

4.1.1. BASIC FIELD PROTOCOL.—The basic MoSI field protocol calls for five monthly "pulses" of station operation . Each pulse of operation consists of mist-netting and banding at the station on two or (preferably) three consecutive (or nearly consecutive) days (for a total of 10-15 netting days) within a 30-day period (see Table 2 for definitions of monthly periods). Pulses should be as close to the midpoints of each of the five monthly periods as possible (although this may be logistically difficult during spells of bad weather and for individuals operating multiple stations). A 5-day "grace period" is permitted on either end of each period for stations unable to operate within a particular period due to poor weather conditions. For example, the period 1 pulse could be begun as early as 28 October or completed as late as 6 December. Every effort should be made to separate consecutive pulses by at least three weeks; the minimum acceptable interval between pulses is two weeks.

TABLE 2. Dates defining each of the MoSI banding periods. In cases where weather or logistics preclude completion of a banding pulse within a particular period, the pulse can begin as early as five days before, or completed as late as five days after, the defined period.

Period	Dates
1	Nov. 2 – Dec. 1
2	Dec. 2 – Dec. 31
3	Jan. 1 – Jan. 30
4	Jan. 31 – Mar. 1
5	Mar. 2 – Mar. 31

Some MoSI cooperators may be unable to complete five pulses of banding during the MoSI season. Stations that cannot be operated for five pulses should be operated for at least three (and preferably four) pulses. Every effort should be made to operate all three- and four-pulse stations on three days during each pulse (for a total of 9-12 netting days). For stations operating during only three pulses, we highly recommend that one pulse be conducted during November or December (early season) and one pulse be conducted during February or March (late season) to ensure coverage during both the early and late winter periods. In addition, the number of periods between pulses should be fewer than two, because between-pulse recapture rates are low for stations that operate during pulses that are more widely-spaced. Thus, ideal 3-pulse protocols include: Nov.-Dec.-Feb., Nov.-Jan.-Feb., Nov.-Jan.-Mar., Dec.-Jan.-Feb., Dec.-Jan.-Mar., and Dec.-Feb.-Mar. Other alternatives, although acceptable, are less desirable.

Stations operating for only two pulses may not be able to be included in survival analyses (2-pulse stations established prior to the 2003-04 season should refer to section 4.1.2 below).

4.1.2. ALTERNATIVE PROTOCOLS FOR "SUPERSTATIONS" ESTABLISHED PRIOR TO THE 2003-04 SEASON—During the first pilot year of the MoSI Program (2002-03), a two-pulse protocol, with 2-3 days of banding conducted on each of two adjacent (or nearby) stations was recommended (for a total of 8-12 netting days). This recommendation arose primarily from concerns that (1) birds would avoid nets run too frequently and (2) the operation of stations for more than two pulses would be logistically difficult for many potential MoSI cooperators. We have since addressed the first of these concerns with analyses of five years of data from a similar IBP project in Cuba. Results of that project, which used a monthly banding protocol, found no temporal trend in recapture probabilities of overwintering migratory warblers, suggesting that net avoidance was not a problem. Additional analyses of the Cuba data suggested that two pulses of data were not sufficient to estimate survival rates with adequate precision for detecting differences among habitats, and preliminary examination of data from the first year of the MoSI Program also suggested low recapture rates with two pulses of data. Because all of these results suggested that more than two pulses of banding were needed to ensure the success of the MoSI Program, we began advocating the new protocol described in section 4.1.1 at workshops held prior to the 2003-04 field season. The new protocol was well-received by current MoSI cooperators and few have expressed concern about logistical difficulties of monthly station operation.

Because of the above outlined problems with two-pulse station operation, we encourage operators, who originally established "superstations" that were to be operated under a two-pulse protocol, to continue operating their superstations under a revised protocol. Ideally, the five- (or at least three-) pulse protocol now advocated would be adopted for each superstation subplot. We realize, however, that most MoSI superstation operators will not be able to invest this level of effort (18-30 banding days per season, plus time for travel, moving nets, etc.). In such cases, one of the protocols outlined in Table 3 should be adopted; each alternative calls for 9-16 days of operation, which is similar to the effort required by stations operating under the new protocols. In general, superstation operators should attempt to increase the number of pulses of operation rather than increasing the number of days stations are operated during each pulse. If only three days of banding can be conducted each pulse, more effort should probably be invested in the plot (station) that tends to catch the most individuals of target species (i.e., 2 days of banding at the more productive station and 1 day at the second station). (An alternative, however, might be to run nets for 1.5 days per plot; i.e., 1 day + 1 morning at the first station and 1 afternoon + 1 day at the second station).

TABLE 3. Alternative field protocols for stations originally established to operate under the 2-pulse "superstation" protocol. Alternatives are listed in decreasing order of desirability. **These protocols should only be adopted at superstations established prior to the 2003-04 MoSI season.**

		No. days per pulse		No. days of
Alternative no.	No. pulses	Station 1	Station 2	operation per season
1 (most desirable)	5	1.5 – 2	1 – 1.5	15
2	4	2	2	16
3	4	1.5 – 2	1 – 1.5	12
4	3	2	2	12
5 (least desirable)	3	1.5 – 2	1 – 1.5	9

4.2 NET OPERATION AND BANDING

If possible, MoSI stations should be operated during all daylight hours on each day of operation. If high temperatures, lack of shade, wind (wind speeds > 10 knots or gusts > 20 knots), rain, or logistic considerations prevent nets from being operated during all daylight hours, every effort should be made to operate nets during at least the first 4-6 morning hrs. Occasionally, spells of bad weather may make the completion of a banding pulse difficult. Missed effort should be made up to the greatest extent possible, with the goal of completing at least 12 hrs of banding during a pulse. In general, days of operation within a pulse should be as close to consecutive as possible.

Nets should be opened and closed and (if possible) checked in the same order on each day of operation and net check. Net opening and closing times should be recorded to the nearest ten minutes (see section 5.1). All birds captured should be identified to species, age, and (if possible) sex. Unmarked birds should be banded with a uniquely numbered leg band (see section 6 for detailed banding instructions). The body mass of each bird captured should be determined to 0.1 g using a portable battery-operated electronic balance, and its unflattened wing chord should be measured to the nearest mm. Although we strongly encourage station operators to color band 1-2 target species and invest effort in resighting birds on the study area (see section 4.3 below), such efforts are not required for program participation.

4.3 COLOR BANDING AND RESIGHTING

Individual color banding and resighting, although labor intensive, can provide an excellent means for improving the precision of survival-rate estimates because, with sufficient effort, resighting probabilities can be substantially higher than recapture probabilities. Although this improvement may not be very marked at stations where dense understories make resighting difficult, we urge station operators with sufficient time and personnel to consider color banding and resighting one or two (at most three) focal species. This work should be conducted during each pulse in conjunction with, or immediately after, the operation of the MoSI station.

Individuals of focal species should be banded with two or three plastic color bands and one numbered metal (e.g., USGS/BBL) band. Ideally, resighting efforts during a particular pulse should continue until either (a) all previously known site-faithful birds are located or (b) no newly resighted birds are located with > 10 person-hours of effort (Latta and Faaborg 2002). In order maximize the efficiency of resighting efforts, we recommend the following:

(1) Create a detailed map of the MoSI station, gridded at 20-m intervals (see section 10.1).

(2) Systematically search the station for individuals of color-banded focal species.

(3) Follow individuals until color band combinations can be identified (up to ~ 15 min).

(4) Record locations of individuals to the nearest 20-m grid point by referring to a copy of the station map carried into the field.

(5) Also, record resighted birds on the MoSI Recaptures Sheet with Capture Code "S" (see section 6.1.7).

(6) Compile a master summary map for each species that contains the locations of all captures and resightings, and update it at the end of each pulse. The color-band combination and the date of the capture or resighting should be marked on the map at the appropriate location. Multiple maps may be needed for species for which many individuals are captured and are recaptured or resighted many times. These maps can be used to guide resighting efforts in subsequent pulses.

5. SUMMARY OF MIST-NETTING EFFORT

The Summary of Mist-Netting Effort form allows us to quantify differences in effort among pulses and years and provides information that can be used in mark-recapture analyses. Please, fill out this form carefully, and double-check your net-hour calculations! Summary of Mist-netting Effort forms can be obtained from regional coordinators or downloaded at www.birdpop.org/MoSI/MoSI.htm.

