# THE NORTH AMERICAN BANDERS' STUDY GUIDE

**A product of the**
**NORTH AMERICAN BANDING COUNCIL**

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THE NORTH AMERICAN BANDERS' STUDY GUIDE

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## PREFACE

The purpose of this Banders' Study Guide is to provide for all banders in North America the basic information to safely and productively conduct bird banding.

This publication is an integral part of several other publications, including a Trainer's Guide, and taxon-specific manuals for landbirds, hummingbirds, shorebirds, raptors, waterfowl, seabirds, and perhaps other groups. While some of the material in this Study Guide may apply more to certain taxa, the material was included if it applied to two or more of the taxa mentioned above. For instance, mist netting is used to capture most taxa (and thus is discussed in this study guide), but skull pneumatization is used primarily for landbirds (and therefore is discussed only in the landbird manual). Some judgments have been made; for instance, traps for catching landbirds are mentioned in that manual, although similar traps are certainly used for shorebirds and waterfowl. The Committee felt, however, that the special adaptations required for capture of these quite different taxa merited separate treatment in the taxon-specific manuals.

We trust that this Guide will be read by all banders and trainers. While guidelines used by various individual trainers and stations may differ slightly from the general guidelines set down in the manuals and guides, we and the North American Banding Council urge, at the least, that full consideration be given to the guidelines presented here, and that trainees be fully exposed to the full variety of opinions that are captured in these publications.

This is a truly cooperative venture, representing many hours of work of many individuals and their institutions. As such, it was necessarily an inclusive document covering, as much as possible, all responsible views of banding in North America. As can be imagined, this was at times an interesting effort. We trust that the final product is worthy of the effort that all have put into it, and of the birds that we study and cherish.

—The Publications Committee of the
North American Banding Council
C. John Ralph, Chair

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The original guide was prepared under contract from the Canadian Wildlife Service to Long Point Bird Observatory and was funded through the Environmental Citizenship Program of the Department of the Environment.

This *North American Banders' Study Guide* has been created, adapted, and considerably augmented for use throughout North America by the North American Banding Council's Publications Committee. This guide is very much the product of many years of collective experience on the part of all the banders and students at Long Point Bird Observatory, Point Reyes Bird Observatory, The Institute for Bird Populations, and many other stations and individuals. It is largely a compendium of material taken from other sources. Some parts summarize important details presented in *North American Bird Banding: Volume I* (Canadian Wildlife Service and U.S. Fish and Wildlife Service 1991) and *North American Bird Banding Techniques: Volume II* (Canadian Wildlife Service and U.S. Fish and Wildlife Service 1977) (see also http://www.pwrc.usgs.gov/bbl/manual/manual.htm). These manuals, collectively, hereafter will be referred to simply as the "Bird Banding Manual." This guide is not intended to supplant the Bird Banding Manual; they still are required reading.

Technical sections of this guide profited enormously from *The Ringer's Manual* (Spencer 1992), *The Australian Bird Bander's Manual* (Lowe 1989), *A Manual for Monitoring Bird Migration* (McCracken et al. 1993), *Handbook of Field Methods for Monitoring Landbirds (*Ralph et al. 1993a), *A Syllabus of Training Methods and Resources for Monitoring Landbirds* (Ralph et al. 1993b), *Identification Guide to North American Passerines* (Pyle et al. 1987), *Identification Guide to North American Birds (Part 1)* (Pyle 1997a), the *MAPS Manual* (Burton and DeSante 1998), the *MAPS Intern Manual* (Burton et al. 1999), and the *Mist Netter's Bird Safety Handbook* (Smith et al. 1999). These references (and others listed in the Bibliography) should be read to gain further insight.

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—Publications Committee

## 1. INTRODUCTION

Bird banding is both a delicate art and a precise science. It should come as no surprise that it requires not only sensitivity and intelligence, but also training. This is in the interest of the birds' safety and in the interest of gathering accurate and useful information.

Nearly all beginning banders are nervous and a little awkward. This is a good sign because it signals that you understand that you are holding something very much alive and precious. After a time, though, it is all too easy to become complacent. A good bander is always on guard against complacency and realizes that, above all, banding is a great privilege.

*The North American Banders' Study Guide* and *The Instructor's Guide to Training Passerine Bird Banders in North America* are designed to complement each other. All banders and prospective banders should familiarize themselves with the information presented in the Study Guide. The Instructor's Guide, however, is generally available only to trainers.

The motivating factor in the production of these guides is the safety and welfare of the birds involved. Indeed, this principle takes precedence over all other considerations in any kind of banding operation.

You may want to band birds only as a small part of a short-term research project, perhaps focusing on a single species, or you may plan to use banding as a major part of your future work. In either case, responsibilities are the same and you need the same basic skills. Some people will need only limited training. For example, if you are banding only geese, it probably does not really matter whether you can tell a robin from a Blue Jay. Your trainer can recommend that a banding permit be limited to a certain species or trap type, or issued for use on a specific project only.

Training must be by a qualified trainer. The North American Banding Council (NABC) maintains a complete listing of NABC-certified trainers in specific geographic regions. For information on NABC, contact the Banding Offices or web site (http://nabanding.net/nabanding/).

The amount of training required depends on the nature of your project, the type of permit you want to acquire, the speed at which you learn, the accessibility of a good trainer, and the availability of training opportunities. It is difficult to establish quantitative guidelines regarding how much time is required or how many birds need to be handled. If you think you need a permit in a hurry, remember that basic training is still a requirement, and you should plan for this. This is particularly relevant to graduate students, who should allow sufficient time for thorough training.

In a NABC-approved evaluation procedure, a trainer must assess a student's knowledge and practical skills, following completion of a step-wise training program. The trainer grades students according to the specifics of the banding project that they will do. Some students will have specific research projects (e.g., graduate students studying a single species), while others will have much broader interests (e.g., personnel at bird observatories). Your permit should reflect the specifics of your research, and you must inform your trainer of any special needs you might have.

Along with a training manual, trainers are supplied with a "Bander's Report Card" to guide the assessment process. A copy of this report card is provided as Appendix E in this manual, to give an overall feel for the content and structure of a thorough training program.

Much information is presented in this guide. Students must read it over at least once before their training to orient themselves and preview what will be learned. After a week or two of training, it should be reviewed in its entirety.

What makes for a good student? A good student is never afraid to ask questions or to insist on adequate training time. First observe, then perform each task under supervision. Learn each new step openly in front of your trainer, so that he or she can see exactly what you are doing. Once you are permitted to do certain things alone, have your trainer spot-check you to see that you are not developing bad habits and to ensure that your age and sex determinations and measurements are reliable. "Brush-up" sessions with your trainer after a few weeks or months on your own can be very helpful. Don't get arrogant or over-confident; a good bander has a life-long attitude that there is more to learn, and recognizes that everyone, even the most experienced, can make a mistake now and then. Keep your humility. At the same time, confident handling is important to bird safety and that's what we want you to learn.

## 2. THE BANDER'S CODE OF ETHICS

Bird banding is used around the world as a major research tool. When used properly and skillfully, it is both safe and effective. The safety of banding depends on the use of proper techniques and equipment and on the expertise, alertness, and thoughtfulness of the bander.

The Bander's Code of Ethics applies to every aspect of banding. The bander's essential responsibility is to the bird. Other things matter a lot, but nothing matters so much as the health and welfare of the birds you are studying. Every bander must strive to minimize stress placed upon birds and be prepared to accept advice or innovation that may help to achieve this goal.

Methods should be examined to ensure that the handling time and types of data to be collected are not prejudicial to the bird's welfare. Be prepared to streamline procedures of your banding operation, either in response to adverse weather conditions or to reduce a backlog of unprocessed birds. If necessary, birds should be released unbanded, or the trapping devices should be temporarily closed. Banders should not consider that some mortality is inevitable or acceptable in banding. Every injury or mortality should result in a reassessment of your operation. Action is then needed to minimize the chance of repetition. The most salient responsibilities of a bander are summarized in the Bander's Code of Ethics; more details are found in Section 13.

Banders must ensure that their work is beyond reproach and assist fellow banders in maintaining the same high standards. Every bander has an obligation to upgrade standards by advising the Banding Offices of any difficulties encountered and to report innovations.

Banders have other responsibilities too. They must submit

## *The Bander's Code of Ethics*

1. ***Banders are primarily responsible for the safety and welfare of the birds they study so that stress and risks of injury or death are minimized*. Some basic rules:**
   **- handle each bird carefully, gently, quietly, with respect, and in minimum time**
   **- capture and process only as many birds as you can safely handle**
   **- close traps or nets when predators are in the area**
   **- do not band in inclement weather**
   **- frequently assess the condition of traps and nets and repair them quickly**
   **- properly train and supervise students**
   **- check nets as frequently as conditions dictate**
   **- check traps as often as recommended for each trap type**
   **- properly close all traps and nets at the end of banding**
   **- do not leave traps or nets set and untended**
   **- use the correct band size and banding pliers for each bird**
   **- treat any bird injuries humanely**

2. ***Continually assess your own work to ensure that it is beyond reproach.***
   **- reassess methods if an injury or mortality occurs**
   **- ask for and accept constructive criticism from other banders**

3. ***Offer honest and constructive assessment of the work of others to help maintain the highest standards possible.***
   **- publish innovations in banding, capture, and handling techniques**
   **- educate prospective banders and trainers**
   **- report any mishandling of birds to the bander**
   **- if no improvement occurs, file a report with the Banding Office**

4. ***Ensure that your data are accurate and complete.***

5. ***Obtain prior permission to band on private property and on public lands where authorization is required.***

their banding data to the Banding Offices promptly, reply promptly to requests for information, and maintain an accurate inventory of their band stocks. Banders also have an educational and scientific responsibility to make sure that banding operations are explained carefully and are justified. Finally, banders banding on private property have a duty to obtain permission from landowners and to make sure their concerns are addressed.

## 3. A BRIEF HISTORY OF BANDING

The first recorded instance of bird marking dates back to about 200 BC when marked birds were used as messengers by the military and sportsmen. Until the inception of systematic, scientific bird banding in Denmark in 1899, all attempts to mark birds were individualistic, involving the use of nonstandard markers such as colored string, paint, metal shields around the neck or tarsus, and toe clipping.

Ernest Thompson Seton and John James Audubon are acknowledged as the first "banders" in Canada and the U.S., respectively, even though they did not use bands. Audubon tied silver wire around the legs of nestling Eastern Phoebes in

Pennsylvania in 1803 and was lucky enough to have the first returns in North America when he caught two of his nestlings again the next spring. In Canada, Seton marked several Snow Buntings with printer's ink in 1882 in Manitoba.

Key to the development of a continent-wide banding and recovery program was the formation and acceptance of a single concept; namely that, with the cooperation of North American ornithologists, the capture, marking, and subsequent encounters of individual birds would lead to invaluable data on species' habits, migration routes, and population status. Leon Cole was the first to publicly and formally introduce scientific bird banding to North America at a Michigan Academy of Science meeting in 1901, but it was P.A. Taverner who initiated the centralized distribution of standardized, aluminum bands. In 1904, Taverner placed a note in the *Auk*, offering bands to ornithologists wishing to cooperate in a banding project. James H. Fleming of Toronto, Ontario, was the first to use these bands, in 1905.

In 1909, the American Bird Banding Association (ABBA) was formed. As a central organization whose role was to oversee the issue of standardized bands as well as the collection and storage of the resulting banding data, the ABBA greatly contributed to the efficiency of the banding program. In 1911, the Linnaean Society of New York offered to administer the banding program for the ABBA, helping to cover the rising administrative costs of the program.

With the signing of the Migratory Bird Treaty Act in 1916 came increased cooperation between Canada and the U.S. and the recognition that migratory birds were of international concern. The development of the banding scheme continued under the direction of the Bureau of Biological Survey of the U.S. Department of Agriculture in 1920. In 1922, Canada's Dominion Parks Branch became officially involved, and by 1923 the Canadian government was responsible for the administration of banding efforts in Canada. Bands were standardized throughout North America and each country became responsible for its own banding data. Now, the U.S. Geological Survey and Canadian Wildlife Service are jointly responsible for administration of the North American banding program.

## 4. PURPOSES AND JUSTIFICATION FOR BANDING BIRDS

### 4.1. The Banding Offices

The work of the Bird Banding Offices in Canada and the U.S. is closely coordinated. Each office acts as a center for the administration of banding within its own country, reviewing proposed banding projects, and issuing bands, auxiliary markers, and banding permits to qualified banders. All banding and recovery data are computerized and freely exchanged between offices. Each country encourages the use of the database by banders and researchers. In so doing, the offices promote the publication of significant findings resulting from bird banding. However, banding birds is not a conservation or research program in itself. The Canadian Wildlife Service and United States Geological Survey do not have a conservation program called "bird banding," and neither government has researchers looking at data collected from banding. Hence, banders are not making a *bona fide* contribution to research if they are banding birds only for the purpose of contributing to the North American database on banding and recovery. While all banding data are potentially valuable, the value of banding data increases enormously if it is collected under a well-designed study or is part of a cooperative program. We strongly encourage all banders to think hard about the usefulness of the information being gathered. Banders are obliged to ensure that their study design and the collection and analysis of data are sound, and that their results are published. The Banding Offices review all applications for permits. If an application is turned down because it lacks scientific merit, this decision should be respected.

### 4.2. Purposes and Justification for Banding Birds

As detailed in Buckley et al. (1998), the basic purposes and justification for banding birds are its scientific merits: it provides data vital for scientific research into bird populations and for the conservation and management of those populations. While some of these data can be provided in other ways, banding often remains the most cost-effective approach. Banding, recovery, recapture, and resighting data remain critical for the conservation and management of birds. Their use in the setting of annual species and bag limits for game birds provides an immediate and widely appreciated example. At the level of basic scientific knowledge, banding is also a valuable tool for obtaining information about avian populations, movements, behavior, etc., regardless of any immediate conservation or management value. Lastly, banding has legitimate and widespread educational values over and above its scientific value.

It is not always appreciated, especially by governmental bodies and the public, exactly how valuable good banding data are, and the important uses to which they are routinely put. Examples include:

(1) Providing knowledge about movements of birds—e.g., establishing migration routes, finding links between breeding and wintering grounds, delineating separate populations, tracking range expansions and colonizations, measuring dispersal within populations, quantifying gene exchange among populations;

(2) Estimating demographic parameters and determining dynamics of bird populations—e.g., estimating annual production of young birds or age-dependent annual survival rates, building models of population dynamics for predicting extinction probabilities, separating population sources and sinks, comparing survival rates of experimental or rehabilitated birds to those of wild birds;

(3) Management of gamebirds—e.g., delimiting flyways; estimating harvest pressure for input to the establishment and modification of hunting regulations; measuring differential vulnerability to harvest and other risks by species, age, sex, and geographic location;

(4) Ecological research requiring individual recognition—e.g., estimating territory size and examining the importance of migrant stopover areas through individual stopover time and weight gains, as well as habitat selection, dominance hierarchies, molting strategies, molt patterns, and the parasite burdens of individuals;

(5) Monitoring populations and individuals—e.g., monitoring Endangered or Threatened species, identifying populations declining from decreased reproductive output or from diminished recruitment, establishing population trends, and validating other techniques of population monitoring;
(6) Educating the public about science and birds—e.g., teaching, in the hand, about birds, their movements, their plumage differences, and how molt proceeds; reinforcing stewardship responsibilities.

We emphasize that the maximum value of banding data is realized only when: (a) accurate and standardized (or well-documented) data are taken; (b) these data are stored centrally and made readily available to analysts and researchers; and (c) the data are used, and the results are published.

Over 1.2 million bands are issued annually in the North American Bird Banding Program. With so many birds involved, the program inevitably incurs casualties. Some birds are injured or die as a result of predators, or of being trapped, handled, or banded. In all careful banding programs, the numbers are small relative to those banded, but every effort must be made to reduce the number to as near zero as possible. These losses can be minimized by increasingly effective training in the capture, handling, and welfare of birds, and by certification of banders. The North American Banding Council's Bander Certification Program addresses these issues.

### 4.3. Designing a Research Project

Banders may conduct research in two ways. You can design your own research project and analyze your own data in the context of the project's design, or you can collaborate with others who have already designed projects (many of which are usually in need of skilled assistance).

If you wish to set up your own research project and analyze your own data, you will need to understand basic statistics (e.g., the mean, probability theory). Among other things, statistics can be used to determine average dates of arrival, significantly early or late occurrences of a species, and the proportion of hatch-year birds to adults in a given population. Zar (1984) and Sokal and Rohlf (1994) are both good statistical textbooks, but they are not written for the lay-person. The U.S. Fish and Wildlife Service and the British Trust for Ornithology (BTO) have produced excellent introductory guides to ornithological statistics (Fowler and Cohen, undated; Nur et al. 1999); see Appendix B for the BTO address.

Grubb (1986) is a good reference on designing simple realistic studies. Good examples of well-designed projects can be found in journals like *North American Bird Bander, Journal of Field Ornithology*, and *Ringing and Migration*. An example of a well-designed research study is outlined in Appendix C.

Project design proceeds through a series of logical steps:
(1) Ask a question. All well-designed projects focus on a well-defined question. Depending on the question, this step usually implies some familiarity with the work of others on the subject. Recently published literature can be consulted at a university library.
(2) Develop a hypothesis. A hypothesis combines the question with your expectation of what the answer might be and why. Much of the necessary theoretical background for forming a hypothesis comes from studying the results of others.
(3) Propose and design a project. Most people need help at this stage. To design a workable project, you need to determine what kinds of, and how many, data need to be collected. This is where statistics can help. Usually the statistical test that will be used to analyze the data dictates, to some extent, the types and sample sizes of data required for analysis. At this stage, banders should have a clearly formulated question, with a hypothesis, a plan for collecting the necessary data, and a plan for the statistical analysis of the data. An experienced researcher or statistician can confirm that the proposed sample size and types of data are sufficient for meaningful tests of the hypothesis. Banders who are experienced with the capture of the proposed species can confirm that the target number and trapping method are easily attainable over the duration of the study. Get others' opinions on the possible limitations of your study; it will save a lot of hardship later.
(4) Collect the data. This is often the most challenging step because field conditions rarely match expectations. Good planning and appropriate practical training will greatly facilitate this step.
(5) Analyze the data. The use of a computer with data entry and statistical analysis programs will make analysis much easier.
(6) Publish your results. Remember that "negative" results are just as important as "positive" results because they allow you and others to build upon them. A range of publication outlets is available, from regional bird bulletins to international research journals.
(7) Questions beget more questions!

### 4.4. Cooperative Programs

Many scientific studies could never be undertaken at an adequate scale by individual banders; they are possible only as collective endeavors. Hence, even if you do not have a specific project yourself, you can still contribute meaningful information to a larger, organized project. Contact the universities, Partners in Flight, and bird observatories, or respond to bulletins in journals or newsletters such as the one published by the Ornithological Societies of North America (OSNA) for information on how you can help. The OSNA newsletter can be viewed online at http://www.ornith.cornell.edu/OSNA/ornnewsl.htm. Cooperative projects in North America are described in Appendix F.

## 5. PERMIT ISSUANCE

Because bird welfare is a primary concern, banding permits are issued only to people who have received proper training and whose projects are designed to contribute to the knowledge, conservation, and management of North American bird populations. Permit authorizations can be very specific. For example, your banding permit may restrict you to banding young Herring Gulls captured by hand. A more general permit could authorize you to run a general bird monitoring station, with special authorizations for the use of mist nets and for banding a wide variety of species. Before applying for a permit, banders should be confident of their qualifications and know which authoriza-

tions are needed to complete their project. Consideration should be given to the species under study, the capture method, and type of data needed.

### 5.1. Types of Banding Permits

Two types of federal banding permits are available: the Master Permit and the Subpermit. The differences between the two relate to the experience and qualifications of the bander and the responsibilities to be assumed. Because it costs money to process banding and recovery data, it is more efficient if banding teams or organizations designate one responsible person to report all banding data. Although this section will deal with federal banding permits, banders should be aware that some states and provinces have separate permit requirements. Banders need to contact their state or provincial wildlife agency for information on state or provincial permits. A listing of all state Department of Natural Resources offices can be located on the internet at http://www.up-north/dnr_news/dnrstates.html. It is the bander's responsibility to obtain all required permits before banding.

Master Permits are issued to "responsible individuals" banding on their own or designated from a team of banders who are working together on a project. Master Banders are responsible for coordinating the activities of all Subpermittees within the project, ordering and distributing bands from the Banding Office, recommending new Subpermittees, reporting encounters, and preparing banding "schedules" (see Section 12.4).

Organizational Master Permit projects (e.g., at universities and bird observatories) are overseen by a designated individual who is granted Subpermit "A" within the organization's Master Permit. In this case, the organization's address is used on all correspondence with the Banding Offices so that data can be filed in a consistent manner, despite possible personnel changes within the organization.

Subpermits are issued to banders guided and supervised by a Master Bander. Data from all Subpermittee banding are filed in the Banding Offices under the Master Permit's number.

Note that banders and students do not require a permit if they are under the direct, on-site supervision of a Permit holder. Banders working unsupervised for any period of time, however, do require a subpermit.

Contact the appropriate Banding Office (Appendix G) for permitting standards, requirements, and application materials and procedures.

### 5.2. Special Authorizations

Banders must request special authorization to:

(1) band waterfowl
(2) band hummingbirds
(3) band endangered species (and provincially protected species)
(4) use mist nets
(5) use cannon nets
(6) use chemicals (i.e., tranquilizers) to capture migratory birds
(7) use auxiliary markers (e.g., color bands, radio transmitters)
(8) take blood or feather samples

In Canada, banders also must request special authorization to band raptors, or to band in a federal or provincial park, a bird sanctuary, or in a wildlife area.

A banding permit allows banders to salvage dead birds encountered during their studies. Specimens are useful for further study and they should be salvaged whenever possible (e.g., sent to museums, universities). However, a special permit is required to collect birds, to hold or transport live birds, and to possess specimens, including eggs and nests. Without this special permit, you can be charged with an offense. Permits to cover these activities can be requested from your regional U.S. Fish and Wildlife Service Migratory Bird Office; see http://-www.pwrc.usgs.gov/bbl/manual/mboffice.htm for contact information.

### 5.3. How to Apply for a Permit

Qualified persons wishing to handle, band, or mark birds in North America should ask for an application form from the appropriate Banding Office (see Appendix G). Master Banders should supply the names and addresses of all prospective Subpermittees when they ask for Subpermittees' application forms. When a request for a permit is received by the Banding Offices, an acknowledgment letter is sent with an application form and a request for any necessary additional information. The Banding Offices review applications for permits and issue when appropriate.

### 5.4. Permit Expiration and Renewal

In general, banding permits are valid for 2 calendar years. In the U. S., Master Banders are contacted at renewal time if banding activity has been limited. In Canada, a renewal questionnaire is sent to Master Banders each December and upon submission of banding data.

In the U.S., auxiliary authorizations are reviewed and renewed every 2 years. In Canada, banding permits are issued for 1 or 2 years depending on the projects. When a project includes the use of auxiliary markers other than colored bands, an annual Animal Care Committee review and approval is required. All other banding permits are issued for 2 years, but Master Permittees must submit a Year-end-report at the end of each year to inform the Banding Office if changes are required to their current banding permit.

### 5.5. Responsibilities of Permit Holders

Master Permit holders are responsible for their Subpermittees' qualifications and conduct. Master Banders order all bands, maintain a band inventory, submit all records to the Banding Offices in a timely manner, maintain updated copies of all banding schedules, report recoveries, maintain quality control, and generally handle all paper work associated with the permit. Subpermit holders are under the direction of the Master Bander, who decides upon individual responsibilities. At the very least, Subpermittees must provide the Master Bander with copies of all banding schedules and band inventories and keep the Master Bander advised on any problems that might arise. Subpermittees also must let the Master Permit holder know their band requirements in plenty of time to allow band orders to be placed and filled.

All Master Permit holders are responsible for the bands issued to them until the data resulting from their use are reported, the bands are returned to the Banding Offices, or they are transferred to another Bander. All transfers must be authorized by the

Banding Offices. In case of fire, theft or loss of bands, a copy of all band numbers received should be kept in a couple of different places. Band inventories should be done at the end of each banding season.