5.1 COMPLETING THE SUMMARY OF MIST-NETTING EFFORT FORM

Below, we provide detailed instructions for completing the Summary of Mist-netting Effort form.

Location: Record your four-character location code.

Station: Record your four-character station code.

Year: Record the current winter season (i.e., 2009-10).

List net numbers of all 12-m nets: Indicate net-site number designations for all 12-m 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.

Intended Period: Indicate the period number for which the day's effort was intended (see Table 2).

Date: Record the month and day of operation for each day in each pulse (mm/dd).

Net-site numbers: Record the net-site numbers for all 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 16 nets were opened at 0700 and nets 08 and 09 were closed at 1000 due to sun or wind while the remaining 14 were closed (as planned) at 1700, then the effort should be recorded on at least two lines.

Open Time and Close Time: Using the 24-hr clock, record, to the nearest 10 minutes, the opening or closing time of the first net opened or closed.

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

Pulse Net Hours: Record the total effort for all days in a pulse on the last line for the pulse.

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.

6. COLLECTING AND RECORDING BANDING DATA

All unbanded birds captured at MoSI stations should be identified to species and, with the possible exception of very small (e.g., hummingbirds) and very large (e.g. many raptors) birds, be banded with uniquely numbered metal bands. IBP can provide USGS Bird Banding Laboratory (BBL) subpermits and bands for use on target species and other species that regularly occur in the US [i.e., all species in Pyle (1997); hereafter, "migrants"], and MoSI Program regional coordinators can assist in the acquisition of bands for use on Neotropical resident species (hereafter, "residents"). In addition to banding, it is critical that the age and sex of all birds (including recaptures) be determined to the greatest extent possible. With practice, fine-scale age and sex determination is possible for most NTMB species (see Bird Banding Offices 1991, Pyle 1997, Froehlich 2003). Unfortunately, few references exist for aging and sexing Neotropical resident bird species. We encourage MoSI station operators to collect as much ancillary data on resident species as possible (i.e., data on plumage, molt, eye color, skull pneumaticization, breeding condition, etc.) to begin filling this data gap. Finally, the wing cord, weight, and fat score should be recorded for all birds to allow for the comparison of the physical

condition of birds among habitats. In this section we detail the materials, methods, and codes used in the collecting and recording of banding data.

6.1 General Procedures for Recording Banding Data

6.1.1. MoSI Banding Data Sheets.—All banding data should be recorded in the field on copies of the 8 1/2" ×14" MoSI banding data sheets (see Fig. 3 for an example MoSI Banding Sheet and section 6.2 for field definitions). There are three types of MoSI banding data sheets: the MoSI Banding Sheet for recording newly banded birds; the MoSI Recaptures Sheet for recording recaptures and re-sighted color-banded birds; and the MoSI Unbanded Sheet for recording birds that are captured but left unbanded. We have examined and used well over 70 banding data sheets and have designed ours to provide the greatest ease, logic, and accuracy for recording data in the field. We find these forms to also be the most efficient and accurate for computer data entry and BBL Banding Schedule production. Banding data sheets can be obtained from regional MoSI coordinators or downloaded at www.birdpop.org/MoSI/MoSI.htm.

A) Front

A) Front

MoSI BANDING Sheet Location V O L A Band Size 0 Year 2003-2004 Page # 3

CODE		SEX		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	Male	M	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	Female	F	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	Indeterm.	U	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	Not attempt.	X	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 Limits	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
				After Third Year	8	Molt	M			Fully Comp.	6					Gr. Bulging	6			>1/2	2			Mixed Basic	M	Wing Injury	W
				Indeterminable	0					Invisible	8					V. Excess.	7			< 1/2	1			Unknown	U	Body Injury	B
				Not attempted	9															None	0					Leg Injury	L
																										Predation P Dead	D

MOLT LIMITS & PLUMAGE — Leave blank if you didn't look at that feather tract.

BANDER'S INITIALS	CODE	BAND NUMBER	SPECIES ALPHA CODE	AGE	HOW AGED	SEX	HOW SEXED	SKULL	CL. PROT.	BR. PATCH	FAT	BODY MLT	FF MOLT	FF WEAR	JUV. PL.	PR.COVS.	SEC.COVS	PRIMARIES	SECONDS	TERTIALS	RECTRICES	BODY PLUM.	NON-FEATH.	WING	MASS	STATUS	DATE MO	DATE DAY	CAPTURE TIME	STATION	NET	DISP	NOTE	FITHR.PULL	NUMBER	COLOR BANDS
J B	N	19303831	Vermivora celata	2	L	S	F	P	4	0	0	1	0	N	3	J	F			F	U	U		57	88.3	3	01	12	1507	CAFE	12			1	P	RL/GS
"	N	302	"	V	E	R	C	E	L	1	P		U			6	0	0	0	0	N	2		B	B	B			B	B				58	90	"	"	"	"	04			2	P	RY/GS
"	N	303	Wilson. pusilla	W	I	L	P	U	S	2	P		F	P		6	0	0	1	0	N	2		J					U	U				52	65.3	300	"	"	"	05			3		
"	N	304	Empid. minimus	E	M	P	M	I	N	2	L	F	U			6	0	0	0	1	N	3		J	L	J			J					60	92	"	"	"	"	01			4	P	
"	N	305	Wilson. pusilla	W	I	L	P	U	S	0			M	P		6	0	0	0	0	A	2		U	U				U	U				56	68.3	300	12	17	0825	BOSQ	01			5	P	
J P	N	306	Vermivora celata	V	E	R	C	E	L	2	P	L	M	P		6	0	0	2	0	N	1		J	F				J					64	90.3	301	"		"	03			6	P	GY/GS
J B	N	307	Magnolia Warb.	D	E	N	M	A	G	1	P		M	P		6	0	0		1	N	2		B	B				B	B				62	95.5	500	12	18	0653	"	15	W		7		
J P	N	308	Am. Redstart	S	E	T	R	U	T	6	P		M	P			0	0	1	1	N	1		B	B	B	B	B	B	B				68	89.9	300	01	15	0741	"	11				P	
J B	N	309	Vermivora celata	V	E	R	C	E	L	1	O		U														30	1	"		0	8	2	CAFE	06			8	P	GL/PS
"	N	310	Wilson. pusilla	W	I	L	P	U	S	5	L	P	M	P		6	0	0	0	1	N	2		J	F				J	F				55	67.3	300	"		0	90	06			9		

Bander: J B Joe Bird Bander: J P José Pájaro Bander: _____ Bander: _____

B) Back

NOTE NO.	NOTE
1	No crown patch. Tail = 48
2	Crown patch = 8 mm
3	Black on crown = 7 mm, 70% green. Rects appear intermediate in shape - relatively worn.
4	Tail = 52 mm; exposed culmen = 6.9 mm
5	PP covs relatively narrow and pointed, but fresh and w/ no apparent contrast w/ gr covs - age could not be determined with confidence. Black on crown = 16 mm, 95% black.
6	Crown patch = 13 mm
7	Had difficulty flying away. We lost sight of the bird so couldn't further monitor it.
8	Bird escaped before all data could be recorded. Aged by date.
9	Black on crown = 12 mm with a few olive tipped crown feathers.

FIGURE 3. An example MoSI Banding Sheet for band size 0. (A) Front of the banding sheet. (Note the change in age designations corresponding to the calendar year change.) (B) Back of the banding sheet. Notes on the back of the banding sheet correspond to records in A. All fields are defined in section 5.2.

6.1.2. RECORDING DATA IN THE FIELD.—Although the submission of hard copies of MoSI banding data sheets is not required (or even encouraged; see section 11) for MoSI Program participation, we recommend adhering to some general guidelines when recording banding data in the field. Adherence to these guidelines will help ensure that your data are collected, digitized, and archived accurately and efficiently. We recommend that you:

(1) Record data in black ink. Data recorded in other ink colors or pencil does not photocopy well, and pencil marks can fade easily. Errors should be fixed by applying a fast-drying correction fluid and then correcting the data. Writing over incorrectly entered data can result in confusion during computer data entry.

(2) Keep separate sets of MoSI Banding Sheets for each residency class, that is, birds banded with USGS-BBL bands (birds in Pyle 1997; migrants) and birds banded with non-USGS bands (residents).