Banders should always double check that the bands they have received correspond to the bands issued to them, as listed on the Banding Offices' Issue Slip. This means checking the numbers on the bands themselves, not just the numbers printed on the band envelopes or boxes. In the case of a discrepancy, or if any band numbers are illegible, missing, duplicated, or out of order, notify the respective Banding Office immediately.

### 5.6. Permit Suspensions and Revocations

Permits may be suspended or revoked if the bander's qualifications or conduct are questioned, investigated, and subsequently found to be in breech of those deemed acceptable by the Banding Offices. This includes exceeding authorizations specified on banding permits, neglecting to submit banding schedules, or the mistreatment of birds.

## 6. NORTH AMERICAN BANDING AND RECOVERY DATA BASE

Banding and encounter data are gathered and stored for the purpose of facilitating research in North America. Researchers are encouraged to request data for analysis. Generally, this information is provided free of charge for those with legitimate research purposes.

Banding and encounter data are contained in their own files and in the Banding Retrieval File and the Encounter Retrieval File, respectively. Data are taken directly from the retrieval files, presented in the formats shown in the Banding Manual, and supplied to you on diskette or as an electronic attachment. The Banding Offices will not usually summarize or tabulate data for you. However, occasionally the information may have already been tabulated by other researchers and can be made available upon request. The Banding Offices have developed their own programs for data manipulation. You may be able to make use of these programs for data summation.

To release banding or encounter data, the Banding Offices require that the need for use of the data is justified. The Offices also need to know whether data are required from the Banding Retrieval File, Encounter Retrieval File, or both, the type of encounter data required, species, age and sex required, area and time period involved, and the various status and additional information codes desired (consult the Bird Banding Manual [Canadian Wildlife Service and U.S. Fish and Wildlife Service 1977, 1991] for more detail).

Much time and effort goes into data collection and storage, both on the part of those who contribute data and those who administer the banding program in North America. Researchers are therefore asked to use data with care and consideration. **Researchers using banding data must obtain permission from the banders involved before their data can be used for publication,** specifically, if a bander's past 5 years of banding or encounter data contribute 5% or more of the total records being used for publication, and/or if individual banding or reencounter records will be cited in the paper. This permission is seldom difficult to obtain, but it is necessary to protect banders' own research interests. Banders have the prior right to the analysis and publication of data resulting from their own banding efforts. To guard against the improper use of data, a Policy of Release is included with each data request. A copy of the "Policy for Release and Use of Banding and Encounter Data," updated September 24, 1998, is presented in Appendix H.

Data on endangered, threatened, or sensitive species may be legitimately withheld by the Banding Offices. Other data also may be withheld if they are required by government for management or administrative purposes.

## 7. THE NORTH AMERICAN BANDING COUNCIL

The mission of the North American Banding Council (NABC) is to promote sound and ethical bird banding principles and techniques in North America. Skill levels of banders will be increased by the preparation and dissemination of standardized training and study materials and the establishment of standards of competence and ethics for banders and trainers.

The immediate objectives are:

(1) to develop a certification and evaluation program by setting standards for experience, knowledge, and skills that must be attained at each level (Assistant, Bander, and Trainer);
(2) to produce and update training materials such as manuals and perhaps videos;
(3) to identify and certify an initial pool of trainers; and
(4) to encourage cooperative efforts in the use of banding in the study and conservation of North American birds.

The NABC consists of 18 to 20 voting members, including one representative appointed by each of the following organizations: American Ornithologists' Union, Association of Field Ornithologists, Cooper Ornithological Society, Colonial Waterbird Society, Eastern Bird Banding Association, Inland Bird Banding Association, Ontario Bird Banding Association, Pacific Seabird Group, Raptor Research Foundation, Society of Canadian Ornithologists, Western Bird Banding Association, Western Hemisphere Shorebird Reserve Network, and Wilson Ornithological Society; and two representatives appointed by the International Association of Fish and Wildlife Agencies (one from Canada and one from the United States). Other groups have been invited to become affiliated. The NABC also designates from four to six additional members. The directors of the Canadian and U. S. Bird Banding Offices are non-voting members of the NABC. The NABC was incorporated as a non-profit California corporation in 1998. While it is expected that the NABC expenses will be covered by a small fee from applicants for banding certification, donations are being solicited during this start-up phase.

### 7.1. What Is NABC Doing?

The NABC has developed a bander training and certification program to set standards of knowledge, experience, and skills at two banding skill levels: Bander and Assistant.

The NABC has prepared training manuals to serve as reference materials for trainers and prospective new banders, and to enhance the knowledge and skills of existing banders. The current ones are: *North American Banders' Study Guide*, *Instructors' Guide to Training Passerine Bird Banders in North America*, *Guide to the Banding of North American Raptors*, *The North American Guide for Passerines and Near Passerines*, and *North American Bander's Manual for Hummingbirds*. Other manuals are anticipated. Printed and electronic versions will be produced in cooperation with the Banding Offices.

In addition, the NABC has designated a group of Trainers who have extensive experience, peer recognition as expert banders, good teaching abilities, and high ethical standards. The NABC also maintains procedures, policies, and bylaws; issues certifications; updates training and testing materials; and maintains a directory of certified assistants, permittees, and trainers.

### 7.2. How Will Bander Certification Work?

Certification of banders will require passing a written test and field evaluation of banding skills. Prospective banders may contact NABC or the Bird Banding Offices for information. Existing banders also may wish to be certified. NABC certified trainers will certify banders at all levels. Some trainers may be involved in teaching formal courses. NABC will issue and register the formal certifications. Modest fees will be charged to cover administrative costs.

The Banding Offices will not require NABC certification of new or existing banders but will recommend certification and refer prospective banders to NABC. They will recognize certification as evidence of qualifications for a federal banding permit. However, a proposal justifying banding will continue to be required (i.e., NABC certification alone will not entitle one to a federal bird banding permit).

### 7.3. NABC Certification

NABC has developed a certification program to recognize standards of knowledge, experience, and skills. The sole purpose of evaluating a bander trainee is to determine if he or she can complete safely, efficiently, and accurately all tasks required of the bander permit for which he or she is applying. The evaluation will be thorough, including all aspects of bird capture, handling, identification, ageing, sexing, banding, measuring, data recording, and report filing. While the information in this manual is considered basic to all applicants for certification and will be tested in a written examination, evaluation of applicants' field skills will emphasize techniques and procedures relevant to the particular group or groups of birds for which the trainee is seeking a permit. Separate evaluations of field skills will be available for passerines, shorebirds, raptors, waterfowl, hummingbirds, and seabirds.

Evaluations are based on both a written test and hands-on demonstration of banding skills. NABC recognizes that both portions of the evaluation are important and, indeed, complementary. Central to the certification process is the evaluation of a trainee's ability to: use nets and traps properly, efficiently, and responsibly; remove birds from them; and handle, measure, and examine birds. A trainee without a basic understanding of bird anatomy and banding techniques, or one who lacks the dexterity and temperament for handling birds, may endanger the birds. The written evaluation includes two parts: questions covering basic knowledge of birds and banding, and problem-oriented short answer questions.

The NABC recognizes the need for and provides certification at three levels:

*Assistant*.—At the Assistant level, a trainee has achieved a level of competence in removing birds from nets, bird handling skills, and banding birds under the direct supervision of a bander who is a Bander or Trainer. This level of certification is provided to recognize the important contributions of those who assist with the handling of birds at banding stations, but who do not wish to take on the major responsibilities associated with record keeping, and to provide a pool of trained individuals to assist banders.

*Bander*.—The Bander level recognizes that a trainee has achieved a level of competence in removing birds from nets, identifying, sexing and ageing them, handling and banding them, taking appropriate measurements, and keeping appropriate records. The Canadian and U.S. Banding Offices issue two levels of permits, the Subpermit and Master (Individual or Station) Permit. NABC recognizes that both Subpermittees and Master/Station Banders need the same level of knowledge and skill and therefore provides only this one level of certification for both—the Bander level of certification.

*Trainer*.—The Trainer level recognizes Banders who (1) have demonstrated considerable banding experience, (2) have the basic knowledge and skills associated with the Bander level of certification, and (3) have demonstrated teaching skills such that he or she can teach and evaluate proficiency in the basic knowledge and skills associated with all levels of certification.

An applicant at the Assistant level must be certified by a Bander or a Trainer. Applicants at the Bander level must be certified by a Trainer. Applicants at the Trainer level must be certified by two Trainers. Each successful candidate for certification will receive a certificate signed by the Chair of the NABC and the Bander or Trainer(s) who conducted the evaluation. Certification is subject to periodic review by the NABC. Issuance of banding Subpermits and Master/Station Permits is the responsibility of the Canadian and U.S. Banding Offices. The Banding Offices do not require NABC certification of new banders or current Permit holders, but they do recommend certification and refer prospective banders to NABC. They recognize certification as evidence of qualifications for a federal banding permit. However, a proposal justifying banding continues to be required. The NABC anticipates that its Trainers will be involved in short courses for bander trainees.

As a result of NABC certification, bird studies will benefit from an increased number of competent banders, more skilled banders, more reliable data, and more opportunities for collaborative studies. Birds will benefit from a safer, more effective North American Bird Banding Program.

## 8. HANDLING BIRDS

The proper way to handle a bird is the safest way. To ensure the bird's safety during handling, it is crucial to use appropriate grips, as described below.

Many birds are capable of inflicting a little pain or discomfort on the bander; some, such as raptors and herons, may even draw blood with their talons or threaten eye injury with their long necks and beaks. Others will defecate on you, and some will bite or scratch, but it is all part of the banding process. In any case, **never** take any of your frustrations out on the bird. Consider the hand that holds the bird to be separate from your body; learn not to flinch when a grosbeak or hawk clamps its jaws down tightly on your finger or when a flicker defecates in your face while you are checking its fat condition. Laughter is often the best medicine.

Right-handed banders normally hold birds in their left hand, leaving their right hand free to scribe, hold banding pliers, and so on. Left-handed banders do the opposite. No matter which hand is chosen, you should feel comfortable transferring birds from one hand to the other, which is part of the banding routine.

Never overlap the wings across the back of the bird or bring the wings forward below the line of the body; this can cause wing-strain and result in tissue damage. Always be careful that the bird's body is not held too firmly. Excessive pressure placed on the neck or body could result in broken ribs, damaged air sacs, or suffocation. Breeding females carrying eggs could suffer internal injuries if the abdomen is pressed. You should always check for any signs of panting or other stress (see Section 13). A good handler quickly learns to balance a secure, firm hold with a gentle, noninjurious touch.

If a bird struggles loose from your grip, it is much better just to let it go rather than to grab for it. What you usually get is a handful of tail feathers, and you risk injuring the bird by a sudden grasp.

### 8.1. The Bander's Grip

The "Bander's Grip" (Fig. 1) is the best and safest way to hold a small or medium-sized bird. Hold the bird with its neck near the base of the gap between your forefinger and middle finger. With these two fingers closed gently around the bird's neck, the wings can be contained against the palm of your hand. The remaining fingers and thumb are closed loosely around the bird's body, forming a kind of "cage." This hold leaves the bird's legs free for banding.

By pinching the tarsus at the metatarsal joint (heel), or slightly foot-side of the joint if leg length allows, securely between thumb and forefinger of the hand holding the bird, the leg is secure enough that, should the bird struggle during banding, the hold will prevent any injury to the leg. It is important that the heel not flex while applying the band. You can measure the wing chord or check for fat safely simply by lifting your thumb away from the bird's body.

The key to the Bander's Grip is to hold the neck firmly

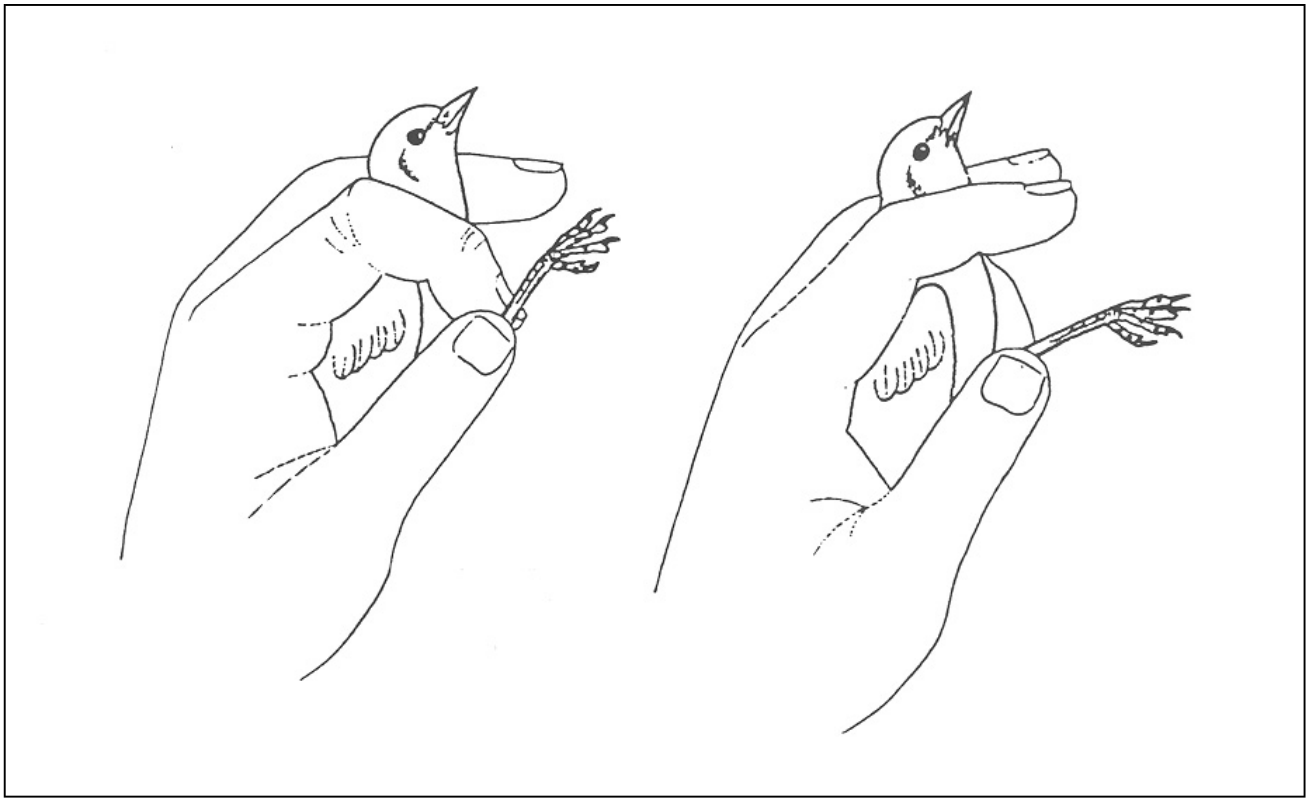


Figure 1. Aspects of the Bander's Grip showing how the tarsal (heel) joint can be held (from Lowe 1989).

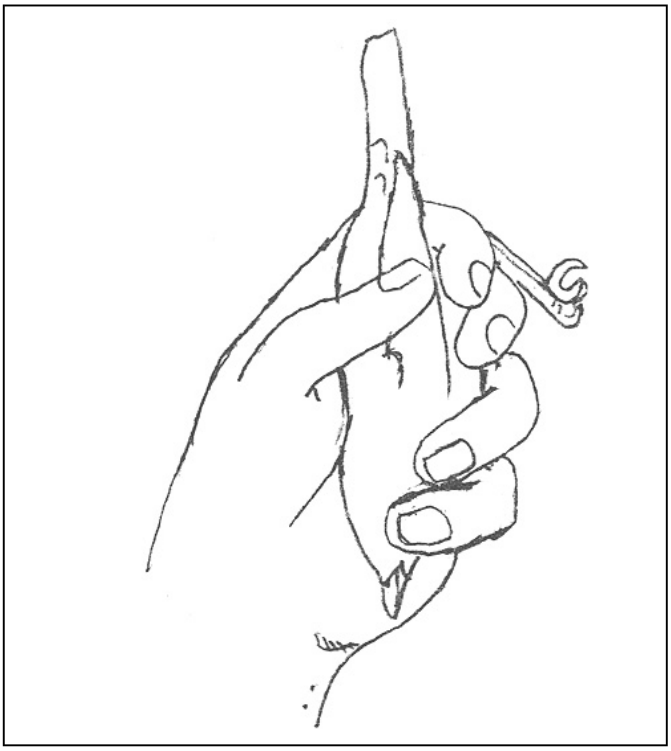


Figure 2. The Reverse Grip (revised from Svensson 1992).

enough that the bird cannot pull its head back through your fingers, but not so firmly as to risk harm or stress. Your hand should cradle the body and restrain the bird from struggling so that it is not injured or expending energy trying to escape. If the bird struggles a great deal and you are finished applying the band, except with shorebirds (see below), the legs can be folded and placed between the bird's body and your ring finger as if the bird were perched. This will minimize struggling and allows you to proceed with other measurements.

Although this is the most basic of all banding grips, there are some things you should know about holding certain species:

(1) Most birds are usually docile, but some (e.g., sparrows, starlings, woodpeckers, blackbirds, grosbeaks, and jays) often kick or bite. Some species (e.g., Song Sparrow) lie calmly, then suddenly kick strongly in an attempt to free themselves from your hand. Be prepared by keeping a firm grip on the neck throughout. Kicking can be minimized by positioning the leg not being banded between your ring finger and the body of the bird as described above. Before or following application of the band, some species in the hand are calmed by allowing then to grasp your ring or small finger, as though they were perched within your grip. Bad biters can be handed a small twig or a cotton roll to bite, or their heads can be covered temporarily by a light piece of cloth. They can also be restricted by keeping the fingers straight. Usually, it is best just to endure the pain and to learn to keep your fingers away from beaks.

(2) Small birds such as wrens are especially adept at wriggling out of the Bander's Grip. They use their feet to put pressure on the fingers around their necks and quickly slip their heads from your grasp. Again, your grip must be sure but not stifling.

(3) Caution is required when handling hummingbirds. Although they are tough birds for their size, they can go into shock due to stress or lack of food. In addition to the Bander's Grip, they can be held with the finger-tip hold, which allows the greatest control of the bird while assuring its safety: thumb on one side of the bird's body, second (middle) finger on the other side of the body, and the forefinger on top of the bird. By holding the first and second fingers in a firm but relaxed grip, you will not endanger the bird nor will you let it loose. Never hold a hummingbird by its legs as this will cause injury.

(4) Use care when handling long-legged shorebirds, cranes, and herons. Leave their legs free for banding and never fold them up against their body (see Section 13.4). Restricting the legs causes stress to the bird and may result in the temporary loss of muscular control of the legs.

(5) When holding small raptors in the Bander's Grip, be very certain that your grip is sure and that the talons are under complete control. Raptors will grasp tightly their own feet together and hold their legs in this position for some time. Then they will lash out suddenly, sinking their talons into the object nearest them.

(6) Some birds (e.g., woodpeckers, mimids, and icterids) are apt to scream a lot. This does not mean they are in pain, but it is certainly disturbing. Forget trying to calm screamers. The best thing you can do is to cover their head with a bird bag, process, and release them quickly.

### 8.2. The Reverse Grip

The "Reverse Grip" is a standard hold in some countries but not widely used in North America. We recommend that you master the standard Bander's Grip before trying the Reverse Grip. In the Reverse Grip, the bird is held with the tail facing away from you (Fig. 2). Your pinky and ring finger secure the neck against your palm. Your thumb is placed gently but securely across the lower abdomen, below the back and wing, or across the rib cage. As in the Bander's Grip, the leg can be positioned for banding by pinching the metatarsal joint between your thumb and forefinger.

The Reverse Grip is not efficient if measurements are to be taken because the bird must be rotated and held in the Bander's Grip for most measurements. Processing is faster and incidents of escape and injury when you stay with a single grip. The Reverse Grip is useful, however, for banders with small hands who must handle medium-sized birds (e.g., Common Grackles and Mourning Doves) or when banding swallows and other birds with extremely short tarsi. This grip puts the metatarsal joint close to the thumb and forefinger. The Reverse Grip also can be useful when you measure or study tail feathers.

### 8.3. The Photographer's Grip

Many passerines can be held safely by their legs for brief periods, but you must grasp the legs as close to the body as possible. Never hold hummingbirds, kingfishers, or goatsuckers in this grip as their legs are too weak. Caution should be used with holding large finches with this grip, since problems of wing strain or fractured coracoids have been reported. Many banders feel that this grip should never be used as a method of extracting

Figure 3. The Photographer's Grip.

birds from nets.

The "Photographer's Grip" (Fig. 3) is used primarily to hold birds while photographing them because it maximizes the amount of plumage in view, briefly to transfer them from one bander to another, or to examine certain features. For this hold, you "scissor" grip the bird's legs, as near to the body as you can, between the fore and middle fingers (or between the ring and middle fingers if your hand is very small) and then pinch the bird's tarsi between your thumb and fore- (or middle) finger. Place index finger between the legs of large birds such as raptors. In this hold, the bird is securely gripped above and below the heel joint, which is bent into an "L" shape. The bird will be able to flap its wings, but it should not be able to rock back and forth or from side to side. Never hold a bird only by the lower part of its legs; they will break! Place your free hand over the bird's back to keep its wings from flapping until the photographer is ready to shoot or the other bander is ready to take the bird in the Bander's Grip.

Many birds, especially short-legged species, present difficulties when the bander attempts to "scissor-grip" the upper tarsus. In this case, you can pinch the bird's feet together between the thumb and forefinger and pull the legs away from the body, allowing you to use the middle and ring finger in a "scissor-grip" higher up the leg. Once secure, the bander can release the feet and reposition the thumb against the lower tarsus.

Birds should not be held in this grip for longer than necessary because they will be using additional energy trying to escape. Still, it is an **essential** grip to master because it can be used while extracting birds from mist nets and to photograph unusual captures for documentation.

### 8.4. Free Holds

Many waterfowl, raptors, herons, goatsuckers, and gulls are simply too large to be easily held and banded by one person. In addition, many large birds have dangerous talons and bills. In these cases, handling is often done by one person while banding is done by another.

Swans, geese, and larger ducks can be held on their backs in your lap, between your inner thighs, between two hands, or under your arm. The head and neck should always be under control and point away from you so that the legs are free for banding. You also will soon learn to point the cloaca away from you. Most waterfowl are not aggressive, but geese may try to bite and they have sharp claws. These are strong, slippery birds that will escape easily if your hold is not secure. Some waterfowl banders were taught to hold them by their wings, overlapped across the birds' backs, but many banders believe that this may cause wing strain. We do not recommend it.

Herons and gulls can be held on the lap or between two hands as described above; to guard against their sharp bills, a cloth bag can be placed over their heads. The person holding the bird must keep the head and neck under control. Herons, loons, grebes, and others will strike with their bill at your eyes.

Approach raptors in a trap or net from behind. Try to distract them with one hand until their talons can be safely controlled. Place them in a secure grip immediately after extraction, covering the head so they can not bite.

Great care is needed to handle powerful birds of prey the size of Cooper's Hawks and larger. For birds larger than a Red-tailed Hawk, we advise having two banders on hand. If only one is available, a large raptor may be held under your arm or on your lap with a cloth bag over its head and your hand clenched firmly around its legs.

### 8.5. Opening a Bird's Bill

Skill in opening a bird's bill reliably and safely is necessary for situations such as extracting a tangled tongue or examining mouth tissue (e.g., for injury or color indicating age or sex). A bander should be prepared for any size and type of bird, which will dictate the approach taken. With smaller birds, especially those controlled using the Bander's Grip, the bill can be opened with just one hand.

The bander's fingernails are used to pry open bills, so maintaining some fingernail length is useful. Do not use foreign objects for prying open the mandibles. A bird can often be tricked into opening its bill by offering a finger or small stick or twig to bite. Special care should be given to species with sensitive Herbst corpuscles at the mandibles, such as ducks and some shorebirds.

The mandibles should not be opened wider than needed to accomplish the task. For smaller birds, one person can accomplish this while controlling the bird. With the bird's body under control in the Bander's Grip, the thumb and index or middle fingernails of the bander's free hand are pried between the upper and lower mandibles. As the mandibles are parted, place more of the thumb and other finger(s) into the mouth and leave in place as stops. The mouth can then be easily examined. Two people may be needed to safely control larger birds (see Section 14.1), which will free two hands for opening the bill. Use the nails of

both thumbs to pry apart the upper and lower mandibles. As the mandibles are parted, place more fingers between them toward the commissures (corners of the mouth) and leave in place as stops. For larger or stronger birds and any whose bill is not easily opened, hold the head by placing fingers behind the jaw and gently extend the neck up and forward, then open the bill as described above.

### 8.6. Carrying Devices

Banders often catch many birds at once. Because working near the traps typically prevents other birds from getting caught, banders of landbirds usually gather the birds up in bags or boxes and carry them back to a central banding station. This procedure also allows the birds to settle down and permits the bander to carry many birds at once. Raptor banders use cans of several sizes to hold raptors for banding and carrying (as do some hummingbird banders). The tubes fit snugly over the hawk and prevent struggling and possible injury. Tubes can be as simple as two small cans taped together with holes punched in one end from the inside out to prevent injury. Each species and sex may require a different can size. Not all birds can be safely held in carrying bags or boxes, but suitable carrying devices should be available for whatever type of bird is being banded.

Once all of your carrying devices are filled, always release any additional birds that have been captured (see double-bagging below). Release them immediately at the trap or net site. Remember, bird welfare always takes precedence. On those odd occasions when you get caught without a carrying device, you can naturally carry the bird in your hand, perhaps under your shirt to minimize stress. Avoid carrying birds in shirt or pants pockets.

#### 8.6.1. Bird bags

Draw-string bird bags are ideally made of thin, soft cotton (e.g., old sheets and pillow cases) and measure about 15 x 20 cm or larger, depending on the size of the bird. The bags must be large enough that you can reach in and extract the bird in the Bander's Grip. If the whole body and tail of the bird can fit easily in the closed bag, it is the proper size. It is a good idea to have an assortment of sizes on hand. Draw-strings must be long enough that they can be hung on a carrying device and hitched shut to prevent the bird's escape. If a bag is too small for the bird, feathers could break or bend, or the wings could be strained from being held in an awkward position. The seams of the bags must be finished with no loose threads (e.g., by French stitching). Otherwise, the bags should be turned inside out to prevent birds' claws from becoming entangled. Finally, bags of different colors or prints help you to recall quickly which bird is in which bag, but do not use very bright colors, which can frighten birds. Avoid making bags with camouflage-colored material because, if dropped, they may be difficult to find. Avoid dark-colored bags when banding in warm temperatures.

Some banders find mesh (zippered) "lingerie" bags to be superior to muslin because you can see what is in the bag. Birds can see out of these bags, however, and could be more frightened by movement during transport and activities at the banding station. Hummingbirds can be banded and measured without removing them from the bag. Mesh bags also are cooler and dry quickly when washed.

When putting a bird into a bag, place your entire hand into the bag, closing your other hand around the neck of the bag and the lower arm and wrist of the hand that is holding the bird. Then gently release the bird at the bottom of the bag and slide your hand out of the bag, assuring that the bird stays in the bottom of the bag. Pull the drawstring of the bag shut before removing your hand from the neck of the bag. With the bird safely at the bottom of the bag, grasp the neck of the bag and loop it into a simple overhand knot to prevent its coming open. Take care that the tail of larger birds is not tied into the closure.

If all cloth bags are in use, it is permissible to carry birds temporarily in small, brown, paper bags, twisted at the top. They are not "breathable," however, can't be hung up, and disintegrate if they get wet, so they are not recommended for regular use. Do not use plastic bags for this purpose because they prevent circulation of air.

Never set bags holding birds on the ground (where they can "hop" away or be stepped upon), in the shelf of a mist net (where they could place excessive tension on parts of the net and injure other birds), or hang them in a place where they can be forgotten. Instead, hang bags on clothes pins (that can have trap or net numbers on them) on your shirt, on the eye cups of your binoculars if large enough, or fashion a wire hook to wear around your neck, wear a necklace made from shower hooks, or simply keep bags looped safely around your wrists. Special posts for hanging bags can be installed at convenient spots near traps or nets, but be sure not to forget bags there.

In some cases, a rush of birds expends the number of bags available. Under these circumstances, place **no more than two birds** of the same species in a single bag, provided space is ample. One definite exception to this is that you **always** should single-bag large or aggressive birds. Jays, grosbeaks, grackles, chickadees, vireos, hummingbirds, woodpeckers, and raptors should never be double-bagged, whereas warblers, kinglets, and nonaggressive sparrows can be double-bagged. Adults may be more aggressive than normal during the breeding season and should also be kept separate. Always be sure that the bander is informed of all bags containing more than one bird, so that they can be processed first or rebagged separately as soon as possible.

Launder bird bags frequently, as they must be kept clean. Dirty bags are unsanitary and unsightly. They may also harbor diseases and parasites and reduce air circulation. Never use wet bags; they might prevent air circulation or chill the bird inside. Turn bags inside out and shake out debris. Loosely fill a net washing bag with bird bags and wash on the gentle cycle in hot water with a small amount of detergent and chlorine bleach. Rinse thoroughly, then leave bags inside the washing bag for drying. After drying, reverse the bags so that the raw edge of the seams are on the outside.

If a diseased bird is caught, it is extremely important to put that bag aside until it has been washed and disinfected. Also, take the time to wash and disinfect your hands before handling other birds. Moist towelettes in your field kit make good antiseptic cleaners. Small bottles of antiseptic lotion also are

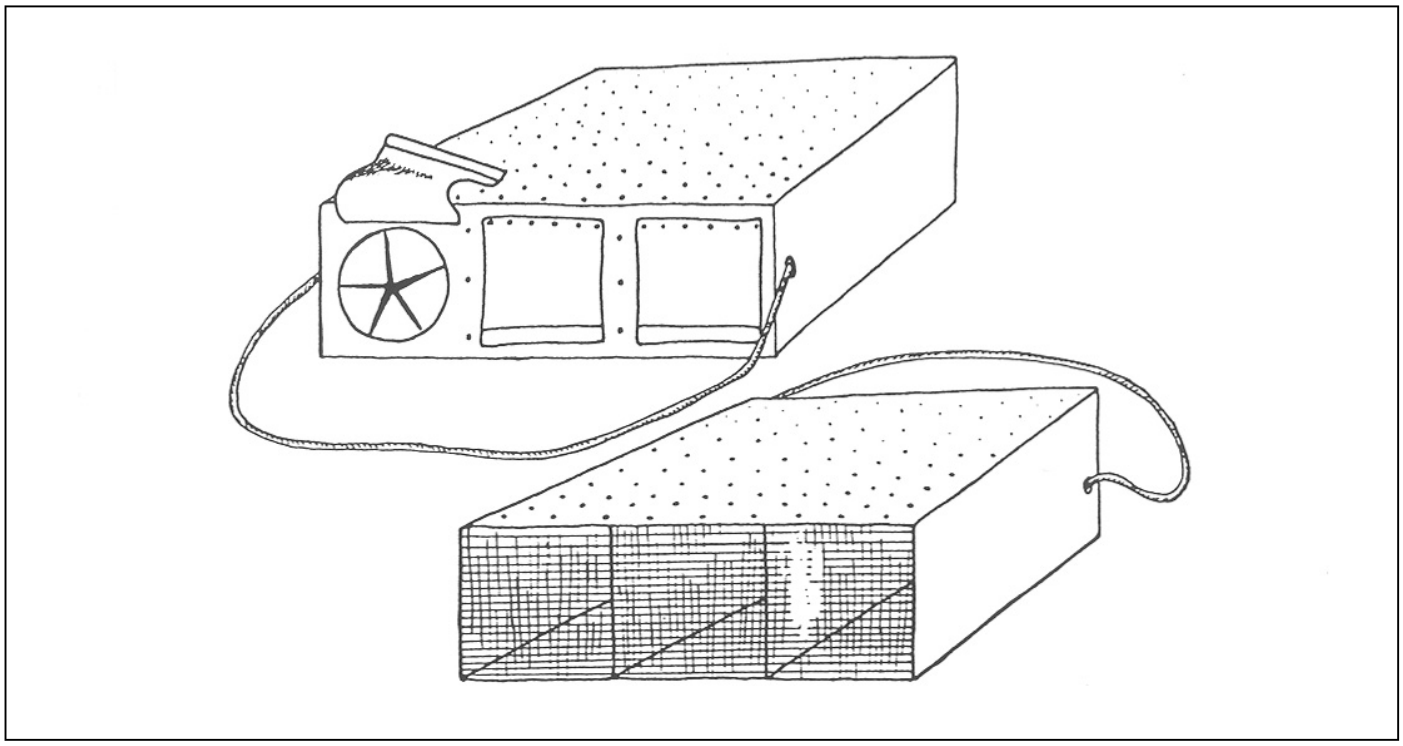


Figure 4. A carrying box (made of wire mesh and peg board) with three compartments (top and bottom views) and a rope carrying handle. Top shows access hole made of rubber with star-shaped cut and weighted flaps that drop over holes. Bottom shows wire mesh construction.

available.

#### 8.6.2. Carrying boxes

Small carrying boxes, usually with two to several compartments, are sometimes used to store birds prior to banding (Fig. 4). While more than one bird can be stored in one compartment, follow the same guidelines as for double-bagging (i.e., don't mix aggressive species, process double-boxed birds first, and separate to individual bags as soon as possible).

These boxes are typically equipped with a denim sleeve or piece of thick rubber with a star-shaped access hole cut into it. Boxes should be made partly of peg-board for air circulation. The floor should be made of wire mesh large enough that excrement does not build up but fine enough that feet can not poke through.

Larger, compartmentalized, holding boxes ("hotels") come in handy back at the banding station when you want to transfer birds to a more comfortable environment but have no empty bird bags. Try to avoid placing more than one bird in a compartment. Do not place birds with powerful bills like jays or woodpeckers in the holding box, as they can tear the screen dividers and kill smaller birds. Hotels also allow you to sort the birds by species prior to processing and even function well as temporary shelters for birds recovering from hypothermia or other stress.

## 9. CAPTURE TECHNIQUES AND EXTRACTION METHODS

Various devices and techniques are used to capture birds. Among the methods used, only mist nets, because they are used so prevalently to capture a great variety of birds, are discussed in detail in this guide. For information on other techniques, consult the taxon-specific manuals of the NABC as well as the resources listed under "Trapping, Netting, and Band Techniques" in the "Selected Bibliography," particularly the Bird Banding Manual (1991), McClure (1984), or Bub (1991).

Traps and nets perform differently and offer banders different opportunities for catching birds. In choosing a capture device, consider your target species and your objectives. For example, if you want to assess natural body weights, do not use baited traps. If you want to catch insectivores, use nets. If you want to catch ground-nesting birds, consider nest traps. Does your study require standardized effort? If so, do not use attractants, such as baits or water drips, which are hard to use in a standardized manner. Will your target species be caught more efficiently if the trap is at ground level or higher up?

Most baited traps attract seed-eating birds only. Their success depends on the availability of wild food, the types of birds in the area, the time of year, and the type of bait being used. For many birds, the food offered in a trap is worth the "price" of being handled and individuals may become "trap-happy," returning again and again to the same baited trap.

Mist nets and Helgoland traps generally provide better (but by no means complete) indications of the total numbers and kinds

of birds in an area than do baited traps because they are less selective. Netting, however, must be conducted with care and requires close supervision and intensive training.

Nets and some traps can be ordered from reputable suppliers. Most traps are home-made. Necessary materials for trap construction are readily available from hardware stores. Traps are generally made of 1.25-cm welded or plastic mesh or hardware cloth. A detailed list of materials is given in the Banding Manual.

All of the most common general-purpose traps are described in the Banding Manual and Bub (1991) and McClure (1984). Literally dozens of trap types exist, however, and numerous special-purpose traps for specific species, nesting birds, night use, etc. Because traps are usually taxon-specific, they will be discussed in each separate group's manual, but since mist nets are used for essentially all groups, and since even a hummingbird bander may catch a raptor, details of mist net use will be included in this Banders' Study Guide.

### 9.1. Setting Up and Operating Mist Nets

Mist nets capture a wider variety of species than most traps but they require more training, dexterity, skill, and experience to use safely. The extraction of birds entangled in mist nets often requires extreme patience. Assistants should be evaluated for their suitability of temperament.

The nets are large panels of either nylon, terylene (polyester), or monofilament mesh. Horizontal shelf strings (trammels) of thicker, stronger thread are woven through the mesh at the top and bottom of the net and at equal distances in between. Each shelf string ends in a loop designed to fit over a pole. The net is strung between two poles, which hold it upright and taut. The shelf strings form pockets of netting and tether the mesh at the top to prevent the net from blowing down to one end during high winds (Fig. 5). Birds fly into the net and usually drop into the pockets and become entangled.

Terylene (polyester) nets are preferred by some banders because of their strength, durability, and design even though they are more expensive and harder to obtain than nylon nets. Because they have more vertical meshes in the netting, good-quality nets have deep pockets, allowing them to catch and retain more birds than cheaper nets.

Mesh size is measured by stretching the net diagonally and measuring the diagonal distance of a square. Different meshes have different catching efficiencies for each species, so mesh size must be chosen carefully to suit your study and should be reported in any publications. In general, the size of the target birds determines which is the most appropriate mesh size to use. A 24-mm (1-inch) mesh is used to catch hummingbirds; 30-mm (1.25-inch) mesh is used to catch small to moderate-sized birds (e.g., kinglets, wrens, warblers, sparrows, and thrushes); 36-mm (1.5-inch) mesh is used for larger songbirds—flickers, jays, small hawks, owls, and many shorebirds; and 60-100-mm (2.5-4-inch) mesh is used for larger hawks. If a small bird gets caught in the larger-mesh nets or in a monofilament net, it is apt to get badly tangled; therefore it should be removed immediately and with care. Some banders suggest that monofilament nets be used only by persons who have mastered the special mist-netting techniques needed (for more information, see Section 13.1.1).

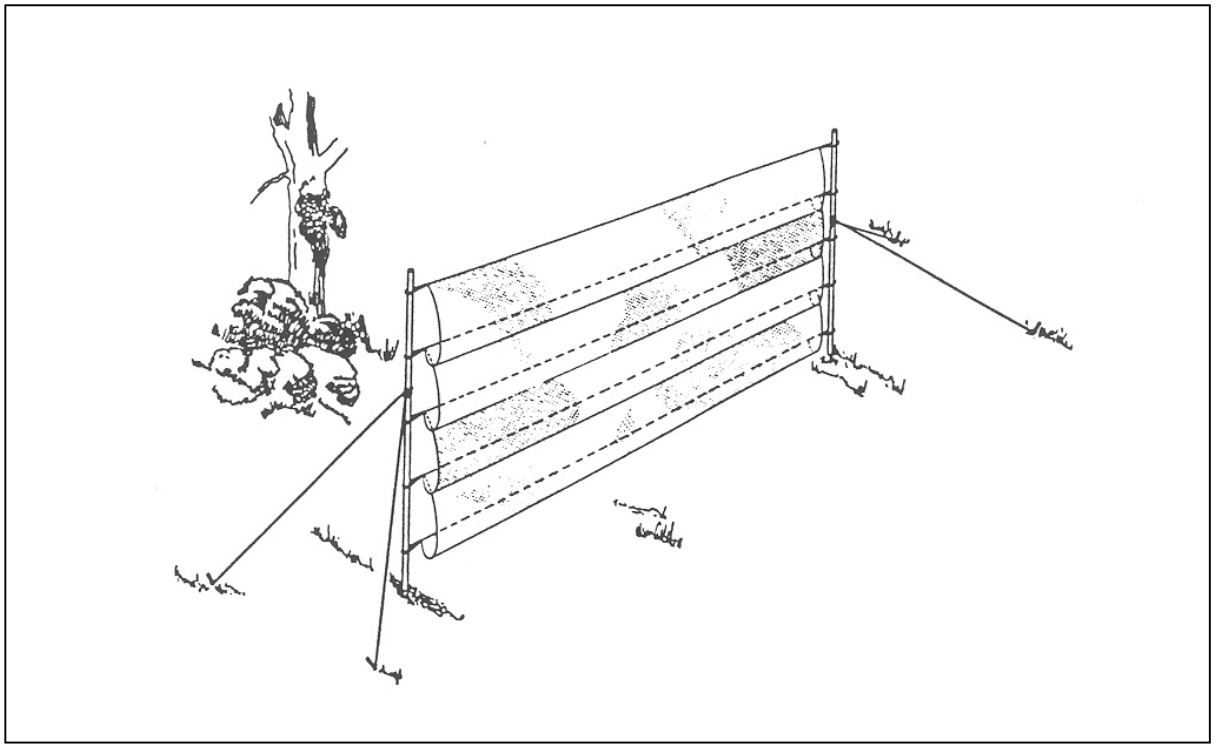


Figure 5. A mist net ready for operation (from Lowe 1989).

### 9.1.1. Problems unique to the mist net

(1) Nets catch on **everything** and then tear. To reduce snagging, avoid clothing with buttons, zippers, and velcro. Do not wear exposed jewelry, especially ornate rings or earrings and wristwatches. Be careful that hats, eye glasses, and binoculars do not become entangled in the mesh. The button on top of most baseball caps is guaranteed to get caught and should be removed. It is best to set the net so that the bottom shelf is off the ground; otherwise, birds that get caught in the bottom shelf get hopelessly entangled in sticks and vegetation, drowned in puddles, dew-soaked, or attacked by ants, and they can hurt themselves by flapping on the ground. If nets are set over water, it is especially necessary to have them off the water level. Be aware of incoming tides, if relevant.

(2) Nets can catch animals other than birds. Bats are frequently caught in the evening and before sunrise. Because bats can inflict a painful bite and may carry rabies, they should be handled carefully. Try dumping them out of the pocket; however bats cannot fly from the ground, so they will need to be offered a stick to grasp and placed in a tree if you use this method. If this does not work, grab the bat firmly by the back of the neck with one hand while the other works to free the netting. Do not be intimidated by their snarls and horrific grimaces. Release bats away from the net site.

(3) Nets can catch humans too! Caution the public viewing your banding operation and post signs if necessary. Beware of people carrying umbrellas, walking sticks, fishing rods, and other items that can tear nets. Holes in nets not only reduce your catching efficiency, they also increase the probability of severely tangled birds.

(4) Nets will catch large insects, especially beetles, dragonflies, and bumblebees, which cannot always be removed alive or unharmed because they get the mesh caught up in their legs, mandibles or wings. The best way to remove a badly entangled insect is to crush it first, quickly and humanely between two rocks, sticks, clothespin, or fingers, or slice off the head.

(5) Birds and other animals in nets attract predators, which can injure birds and damage nets.

### 9.1.2. Setting up and taking down mist nets

Select a suitable site before setting up a mist net. Depending on the group of birds you are catching, you will need to consider likely movements of birds, vegetation structure and height, accessibility, proximity to a processing site, slope, type of ground surface, possible depth and type of water, wind, and public access. In salt water locations, tidal stage is an essential aspect. If the site is in vegetation, cleared space of 1 m should be created on each side and at each end of a net to allow proper access. Setup is easiest with two people.

Various types of poles are used to support mist nets. The most common type – electrical conduit – is the cheapest. Conduit is sold in 3-m (10-foot) lengths of various weights. The lightest weight (0.5-inch, thin-wall EMT) is frequently used for mobile stations that are set up and taken down often. Heavier conduit may be set over rebar supports or inside pipes set into the ground. Poles that come apart in sections also are used, making set up and take down easier for one person.

Nets that are intended to catch larger birds, or are in an area where these birds can be expected to fly into the nets, can have rubber bands at one or both ends of the net. Rubber bands are usually cut from inner tubes of auto tires in 7-10 mm (0.25-0.5 inch) widths. Bands are better cut with a paper cutter than with scissors. These are then tied to the ends of the loops on the net by slipping one end through the net loop and pulling the other end of the rubber band through the first end. The rubber loop is then placed over the pole and works to prevent large birds from bouncing out of the net. Rubber loops can also minimize the potential for injury to fast-flying birds that strike the net. Using rubber bands on the trammel loops lends stretchability to a net, allowing a bander to reach over a net to remove a bird on the opposite side; or to lift up the bottom shelf of a net to duck under the net to get to the opposite side.

*General set-up procedures for single-piece net poles.*—Many variations exist. The following is a generalized description of one way to set up, furl, and store a mist net. Methods vary with different banders and may need modifications because of local terrain.

(1) Carefully remove the net from its storage bag and find one set of shelf-string loops. This process can be facilitated if a shower curtain clip is used at each end of the net to prevent commingling of loops from both ends. A white loop usually identifies the top shelf string, which is usually doubled and tethered with small knots spaced at regular intervals. With one set of loops over the fingers of one hand, carefully hold all of the mist net securely under one arm.

(2) Separate the loops, one by one, and arrange them in sequence so that no shelf strings are crossed. Remember, the white loop (the tethered top-line) goes on top.

(3) Slip the loops over one net pole, keeping the white loop on top and the other loops in sequence. If soil conditions permit, stick the pole in the ground to a sufficient depth to support the pole upright. Support the pole with two guy lines.

(4) One person holds the first net pole while the other walks toward the other end of the net lane, gradually letting the net out. Never let the net touch the ground or vegetation; it will entangle with sticks and leaves.

(5) Once at the other end, separate the loops one by one sequentially, ascertaining that no twists or tangles exist in the shelf strings. With the loops in order, place them onto the second pole.

(6) Pull the net taut and sink the second pole securely into the ground. A second person is useful here to place the pole securely. Guy it properly and adjust the tension of the net if necessary. The top shelf should be taut, not slack. Check to make sure that the poles are vertical, not leaning inward or sideways. Leaning poles provide uneven tension and strain nets. New nets are apt to stretch after a few days, so the poles will need to be repositioned periodically to keep the net taut. Humidity also can cause nets to stretch and

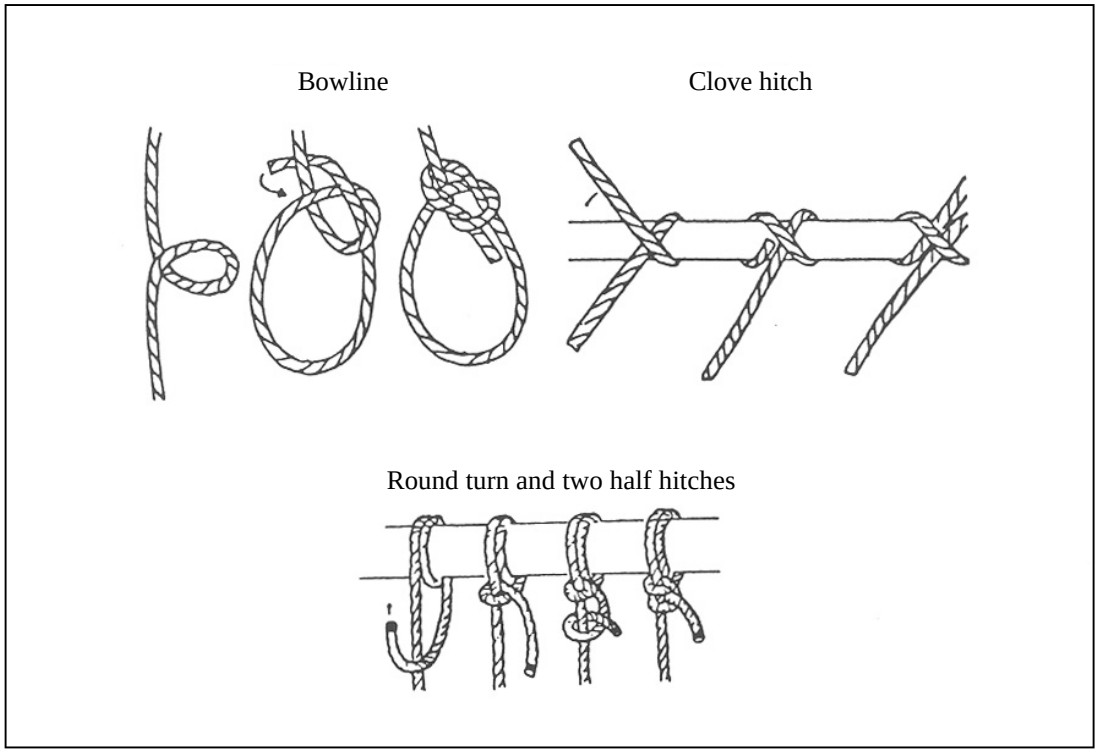



Figure 6. Knots used to tie mist-net poles.

sag. Learn to tie proper knots (e.g., clove hitch and half hitch) when guying the poles so that repositioning is simple (Fig. 6). If using fairly thick guy rope, a slip knot can be used and quickly adjusted.