(3) Fill out all heading fields (Location, Year, Band Size, and Page #) on all data sheets. Be sure to enter the location code exactly as it is entered on your registration form (see section 3.1). Fill in Year with the current winter season (i.e., 2006-07). If you are using different band strings for migrant and resident birds, clearly indicate which band string is being used in the Band Size field (e.g., "M-1B" for migrant birds of band size 1B, while "R-1B" might be entered for residents).

(4) Number pages sequentially for each band size/residency status combination, starting with page 1 every year. This is very important, as it will allow you to see at a glance that you have all of your data when entering it into the computer. By writing "End of year" at the bottom of the last page of each band size/residency combination at the end of each season, you can further ensure that you have the entire season's data.

(5) Do not use separate band strings and data sheets for multiple stations operating at a given location UNLESS these stations are operated simultaneously (i.e., by different banders on the same day). By keeping all records for a band string together, you will facilitate data entry by avoiding gaps in the band sequences on the data sheets. If more than one set of banding-data sheets (per residency status) must be used, use a different page-numbering sequence for each set (e.g., A1, A2,...for station 1; B1, B2...for station 2).

(6) Write out the first record of each day completely. After that, use "greater than" (>) or "less than" (<) symbols 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.

(7) Leave blank any fields for which data are not collected; 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 don't make assumptions.

6.1.3. NON-MOSI DATA.—Birds captured and banded outside of MoSI stations (e.g., birds trapped at feeding stations) or outside of the MoSI season (i.e., 1 Apr. - 1 Nov.) *should not* be banded with USGS-BBL bands provided by IBP and *should not* be submitted to regional coordinators or IBP as part of the MoSI Program.

6.1.4. NEWLY BANDED BIRDS.—To ensure that band numbers are recorded and computerized correctly and to facilitate band inventory and scheduling, it is important that original banding data for only a SINGLE STRING OF BANDS be included on any SINGLE MoSI Banding Sheet and that the bands be recorded (and, as much as possible, used) in sequence. As indicated above, records for non-USGS bands should be recorded on a different set of banding sheets than the set being used to record birds banded with USGS bands.

6.1.5. LOST AND DESTROYED BANDS.—Lost and destroyed bands should be recorded in sequence on MoSI Banding Sheets. Record only CODE, BAND NUMBER, SPECIES NAME as "Band Lost" or "Band Destroyed," DATE, and STATION (see section 6.2 for banding field definitions).

6.1.6. RECAPTURES.—Recaptured birds are recorded on the MoSI Recaptures Sheet. Every capture of a banded bird is a "recapture". Thus, recaptures include returns (first captures in a given period at a given station of birds banded at the same station in a previous period), repeats (subsequent captures, even on the same day, of birds banded or recaptured at the same station earlier in the period), and recoveries (first captures of birds banded at a different station or on a different permit). Birds banded outside of the MoSI season and recaptured during MoSI 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. Recaptured birds should receive CODE = "R". Complete data should be taken for all recaptures and recorded only on MoSI 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.

6.1.7. RESIGHTED BIRDS.—All color-banded birds resighted during field work should also be recorded on the MoSI Recaptures Sheet. For these records, record only the following fields: BANDER'S INITIALS (here, referring to 'observer's' initials), CODE, SPECIES NAME, SPECIES ALPHA CODE, AGE, SEX, DATE, CAPTURE TIME (here, referring to the observation time to the nearest 10 minutes), STATION, and COLORS. The CODE for resighted birds should be entered as "S".

6.1.8. CHANGED BANDS.—If a band is replaced, record the capture on both the MoSI Banding Sheet (new band) and MoSI 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. If the old band is so worn that the number is unreadable, it should be sent to the BBL (where the number can be determined by subjecting the band to reagents) along with the schedule on which the new band is reported; or, if you are operating as a subpermitee under IBP's banding permit, it should be sent to IBP for submission to the BBL. Both records should be given 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.

Changed bands should be counted only as recaptures on the Summary of Mist-netting Results (see section 8.1).

6.1.9. 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 section 8.1).

6.1.10. UNBANDED BIRDS.—As much information as possible should be recorded on the MoSI Unbanded Sheets for birds that are captured but not banded (escapes, releases, and mortalities). These data, although not used directly in MoSI analyses, allow us to more accurately gauge capture rates. 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 individuals of a species that a bander is not authorized to band or birds for which the recommended band size is unavailable.

6.1.11. MORTALITIES.— Even when all reasonable precautions are taken, mortalities occasionally occur in the course of mist netting. If a bird dies before it is banded, it should be recorded on the MoSI Unbanded Sheet. If a bird dies just after it is banded, remove and destroy the band, record *the bird* on the MoSI Unbanded Sheet, and record *the band* on the MoSI Banding Sheet as destroyed (enter "D" in the CODE field; see section 6.2). Dead birds 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, it should be recorded on the MoSI Recaptures Sheet and its band should be removed and destroyed (unless it is a recovery, that is, a migratory bird that was banded at some other station or on some other permit, in which case it should be reported to the BBL on form 3-1807 or, if you are operating as a subpermitee under IBP's banding permit, should be reported to IBP to report to the BBL). As before, enter "000" in the STATUS field and "D" or "P" in the DISP field.

6.2 BANDING DATA FIELD DEFINITIONS, CODES, AND SCALES

All banding data should be taken according to the standardized guidelines and codes described below. We realize that some contributors to the MoSI Program have used slightly different codes and scales when recording these data in the past. In an effort to standardize banding data collected across the Americas and Caribbean, we strongly encourage MoSI cooperators to adopt the codes presented here. These codes are the result of thousands of hours of field work and subsequent analysis by researchers at the USDA Forest Service, the US Fish and Wildlife

Service, Point Reyes Bird Observatory, and The Institute for Bird Populations (Ralph et al. 1993). If you do not adopt these scales and codes, you must provide an explanation of how your codes correspond to MoSI codes so that they can be converted for incorporation into the MoSI database.

Front of the banding-data sheet: The front of all MoSI banding data sheets is comprised of 38 fields, each with one or more columns. They include (see Fig. 3A):

BANDER'S INITIALS – Initials of the bander or person recording the data. Initials and full names of all banders on the page must be written in the spaces provided at the bottom of the banding data sheet.

CODE – Capture Code. Use codes shown at the top of the banding data sheet:

N – Newly banded bird (see section 6.1.4)
L – Lost band (see section 6.1.5)
D – Destroyed band (see section 6.1.5)
R – Recaptured bird (see section 6.1.6)
S – Resighted bird (see section 6.1.7)
C – Changed band (see section 6.1.8)
A – Added band (see section 6.1.9)
U – Unbanded (see section 6.1.10; note: U is already printed on the Unbanded Sheet)

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. For USGS bands, three-digit prefixes should be preceded by a "0" (e.g., 972 should be recorded as '0972'). Two-digit prefixes should be preceded and followed by a zero (e.g., 81 should be recorded as '0810'). Resident bands with fewer than nine digits should be right-justified and preceded by zeros. Thus, all band numbers will be nine characters long. Please double-check to be sure that the first band number on each MoSI Banding Sheet is correct. After the first record has been entered on a MoSI Banding Sheet on a given day, only the last 3 digits of subsequent bands (right justified) need be recorded on that day. By entering the complete number only for the first record on a particular day, you can easily delineate records on different days and save time when entering data in the field.

For all recaptures, be sure to enter the full band number for all records. PLEASE DOUBLE-CHECK the band numbers of all recaptured birds before releasing them – incorrectly recorded band numbers are detrimental to mark-recapture analyses! The reading of band numbers can be aided with some sort of optical magnification device. The best magnification device 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 (it is also useful for skulling birds; see 'SKULL' below). We recommend the DA-5 model (2.5 power at a focal length of 8"; price about $29 US) coupled with a 2.5 power OptiLoupe attachment (price about $5 US) that can be swung down in front of one of the eyepieces. This device is widely available in the United States at jewelers' supply houses. To find a distributor near you, contact the

manufacturer: Donegan Optical, Lenexa, Kansas, (913) 492-2500. Those having difficulty obtaining this device should contact IBP. For unbanded birds, leave BAND NUMBER blank.

SPECIES NAME – Enter at least an abbreviation of the species name. We prefer that English or scientific names be used for this field (see www.birdpop.org/AlphaCodes). Spanish common names may also be used, so long as they are paired with the appropriate four- or six-letter alpha code (see below). Species names (or abbreviations) will not be entered in the MoSI database but will serve as a check against the SPECIES ALPHA CODE (below), which is often error-prone. Write "Band Lost" or "Band Destroyed" in this space where appropriate (see 6.1.5).

SPECIES ALPHA CODE – Four- or, preferably, six-letter alpha codes should be entered in this field to indicate the species. A list of species alpha codes for all species can be downloaded at: www.birdpop.org/AlphaCodes. Four-letter codes are based on English names (e.g., Orange-crowned Warbler = OCWA) and largely follow codes long used by the BBL. Six-letter codes are derived from scientific names (e.g., *Vermivora celata* = VERCEL), which may be preferred by bird banders in Latin America. 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 - A single-digit numeric code for the age class of the bird. Use the codes shown at the top of the banding-data sheets:

4 – Local: 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 (HY): A bird capable of sustained flight and known to have hatched during the calendar year in which it is captured.
1 – After Hatching Year (AHY): A bird known to have hatched before the calendar year in which it is captured; year of hatching otherwise unknown.
5 – Second Year (SY): 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 (ASY): 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 (TY): 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 (ATY): 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: Age unknown because age indeterminable; i.e., age determination attempted but not possible with confidence.
9 – Not attempted: Age unknown because age determination not attempted.

Please attempt (without relying on previous capture data) to age all birds captured before January 1 as HY (AGE = 2) or AHY (AGE = 1) and all birds captured after December 31 as SY (AGE = 5) or ASY (AGE = 6). It should be possible to reach this level of precision with at least some individuals of most NTMBs (Pyle 1997; Froehlich 2003). In addition, many North American

near-passerines (including woodpeckers) and a few passerines can occasionally be aged to TY (AGE = 7) and ATY (AGE = 8). We hope that the MoSI Program will stimulate research into the molt limits of Neotropical resident species in order to allow similar fine-scale ageing of those species.

PLEASE NOTE that when aging birds by fine-scale criteria, such as the MOLT LIMITS AND PLUMAGE fields (see below), it is possible that various feather tracts may show conflicting characteristics (i.e., characteristics that indicate different age classes). When making an age determination, give more weight to feather tracts that are more reliable or have the most obvious definitive features. Although it is not necessary that all feather tracts in a record agree, you should be confident in your ultimate age designation. A bird for with no definitive feather tracts or for which conflicting characteristics make age determination uncertain should be aged as unknown (AGE = 0) prior to Jan. 1 or AHY after Dec. 31.

HOW AGED – This field indicates the criteria used to determine age. Two codes should be used whenever possible. They should be entered from left to right in their order of importance in your age determination. You must record at least one criterion unless the age is unknown (i.e., unless age = 0 or 9). Please study the sample banding sheet (Fig. 3) to better understand how this field should be used. Use only the codes listed at the top of the banding data sheets. Note that additional details concerning fine-scale ageing (i.e., distinguishing HY/SY, AHY/ASY, SY/TY, and ASY/ATY birds) will be provided in the MOLT LIMITS AND PLUMAGE fields (see below). Please do not age recaptures based on 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. Acceptable codes for HOW AGED include:

S – Skull: Degree of skull pneumaticization.
C – Cloacal Protuberance: Presence of a cloacal protuberance (indicates an adult bird of a resident species).
B – Brood Patch: Presence of a brood patch (indicates an adult bird of a resident species).
J – Juvenal Plumage: The presence of juvenal *body plumage* (indicates a young bird). This field should **NOT** be used to indicate the presence of retained juvenal flight feathers or coverts.
L – Molt Limit: The presence of two generations of feathers within a feather tract (e.g., within greater coverts) or between adjacent feather tracts (e.g., between primary coverts and greater coverts). If this code is used, at least one of the first seven MOLT LIMITS AND PLUMAGE fields must be filled in.
P – Plumage: The appearance of plumages other than juvenal body plumage. Feather color and shape are plumage characteristics; measurements are not. Contrast in color or shape between two generations of feathers or groups of feathers should generally be treated as a molt limit characteristic, not a plumage characteristic. If this code is used, at least one of the first seven MOLT LIMITS AND PLUMAGE fields must be filled in.
M – Molt: The presence and characteristics, if reliable, of molt, indicated by pinfeathers 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, wing length, tail length, 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.

SEX – A single-digit alpha code indicating the sex of the bird. Acceptable codes include:

M – Male.
F – Female.
U – Indeterminable. (i.e., sex determination attempted but not possible with certainty).
X – Not attempted. Sex unknown because sex determination 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. Valid codes for this field include:

C – Cloacal Protuberance. The presence of a cloacal protuberance (indicates an adult male).
B – Brood Patch. The presence or degree of a brood patch (if reliable, indicates adult female).
J – Juvenal Plumage. The appearance of juvenal body plumage.
P – Plumage. The appearance, if definitive, of all plumages after juvenal 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.). This code requires an explanatory note.

SKULL – Skull Pneumaticization. A fully pneumaticized skull consists of two layers of bone connected by tiny "struts" and filled with air, much like the wing of a plane. A pneumaticized skull appears opaque and grayish with tiny whitish dots. In contrast, an un-pneumaticized skull, consisting of a single, thin layer of bone, appears pinkish and somewhat translucent and never shows the minute dots characteristic of a pneumaticized skull. Skulls that are partially pneumaticized can be recognized by the color contrast between pneumaticized and pneumaticized regions. In order to determine the degree of skull pneumaticization, 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 forward looking for the line that separates the pneumaticized area from the area that is not pneumaticized. Although the skulls of many small passerine species can become fully pneumaticized as early as October 1, the time at which the last individuals complete skull pneumaticization is unknown for many NTMBs. Thus, we recommend that as many birds as possible be skulled throughout the MoSI season in order to help fill this data gap. We recommend the use of a binocular magnifier such as the OptiVISOR (see above under BAND NUMBER) for determining the degree of skull pneumaticization. See Yunick (1979), Ralph et al. (1993), and Pyle (1997) for more information (including diagrams) on the determination of age by skull pneumaticization. Skull pneumaticization should be recorded by means of the following numeric scale:

0 – Skull not pneumaticized. 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. This situation can be found only in very young, newly fledged juveniles. 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 – Skull 1–5% pneumaticized. A trace of skull pneumaticization can be seen at the very back of the skull, usually appearing as an opaque, grayish crescent or a very-small, triangular area.
2 – Skull 6–33% pneumaticized. Skull less than 1/3 pneumaticized but some pneumaticization is obvious. Generally, the posterior part of the cranium has an inverted 'u'- or 'v'-shaped area of pneumaticization that is usually distinctly grayish and contrasts with the unpneumaticized area. The grayish area typically shows the characteristic, small, whitish dots of a pneumaticized skull.
3 – Skull 34–66% pneumaticized. In typical birds, most of the rear half of the skull is pneumaticized, 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 pneumaticized area extending up the midline or sides of the skull.
4 – Skull 67–94% pneumaticized. Skull at least 2/3 pneumaticized but at small areas of skull not pneumaticized. Unpneumaticized areas are usually evidenced as two oval, pinkish spots on either side of the cranium. Rarely, the unpneumaticized area may be a single pinkish spot in the center of the skull.
5 – Skull 95–99% pneumaticized. These birds have a nearly fully-pneumaticized skull that shows one or two tiny, dull pinkish spots. Some birds, including many flycatchers, thrushes, and vireos, never develop fully pneumaticized skulls, even when adults. Thus, a "5"-skull cannot be reliably used for aging birds.
6 – Skull pneumaticization complete. Skull opaque, grayish, with white dots; no pinkish spots evident.
8 – Extent of pneumaticization not visible. Do not use this code if you have determined that pneumaticization is incomplete but are unsure of the appropriate score; in this case, make your best guess!

CL. PROT. – Cloacal Protuberance. The MoSI season may overlap somewhat with the breeding seasons of some tropical resident species. As the breeding season approaches, the cloaca of male birds of most species begins to enlarge and form an obvious bulge where sperm are stored. Thus, this field (and BR.PATCH, below) will only be useful for sexing resident species. The development of the cloacal protuberance should be scaled as follows:

0 – None. Cloaca not enlarged.
1 – Small. Cloaca somewhat enlarged and noticeably swollen. The shape of the protuberance is such that it is wider at the base than near the tip (conical). Since small cloacal protuberances (CPs) can be hard to discern, caution should be used in ageing or sexing birds based solely on the presence of a CP of 1.
2 – Medium. Cloacal protuberance large, with a diameter fully as large near the tip as at the base (cylindrical).