(7) If the net is not twisted, it can be opened. Unless you are tall, you will need to use a stick to raise and lower the top shelf string. Lift the shelf string's loops away from the pole (to avoid abrasion and wear) and move them up or down the mist-net pole to adjust the net position. Do not push or pull the shelf strings; they may break. As a general rule, pockets should be about 10-15 cm (4-6 inches) deep; this usually requires a spacing of about 45 cm (18 inches) between loops. The other panels are opened accordingly; no pockets should overlap and no tension should be placed on the vertical panel supports of the net. If it is breezy, the net should be set even more loosely or birds will bounce out. Figure 5 shows a mist net properly set. When the net is opened, the bottom pocket should not be low enough to sag and touch the ground with a bird in the bottom pocket. Test this by throwing bird bags into the bottom pocket.

(8) Untended nets should not be left unfurled or left open overnight, especially in an area frequented by deer. Before closing a net, remove any debris (twigs, leaves, insects). If you wish to leave the net on the poles, lower all upper shelf strings to where the guy ropes attach to the pole, leaving the top panel about a foot above the rest. Raise all the lower panels up to meet the other loops, still keeping the top pocket open. Grasping the shelf strings near the loops, twirl the entire net so that the lower panels are furled into the pocket of the top panel. Then lower the top shelf quickly to meet the others and give the whole net one or two extra furls. If it is to be left in place for one or more nights, many feel that it is best to tie the net shut with ribbon or flagging tape at either end and at two or three places in between. If half bows are used to tie the ribbon or flagging tape, the knot can be undone quickly with one hand. Without these ties, the loops and shelf strings can separate, particularly if a guy line on a pole should loosen or fail, which often happens. Even a small separation in the loops can open the net at one end sufficiently to trap birds (or bats) by accident. Moreover, ties guarantee that the nets will never become unfurled by a gust of wind or jostling by passing animals. This furling technique is fast and ensures that no birds are caught by accident. It also results in a furled net that is easy to reopen. The furled net can also be "locked" by hitching the top loops down over the others on the pole.

(9) To reopen a net, simply undo each tie. The ties can be stored between one loop and the mist-net pole to keep them from blowing away or getting misplaced. Carefully raise the upper shelf string on both poles without placing any tension on the vertical panel supports. This raising should cause the lower panels of the net to roll out of the upper pocket. Arrange all shelf strings as described above. The net usually unravels itself. If it does not, it could be caught on itself by a hole in the net, frost clinging to the mesh, a stick or an insect entangled in the mesh, or a shelf string or vertical panel support that has broken. When the net will not spring apart on its own, and if all objects have been removed from the mesh, use your fingertips to gently tease

the tangle free.

(10) Taking down a net is simply the reversal of the steps taken to put it up, though several techniques are used. It is a good idea to inspect the net's condition, noting this information on the net bag. Some operators close the net but do not furl it, because they feel it will be hard to put back up again at a later date. Secure the loops together (in sequence) on the pole with a shower curtain clip, piece of ribbon, or flagging tape, or by weaving the top loop several times through the other loops. Walk toward the opposite pole, gathering the net into a bag as you go. Make sure the net does not touch the ground. Secure the shelf strings of the opposite end of the net in the same manner. If the net is dry, it can be safely stored inside a cloth bird bag or a plastic bag. If it is wet or damp, it should be dried before storing to prevent mildew and rot. Label each storage bag with mesh size, net length, and condition.

*Alternative set-up procedure*.—The following method can be used when it is necessary to set up and remove the nets for each banding session. Choose one end of the lane as the fixed end and the other as the moveable end (Fig. 7). This allows adjustments to accommodate variations in net length. You can use 2-cm (0.75-inch) PVC pipe cut into 30-cm (1-ft) sections—one for each net, 60-cm (2-ft) sections of 6-mm (0.25-inch) rebar bent at one end (three for each net), and three 26-m (8-ft) sections of 6-mm (0.25-inch) rope for each net. Install a PVC section at the fixed end of the net lane (Fig. 8). This should be placed at the end the least public traffic. The PVC should be installed at a slight angle away from the direction the net is running (Fig. 8). This will help maintain the pole in a vertical position against the tension of the opened net. Install one guy line directly in line with the net. Pound the rebar into the ground approximately 16 m (5 ft) away from the PVC at an angle facing away from the net (Fig. 8). Tie a section of rope to the rebar and then make an adjustable slip knot at the net-pole end of the rope. Measure the length of the lane using an old net or a net-length section of rope. Install two guy lines at approximately 120E angles with the net to form a tripod with the pole at the center (Fig. 7).

With the above net set-up, using this method with Blackshaw's (1993) improvements involving a grocery store plastic bag with handles for net storage, with prepared guy lines, and shackles on the poles, net setup should take no more than 2 minutes.

Locate and lay out the poles and guy lines at each end of the net lane, starting at the fixed end. Insert the pole through the net loops and then put the shackle on the pole. Set the pole into the PVC and attach the guy line. Walk to the moveable end feeding the net out of the bag as you go. When you reach the end of the lane, place the net, and then the shackle, on the pole. Usually two net loops are placed below the shackle. Attach the two guy lines to the shackle, pull the net taut, and slide the shackle up the pole to tighten the guy lines. Nets stretch out after opening and will most likely need to be tightened on the next net run.

Because two people set up a net only slightly faster than one experienced person, some banders feel it is better for people setting up nets to split up (rather than leap-frog), meeting in the middle of the line of nets. Some banders feel that in a standard netting situation, however, the leap-frog method works well because the nets can be more easily opened and closed in sequence (the same sequence in which they are checked).

### 9.1.3. Frequency of net checking

Do not use nets in the rain, snow, or sleet. At all other times, consider heat, cold, wind, and sun when using nets. Your personal comfort as well as that of the birds can be an indicator that it is too hot, too cold, or too windy. If your hands are too cold to effectively remove birds, or birds are puffing their feathers, then it is too cold to be operating nets. If you are feeling the effects of the heat, or birds are gaping or showing other signs of stress, then it is too hot to be operating nets. If nets are exposed to wind that unduly bounces birds held in the netting (usually also causing wind chill that induces hypothermia), then it is too windy. Wind speed itself may not be a factor if nets are set in sheltered lanes where birds may be calmly held in a net not exposed to the full force of the wind.

Nets should be assessed individually with response to wind and temperature, as different placements result in different degrees of exposure. Individual nets that are blowing too much should be closed, as should nets that are too hot, while nets that are shaded may be kept open. Part of your judgment should depend on how the usual temperatures are in the area. In mid-winter in the northern states or Canada, a still day can be below

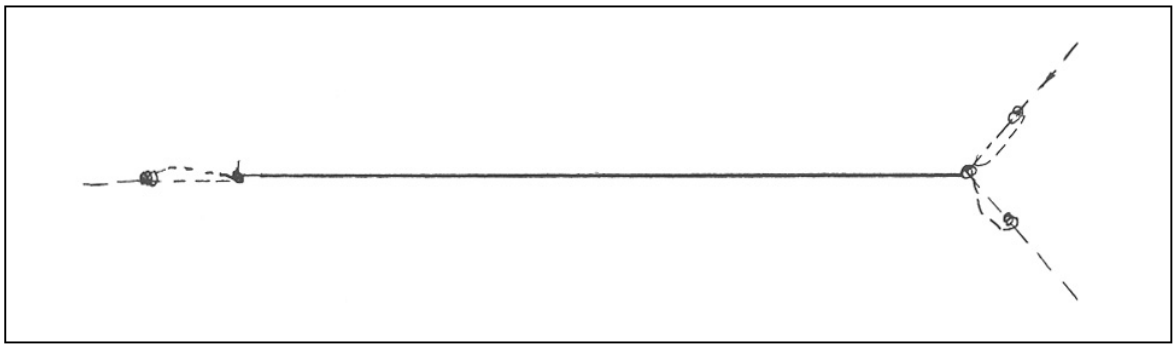


Figure 7. Quick net set-up showing fixed vs. moveable ends of net.

freezing, but birds there are somewhat acclimated to these temperatures. Anticipating and responding to deteriorating weather helps avoid casualties. Birds in nets are far more vulnerable to inclement weather than birds in traps, because they are more exposed to the elements and because the netting disarrays their feathers, interfering with thermoregulation. For this reason, mist netters especially must be acutely aware of current and imminent weather. Be prepared to close up **before** rain starts.

Once set, nets **MUST** be checked frequently. Under good conditions, this usually means every 20-30 minutes, more often in weather that is hot, cold, damp, or windy. That is, if you decide on a 30-minute interval, the net round should begin no longer than 30 minutes after the **start** of the previous round. For projects that require the use of nets in more extreme weather conditions of heat, cold, or light drizzle, nets may need to be monitored nearly continuously. If nets are shaded, weather is moderate, and the capture rate is relatively low, some very experienced banders can check their nets every 45 minutes or so.

### 9.2. Extracting Birds from Mist Nets

Most birds that fly into a mist net do not struggle immediately. After a few minutes, the bird will begin to grasp with its feet and flutter its wings. The longer a bird is left in the net, the harder it will be to get out. This is particularly true of a bird that can fit part of its body or the bend of the wing through the mesh. The longer a bird is left in a net, the greater the risk of death or injury from entanglement, exposure, or predation. Always minimize risks to netted birds.

Removing a bird from a mist net is mostly a matter of common sense and logic. Net extraction must be learned under the supervision of an experienced person. Much of what is described here will make more sense after being observed.

Removing a bird is normally a one-person operation; two people trying to work together are seldom successful. Trainees should remember this and refrain from giving unsolicited "help" by holding the bird or net. Different banders frequently have slightly different ways of extracting birds. In all techniques, the key to good extractions is a light touch. Part of learning how to extract birds is learning their habits and getting familiar with how different species react and become entangled. It takes a lot of practice to master extraction techniques, but you will eventually develop a "feel" for the process. Extraction is generally easiest if you simply reverse the process of entry. If trainees have excessive difficulty in developing these skills within a reasonable period of time, however, they should consider that their time might be better spent using traps, concentrating on helping out as bander or recorder, or in other ways. Not everyone has the dexterity, eyesight, patience, and ability necessary to become proficient at mist-net extractions.

Approach the net quietly. Approaching perpendicular to the net reduces the chance of escape by poorly caught birds. Assess the situation. If many birds are caught, call for assistance if needed; a whistle or walkie-talkie is a good alternative. First, look for any bird that is in distress. Is any bird double-pocketed, caught by one leg only or by the tongue; are large and/or aggressive species next to small ones or species susceptible to stress; or is any bird hanging on the ground or in vegetation? Calmly and efficiently remove these high-risk birds first.

As you work on an entangled bird, remember that the bird

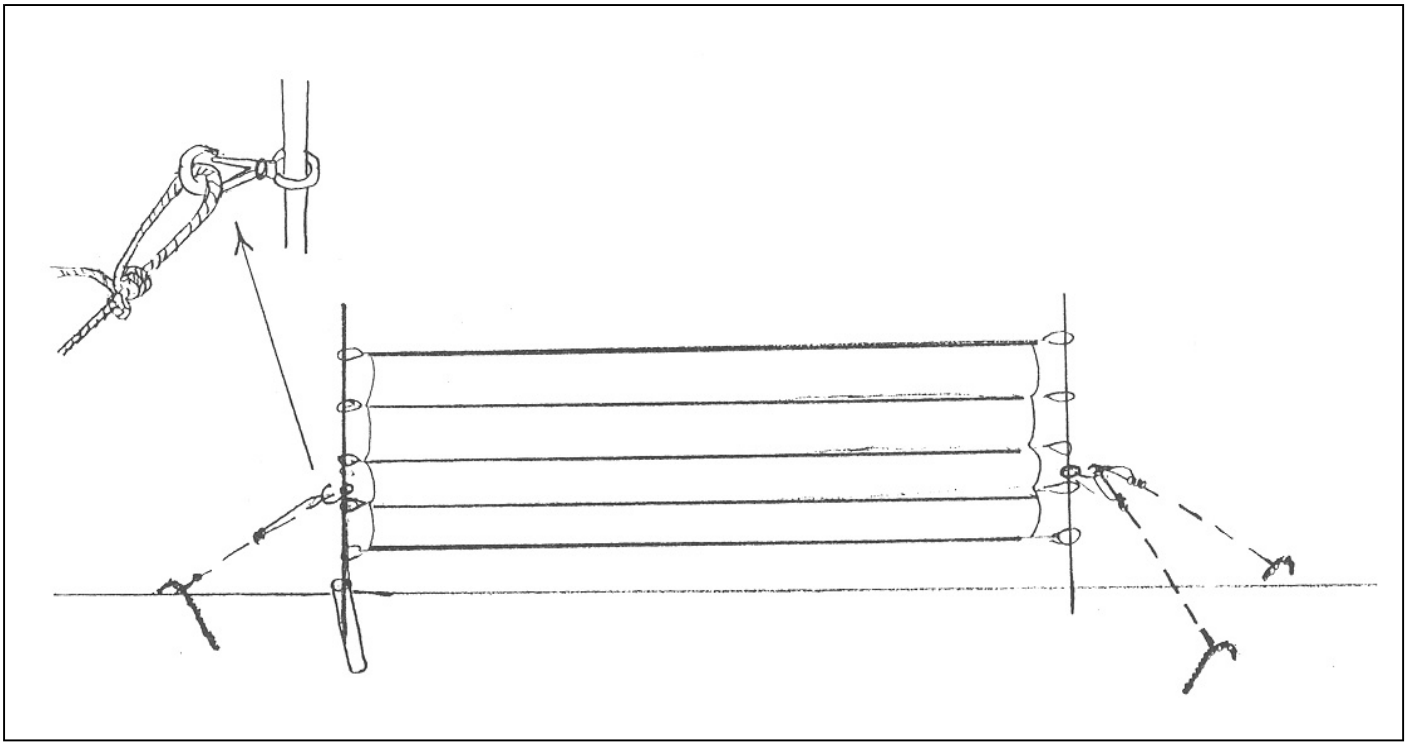


Figure 8. PVC pipe on fixed end of quick net set-up, showing angle.

usually can be backed out easily only in the direction from which it entered the net. You *must first* determine exactly how the bird went into the net. Observe carefully from which side and between what trammels the bird entered the net, to find the opening of the pocket the bird made. Because the tail is the last to enter, look at its position to get a clue about how the bird entered the net, and remember, that it is virtually always hanging in a pocket on the side opposite from where it entered. Do not just grab the bird, tempting as it may be. Start on the side of the net from which the bird entered; part the trammels and netting loosely and look into the pocket caused by the weight of the bird. Back the bird out the way it went in, step by step. A light touch is the most important prerequisite for all methods. After determining where the bird entered, several standard procedures are used for removing it, but different species and different problems will require improvisation.

Herein, we describe the various methods used to remove birds from nets. No single method will suffice for all birds because each flies into a net differently. Combinations of methods will certainly be necessary at times. In all methods it is often desirable to know where the strands of net are amongst the bird's feathers, which can help you decide where to move your fingers next. The best method is to pull gently at the exposed netting and see where feathers move on the bird. This will tell you where net strands are binding, leading to quicker removal. Blowing apart the feathers to see where net strands are located is sometimes less efficient, as it tells you only if net strands are present where you blow. Gently tugging at the strands, causing feathers under strands to move slightly, can usually reveal strands caught on other body parts, for instance around the opposite wing. Some banders still find it helpful, throughout the extraction process, to blow occasionally on the bird's feathers to reveal strands of netting. Try both techniques.

#### 9.2.1. Feet-first method

This is the original and, perhaps, still the most widely used method. It is usually how beginners are taught. It can, however, be somewhat slower than the body-grasp method. An additional disadvantage is that it requires holding the legs in a Photographer's Grip, which, if done carelessly, can cause injury or breakage. It involves the following steps:

(1) Make sure you are working on the side of the net from which the bird entered. Find a patch on the belly that is free of mesh and securely grasp the bird by the legs in the Photographer's Grip, letting the net support the rest of the bird. Check that mesh is not hidden beneath belly feathers, either tugging gently on strands or by blowing feathers apart to determine locations of net strands. If strands are caught on the bird's thigh, pull them down toward the foot. If the strands are caught too tightly on the thigh, leave them for now. If the netting is loose enough, lift the bird out of its pocket toward you, so that it cannot become more entangled if it struggles.

(2) Bird's legs are designed so that the toes lock in a closed position when the bird perches. In many species, the toes naturally relax and open when the legs are straightened. With the bird in the Photographer's Grip, gently use the fingers of your other hand to extend the legs and toes and "roll" or massage the net off the feet and toes with your fingers.

(3) Once the legs are free, continue holding the bird in the Photographer's Grip and try to free the wings. As the bird struck the net, it folded its wings. Hence, it is the bend in the wing (the carpal joint) that often goes through the mesh, at least part way. Sometimes the strands will ride down the primaries of the wing. In such cases, and often with birds having extended carpal joints (e.g., such as shorebirds and terns), it can help to maneuver the primaries through the strands, then work the strands back over the carpal joint. The strands will inevitably be tight. Careful use of a toothpick or blunt probe will help to lift away hard-to-reach strands. **Never** force strands over the joint or up the feather shafts. This can cause tissue or feather damage. If the net is lying loosely on the wing, or if it is a small bird, the net can simply be lifted over the carpal joint. Use your best judgement and disentangle the easiest wing first.

(4) After freeing one wing, decide whether it will be easier next to remove the net from the head or the other wing. If the opposite wing is freed easily, then change your hold to the Bander's Grip so that more of the bird's body is supported when you start to work on the head. This will minimize the bird's struggling and make extraction easier.

(5) Removing strands from around the head is usually easy, but it takes some experience to develop the knack. This step is likened to the removal of a turtle-neck sweater. The hardest part is to locate the exact mesh opening(s) of strands through which the bird has put its head. Once you have found this, hold the bird in the Bander's Grip and use the thumb of your other hand to press the bird's upper mandible down towards the fingers of the hand holding the bird. With your forefinger of your free hand, hook the net up and over the bird's head (Fig. 9). If the bird is as large as a thrush, watch that you do not injure the eyes and that no pin feathers catch on the net.

#### 9.2.2. Body-grasp method

This method has recently been used by some stations and found to surpass other methods in ease of learning, reduced injury to the birds, and speed of removal. It should apply to the great majority of passerines in mist nets.

(1) Determine which side of the net the bird entered. Find the opening of the pocket caused by the weight of the bird.

(2) You have three choices at this point. (a) If the bird's body is accessible, without any netting in the way, and the net is free of the back and head, just put the bird into the Bander's Grip, with (if using your left hand) your palm against its back, your index and middle fingers on either side of the neck, the right wing held with your thumb, and the other fingers curled around the body and the left wing (Fig. 10). Then proceed to step #7 below. (b) If the net is tangled around the head and wing, slip your fingers over the body and under the wings. This usually involves your thumb around the breast and your fingers over the bird's back, around its sides and under the wings, and carefully around

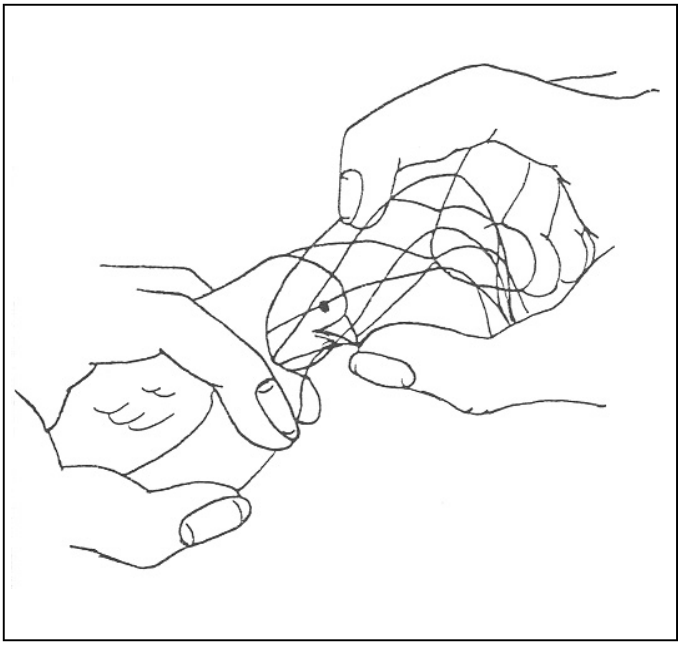


Figure 9. Removing mesh from around a bird's head.

the curve of the body. Make sure no net is under your fingers—between your fingers and the bird. (c) If the body is too tangled for a body grasp, then another method must be used.

(3) With the body now firmly secured, back the body out of the net to expose at least the bend of one wing. Remove the net from that wing. Flick net threads from the bends of the wing, working from the underside. Generally your thumb should be placed under the thread(s) on the underside of the wing and your forefinger placed on the outer bend of the wing as a fulcrum over which to flick the threads. Often it is helpful at this stage to pull gently on the exposed portions of the still-tangled threads to free them or to see where they are caught.

(4) When one wing is free, slip your fingers around it, securing it against the bird's body. Next, pull remaining loops from around the neck, working from the back of the head forward in the manner of removing a T-shirt.

(5) Remove the net from the other wing, as above.

(6) The bird now should have been gradually put into the Bander's Grip.

(7) Pull the bird up and away from the net, and it will usually free its own feet in an effort to fly. If the toes are caught, untangle them by pulling strands gently. You will notice that if the heel joint is straightened out, the bird's toes have a tendency to relax, so the netting can be more easily removed. If the bird is clutching the net firmly, extract the feet by (a) first freeing the opposable toe or hallux (the "thumb") by sliding the threads over it and lifting it away from the other toes; (b) straightening out the other three toes out with your fingers; and (c) sliding the netting over the toes with repeated strokes. Wetting the toes helps in difficult cases.

This method, when administered with a nimble hand and a light touch, is gentle to the bird because the only firm contact is on the sides of the neck and body. It is also a time saver because feet usually untangle themselves. The method works best with a recently caught bird that has had little time to entangle itself, but is applicable to most birds.

### 9.2.3. Tricky extraction situations

The procedures outlined above have many variations. If you run into any kind of difficulty, **ALWAYS** get help from a more experienced bander. Sometimes you may reach a mental block when working on a difficult bird for a long time, and even an equal or inexperienced bander may be able to help. Do not let your ego get in the way of a bird's safety.

If the bird has spun in the net, unwind the spin with your fingers as much as possible as you begin the extraction and continue unwinding as you work. Often this needs to be repeated several times for badly spun birds.

If at first you cannot find the belly or tail free of netting, or cannot decide from which side the bird entered the net, free the feet and legs to give you a clue. Sometimes a small bird will enter from one side, struggle, make it part way through the strands, then flutter and re-enter from the opposite side. Freeing the legs and feet may make it easier to see the bare belly patch. Beware of strands concealed under body feathers of the belly and be equally aware that if the strands are caught high up on the bird's thigh, they may appear to be covering the belly. Use gentle tugging at net strands to reveal complexities of entanglement.

If the bird is caught in one pocket and weights the net so that it hangs down to overlap another pocket, it could become "double-pocketed." That is, its head, legs and possibly wings could be entangled in two pockets. Remove the strands from the outer pocket first, then deal with the pocket into which the bird actually flew.

If the bird has gone through the net at a hole in the mesh, be patient. It may have flipped up and around another shelf string, twisted, become double-pocketed or any number of other twists

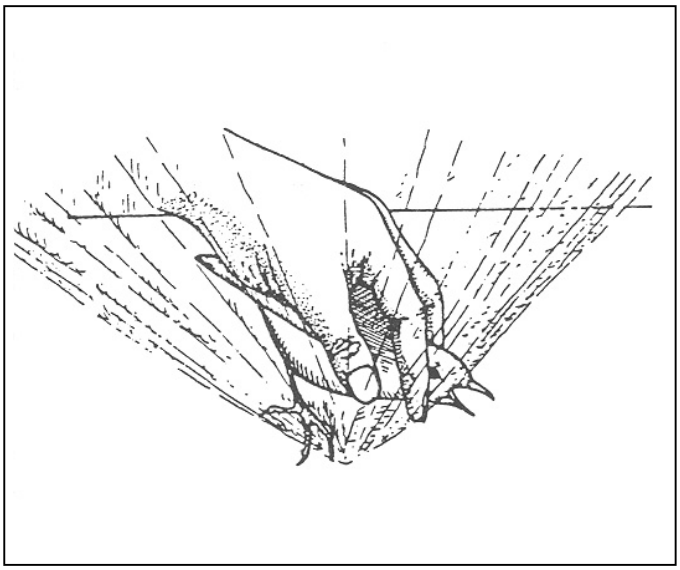


Figure 10. Removing a bird from a mist net using the Bander's Grip (from Spencer 1992).

and flutters. This can be the most dangerous extraction situation. After extracting a bird from a hole in the net you will appreciate the importance of frequent net repairs.

During most extractions, switch to the Bander's Grip as soon as possible because the bird will begin to struggle and flap more when it feels itself being freed. When extracting a raptor, grip the legs securely, being careful to avoid the talons. Because the toes are large and the raptor will grip at the strands, the feet may be badly entangled and strands may need to be picked off one by one.

Some birds have strongly arrowhead-shaped tongues. When a bird gets caught by its tongue, the strands have slipped behind the fork at the back of the tongue. Ensure that the bird is not pulling with its feet at the strands caught around its tongue. If so, it is often best to immobilize the feet and legs as soon as possible and extract from those strands, leaving tongue until later. This will release the tension on the tongue. Hold the bird in the Bander's Grip and pry open the bill with your fingers (see Section 8.5). At this point, a toothpick is helpful to carefully pull the threads backward, off the fork of the bird's tongue, and out of its mouth. This can be a delicate situation and is often left as the last step of extraction. With badly "tongued" birds, it can help to gather all of the strands on one side of the mouth, the better to see the strands actually caught around the tongue. Proceed slowly and be gentle, all the while keeping the net tension-free. It is sometimes helpful if one person holds the bird while another frees the netting from its tongue.

All banders should carry a plastic toothpick, blunt metal probe, pocket scissors, or nail clippers to help free those hard-to-get-at threads. A Swiss Army Knife is useful because it contains **both** scissors and a toothpick. Note, however, that a good bander rarely needs to cut strands to extract a bird. Because holes can pose a risk to other birds that are subsequently captured, cutting the net is a last resort (e.g., when injury is occurring to the bird that will only worsen with more handling and/or when the most experienced bander on hand is unable to quickly free the bird). Even then, it is used judiciously and sparingly. Students **MUST** seek help from more experienced banders before cutting strands to extract a bird. If you must cut a few strands, be certain that no strands are left hidden on the bird. It is generally not helpful if you have to cut more than a couple of strands—then you just have netting that is not taut (and difficult to see) caught on the bird.

Finally, if extraction takes a long time (more than a few minutes) and the bird is showing signs of exhaustion, release it as quickly as possible, taking only the minimum data, preferably on the spot. Some banders prefer to release such birds immediately upon extraction, but then the bird has endured the ordeal for nothing. Again, trainees **MUST** seek assistance from more experienced banders whenever they are faced with severe extraction difficulties.

# 10. BANDING BIRDS

## 10.1. The Essential Basics

Banders must master bird identification and bird "topography" (Fig. 11). Unless you are certain that the species you are banding has been correctly identified, the bird **MUST** be released unbanded. Data for a misidentified bird are worse than useless; they are misleading and may contribute to false conclusions based on banding data. Good-quality photographs at some stations are permitted for subsequent reference by more experienced banders. Do not be embarrassed to admit that you are uncertain. You also usually are not permitted to band sick, injured, or domesticated birds, Rock Doves, nor any of the Gallinaceous ("chicken-like") bird species like turkey, grouse, pheasant, and quail. These species are not covered by the Migratory Bird Treaty Act and are banded with state or provincial bands.

Banding is most useful when accurate age, sex, and various measurements and plumage descriptions are recorded. After all, by examining live birds, you can learn a great deal about molt patterns, color variations of races, differential migration times between sexes and ages, and so on. It is every bander's responsibility to record as much information as is safely possible from each bird banded.

Part of being able to correctly identify, age, and sex birds is becoming familiar with terminology describing different parts of a bird. You need to familiarize yourself completely with field guides and with age and sex keys.

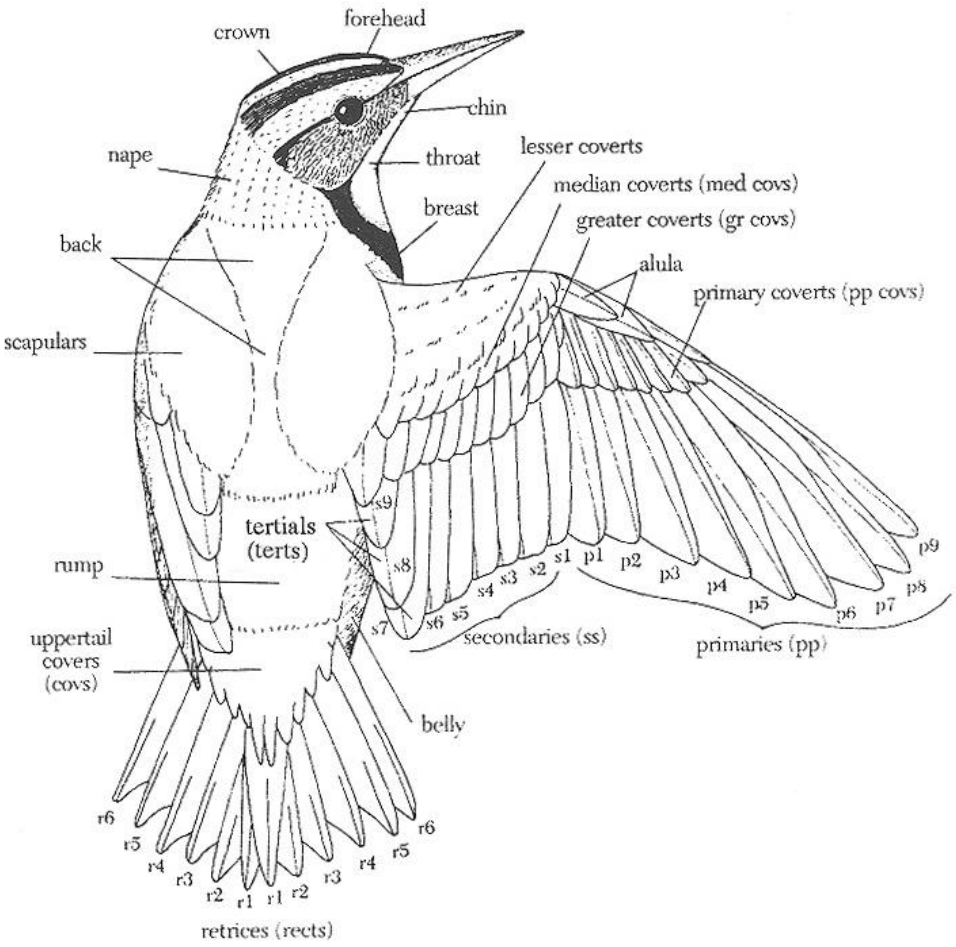
All banders of landbirds **must own and use** Pyle (1997a). Especially the introductory material in this volume (pp. 1-40) should be treated as an essential and integral part of this Banders' Study Guide for the groups covered. Certification of applicants at the Trainer and Bander levels will presuppose a thorough knowledge of the material contained in these pages in Pyle.

## 10.2. Band Fit and Size

Every band size is designated by a number or a number-letter combination, ranging from 0A to 9C. Like shoe size, this number is for identification only; the actual size of the band is measured by its inside diameter. Selection of band size is naturally governed by the size of the bird's leg. Most species are banded below the metatarsal joint, but some (kingfishers and some shorebirds) are banded above.

Generally, a band is said to be a good fit if, when closed properly, it can rotate and slide freely up and down the tarsus without slipping over the metatarsal joint or down over the bird's toes. Loosely fitted bands may slip and so constrict the toes that the bird cannot grasp with its feet, catch the hind toe between the leg and the band, or slip onto the metatarsal joint so the bird cannot bend its leg. A band that is fitted too tightly can damage a bird's leg. Keep in mind that tarsi are usually elliptical in cross section and that the band should be fitted to the widest part of the leg.

Based on the above criteria, the Banding Offices recommend a certain band size(s) for each species and sometimes even for sexes within a species. Because leg diameter varies considerably



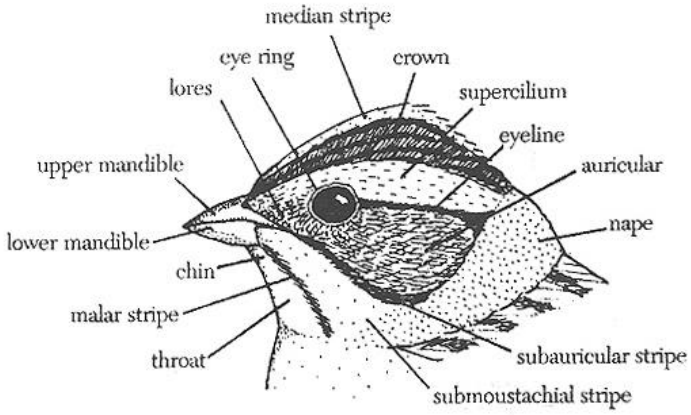




Figure 11. "Topography" of a bird, showing nomenclature for feather tracts and anatomical areas (from Pyle 1997a).

among individuals of some species, however, (e.g., Common Grackle) the legs of these variable species should always be guaged (see Section 10.6) to select an appropriate band size. Record this in your field notes and on the Banding Schedule, noting why a band of the "wrong" size was used (e.g., "large leg, hence this band size"). If you accumulate experience suggesting that a different size band would better suit a particular species, submit this information to the Banding Offices and publish your findings. If the band is a poor fit, it should be removed (see Section 10.9).

### 10.3. Types of Bands

All standard bands provided by the Banding Offices are made of a light-weight aluminum alloy. Butt-end bands are designed for general use on most species and are available in all sizes and are routinely issued unless another type is specifically requested.

Lock-on bands have a special crimping flange to "lock" the band onto the bird's leg. These are especially useful for raptors, which may be capable of removing standard, butt-end bands. They are available in sizes 4 through 9. Rivet bands, available only in size 9, are used on eagles.

Hummingbird bands are shipped to the bander as a thin sheet of aluminum with numbers printed on it. Banders must cut out and trim the bands, smooth the edges, and shape the bands before use. Instructions are provided by the Banding Offices. Hummingbird bands are denoted sizes X, XA, and XB. A special authorization is required to band hummingbirds; bands will not be sent unless the banding permit has this authorization. See manual for banding hummingbirds.

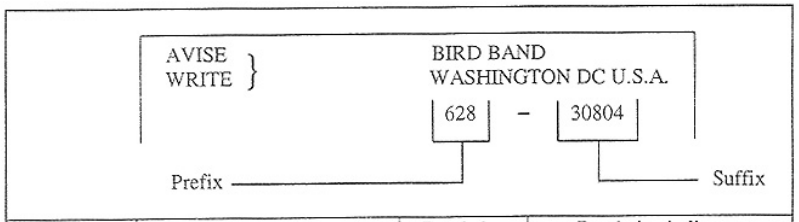
Depending on circumstances, you may require bands made from harder metals, different alloys, or made to other specifications. Some banders have found that aluminum bands are not suitable on birds that frequent saltwater habitats. Birds with strong bills (e.g., raptors, grosbeaks, cardinals, and crossbills) can remove a band, so bands made of stronger metals (e.g., stainless steel) may be used for these species. Contact the Banding Offices to obtain these specialty bands. Often you will be required to cover the production cost of specialty bands. Uncommonly used alloys and their properties are listed in the Banding Manual. Markers, of whatever metal, other than the official, numbered leg band must be authorized before use and are not normally supplied by the Banding Offices.

Colored, plastic leg bands are available from commercial suppliers (see Appendix B). Two (exceptionally, three) color bands can be put on the same leg. In some cases, for example small flycatchers and swallows, the tarsus is so short that only one band (either plastic or metal) may be used per leg. Two metal bands should NEVER be used on one leg, as the bands wear against each other and become razor sharp. You must record which colors are used, in which combinations, and on which leg (right or left). A special authorization is required for the use of color bands and other auxiliary markers. These authorizations are issued on a species-by-species basis for close observation of individuals.

### 10.4. The Band Numbering System

Every band has a unique eight- or nine-digit number stamped on it (except hummingbird bands, which have a letter + 5 digits), along with the return address of the Bird Banding Laboratory (Fig. 12) or 1-800-327-BAND. On smaller band sizes (sizes 0-1A), the address is impressed on the **inside** surface of the band. Band numbers consist a three- or four-digit prefix and a five-digit suffix. The prefix is a combination of a variable series number and a band-size indicator; the last digit of the prefix indicates the size of the band (as in the table in Figure 12). The suffix is the identification number that, in combination with the prefix, is different for every bird.

Standard bands are strung in consecutively numbered "series"




| Band size | Band-size indicator (last digit of prefix) | Band size | Band-size indicator (last digit of prefix) |
|---|---|---|---|
| 0A | 0 | 3A | 3 |
| 0 | 0 | 4A | 4 |
| 1C | 1 | 5 | 5 |
| 1 | 1 | 6 | 6 |
| 1B | 1 | 7A | 7 |
| 1A | 1 | 7B | 7 |
| 2 | 2 | 7D | 7 |
| 3 | 3 | 8 | 8 |
| 3B | 3 | 9 | 9 |

Figure 12. Information as placed on a standard band, labeled for prefix, suffix, return address, band size indicator, and variable series number (from CWS and USFWS 1991).

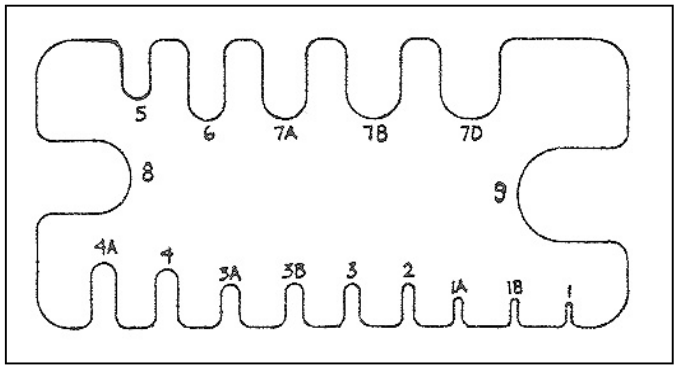



Figure 13. The leg gauge.

or "strings" of 100 on wire, plastic tube, or string. For example, a band string may contain bands with the numbers 1201-56501 to 1201-56600. The final digit of the prefix indicates that the bands are of any one of the four size one bands (1, 1C, 1B, or 1A). The first band of every string carries the final two digits "01" while the final band always ends with "00" of the subsequent hundreds digit. For most effective record-keeping, all bands of a series should be used consecutively.

### 10.5. How to Order Bands

Only Master Permit holders may order bands from the Banding Offices. When ordering hummingbird or specialty bands, banders must include a statement of need along with their permit application or indicate previous authorization. You should order as many bands as needed to last the duration of your banding project, or 6 to 12 months, whichever is less. It is important to inquire about any unusual band orders well in advance so that your banding operation is not left short.

### 10.6. Banding Pliers and Other Equipment

Following is a basic checklist of the bander's equipment:

- banding pliers (different sizes)
- bands (different sizes)
- device for holding band strings (e.g., film canisters, wire clips)
- band removal tools (e.g., circlip pliers, end nippers, fingernail scissors)
- wing rule
- thin ruler for tail measurement
- calipers
- balance and weighing containers
- leg gauge
- bird bags
- nail clippers
- crochet hook
- small scissors, pen knife
- magnifying glass or Optivisor
- light source
- black pens and soft pencils
- white out for pen use
- data sheets (e.g., banding sheets, journal sheets, retrap cards, molt cards)
- binder or file box for data sheets and cards
- clipboards
- nets, poles, and/or traps
- identification and age/sex manuals
- toothpicks
- adhesive bandages
- hand cleaner or moist towelettes
- anti-viral wash
- antiseptic ointment
- container of water (for skulling)
- sugar
- thermometer

Suppliers of banding equipment are listed in Appendix B.

Use a leg gauge (Fig. 13) to determine the correct band size for species with more than one recommended band size, on species with variable leg thickness, or whenever you are in doubt. The thickest part of the bird's tarsus is placed in the slot on the leg gauge that corresponds to the anticipated band size. The gauge is then moved up and down the bird's tarsus to assure sure that a band of that size would fit properly. It is always a good idea to try two or three slots to arrive at the best fit, which is determined in properly bored gauges by finding the slot in which both sides of the slot most closely fail to touch the widest parts of the leg.

For 0A-1B, bands are small enough that it is more useful to use the actual band and not a representation of the ideal or standard band size. The actual band may be at the high end of the specifications or the low end, but rarely will it be right at the middle. Any shape other than round also changes how a band fits. Holding a closed band behind the tarsus and check for space on both sides of the leg.

Small bands (sizes 0-3) are usually opened and closed using specially designed banding pliers (Fig. 14), which are available in a selection of sizes according to band size. They are much better than regular needle-nosed pliers or other kinds of closing devices, because they greatly reduce the chance of overlapping bands and harming a bird's leg. Avoid any closing device with serrated jaws, as these can scar the band and obscure band numbers.

Banding pliers usually have a split pin, which is used for opening the band. The band is placed over the pin, with the seam

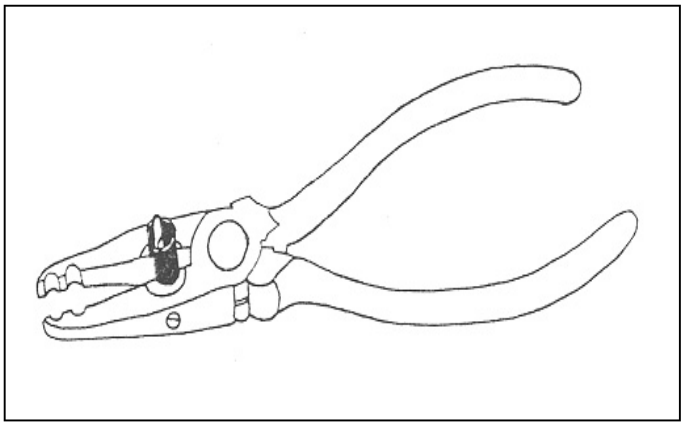


Figure 14. North American banding pliers, showing holes in the jaw and the split pin opening a band.

of the band oriented exactly toward the tip of the pliers and even with the split in the post so that, when the pliers are opened, the band opens evenly (Fig. 14). This evenness is important to assure that the band also can be closed evenly.

A pair of banding pliers has holes in its jaws that fit one or two standard band sizes. When the pliers are used to close a band placed in the right-sized hole, the band will close properly without overlapping or leaving a gap between the ends of the band (Fig. 15). Never use an incorrect plier hole for the band size; this risks overlapping the band and crushing the bird's leg. To be on the safe side, make tracings of the pliers in use at your station, labeling the hole sizes for the benefit of students.

Large bands and lock-on bands are opened with a pair of needle-nosed pliers. On lock-on bands, the flange is bent upwards to be perpendicular to the rest of the band. The band can be closed using the correct-sized banding pliers or a pair of needle-nosed pliers, but be careful not to overlap the band. Use pliers to bend and lock the flange in place (Fig. 16). Larger butt-end bands can be closed using needle-nosed pliers, but larger banding pliers and the British banding pliers are even better. Eagles require rivet bands, and a pop-rivet gun is needed for application.

### 10.7. Banding a Bird

Before starting to band, banders must be completely familiar with the data that need to be collected, and how those data are to be recorded. If a person is available for recording data on the data sheets, the bander can dictate the measurements and other data taken from the banded bird. After correctly identifying the bird, check both legs for previous banding. Check the list of recommended band sizes. If more than one band size is recommended or if it is a species known to have a variable leg size (e.g., raptors, Mourning Dove, Common Grackle), use a leg gauge to determine the appropriate band size. If in doubt, use the larger, especially for ground-foraging species (e.g., towhees, some sparrows). Use the next band from the string of the appropriate size. Some banders like to read the band number before banding the bird to ensure that no band has been missed or lost without record of an explanation. Even though the band will be read after it is put on the bird, reading size and band number before its application precludes the need to remove it if the band chosen is not correct.

While holding the bird in the Bander's Grip in one hand and the pliers in the other, place the band over the opening pin on the pliers. First-time banders usually have a little difficulty in mastering the banding operation smoothly without finding a need to set the pliers down. With practice and a little coordination, however, it is easy to hold the bird, the band, and the pliers at the same time.

Open the band evenly and just enough that the band will fit over the bird's leg (Fig. 14). Place the band in the correct hole of the pliers with the split in the band oriented toward the tip of the pliers (Fig. 15). Firmly grip the bird's toes with thumb and forefinger, immobilizing the leg and exposing the tarsus. This method ensures that the toes cannot be caught in the pliers while closing them. Some banders prefer to firmly hold the bird's metatarsal joint (heel) between their thumb and forefinger (Fig. 1). The leg must be supported at the heel joint or you risk its breaking or dislocation if the bird suddenly struggles. With the band correctly in the pliers, gently slip it around the tarsus and carefully close it, watching that you do not pinch the tarsus or overlap the band. Kingfishers have short tarsi and will be injured if banded below the tarsal joint. Shorebirds and rails are often banded above the joint due to mud and erosion.

Open and withdraw the pliers, being careful that the band is not jammed in the hole, and inspect the band to ensure that the ends firmly abut and no sharp edges protrude. If a gap exists, rotate the band 90E and pinch it again in the appropriate hole of the pliers (Fig. 15). If the band is skewed (ends not directly opposite each other), correct this by angling the pliers so that the jaws contact the top and bottom surfaces of the band. The technique for closing a lock-on band using a pair of British banding pliers is shown in Figure 16. If you open the pliers and a band sticks to one side of the pliers, the pliers should be reclosed. If this happens often, careful application of a fine emery abrasive can eliminate the problem.

Once the bird has been banded, set the pliers down gently and quietly onto a cushioned surface so that they are not damaged and

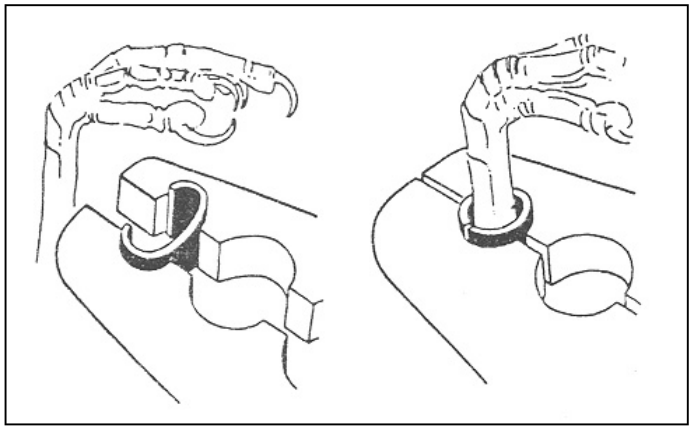


Figure 15. Applying and closing a butt-end band, including the 90º rotation (from Spencer 1992).