3 – 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 large and prominent in such species as sparrows and thrushes and less prominent in such species as jays and flycatchers. It is possible to sex individuals of some species that rarely show prominent CPs by examining the angle of the CP with respect to the body axis. In males of these species, the CP seems to point straight out, more or less perpendicular to the body axis, while females have cloacas that point more to the rear, such that they are more parallel to the body axis. Because of this difference in orientation, some females with slightly enlarged cloacas can be separated from males with class-1 CPs. Male class- 2 and - 3 CPs cannot be confused with female cloacas 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 egg incubation, females, and males of some species, develop a brood patch. Brood patch development involves feather loss, increased vascularization, and fluid accumulation just beneath the skin of the lower breast and abdomen. The purpose of these changes is, of course, to facilitate heat transfer from parent to eggs. As for CL.PROT., this field will only be used for tropical resident species. The scale below should be used to gauge the stage of development of a brood patch.

0 – None. No brood patch is present. The lower breast and abdomen are mostly feathered. Unfeathered areas of the breast and abdomen are smooth, without evident vascularization.
1 – Smooth. Lower breast and abdomen feathers are dropped and some vascularization is evident, but most of the area is still rather smooth and dark red.
2 – 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 – Heavy. 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 – Wrinkled. Vascularization and fluid mostly gone. The skin, however, retains many thin, dry-looking, contracted wrinkles.
5 – Molting. Vascularization and fluid and most of the wrinkles are gone. 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. Note that in hummingbirds and 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.

FAT – Fat Content. Subcutaneous fat is a yellow or orange substance that is stored just under the skin and used as fuel for migratory flights and for maintenance during the colder winter months. Fat is generally stored in three discrete areas that usually fill 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 "wing pit"; 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. The codes below should be used to assess fat accumulations.

0 – None. No fat in the furculum or anywhere on the body.
1 – 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 under the wing, on the abdomen, or anywhere else on the body; **or**, if there is no fat in the furcular hollow, more than a trace of fat is present under the wing, on the abdomen, or both.
2 – 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 wing pit and, usually, on the abdomen.
3 – 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 wing pit 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 – 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 – 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 on the abdomen is also well mounded.
6 – Greatly bulging. Fat is bulging greatly above the furculum. Large mounds of fat occur under the wings and on the abdomen.
7 – Very excessive. The fat pads of the furculum, "wing pit," 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 the upper- and underwing coverts (both secondary coverts and primary coverts) and the upper and undertail coverts. The bases of 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 a number of 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.

0 – None. No body molt. No feathers in sheath or growing.
1 – Trace. Only a very few feathers molting anywhere on the bird's body, usually in no discernible pattern.
2 – Light. A few feathers are molting from a few feather tracts or some feathers (less than 1/2) are molting from only one tract. In general, less than 1/3 of the contour feathers are molting.
3 – Medium. Some feathers (generally less than 1/2) are molting from most tracts or many feathers (generally more than 1/2) 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 less than 1/3 of all its contour feathers are molting.
4 – Heavy. Many feathers (generally more than 1/2) are molting from many or most tracts. In general, 2/3 of the contour feathers on the bird are in molt.

FF MOLT – Flight-feather Molt. The prebasic molt of most north-temperate passerines and other landbirds is completed prior to fall migration (Pyle 1997). Thus, with a few important exceptions, it is unlikely that individuals of most NTMBs will be molting flight feathers during the MoSI season (but see Leu and Thompson 2002). Molts of many neotropical resident landbirds, however, can extend later into the fall (Poulin et al. 1992, Levey and Stiles 1994), and flight feather molt in these species will likely be encountered during MoSI banding. Because juveniles and adults of many species differ with respect to the presence or extent of flight-feather molt, this field can be useful for ageing birds. With a few exceptions, the prebasic molt in adult passerines is "complete"; that is, it includes all body and flight feathers. In contrast, the first prebasic molt of most 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"). Be sure to examine all primaries, secondaries, and rectrices. Examine both left and right sides to distinguish symmetric (code "S" below) from adventitious (code "A" below) flight-feather molt. Acceptable codes for flight feather molt include:

N – None. No flight-feather molt.
A – Adventitious or accidental. This type of flight-feather molt is identified by its being asymmetric and usual occurrence outside of the normal molt period.
S – Symmetric. Normal, essentially symmetric flight-feather molt, indicative of prebasic molt in adult and some young birds. A few species also may exhibit prealternate flight-feather molt.
J – Juvenal growth. Not a molt, strictly speaking. This category refers to growth of juvenal 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

can aid in the verification of age data and document occurrences of NTMB flight feather molt on wintering grounds.

FF WEAR – Flight-feather Wear. Examine only the outer 4-5 primaries to determine wear. Flight-feather wear should be classified according to the scale shown below.

0 – None. The feather edges are perfect. A light-colored edge exists all the way around the feathers, including the tips.
1 – Slight. 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 – Light. Feathers are definitely worn but with very little fraying and very few actual nicks.
3 – Moderate. Feathers show considerable wear and some very definite fraying. Nicks and chips are obvious along the vanes.
4 – Heavy. Feathers are very heavily worn and frayed. Tips are often worn completely off.
5 – Excessive. 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 Juvenal Body Plumage. Most fledgling birds wear a juvenal plumage that is distinct, at least in texture, from any other plumage of the species. Juvenal plumage is generally distinguished from adult plumages by loosely-textured ("fluffy") contour feathers that often have streaks or spots not found on corresponding adult feathers. It is important to examine individual feathers in assessing the extent of juvenal plumage. This plumage may be worn from only a few days to several months, depending on species and fledging date, until it is molted into formative ("formative" = "first basic" in Pyle 1997),or in some species, supplemental, plumage (see Pyle 1997 for descriptions and timing of juvenal plumage). The extent of juvenal body plumage on a young bird, therefore, is often a good indicator of how long the individual has been out of its nest. Because young birds of most NTMBs will have completed the preformative ("preformative" = "first prebasic" in Pyle 1997) molt by the time they arrive on the wintering grounds, this field will likely be useful only for some resident birds during the MoSI season. Flight feathers (primaries, secondaries, and rectrices) are generally not replaced in the preformative molt and should not be considered when assessing the extent of juvenal plumage. In addition, birds of many species retain juvenal wing coverts through their first breeding season – these also should not be considered when assessing juvenal plumage. The following codes should be used to describe the extent of juvenal plumage remaining:

3 – Full. All contour feathers are juvenal feathers. The bird has not yet begun its preformative (or presupplemental) molt.
2 – More than half. The bird has begun its preformative (or presupplemental) molt, but still has mostly juvenal plumage.
1 – Less than half. The bird has mostly molted into formative (or supplemental) plumage, but some juvenal plumage remains.
0 – None. No juvenal body plumage remains. The individual has already molted into formative (or supplemental) plumage. All adult birds, including SYs, therefore, have "0 " juvenal plumage, even if they have some retained juvenal coverts.

In summary, a bird is in full (3) juvenal plumage (JP) from fledging until the onset of the preformative (or presupplemental) molt. During this molt, JP is replaced by formative (or supplemental) plumage. Thus, birds in partial (2 or 1) JP must be in molt. Note, however, that hatching year birds in molt are not necessarily in partial JP. Recently-fledged birds still may be growing their juvenal feathers but should be classed as "3" JP. Similarly, birds in the final stages of the preformative (or presupplemental) molt may have lost all their juvenal feathers but still be growing their formative (or supplemental) feathers; such birds have "0" JP.

MOLT LIMITS AND PLUMAGE – These fields are to be used for birds aged as HY or AHY after completion of skull pneumaticization and the preformative molt or completion of the prebasic molt, respectively, prior to January 1, and for birds aged as SY or ASY or TY or ATY after December 31. 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 field must be filled in if the bird is aged by molt limits (HOW AGED = L) or plumage (HOW AGED = P). Refer to Pyle (1997) and Froehlich (2003) for additional discussion and examples of the use of molt limits and plumage criteria for ageing landbirds. The eight fields include:

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 – Includes all feather tracts of the head, upperparts and underparts.
NON-FEATH – Includes all non-feather parts including bill, mouth, eye, legs, and feet. A note is required if this column is used.