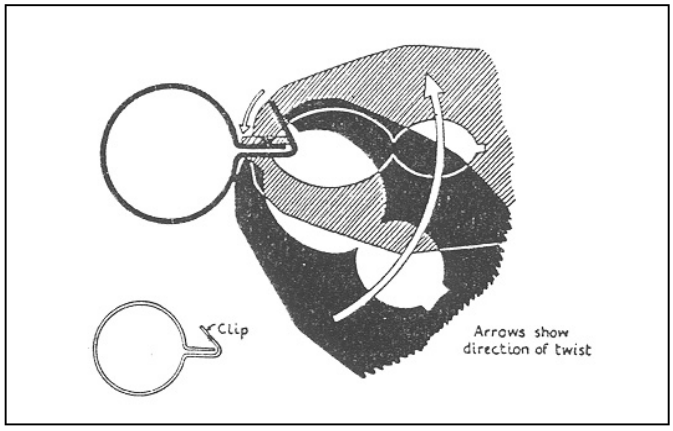



Figure 16. Closing a lock-on band using a pair of British banding pliers (from Spencer 1992).

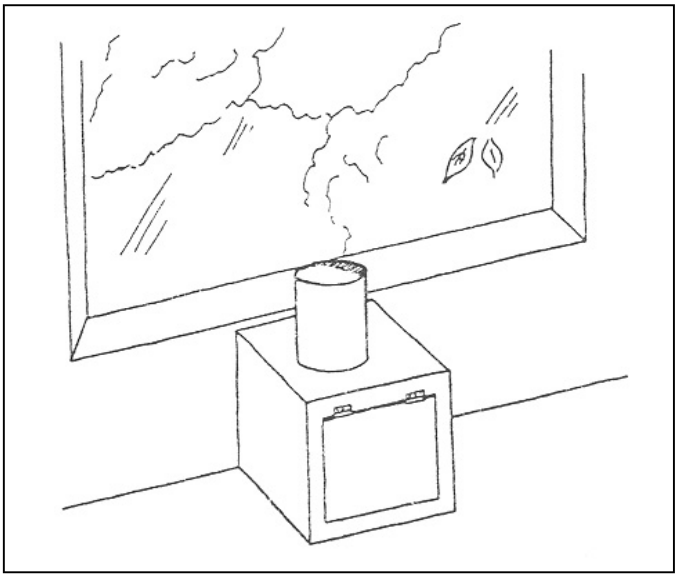


Figure 17. A release hatch is set in the wall of a banding lab, just above the banding table, and just below a window.

the bird is not startled. Then read and record the band number. Doing this **after** the band is applied ensures that the band number is correct and legible and that the bird is not inadvertently released unbanded.

Band and process the bird as quickly, quietly, and carefully as possible so it can be released unharmed, having endured minimal stress. As a general rule, no need exists to handle birds for more than a couple of minutes. A skilled bander is able to process a bird completely (including ageing, sexing, and measuring) in about a minute. One bander, or at most two, should be sufficient to handle all data collection. Passing birds from bander to bander in a line with each recording or measuring one piece of data is very stressful to the birds, and not recommended practice. While it is important to pass birds from student to trainer, it is not recommended as a routine way of collecting data.

Your banding area should be a Quiet Zone when birds are being handled. Trainees should resist their natural temptation to comfort a bird by talking to it or patting it on the head. Birds have no clue what you are talking about and are frightened by strange sounds and quick motions. They doubtless would prefer to be released sooner than to be held for "soothing." Keep in mind that, to a bird, even the most well-intentioned bander is a predator. Try to put yourself in their situation.

### 10.8. Releasing Birds

As a general rule, birds should be released unbanded if they have been waiting to be banded for longer than an hour. The time really depends on temperature, species' behavior, and other conditions. For example, if it is very cold outside, birds should be released as quickly as possible to allow them maximum time to feed. Dependent juveniles should be banded as soon as possible and **must** be released at their point of capture. Many banders agree that it is good to band and release family groups together and other birds captured together (i.e., flocking species). Some banders feel that, during breeding season, female birds with brood patches should be released immediately at the point of capture after quick processing on the spot. At the least, when on a net run, it is important to keep track of priority individuals (such as brooding females) and species and to process them first.

For the release itself, waterfowl can be grasped by both hands and thrown gently upwards, into the wind and towards water. Most shorebirds should be taken near the water's edge and released by lowering them to ground level. When your grip is loosened, the bird should walk away by itself.

Raptors should be released while facing into the wind and away from nearby obstacles (e.g., trees or buildings). The bird may be gently but firmly thrown upwards and away from you (any large bird with long wings and short legs may be released this way). Owls at night should be placed in a safe, dark spot; when their eyes readjust to the dark, they will fly away.

Passerines should **never** be thrown into the air or released high above the ground, as they may be unable to fly properly as a result of cold, stress, or wing-strain. When releasing a small bird, it is often best to hold it in the Bander's Grip, crouch down low so they will not fall, and simply open your hand palm downwards onto your other hand. If the bird tips over, help it to roll upright, as the ventral-up position paralyzes some birds. A gentle nudge may aid departure. Some banders like to put birds into a small, open box, perhaps with a heating pad on the bottom; they will fly out when ready. Again, be careful not to combine aggressive birds with other birds.

Stations that band many birds often use a release hatch built into the banding-lab wall (Fig. 17). After banding and measuring, the bird is gently dropped through the release hatch, where it lands on a platform. The release hatch is open to the outside but the entrance back to the banding lab is blocked. Birds usually fly away immediately, but watch each bird after it has been released to verify that it is healthy. You must be able to see or hear each bird as it flies out of the release hatch, which is why the hatch is normally located beneath a window. The flap door to the inside also can be used to check for departure.

### 10.9. When and How to Remove a Band

Bands that are too loose, too tight, or worn down (sharp-edged or hard to read) need to be removed. Getting a band safely onto a bird's leg is simple. Getting one off, however, can be difficult, especially if it is tight against the tarsus.

A band is subject to constant wear and corrosion from the moment it is placed on a bird's leg. Much of this wear is produced by the simple action of the band moving up and down the bird's leg and occurs on the inner surface. Eventually, if the bird lives long enough, the band will fall off. Corrosion and wear to the outer, numbered side of a band depends a great deal on the bird's habits. Corrosion occurs most often to bands of birds inhabiting saline or alkaline waters and to bands that come into frequent contact with feces. In time, the band number becomes illegible and to read it the band must be returned to the Banding Office to be etched. Bands are etched by placing a very strong

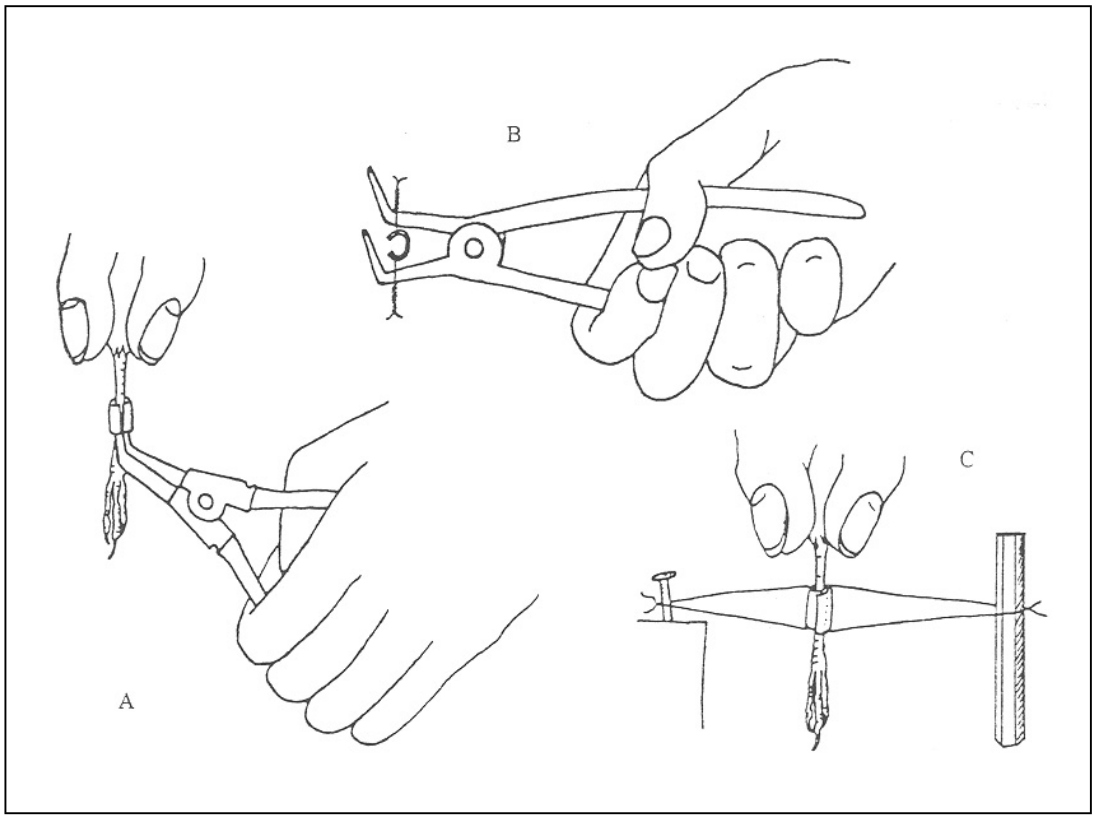



Figure 18. Band removal using (A) circlip pliers, (B) wire and circlip pliers (adapted from Lowe 1989), and (C) a wire, stick, and nail (adapted from Spencer 1992).

acid with a metal catalyst on the band under controlled conditions. It is best to report the band replacement on the schedule and attach the band to the schedule for etching by the Banding Office. You will be notified of the original banding information for that bird and of all additional reports of that number, whether your band is the original or the replacement band. Bands adjacent to other bands (such as color bands) experience wear along the edges where they come into contact.

If a band rotates freely and slides up and down without pinching the tarsus or causing foreseeable injury, it should be left on, even if it is the "wrong" size. On occasion, it may be better to slightly "oval" a band that is marginally too small rather than risk band removal, especially if you are on your own. Band removal is an extremely delicate process and can itself result in a broken leg or foot.

Circlip pliers (Fig. 18) frequently are used for band removal because they have fine, angled tips, enabling their insertion between a band and a bird's tarsus. When the handles of these pliers are closed, the tips open, thus opening the band. When removing a band with circlip pliers, all leverage must be applied to the band and **none** to the leg. As during banding, the tarsal joint must be supported throughout the whole process. The band and tarsal joint can be held by the thumb and finger, ensuring that the band cannot move during opening. Insert the tips of the pliers so that they are on either side of the seam of the band. Gradually apply pressure to the circlip pliers, opening the band a little at a time and readjusting the plier tip in the opening band until it is open far enough to be taken off the leg.

If the band is too tight against the leg to use circlip pliers, loop two strands of thin, strong wire, such as that on which bands are strung, on either side of the seam of the band, being careful not to puncture the leg. Wrap each end of the wire around improvised handles, which must be unbreakable (not a pencil) (Fig. 18) or twist the ends around the tips of needle-nosed pliers opened around the band. Provided the twists are very tight, opening the pliers further should force the band open. One person holds the bird, preventing it from struggling, and supports the leg. The other person pulls the "handles" apart **evenly and simultaneously**. Once the band is sufficiently loosened, circlip pliers can be inserted to complete the task. Wrapping one wire end around a stationary anchor, such as a nail in a block of wood (Fig. 18), can be especially useful if you are alone. You often can pry very tight bands open a little by carefully twisting the tip of a pen knife blade into the seam.

Some banders favor the use of "end-nippers" in band removal. An end-nipper's jaws are parted to a distance that will include the band's length. The jaws' edges at one side of the nipper are brought to each end of the butt-end's joint. Assure perfect alignment to the butt-end joint and safe distance from the tarsus. The end-nippers are then squeezed slowly and the butt-ends of the band will part to about 1-2 mm. This will be sufficient for removal of smaller bands. A repeat of the above may be necessary. Larger bands will be opened enough for further parting with pliers or fingernails. This method avoids much of

the difficulties of supporting the pressures applied in other removal methods.

Some banders favor the use of cuticle scissors or other fine-pointed scissors for removing the bands from small passerines. Cuticle scissors are useful in that the tips are recurved. Insert the tips into the band with the curve pointing up at the band and not down at the bird. Carefully open the band, readjusting the scissors as necessary until the band can be slid off over the tarsus.

After the band is removed, determine whether to destroy or reuse it, depending on its condition.

### 10.10. Banding Nestlings

Banding nestlings is important to many research projects, as it provides useful recovery information on age and place of origin. It can lead, however, to nest failure or premature fledging if done improperly. If possible, avoid banding nestlings in the morning or during cold or wet periods. Place all nestlings from one nest in one bird bag.

Do your best not to reveal a nest to predators. Look for avian predators when approaching the nest. Jays and crows may be attracted by parental alarm calls and rob the nest after you leave. To reduce the risk of mammalian predation, use a round-about way of getting to and from the nest, go late in the day so that your scent is not trapped in dew on the grass, and leave by a route different from that used to get to the nest so your trail does not dead-end at the nest; dead-end trails are apt to give the nest away to mammalian predators. Wearing rubber-soled shoes or boots helps prevent a human scent trail. In all instances, minimize your time at the nest; simply band the birds, record any necessary data, and leave the area immediately.

Nestlings should be banded only after their legs are nearly adult size. If they are banded too early, the band may not close properly over the enlarged, fleshy leg (for small passerines, shorebirds, and many other birds, leg diameter decreases as the nestling grows). For larger species with heavy legs that increase in diameter as the nestling grows, the band may slide over the toes and prevent the foot from developing properly. Also, the parents may mistake the band for a fecal sac and throw it, along with the nestling, out of the nest. To minimize further the chance of this happening, dull the finish of new bands with a couple of dabs from a magic marker. Avoid using white color bands on nestlings; these are readily mistaken for fecal sacs!

Young birds occasionally leave a nest prematurely because of disturbance. Early departure of nestlings can be fatal, particularly if the nest is over or near water. Banders must be cautious during a first-time approach to a nest believed to contain young and be prepared to withdraw at the first sign of possible premature fledging. In general, do not attempt to band nestlings that look old enough to explode from the nest. Routine banding of nestlings should be timed to take place before young are capable of leaving the nest but, of course, after the legs are hardened enough to hold the proper adult-sized band. The Bird Banding Manual: Volume II (Canadian Wildlife Service and U.S. Fish and Wildlife Service 1977) provides the appropriate ages for banding nestlings.

When removing nestlings, watch that they do not grasp the nest or nest lining. Check the toes and tarsi before pulling too hard. Count as you remove young to ensure that you put back as many as you took out. Some banders recommend that you stay at the nest while banding so that the parents do not come back to an empty nest. If you are working in a colony, however, it is better to leave one young in the nest and move away to band the rest so other birds are not disturbed. It is all right to leave the nest empty for 5-10 minutes; parents almost never desert nestlings that easily. It may be better to band young away from the nest to reduce the chance of predation, but work quickly, being sure that you have all necessary banding equipment ready for use prior to removing the young.

Use the Bander's Grip when handling nestlings unless they wriggle a lot, are very tiny, or have short tarsi. In these cases, the reverse grip can be used. Large nestlings (crow-sized or larger) can be held in the lap and covered with a cloth, but be sure they do not wriggle away.

Replace all young and do not leave them hanging out of the nest, even slightly. Ensure that all bands are tucked away below the nestlings and out of sight. Cover the nest with your hand or a cloth until the nestlings settle down. If some do fledge early, it is normally better to leave them and retreat from the nest site.

## 11. PROCESSING BIRDS

### 11.1. Ageing and Sexing

Banders have a unique opportunity to examine live birds closely, and this opportunity should not be wasted. By closely observing many individuals of a species, you may begin to recognize age- or sex-related features that have not been noted previously. These observations should be recorded and published.

The Banding Offices formally recognize and recommend the use of Peter Pyle's (1997a) *Identification Guide to North American Birds, Part 1* as a source of ageing and sexing criteria for passerines and "near passerines," including doves, owls, swifts, hummingbirds, and woodpeckers. At the time that guide went to press, all criteria were accepted by the Banding Offices unless noted in the text. Errata to this guide are published on the web (http://www.prbo.org/Errata.html). When Part 2 is published (covering diurnal raptors and waterbirds), it also will be recommended for banders. Until that time, the remaining keys in the Banding Manual and published peer-reviewed references should be used for diurnal raptors and waterbirds.

Many criteria can be used to age and sex birds. Most of these will be detailed in NABC's taxon-specific manuals. In general, skulling is extremely useful for ageing passerines. Feather condition can tell you much about a bird's age if you have a basic understanding of the bird's molt strategy. In contrast to old feathers, new feathers appear smoother, with more color and sheen. Abrasion wears away the outer edges of older feathers—most noticeable on the tips of flight feathers and tail feathers. Birds cope with this constant degeneration of their plumage by molting. Molt is generally confined to two times of the year; the prealternate (prenuptial) molt occurs just before the breeding season when the bird molts into its alternate breeding

plumage. The prebasic (postnuptial) molt occurs after the breeding season, though nonbreeders may molt during the breeding season. The pattern of this molt can help age captured birds. Although feather shape and wear are useful features when ageing birds, the differences between after hatch year/after second year (AHY/ASY) and hatch year/second year (HY/SY) feathers are often subtle. Hence, as an ageing technique, feather characteristics are usually used with caution and practice.

Sexing birds often can be based on plumage characters and physiological changes. During the breeding season, many adult males develop enlarged, swollen cloacal protuberances, functional in sperm storage and transfer. During nesting, females (and in some species, the males) lose the feathers on their belly and develop a brood patch. This clear patch of skin becomes highly vascularized and a little swollen at the time of egg laying to facilitate heat transfer from the body to the eggs.

A bird is aged according to the number of **calendar** years it has survived. Birds in their first year are designated as hatching year (HY) birds until 31 December. Beginning on 1 January of the next calendar year, the bird is in its second calendar year (SY) even though it may be only 6 to 7 months old. This system of ageing allows the bander to place a bird in any of the following age classes:

(1) U denotes birds of unknown age. The corresponding numeric code is 0. Do not use U from January 1 to the nesting season. At this time of year, the "unknown" category is AHY as no young have been produced in the current calendar year.

(2) HY, SY, and TY, respectively, refer to birds in their first, second, or third calendar year. These age classes are coded numerically as 2, 5, and 7, respectively.

(3) AHY, ASY, and ATY, respectively, denote birds that are **at least** in their second, third, or fourth calendar year and are coded 1, 6, and 8, respectively. AHY stands for "after hatching year;" the bird is **at least** in its second calendar year. A bird hatched in May will be AHY in January, but it is still only about 8 months old. AHY is simply a catch-all code to designate birds that are at least SY, but for which the age could not be more precisely determined.

The following alpha and numeric codes are used to indicate sex: M (or 4) = male, F (or 5) = female, and U (or 0) = unknown sex.

For many species not yet covered in Pyle's Guide, the Bird Banding Manual provides dichotomous keys for ageing and sexing. Merely start at the top of the page and work your way through the series of couplets, always choosing the more appropriate option, until you arrive at the right age and sex "answers." The answer is often an age choice, separated by a backslash (e.g., HY/SY). The slash merely represents the calendar year change. Choose the correct code depending on whether the season is before the new year and post breeding (e.g., fall HY) or after the new year and prior to breeding (e.g., spring SY). Hence, a bird of the year that is banded on 31 December might be aged correctly as HY. If it is recaptured on 1 January, however, it automatically becomes SY (i.e., it is in its second calendar year). Likewise, a bird aged as U in December automatically becomes AHY in January.

Often it is impossible to correctly age a bird unless you know its sex. Just as often, you'll need to know its age before you can sex it. It sounds a little confusing, but it is a matter of applying what you know in a logical sequence.

Be aware of the difference between "useful" characteristics (e.g., feather shape) and "reliable" ones (e.g., degree of ossification). A general rule of thumb is that reliable characteristics receive greatest priority; useful characteristics are used primarily as additional clues.

Many physiological processes cause age-dependent changes in birds and are primarily used as age indicators, while other processes, such as the development of cloacal protuberances in males during the breeding season, can be used as sex indicators. Measured characteristics are most often used to indicate sex. With the exception of raptors and most shorebirds and hummingbirds, males are generally larger than females. As a general rule, graded characters (e.g., "less dark," "more pointed") should not be used alone as criteria for age or sex without a good deal of experience.

It is extremely important that banders be aware of potential pitfalls of many of the ageing and sexing criteria, such as those described in Pyle (1997a) and the Bird Banding Manual. For example, when used for sex determination, usually a certain amount of overlap exists in the wing lengths of males and females. In bird banding, it is appropriate to ensure that our age and sex determinations are right 95% of the time. Consequently, birds of "intermediate" wing length are recorded as "unknown" sex. Too much processing time can be spent on a fruitless quest to age or sex a bird, delaying processing of other birds, when the criteria available can correctly ascertain age or sex for much less than 95% of the birds. In these cases, such data should be considered research-oriented and taken only when sufficient time is present to explore these topics.

Virtually all analyses first divide the birds into age classes, usually AHY vs. HY. While plumage, molt patterns of wing feathers, feather wear, and breeding condition all can contribute to the determination of age in the fall, the degree of skull pneumatization is the most certain in passerines. Because these patterns of pneumatization can be difficult to discern, we recommend using a magnifying device, such as a visor that slips over your head or a suspended magnifying glass, preferably with an additional light source. Both visor and suspended magnifying glass leave both hands free. Most banders find them to be useful tools when learning to skull. Although it is possible in many species to determine SY, or even TY birds, and we encourage this—the minimum data should be adult (AHY) vs. young (HY).

If you are not 100% certain of a bird's age or sex, **do not guess!** Guesswork destroys the reliability of your data, making it less useful. It is much better to record it "unknown" and move on to the next bird. If you have a good hunch though, record it in the "remarks" or "notes" section of your banding sheet. Subsequent recaptures may verify or refute your hunch and, in either case, you will have learned something.

The introductory sections of Pyle (1997a) provide a thorough treatment of age- and sex-related physiological processes and

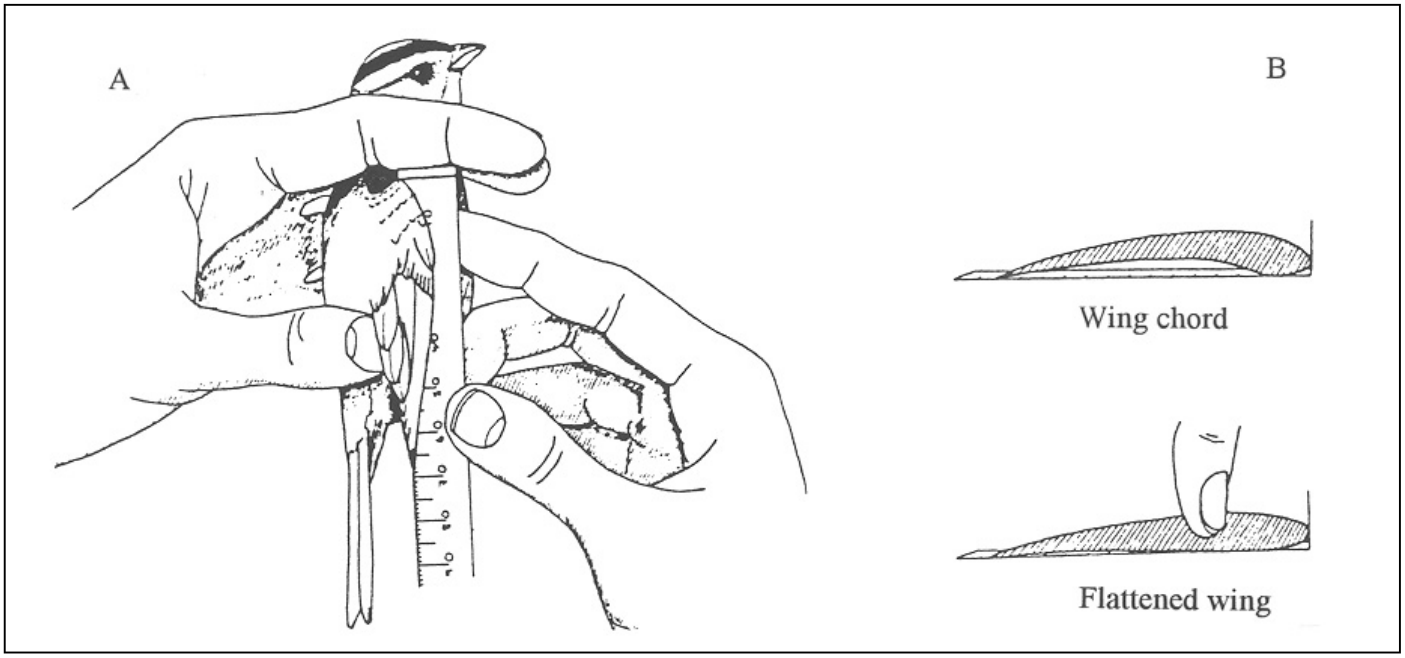



Figure 19. (A) A good hold to use for measuring wing chord; (B) profiles of wing measurement techniques (from Pyle 1997a).

useful measuring techniques. This material (pp. 1-40) is considered to be an essential part of this Banders' Study Guide.

### 11.2. Useful Measurements

#### 11.2.1. Wing length

Wing length is a useful measurement for several reasons: it can help identify species; it is useful as a standardizing feature when analyzing bird body weights; and in some species it can help separate the sexes. Before measuring wing length, make sure the features that constitute the wing tip are not heavily worn, broken, missing, or growing. If the longest feathers are growing or broken, you should note this or consider not recording wing length.

Wing length is commonly measured in two ways. To measure the wing chord or **unflattened** wing length (Fig. 19), hold the bird in the Bander's Grip and lift the thumb away from the side of the bird's body. The wing then will be accessible for measuring. Slip a ruler with a perpendicular metal stop fixed at zero under the wing. Slide the stop of the ruler until it fits snugly against the carpal joint, with the primaries parallel to and extending down the ruler. The wing chord is usually read to the nearest millimeter. Tilting the ruler to a 45E angle to the plane of the wing keeps the feathers off the ruler, reduces friction, and increases accuracy. The wing should be as close to a natural resting position as possible, ensuring that all primaries lie in their natural alignments. Imagine an axis running from the apex of the closed wing at the carpal joint to the very tip of the longest primary. This axis should lie parallel with the edge of the wing rule. Do not record wing length if you know or suspect that the longest primary is missing, broken, or in molt and less than fully grown.

The **flattened** and straightened wing length (Fig. 19) is measured in a similar manner except that the wing is pressed flat against the ruler with the thumb on the wing coverts. This method removes the natural curvature of the remiges, so the measurement is longer (about 0.5-2.0%) than the wing chord. In North America, this measurement is used more often on museum specimens than on live birds, but is an important measurement for shorebirds because the literature tends to use the flattened (or straightened) wing length.

#### 11.2.2. Wing formula

The "wing formula" is determined by (1) the length and position of each primary feather in relation to the others; (2) the occurrence, position, and length of notches on the inner (i.e., trailing) edge of each primary; and (3) the occurrence, position, and length of emarginations (narrowings in the vane) on the outer (i.e., leading) edge of each primary. The specifics of wing formulae for various species are extremely useful as tools for the identification and separation of similar species (e.g., *Empidonax* flycatchers). Not much is known about wing formulae of North American birds in general, so further study would be valuable, especially relation to ageing and sexing by the length of the 9th or 10th (outer) primary or by the length of emarginations in the outer primaries.

To measure, the wing should be in its natural, closed position. A transparent ruler or calipers are useful to take the measurements. Differences in feather lengths (e.g., p6-p5 [the length of primary 6 less the length of primary 5]) are measured as the distance from the tip of the shorter feather(s) to that of the longer (Fig. 20). Emarginations are measured as the distance from the tip of the feather inward toward the base, to the **start** of the flaring of the outer web (the base of the emargination), that is to the point where the feather **begins** to widen. As with the

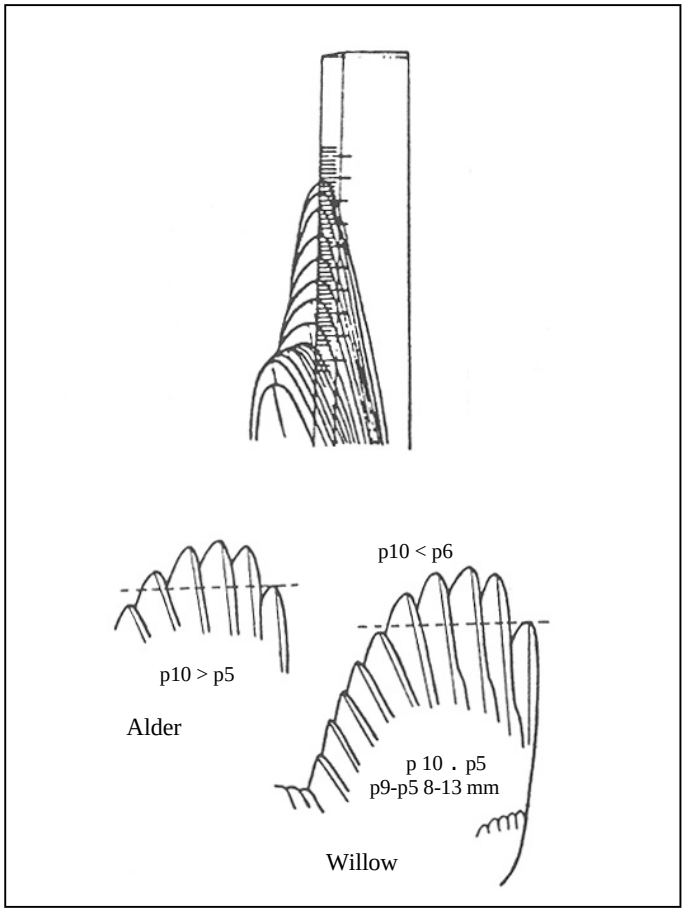



Figure 20. How to take wing formulae (from Pyle 1997a and Svensson 1992).

measurement of wing length, make sure the feathers involved are not heavily worn, broken, missing, or growing and that the wing is held in its natural, closed position.

Remiges (wing flight feathers) are numbered beginning at the carpal joint. Thus, the 1st primary (p1) and the first secondary (s1) are adjacent. The outermost (distal) primary and the innermost (proximal) secondary are the highest numbered. Rectrices (tail feathers) are numbered from the innermost to the outermost on each side.

### 11.2.3. Tail length

Tail length is sometimes used for species identification or to determine age and/or sex. It is defined as the distance between the tip of the longest rectrix and the point at which the two central rectrices protrude from the skin. Use a ruler that has the zero mark set flush at one end. A thin ruler works best. Insert the ruler between the two central rectrices, holding the ruler in line with the tail and pushing the end of the ruler firmly against the feather roots (i.e., the point of insertion of the feathers), or lay the ruler flat along the underside of the tail and push it gently against the base of the central tail feathers (Fig. 21). In addition, the difference in length between the longest and shortest rectrices (the furca) is useful for ageing and sexing a few species. As with wing length, do not record tail length if the feathers of concern are worn, broken, missing, or growing.

### 11.2.4. Body weight

Birds normally are weighed as the last step of the banding procedure as it is sometimes difficult to remove a bird from the weighing "cone" without letting it go. Body weight is most quickly and accurately measured with the bird confined in some sort of weighing cup or cone. Pesola scales or triple-beam balances are adequate, but an electronic balance is best.

Total weight is extremely variable in birds, depending on time of day; food availability; and whether the bird is migrating, breeding, molting, or loafing. Although this measurement is not very useful for ageing, sexing, or identifying species, it is a quantifiable indicator of the bird's condition. It can be used separately or in conjunction with how much fat is present on the bird. To compare weights of different individuals, the weights ought to be calibrated to body size; since wing chord is a reasonable indicator of bird size, weights may be compared to wing measurements. Note that females carrying eggs will weigh considerably more than normal.

### 11.2.5. Fat and crop content

Birds store fat as a readily accessible source of energy, especially during migration. During migration, birds that have little or no fat probably have just arrived and will need to spend a few days replenishing their stores. Birds with large amounts of fat probably are ready to depart on the next phase of their journey. Fat content is also a good general indicator of the condition of the bird and is useful for gauging the condition of sick or injured birds.

Birds store fat in the furcular hollow (or "furculum" where

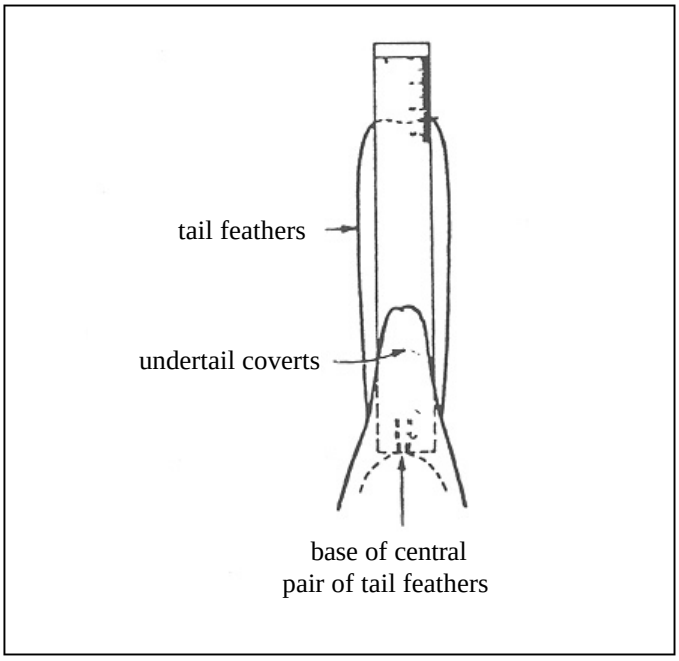



Figure 21. Measuring tail length (from Svensson 1992).

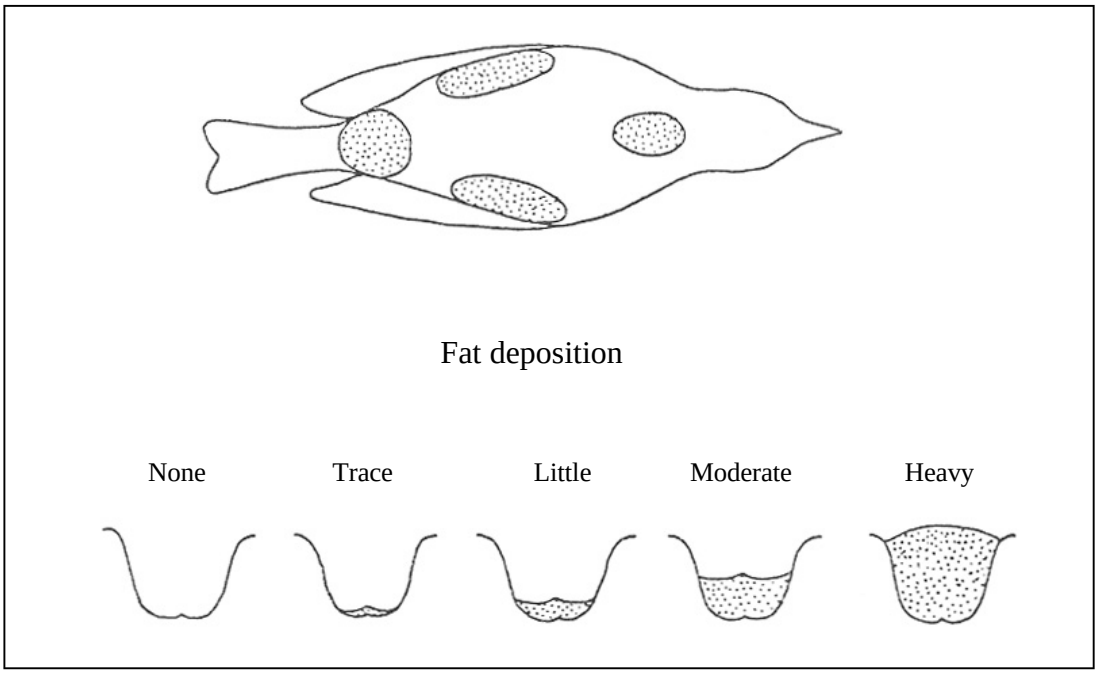



Figure 22. Where to look for fat deposits and a representation of increasing fat in the furculum (neck hollow). There are several systems in use for coding the amount of fat accumulation.

the throat joins the body), lower abdomen, and sides of the body beneath the ribs, and underneath the wings (Fig. 22). After banding, blow on the body feathers, parting them along their natural tracts. You can see easily the fat deposits through the skin, which appear as yellowish or orangish masses contrasting with the burgundy-colored muscular areas. With a little practice and a sense of the depth of an empty furculum, you can gauge the relative amount of fat on a bird's body (Fig. 22). Fat deposition is a continuum. Once you understand how that continuum proceeds, scoring is just a matter of dividing up the continuum into discrete increments. Considerable variation exists in assigning fat scores, so if your study depends on consistent scores, have one person do all this work or ensure that everyone is trained to the same criteria.

The crop content of raptors and doves is assessed by gently placing a finger on the furculum. A large lump means that the bird has just eaten and the crop is full. With experience, you can easily distinguish among empty, half-full, and full crops. Beware of the folded trachea; do not mistake this for food in the crop. Many species of birds lack a crop.

### 11.2.6. Bill length, width, and depth

Two common methods of measuring bill length require the use of calipers. One, "bill from nares to tip," refers to the distance between the anterior (distal) end of the nostril and the tip of the bill (Fig. 23a). "Exposed culmen" refers to the distance between the tip of the bill and the edge of the feathering at the base of the upper bill (Fig. 23b). The former may be the less meaningful of the two due to variation in the lengths of the nostrils and bill tip, but it is likely to be the easier and more-repeatable measurement.

Unless otherwise noted, all references to bill width and depth in Pyle (1997a) refer to measurements taken at the anterior ends of the nostrils. To measure bill depth, the caliper jaws should be perpendicular to the axis of the bill (Fig. 23c). To measure bill width, open the caliper jaws so they stop at the anterior end of the nostrils when moved toward the base of the bill (Fig. 23d). Be sure you can read properly the measurements displayed on the scale of the calipers. Note also that stiff calipers can crush. To get a reading, always open, never close, the calipers to the appropriate point. Use a high-quality tool or a set of dividers to get the span, and read the measurement from a ruler.

### 11.2.7. Tarsus and foot length

With calipers, tarsus length is measured as the distance between the depression in the intertarsal joint anteriorly to the distal end of the last leg scale before the toes diverge distally (Fig. 24a). Variation in tarsus length among similar species and between sexes is usually small, so this measurement is not often taken.

Foot pad length, or maximum toe spread, is useful for sexing some owls. It is the distance between the edge of the pad of the hind toe and the edge of the pad of the longest front toe (Fig. 24b). This measurement is most accurate when made with calipers. Beware of the talons!

### 11.2.8. Crown patch

Some warblers have crown patches, the length of which is useful for sexing. Using calipers, measure the distance between the anterior and posterior edges of the crown patch, along the medial axis. The feathers must be lying flat in their natural position, so this measurement should be made before skulling.

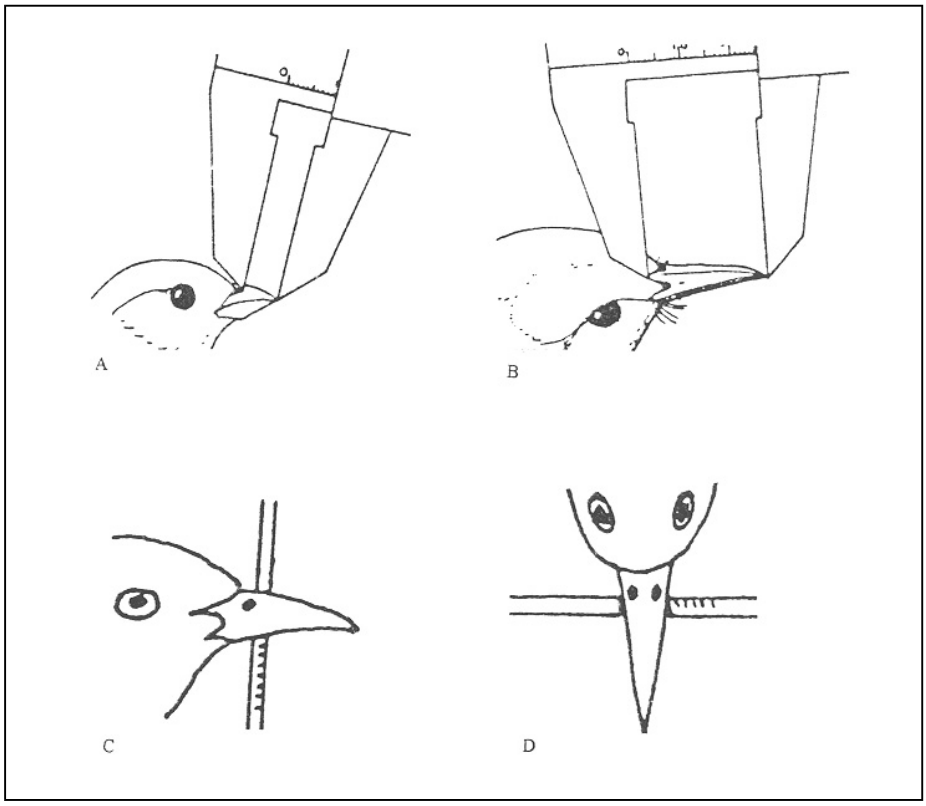



Figure 23. (A) Measuring culmen and (B) exposed culmen (from Pyle 1997a); (C) measuring bill depth and (D) width at the anterior edge of the nostril.

The crown patch is often concealed, however, so it may be necessary to blow on the head to reveal its anterior and posterior edges.

**11.2.9. Rare birds**

All banders should be familiar with the species commonly captured, and they should be aware of any similar, less-common species and their diagnostic characteristics. When you capture an unusual or confusing bird, photograph it with a camera with a close focus function. The bird should be held in front of a uniform background with a label giving date, location, and the last three digits of the band number. Be sure to show diagnostic characters. At the very least, take a side view with the far wing flared up to show molt and upper coverts. A top and bottom view would be advantageous. If you do not have a camera, make a thorough written description covering all the major plumage

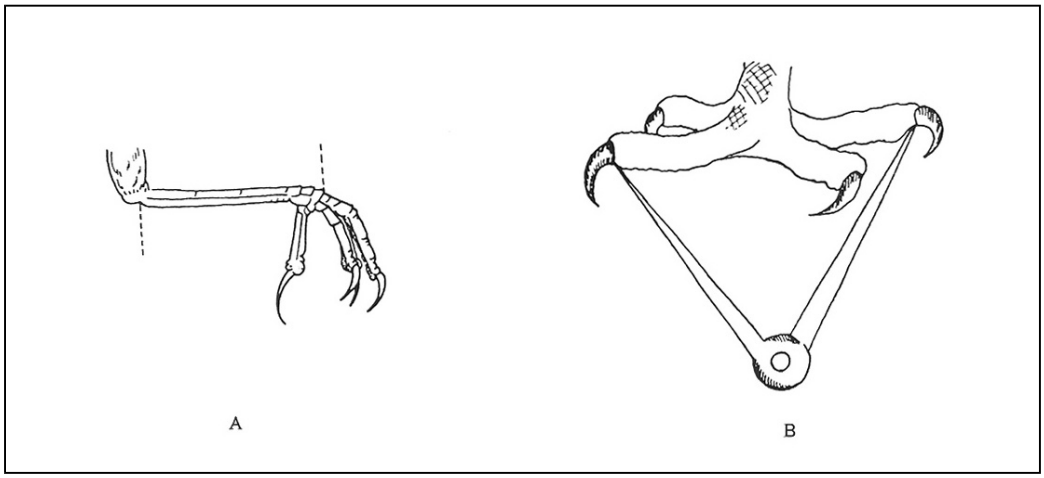



Figure 24. Measuring (A) tarsus length (from Pyle 1997a) and (B) the length of an owl's foot pad.

areas and color of body parts. Birds that can not be identified should not be banded, but they should be processed completely and photographed.

### 11.3. Parasites

All animals carry parasites. Comparatively little is known about bird parasites. Depending on available time and personal interest, parasites can be collected to study how they change with the bird's age, the seasonal infestation rate, which species areinvolved, and the geographical distribution of vectors. Ectoparasites can generally be stored in 70% alcohol, but interested banders should contact university entomologists for more specific information on procedures. Most ectoparasites can be easily removed from live birds, while blood samples are taken to collect blood parasites. Endoparasites can be obtained from very recently dead birds.

Encounters with parasites should be anticipated when working with birds. This is particularly important when reaching into nests above your head to retrieve nestlings for banding. Blow fly larvae can be the most obvious of these parasites, but flat flies, lice, and mites also are common. Most bird parasites are harmless to humans.

Flat flies (Hippoboscidae) are able to slip in and out among body feathers. They generally fly only when the bird is handled and its feathers are ruffled. They give birth to live young. The larva is deposited on the feathers of the bird, drops to the soil where it pupates into an adult, and attempts to find a host. When flying from host to host, flat flies can carry feather lice and mites, thus serving as dispersal agents.

Feather lice (Mallophaga) are small, soft-bodied, wingless insects that have specially developed claws for clinging to feathers and skin. They feed on feather scales, blood, and lymph. Entomologists suspect that these organisms carry infectious agents for birds. Healthy birds usually can cope with a few lice by preening, whereas sick or weak birds often seem to be infested with them.

Soft-bodied, wingless, blood-sucking lice (Anoplura) also can be found on birds. Their heads are pointed or tapered, not rounded as in the Mallophaga, and are known vectors of *Typhus reckettsiae* of mammals and birds.

Blow fly (Diptera) larvae will attach themselves to any part of a nestling, including the inside of the nostrils and ears. The larvae hang on the birds until they have taken enough blood to become a sufficient size, then they drop off and pupate. Their populations are cyclic, so when the flies are at a population peak, an individual nestling can literally be covered with them and die from loss of blood.

The most common mites and ticks (Acarina) found on birds are very tiny feather mites that live (presumably harmlessly) among the feather bracts and feed on feather scales and detritus. Ticks are larger than mites. They are eight-legged as adults, and six-legged as nymphs. As adults, they must take a blood meal before dropping off their host and laying eggs in the soil. They are vectors of tick typhus and Lyme Disease. A scaly leg mites infection might preclude banding.

Flukes (Trematoda) are parasitic flatworms that are internal parasites, but have been found around the cloaca of passerines.

Many types of blood parasites occur in birds. Sampling blood is a delicate process that must be carefully demonstrated and taught to a beginner. Blood sampling also needs to be reviewed by an Animal Care Committee and requires special authorization from the Banding Offices. Methods for taking, storing, and transporting blood samples and smears are detailed in McClure (1984), but prior arrangements should be made for collaboration with researchers who can analyze and study the samples. The red blood cells of birds contain genetic material; a small sample of blood is invaluable for studies of avian genetics and to confirm sex when other features do not (e.g., useful for nestlings).