The codes entered in these fields reflect the feather generation(s) present within the particular feather tract (or multiple feather tracts in the case of secondary coverts or body plumage). Note that in the material that follows, we use the new molt terminology of Howell et al. (2003). 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 use of any of the following three codes indicates a HY/SY bird:

J – Juvenal. Feather tract comprised of all retained juvenal (or a mix of juvenal and alternate) feathers; no formative (= "first basic" in Pyle 1997) feathers are present within the tract. This code should also used for NON-FEATH if non-feathered body parts show characteristics indicative of a young bird.
L – Molt limit. Molt limit between juvenal and formative feathers exists **within** the tract, regardless of whether alternate feathers are present or not.
F – Formative. Feather tract comprised entirely of formative (or a mix of formative and alternate) feathers; no juvenal feathers are present within the tract.

The use of the following code indicates an AHY/ASY 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). This code should also be used for NON-FEATH if non-feathered body parts show characteristics indicative of an adult bird.

Individuals of some near-passerine species (e.g., woodpeckers) can be aged to SY/TY and ASY/ATY (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 juvenal 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 juvenal and basic (rather than juvenal and formative) feathers are present from situations in which two generations of basic (not formative) feathers are present:

R – Retained. Both juvenal and basic (rather than juvenal and formative) feathers are present within the feather tract (e.g., see Figs. 25 and 26 in Froehlich 2003). This code would be indicative of a SY/TY bird.
M – Mixed. Multiple generations of basic feathers are present in the tract (e.g., see Fig. 28 in Froehlich 2003). This code would be indicative of a ASY/ATY bird.

The following three codes, although of little use for ageing during the overwintering season, should be used for feather tracts examined, but not meeting any of the above criteria:

A – Alternate. **ALL** feathers in the feather tract are of alternate plumage; if **ANY** juvenal, 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". This code provides no useful information for ageing birds.
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; the feathers in the tract could be juvenal, formative, or basic feathers.
N – Non-juvenal. Feathers in this tract are definitely not juvenal 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.

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 identification of a HY/SY bird (i.e., AGE = 2 prior to Jan. 1 or AGE = 5 after Dec. 31). HY/SY birds are usually identified by the retention of juvenal 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 juvenal 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 juvenal 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 juvenal and formative feathers can be discerned, the bird should be aged by molt limit (HOW AGED = L). If, however, a molt limit can not be discerned, but the juvenal feathers present can be distinguished as juvenal (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 AHY/ASY bird (i.e., AGE = 1 prior to Jan. 1 or AGE = 6 after Dec. 31) after its prebasic molt. Birds of this age are typically distinguished by having undergone complete prebasic molts – adjacent feather tracts show little if any contrast in color 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 juvenal) 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 limits (HOW AGED = L) because there is no molt limit evident. Note that any alternate feathers present provide no information as to whether the individual is a SY or ASY bird.

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. A bird with no reliable feather tracts or for which conflicting characteristics make age determination difficult should be aged as unknown (AGE = 0) prior to Jan. 1 or AHY (AGE = 1) after Dec. 31.

WING – The unflattened wing cord should be determined **to the nearest 1 mm** using a wing rule (see Pyle 1997 and Ralph et al. 1993 for instructions for measuring wings). 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. **Remember: wing cord and mass (below) are among the most important data collected at MoSI stations because they enable an assessment of body condition.**

MASS – Body mass should be determined **to the nearest 0.1 g** using a portable battery-operated balance.

STATUS – Record status as a single, three-digit code as shown in Bird Banding Offices 1991 (revised 1992). The most-frequent codes are "300" - normal wild bird captured, banded, and released; "301" - normal wild bird captured, banded and color-banded, and released; "500" - injured banded bird (see DISP); and "501" - injured banded and color-banded 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 not included in schedules submitted to the banding offices, and that this status code is not recognized by the banding offices.

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 months and days as two-digit numbers (e.g., June is written "06").

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 entered. Do not enter the time at which the bird was extracted, processed, or released. Always enter three digits. For example 2:40 p.m. or 14:40 would be entered as "144".

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

NET – Enter a two-digit, numeric code (e.g., "06") to indicate the net site at which the bird was captured. It is important that net codes not include alpha characters or be more than two characters long.

DISP – Disposition. Enter a code from the list below indicating the final disposition of an injured or dead bird. A bird is considered "injured" if its survival probability is thought to be compromised, or for healed injuries, could have previously been compromised. A minor flesh wound or loss of a few feathers is generally not worthy of note. Injured or dead birds should have a status code of "500" or "000," respectively (see above). We recognize nine categories for injured birds and two for dead birds:

<u>Injured birds</u>
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 (often, unable to fly).
B – Body injury.
L – Leg injury.

<u>Dead birds</u>
P – Predator-caused mortality.
D – Death due to a cause other than predation.

NOTE NUMBER – Enter a number (starting with "1" on each page) if additional information is recorded and record this information with the corresponding note number in the NOTE NO. field on the back of the banding-data sheet. 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).

COLOR BANDS – This 5-character field is used to indicate color band combinations. Up to four of the five available spaces should be used to indicate band colors [e.g., L = light blue, Y = yellow, G = green, S = silver (metal), etc.]. The order in which color codes are entered should correspond to their relative positions on each leg. The leftmost space or spaces are used for the left leg and the rightmost space or spaces for the right leg. A slash "/" is used to distinguish left from right legs. For example, a bird with a light blue band above a yellow band on the left leg, and a green band above a silver (metal) band on the right leg would have (based on the example color code definitions above) its color band combination entered as "LY/GS". When banding data are submitted at the end of each MoSI season, a separate sheet must be included to define the color band codes used.

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 – 1 mm wide swab used to collect the sample from within the cloacal cavity.
2 – 2 mm wide swab used to collect the sample from within the cloacal cavity.

Back of the banding-data sheet: The back of the banding sheet is comprised of two fields (Fig. 3B):

NOTE NO. – Corresponds to the NOTE NUMBER field on the front of the banding sheet and is used to index all additional notes taken for each record.

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 sex code "U"; details of any "O" (other) code for HOW AGED or HOW SEXED; and explanations for injured, dead, and unbanded birds. Please be liberal in your note-taking, especially to indicate which, if any, flight feathers are missing, erupting, or in sheath.

7. FEATHER COLLECTION

In order to help link breeding and wintering migratory bird populations, we encourage MoSI station operators to collect feathers from migratory birds captured at their stations. These feathers will be archived and analyzed as part of the Neotropical Migratory Bird Conservation Genetics Project at the Center for Tropical Research at the University of California - Los Angeles. Questions related to this project should be directed to Borja Mila, Center for Tropical Research, Institute of the Environment, University of California – Los Angeles, 1609 Hershey Hall, 610 Charles E. Young Dr. East, Los Angeles, CA 90095, USA; (310) 206 6234; bmila@ucla.edu. The following protocol was submitted by Borja.

7.1 FEATHER COLLECTION PROTOCOL

Feathers can be collected from any species of interest (bearing in mind that special permits are required for endangered species). However, based on samples from the breeding grounds and other criteria, 37 species have been selected as priorities for this project (Table 4; note that this list is more extensive than, and differs slightly from, the list of MoSI target species).

Table 4. Priority species for feather collection for the UCLA Neotropical Migratory Bird Conservation Genetics Project.

Empidonax difficilis	*Dendroica nigrescens*
Empidonax occidentalis	*Dendroica townsendi*
Empidonax traillii	*Oporornis tolmiei*
Turdus migratorius	*Oporornis formosus*
Catharus fuscescens	*Mniotilta varia*
Catharus ustulatus	*Setophaga ruticilla*
Catharus minimus	*Seiurus aurocapilla*
Catharus guttatus	*Geothlypis trichas*
Hylocichla mustelina	*Wilsonia citrina*
Vireo gilvus	*Wilsonia pusilla*
Vireo plumbeus	*Icteria virens*
Vireo huttoni	*Piranga ludoviciana*
Vireo leucophrys	*Piranga rubra*
Vermivora celata	*Pheucticus melanocephalus*
Vermivora ruficapilla	*Melospiza melodia*
Dendroica petechia	*Melospiza lincolnii*
Dendroica coronata	*Spizella passerina*
Dendroica auduboni	*Carduelis pinus*
Dendroica virens	

For up to 30 individuals of priority species per location, one inner and one outer rectrix should be pulled, one from each side of the tail. It is very important not to touch the tip of the rachis of pulled feathers as this is where the epithelial cells for DNA extraction will be taken. Pulled feathers should be placed in an envelope (one envelope per sample) and sealed. The following information should be clearly recorded on the outside of each envelope:

(1) Species
(2) Band Number
(3) Date
(4) Locality (station name, nearest town, state or province, and country)
(5) Age, sex, and reproductive condition of the bird.

At the end of each MoSI season, station operators should contact regional coordinators for instructions on submitting feather samples.

8. SUMMARY OF MIST-NETTING RESULTS

This summary allows us to ascertain whether all capture records have been submitted for each station. It also allows us to check whether the date and station code were correctly recorded for each capture. This form can be obtained from regional MoSI coordinators or downloaded at www.birdpop.org/MoSI/MoSI.htm.

8.1 COMPLETING THE SUMMARY OF MIST-NETTING RESULTS FORM

Complete this form at the end of each banding day using your raw banding-data sheets. Please, do not fill out this sheet from your computer file! Below, we provide detailed instructions for filling in each field contained in the form.

Location: Record your four-character location code.

Station: Record your four-character station code.

Year: Record the current winter season (i.e., 2009-10).

Intended Period: Indicate the period number for which the day's effort was intended (see Table 2).

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

New: Record the number of new individuals banded. Remember, if a bird dies before release, it should be recorded as *unbanded*. Bands applied to any such bird should be removed and 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 here. Birds with replaced or added bands should also be counted as recaptures.

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.

9. RESIDENCY STATUS LIST

The Residency Status List (RSL) provides another means (in addition to banding) of monitoring the site occupancy of bird species at MoSI stations throughout the winter season. By incorporating information on bird behavior, the RSL also helps determine whether a particular species is a resident at the site. Because the RSL is an adaptation of the Breeding Status List used by the MAPS Program, many behavioral categories will apply primarily to breeding residents (and not overwintering NTMBs).

RSLs provide very useful information for mark-recapture analyses. For example, individuals of a species only captured early in the MoSI season at a particular station could represent a population of passage migrants (e.g., at stations near the edge of the species wintering range), a population exhibiting net avoidance (a negative "trap response;" Pollock et al. 1990), or a population comprised of few residents and many transients that are mostly present early in the season. Distinguishing the latter two scenarios from the first is critical for obtaining unbiased estimates of the proportion of residents in the larger (i.e., pooled across stations) population (Pradel et al. 1997). The proportion of residents, aside from being a nuisance parameter for the modeling of survival, probably varies predictably as a function of population change and, thus, may be of fundamental importance to avian population dynamics. By recording observations of species with low recapture probabilities, or comprised largely of transients, the distinction between these different types of populations can be made easier.

9.1 COMPLETING THE RESIDENCY STATUS LIST

MoSI stations for which no previous RSLs have been received by regional coordinators should begin the MoSI season with a blank RSL form. As with other MoSI data sheets, blank RSL forms can be downloaded at IBP's MoSI Program website: www.birdpop.org/MoSI/MoSI.htm. RSLs preprinted with station-specific species lists (in AOU checklist order) will be sent by regional coordinators to MoSI station operators that have previously submitted RSLs. On each station visit, the daily residency status of each bird species and the criteria used to determine that status should be indicated on the RSL form. These data should be entered in the daily status fields beneath the headings for each pulse ("Day in period 1", ..., "Day in period 5"). New species should be added to the RSL list as they are encountered. The LOCATION CODE, YEAR, STATION CODE, SPECIES, and SPEC6 (equivalent to the 6-letter alpha-code) fields are to be filled in the same manner as for banding-data sheets (section 6). Names of observers for each period should also be entered at the top of the sheet. Daily residency status codes and the behavioral criteria used in their determination are listed in Table 5 and are summarized at the top of the RSL. For each species each day, provide only the highest daily residency status (i.e., B, R, or O) recorded that day and the highest behavioral criterion for that status.

TABLE 5. Daily residency status codes and behavioral criteria used in their determination. On each day of station operation, one uppercase (residency status) and one lowercase (criteria) letter should be entered on the Residency Status List (RSL) to indicate their status on the study area. The hierarchy of daily status codes is B, R, O, in that order and, for each residency status, the hierarchy of criteria is as shown.

Daily Status	Criteria
B = Breeder	**n** = current year's nest found in the study area in the process of being built, with eggs or young, 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 = young bird incapable of sustained flight (a "local") captured or very young (stub-tailed) fledglings found being fed by parents.
	c = courtship behavior or copulation observed in the study area of a species within its breeding range.
R = Resident	**p** = behavior indicating active pair bond (e.g., pair foraging together) observed.
	s = territorial song or drumming heard.
	t = other territorial behavior observed.
	r = bird observed at same location where observed during a previous pulse.
O = Observed	**b** = bird banded or captured.
	e = bird encountered in the study area but not exhibiting resident behavior.
	o = bird observed flying over the study area
– = Absent	bird not encountered on that day.

In addition to the daily residency status fields, the RSL contains fields for the seasonal (WINTER STATUS) and cumulative (RSTAT) status of birds on the study area. The WINTER STATUS field should be filled in by MoSI Cooperators at the end of the MoSI season; it summarizes the daily status determinations and indicates the overall status of each species for that winter period. Codes used for the WINTER STATUS field are the same as those used for daily status (B, R, O, or –) and are defined in Table 6.

As indicated above, station operators that have submitted RSLs in previous years will receive an RSL form at the beginning of each MoSI season for each station they operate that is preprinted with the species list from prior seasons. These preprinted forms will also contain codes in the RSTAT field representing the cumulative status of birds across all years that the MoSI station has been run. The RSTAT field is preprinted with dashes on the blank RSL forms used by new MoSI station operators (and operators that have not previously submitted RSL forms). RSTAT codes are defined in Table 7.

TABLE 6. Seasonal residency status (WINTER STATUS) codes and criteria used in their determination. The seasonal status represents a summary of daily status codes.

WINTER STATUS	Criteria
B = Breeder	Evidence of breeding observed on at least one day at the station during the MoSI season.
R = Resident	Species observed on the study area throughout the winter period. Evidence of territoriality noted during at least two pulses or repeated observations of individual birds at particular locations are good indicators of residency.
O = Observed	Species typically observed during only one or two pulses (particularly 1 and 5) or, if recorded more frequently, exhibiting no signs of residency.
– = Absent	Bird not observed during that particular MoSI season. This code will not be used for the first season for which an RSL is submitted because all species on the RSL in that season will be those entered by the MoSI station operators. RSLs in subsequent years, however, will have pre-printed species lists, and some of the species on those lists might not be observed in a particular year.

TABLE 7. Cumulative residency status (RSTAT) codes. RSTAT represents a summary of seasonal status (WINTER STATUS) codes.

RSTAT	Criteria
RB = Regular breeder	Evidence of breeding observed during all years of MoSI station operation.
UB = Usual breeder	Evidence of breeding observed during > ½ of all years of MoSI station operation.
OB = Occasional breeder	Evidence of breeding observed during ≤ ½ of all years of MoSI station operation.
RR = Regular resident	Evidence of winter residency (but not breeding) during all years of MoSI station operation.
UR = Usual resident	Evidence of winter residency (but not breeding) during > ½ of all years of MoSI station operation.
OR = Occasional resident	Evidence of winter residency (but not breeding) during ≤ ½ of all years of MoSI station operation.
TR = Transient	The station lies within the winter range of the species, but evidence of winter residency has never been observed.
MI = Migrant	The species is a passage migrant at the station (i.e., the station lies outside the winter range of the species).
? = Unidentified	Individuals of the taxon not identified to species; no residency status assigned.

10. STATION MAPPING AND HABITAT ASSESSMENTS

Create a station map of the study area

Please draw a map of the station (study area) on coarsely-gridded graph paper (grid lines spaced at about 1/4 inch or 1/2 cm intervals) using a scale of about 1/4 inch = 20 m or 1 cm = 40 m. On the map, draw the boundary of the station, which should extend 50 m or a little farther beyond the outermost nets and should total about 20 ha (200,000 m^2). The longer axis of the station should be oriented with the longer axis of the paper, and the top of the paper should be oriented either to compass north or east, depending on the orientation of the longer axis of the station. The east-west lines should be labeled alphabetically beginning at "A" at the southwest corner of the map, and the north-south lines should be numerical beginning at "0" at the southwest corner of the map. Coordinates on the grid can be used to help track color banded birds (for stations incorporating color banding and resighting as part of their protocol; see section 4.3) and will serve to delineate units for habitat descriptions. Clearly delineate the station boundary, boundaries between major habitat types (up to five habitat types allowed), net locations and orientations, and bodies of water (streams and ponds), roads, trails, and human-made structures. Using the map, estimate the percentage of the station (study area) covered by each habitat type by counting the number of grid squares contained within each habitat type and dividing by the total number of grid squares within the station (study area). Create a short descriptive name for each habitat type present in the study area, and provide a legend for the map by assigning a letter on the map to each habitat type, starting with "A" for the most extensive habitat, followed by "B" for the second most extensive habitat type, "C" for the third most extensive habitat type, etc.

Complete the MoSI Habitat Assessment Form

Use copies of the MoSI Habitat Assessment Form (one for each habitat type) to provide an overall description of each habitat type, as well as to describe and record the percent coverage and average height of each layer (canopy, subcanopy, shrub, and ground cover) present in each distinct habitat type found at the station (in the study area). Use the following guidelines for recording data and information on the data form:

Fill in the **headings** of the form, including the location, station, page number, date, observers, total number of habitat types present (thus the number of pages), the letter code and name of the particular habitat type being described, and the percentage of the study area covered by that habitat type.

Provide a detailed, overall **description of the habitat**. When describing the habitat, record details that will allow a reader who has never seen the station to visualize the habitat being portrayed. This section should include the types of information one would relay to another biologist when describing the station, particularly as it relates to the bird species using the habitat. Start this written description with the physical characteristics of the habitat type, including its general topography (slope and aspect) and whether it is well- or poorly-drained (i.e., is the ground usually dry and hard or soft and wet?). If it is a forest or woodland habitat type, does it tend to be dense and closed or sparse and open, and how uniform are these characteristics throughout its extent of the study area? If it is a shrubland habitat type, is the shrub cover

uniform or does it vary throughout its extent of the study area? If the latter, how does it vary? Describe characteristics of the edges where the particular habitat type being described meets other habitat types. Is it an abrupt easily discernable edge, or does the habitat type grade into another habitat type over a diffuse edge? An example of a detailed description of the habitat type might be: This broadleaf forest is dense and moist. Being late-seral in age, many species of varying ages are present throughout the habitat forming an emergent canopy as well as a dense subcanopy. Emergent trees are of two species, heavily buttressed, spaced evenly apart, and grow to a height of 37 m. There are approximately 8 different species of subcanopy trees growing throughout spaces between the emergent trees forming a definite vegetation layer at 23 m. Subcanopy tree species present include a *Ficus* and a *Bursera*. Shrubs grow up sparsely between trees and include: *Palicourea coccinea*, *Pipper nigrum* and a *Miconia sp*. The ground cover consists mostly of decomposing litter atop a moist forest floor. Habitat edge grades abruptly into open post-clear cut agricultural land.

Describe the **successional stage** (or actual age if known) of the habitat type. Use terms like early-successional (young), mid-successional, late-successional (mature), post-successional (old growth).

Describe any **natural disturbance history or regime** (e.g., regularly flooded in late spring; subjected to irregular hurricanes, the most recent in 1992; burned by major fire in 1985; etc.).

Describe any **known human-caused disturbance of management history** (e.g., selectively logged in 1998; cleared for pasture during 1980s, but a few scattered large trees left standing; grassy field maintained by heavy grazing; etc.).

Record up to four **layers of vegetation**: canopy, subcanopy (defined as a distinct layer of vegetation that extends upward to below the canopy), shrub (defined as all vegetation between 0.5 and 5 m), and ground cover (defined as all vegetation below 0.5 m). Record the **percent cover** for each layer to the nearest 10 % (i.e. <5%, 5-15%, 15-25%, 25-35%, etc.). Any given habitat may or may not have a canopy, subcanopy, or shrub layer. If a layer is not present, record "0" in the percent cover field. The percent cover in the subcanopy and canopy sections should include epiphytes and lianas when present. Estimates should be made by traversing the habitat type as thoroughly as possible and providing estimates that are representative of the entire habitat.

Estimate the average **height** of each layer to the nearest meter. Again, estimates should be made by traversing the habitat type as thoroughly as possible and providing estimates that are representative of the entire habitat.

For canopy and subcanopy layers, circle the appropriate **number of snags** present within the entire area of that habitat contained in the study area.

Provide a list of the **major species present** in each vegetation layer. Identify to species, genera, or family to the extent possible.

Provide a detailed description of **each layer within the habitat.** Be sure to describe any non-living substrate (such as litter, rocks, and dirt) present when describing the ground cover. An example of a detailed canopy layer description might be: Open canopy of emergent broad leaved trees, trunks and tree tops spaced evenly apart throughout habitat and grow to a height of 34 m. An example of a detailed subcanopy layer description might be: At least eight species contribute to a dense subcanopy layer forming a definite vegetative mass from 16 – 24 m above ground. Subcanopy trees dominated by three species with at least five others associating in varying amounts. Lianas grow throughout forest structure.

An example of a detailed shrub layer description might be: Few true shrubs are found in this forest; most of the moderate amount of clumpy shrub growth occurs in sunny openings in the forest and is made up of young forest trees of a few species found in the subcanopy layer when mature. A few true shrubs do grow beneath the subcanopy, typically in moist areas and not in association with emergent trees. An example of a detailed ground cover layer description might be: Sparse amounts of living ground cover in the form of mixed species of forbs growing in small amounts throughout plot. Majority of ground covered by deciduous broadleaf litter, sticks, and bare exposed moist dirt.

If **running water** or **standing water** is present in the habitat type, circle all the types that apply to each, estimate the total percent coverage of the particular habitat type that each provides, and circle their appropriate permanence.

11. DATA SUBMISSION

All MoSI data should be submitted as e-mail attachments to MoSI regional coordinators and cc'd to the overall MoSI Coordinator, Peter Pyle (ppyle@birdpop.org). Data from Mexican stations should be submitted to José Luís Alcántara (jlalcant@colpos.mx) and cc'd to Peter Pyle; data from Central America should be submitted to Lety Andino (letyandino@salvanatura.org) and cc'd to Peter Pyle; and Caribbean data should be submitted to Jim Saracco (jsaracco@birdpop.org) and cc'd to Peter Pyle. Data to be submitted annually include all information contained on the following forms:

(1) Completed MoSI Banding Sheets
(2) Completed MoSI Unbanded Sheets
(3) Completed MoSI Recaptures Sheets
(4) Completed Summary of Mist-Netting Effort (for each station)
(5) Completed Summary of Mist-Netting Results (for each station)
(6) Completed Residency Status List (for each station)

Habitat data should also be submitted at least once during the MoSI pilot project. All data should be submitted as spreadsheet (preferably Microsoft® Excel) files. For all banding-data, be sure to enter data for a single field of the banding sheet into a single spreadsheet cell (**e.g., band number should be recorded in a single cell, not spread out over nine cells**). Also be sure to include *only the fields included on the raw data sheets*; these fields should *follow the same order as they appear on the banding-data sheets.* Finally, DO NOT use date or hour cell formats for the DATE and TIME fields of spreadsheet files. To ensure that data are submitted in proper

format, templates for all spreadsheets will be provided to all cooperators prior each MoSI season. File structure templates can also be downloaded at the MoSI website: www.birdpop.org/MoSI/MoSI.htm.

For stations receiving funding through IBP, banding-data for Periods 1 and 2 (Nov. 2-Dec. 31) should be submitted to regional coordinators during January, so that the first payment can be sent to you; **all data should be submitted by 15 April** (or as soon thereafter as possible). All other cooperators should submit the entire season's data as soon as possible after completion of the current season's work. All cooperators should bear in mind that late (and incomplete) data compromise our ability to conduct analyses, prepare reports, and submit funding requests.

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