### 11.4. Deformities

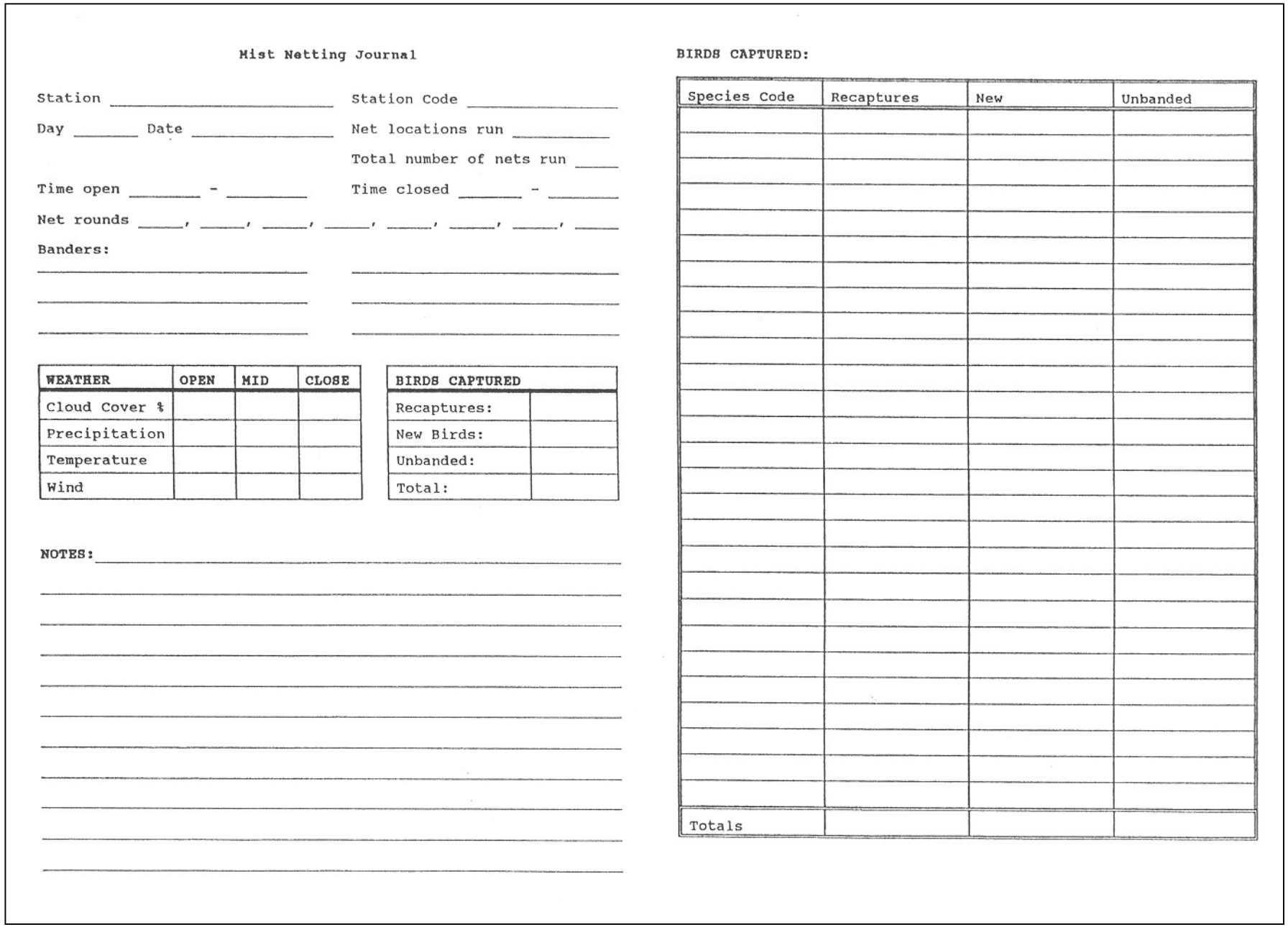
Birds are sometimes encountered that have crossed bills, deformed legs, feet or eyes, bald patches of skin, pox, and other afflictions. These may result from disease, the bird's genetics, or toxic chemicals. Not much is known about deformities, or how well a bird can cope with various afflictions. Banders should record deformities on their banding sheets, photograph them (if possible), and report any significant findings.

## 12. RECORD KEEPING

The primary reason for banding is to collect useful, reliable data, and to store these data in a manner that makes them readily accessible for analysis. Success of the banding and recovery reporting system depends on international cooperation among the Banding Offices, all banders, researchers, and the public. Prompt submission of data to the Banding Offices allows them to respond immediately to people who submit encounter information and to banders in need of recovery data. All necessary forms for reporting and inquiring about banding data are summarized below and are available from the Banding Offices.

Every banding operation must keep careful track of all birds banded and recaptured. In addition, all banders should maintain a daily journal. Information for a journal would include number and type of traps or nets used, hours of operation, weather conditions, names of personnel, a summary of the day's activities, details of any unusual events, details of any casualties, capture tally, and possibly a bird list. A sample form is shown in Figure 25.

Each bird's band number, species, age, sex, banding location, and date trapped must be recorded at the time of banding. Additional information also may be recorded. Many banders routinely record wing chord, weight, fat condition, time trapped, time released, and trapping device. Data on plumage aberrations, parasites, infections, and descriptions of molt patterns are also often recorded. Banding records must be kept in a comprehensive, orderly fashion. For example, it is much easier to summarize and report data if records of retraps are kept separate from the regular banding records.



Mist Netting Journal

Station _____ Station Code _____

Day _____ Date _____ Net locations run _____

Total number of nets run ____

Time open _____ - _____ Time closed _____ - _____

Net rounds _____, _____, _____, _____, _____, _____, _____, _____

Banders:

_____ _____

_____ _____

_____ _____

| WEATHER | OPEN | MID | CLOSE |
|---|---|---|---|
| Cloud Cover % | | | |
| Precipitation | | | |
| Temperature | | | |
| Wind | | | |

| BIRDS CAPTURED | |
|---|---|
| Recaptures: | |
| New Birds: | |
| Unbanded: | |
| Total: | |

NOTES: _____

BIRDS CAPTURED:

| Species Code | Recaptures | New | Unbanded |
|---|---|---|---|
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| Totals | | | |

Figure 25. Sample of a journal form.

In the interests of reliable data collection, every bander must keep field notes (preferably on preprinted sheets) or enter data directly into the computer program available from the Banding Offices. Banding sheets ensure that you will be able to verify your data. In the case of transcription or computer entry errors, data must be traceable to banders and their original field records. Every band must be accounted for, either with data or with an explanation of band loss.

The type and organization of record keeping will depend on the type of banding being undertaken. For example, when banding only one species, a different band series can be used for each age/sex combination. Field notes can then be organized by age/sex category.

### 12.1. Standard Codes

All codes used in the preparation of banding and recovery data are detailed in the Banding Manual. Every species is given its own common name, species number, and alpha code by the Banding Offices. These are the only acceptable names and codes for reporting information on a particular species. The four-letter alpha code generally consists of the first two letters of the first part of the common name, followed by the first two letters of the second part of the common name of the species, but exceptions to this rule are common. If you have any doubt, record the full species name on the banding sheet and look up the correct code later. Particularly if you are banding many species, you will find it extremely useful to keep a list of the alpha codes posted in plain view at your banding site. The same list should also give the recommended band sizes for each species.

Banded birds are given a 3-digit status code. The first digit describes the state of the bird at the time of capture. For example, a code of three (3) means that a normal, wild bird was banded. The second two digits are additional information codes. They tell what was done to the bird in addition to placing a standard band on one of its legs. For example, was the bird color banded (code 01), or did it receive a state or other address band (code 06), or was nothing special done (code 00)?

Other codes are used for the remaining data: age and sex (see Section 11.1), province, regional code, location, station name, and date.

### 12.2. Banding Sheets

Since the initiation of computers to analyze banding data in the 1970s, many data sheets have been devised at different stations for recording capture data. Widely used versions can be found in Ralph et al. (1993a) and the MAPS Manual (Burton and DeSante 1998). Each banding station will evolve its own, specific techniques and data fields. If you contribute to a cooperative program, however, you may be required to use standardized forms. We present here some general forms and formats with notes on pitfalls to avoid. Consider each of the following items as a suggestion, unless otherwise indicated.

In addition to the required information (e.g., state or province, regional code, station name, species name, band number, age, sex, date, location), all stations should maximize the usefulness of their data sets by recording other important information. For example, consider the following. "How aged" and "how sexed" codes help assure that birds are being aged and sexed according to the proper features, at the appropriate time of year. Wing chord is not only useful for determining species and sex, but also can be used as a standard correction factor for studies involving bird mass. Body mass itself can be used in many different studies, as can information on fat and such things as degree of skull pneumatization. Breeding condition (presence or absence of a cloacal protuberance or brood patch) can supply important information about breeding phenology, as well as information as on age and sex. Trapping time and weighing time are useful because birds lose weight during the interim; trapping time itself can be a useful measure of several variables. The initials of the bander are recorded so any systematic difficulties in data can be traced back to the proper person and recoveries ascribed to the original bander. Trap or net type is recorded because most studies require banding totals to be corrected for effort, and separate corrections are required for each type. Some studies may even require recording which individual trap or net each bird comes from. Most stations include at least an abbreviation of the species name, as a check against the 4-letter species code. Molt can be an important variable, telling much about the age of the bird. A basic system of recording molt in the flight feathers is to record presence or absence of molt in the primary feathers or the secondaries (except the innermost three). Molt of tail feathers is often not recorded, except as a note. You should always check both wings, because birds often lose feathers accidentally ("adventitious molt"). More detailed recording of molt can be done by using a molt card, recording both active molt using the British Trust for Ornithology's method (Ginn and Melville 1983) as well as evidence of previous molts (see Appendix D). The extent of body molt can be recorded by a subjective determination of none, trace (a few, perhaps adventitious molting feathers), light (involving more than one feather tract), medium, or heavy. Finally, "Additional Information" can be used to record brief notes about the bird's age or sex, the presence of any deformities, molt patterns, and any apparent discrepancies regarding such things as band size.

Some comments about data sheets: Many stations insist that only black ball-point pen be used to fill out data sheets, because pencils can smudge or erase, ink from felt-tipped pens tends to run, and neither pencil nor blue ink reproduces well when photocopied. "Liquid paper" must then be used to correct mistakes. Others feel that liquid paper might eventually flake off, so one should record over the mistake. All data must be legible, particularly if someone else will be entering your data into a computer. Many stations, however, use soft (#2) pencil without problems in copying and legibility. They contend that the pencil corrections, through erasure, makes cleaner, more legible data sheets and reduces the temptation of recorders to mark over a mistake, rather than erase (or cover it with white-out).

On the banding sheet, all data are usually right-justified in the boxes within their own field of columns. Various methods are used to indicate that data are repeated from one line to the next. At many stations, a symbol (e.g., a less than (<) or greater

than (>) sign) is drawn below the repeated data, except where ">" can be confused for a "7." Ditto marks (") are not generally used to indicate repeated data, because they are easily misinterpreted as a number "11." If data in a field are repeated for several sequential lines, a vertical line can be used to indicate the repeated data. Do not use a vertical line for only one line of repeated data, as it can be mistaken for the number "1." Lost or destroyed bands are recorded as such on the appropriate line for that band number. Any data recorded on the line following a band lost or destroyed should be written in full again, even if it was the same as the previous line containing banding data. It is a good idea to ensure that **either** the full name or the appropriate species code is written out for each entry: it is too easy, when large numbers of birds are being banded, for a recorder to use the repeat-line indicator and then accidentally miss a change in species.

It is imperative that the banding sheets be thoroughly proofed and corrected. This is usually done by the Master Permit holder, but students and Subpermit holders can help. Complete proofing involves confirming that species codes are correct, and looking for unacceptable age/sex/month combinations, out-of-range measurements, birds banded with the wrong band size, missing notes, and so on.

### 12.3. Recapture Data

Information on recaptures can tell you much about body weight fluctuations, stop-over periods, site fidelity, annual survival, quality control for previous captures, and so on. Some banders suggest that recapture data should be recorded for all recaptures, even those that have been handled within the previous 24-hour period. Same-day repeats can provide valuable information about the effects of handling. Alternatively, other banders suggest that same-day repeats can be released without processing. If you do this, **make sure** that the bird was previously captured the same day. At most stations, recapture sheets are identical to the banding sheets.

The most important recapture information is the band number. All too often, it is the datum to which banders are the least attentive. Every year, important recoveries are lost because band numbers are misread, and banders report recoveries of their own birds because the band numbers were misread. Always read the band number on the retrap slowly to the recorder. Then verify the number as the recorder reads it back to you. You will pay more attention to the number if the recorder repeats it **backwards**. Have another bander look at any number that is in question on the band. If time allows, and the filing system is efficient, look for original data while the recaptured bird is still in the hand, so that any discrepancy can be double checked and solved.

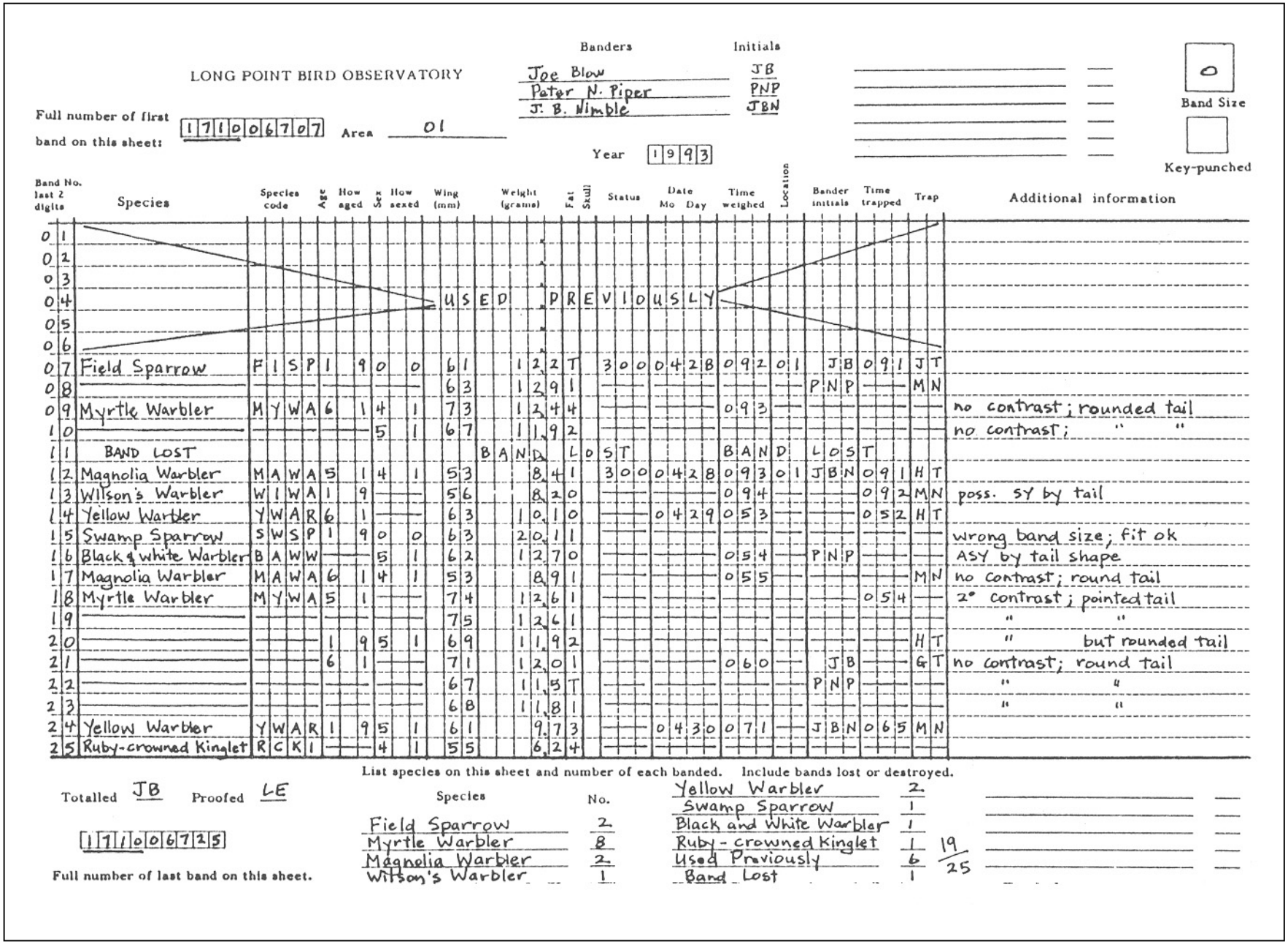
Some stations use recapture cards with the recapture information entered, beginning on the second row, and subsequent retrap information entered on the next lines. At the end of each day, they enter the original banding data on the first row on the card, allowing confirmation of measurements and other data. This cuts down on the work that must be done at the end of the season but prevents the use of the data for quality control. Cards can be filed by band number in a small file box for easy access and later entered into a personalized version of the Banding Offices' computer data entry program. The use of personal computers, however, is more efficient than the use of recapture cards.

### 12.4. Banding Schedules

Banding records are reported to the Banding Offices on "Banding Schedules" (Fig. 26). In the past, data were hand-written onto these schedules, but the Banding Offices now require submission of data on computerized Banding Schedules using their software. This software can produce the schedules on either MacIntosh (utilizing a program such as virtual PC) or IBM-compatible PCs; the data-entry program and the Banding Manual provide detailed, step-by-step instructions for completing the schedules. Data may be computerized at the time of banding or entered later from hand-written field sheets. The computerized schedules facilitate data analyses, provide database management capabilities, and save the Banding Offices time formerly spent computerizing the thousands of hand-written schedules submitted in the past.

You must proof your field data before transcribing them onto the Banding Schedules. Proof the schedules again to detect data entry errors before the schedules are submitted to the Banding Offices. The computer data entry program incorporates several built-in editing subprograms to help you out, once the manual checking has been done. For example, while you are entering data the computer may beep a warning at you when you try to enter something that is unacceptable. Once the data have been entered, sorting and sequence checking routines are run to ensure that all bands are accounted for and that bands and dates appear in their proper sequence. If any errors are found at this stage, then you must cross-check them against the original banding information and make the necessary corrections. Once this is done, it is a good idea to run the data listing program to print out the entire data set. This is then proofed against the original banding sheets as an added check against data entry errors. After these are corrected, the data file is then run through an editing program that flags any suspicious data and warns you of any significant errors that must be corrected prior to schedule generation. As a final check, the schedule-generating program runs a final edit to make sure you have corrected the significant warnings. If no significant errors are detected, the program will then allow you to print the schedules.

To ease the workload, some large-scale banding operations enter data directly into field computers, thus bypassing banding sheets. This can work well, but we recommend that it be used with caution. We advise that you contact someone who has worked the "bugs" out of an in-house data entry system before embarking on it yourself. Manomet Center for Conservation Sciences (see Appendix A) appears to have a good system in place.



LONG POINT BIRD OBSERVATORY

Banders / Initials: Joe Blow — JB; Peter N. Piper — PNP; J. B. Nimble — JBN

Full number of first band on this sheet: 17100673 07 Area 01

Year 1993

Band Size: 0 Key-punched

| Band No. last 2 digits | Species | Species code | Age | How aged | Sex | How sexed | Wing (mm) | Weight (grams) | Fat | Skull | Status | Date Mo Day | Time weighed | Location | Bander initials | Time trapped | Trap | Additional information |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | | | | | | | | | | | USED PREVIOUSLY | | | | | | | |
| 02 | | | | | | | | | | | | | | | | | | |
| 03 | | | | | | | | | | | | | | | | | | |
| 04 | | | | | | | | | | | | | | | | | | |
| 05 | | | | | | | | | | | | | | | | | | |
| 06 | | | | | | | | | | | | | | | | | | |
| 07 | Field Sparrow | FISP | 1 | 9 | 0 | 0 | 61 | 12.2 | T | | 300 | 0428 | 0920 | 01 | JB | 0911 | JT | |
| 08 | | | | | | | 63 | 12.9 | 1 | | | | | | PNP | | MN | |
| 09 | Myrtle Warbler | MYWA | 6 | 1 | 4 | 1 | 73 | 12.4 | 4 | | | | 093 | | | | | no contrast; rounded tail |
| 10 | | | | | 5 | 1 | 67 | 11.9 | 2 | | | | | | | | | no contrast; " " |
| 11 | BAND LOST | | | | | | | BAND LOST | | | | | BAND LOST | | | | | |
| 12 | Magnolia Warbler | MAWA | 5 | 1 | 4 | 1 | 53 | 8.4 | 1 | | 300 | 0428 | 0930 | 01 | JBN | 0911 | HT | |
| 13 | Wilson's Warbler | WIWA | 1 | 9 | | | 56 | 8.2 | 0 | | | | 094 | | | 0925 | MN | poss. SY by tail |
| 14 | Yellow Warbler | YWAR | 6 | 1 | | | 63 | 10.1 | 0 | | | 0429 | 0553 | | | 0552 | HT | |
| 15 | Swamp Sparrow | SWSP | 1 | 9 | 0 | 0 | 63 | 20.1 | 1 | | | | | | | | | wrong band size; fit ok |
| 16 | Black & white Warbler | BAWW | | | 5 | 1 | 62 | 12.7 | 0 | | | | 054 | | PNP | | | ASY by tail shape |
| 17 | Magnolia Warbler | MAWA | 6 | 1 | 4 | 1 | 53 | 8.9 | 1 | | | | 055 | | | | MN | no contrast; round tail |
| 18 | Myrtle Warbler | MYWA | 5 | 1 | | | 74 | 12.6 | 1 | | | | | | | 0544 | | 2° contrast; pointed tail |
| 19 | | | | | | | 75 | 12.6 | 1 | | | | | | | | | " " |
| 20 | | | 1 | 9 | 5 | 1 | 69 | 11.9 | 2 | | | | | | | | HT | " but rounded tail |
| 21 | | | 6 | 1 | | | 71 | 12.0 | 1 | | | | 060 | | JB | | GT | no contrast; round tail |
| 22 | | | | | | | 67 | 11.5 | T | | | | | | PNP | | | " " |
| 23 | | | | | | | 68 | 11.8 | 1 | | | | | | | | | " " |
| 24 | Yellow Warbler | YWAR | 1 | 9 | 5 | 1 | 61 | 9.7 | 3 | | | 0430 | 0711 | | JBN | 0655 | MN | |
| 25 | Ruby-crowned Kinglet | RCKI | | | 4 | 1 | 55 | 6.2 | 4 | | | | | | | | | |

List species on this sheet and number of each banded. Include bands lost or destroyed.

Totalled JB Proofed LE

| Species | No. |
|---|---|
| Field Sparrow | 2 |
| Myrtle Warbler | 8 |
| Magnolia Warbler | 2 |
| Wilson's Warbler | 1 |
| Yellow Warbler | 2 |
| Swamp Sparrow | 1 |
| Black and White Warbler | 1 |
| Ruby-crowned Kinglet | 1 |
| Used Previously | 6 |
| Band Lost | 1 |

19/25

17110673 25 Full number of last band on this sheet.

Figure 26. An example of a correctly completed banding schedule (from CWS and USFWS 1991).

Other data entry systems use two people to enter duplicate data sets. Once all data are entered, a computer program cross-checks the two computer files and flags all inconsistencies between the two. This virtually eliminates data entry errors, but it is time consuming and may be expensive if paid personnel are used. In the future, easy-to-use "machine readable" banding sheets may be developed, allowing an electronic scanner to read and enter data into a computer.

Despite all of your efforts, errors do occur. If schedules already have been submitted, simply advise the Banding Offices of errors. Upon receipt of the correct data, the original schedule will be corrected by the Banding Offices. Do not submit new schedules.

The Banding Offices may have questions concerning the data submitted on the Banding Schedules and will contact the Master Permittee directly to resolve questions. A prompt reply is always appreciated. After complete processing of your schedules, the Mater Permittee will receive an evaluation form which informs you whether your schedules required corrections of non-biological data and what those corrections were. Corrections for biological data will be made where required (e.g., age U changed to AHY in January for most species), but most questions will be sent to the Master Permittee for resolution.

### 12.5. Computer verification and edit programs (MAPSPROG)

Because of the widespread availability and use of personal computers and the importance of accurate ageing and sexing of banding and recapture data for use in demographic analyses such as mark-recapture models, The Institute for Bird Populations, in conjunction with the Bird Banding Laboratory, has developed a sophisticated new program, *MAPSPROG*. Although developed specifically for MAPS contributors who are banding landbirds, this user-friendly, windows-based program allows banders to enter or import raw banding data. It then verifies the validity and consistency of data in each record by comparing skull pneumatization, breeding condition, molt, plumage, and feather-wear characteristics to age and sex determinations; it verifies the consistency of species, age, sex, and location data among multiple records (spanning multiple years) of the same band number; and it tracks the rate of errors in the data. To obtain a copy of *MAPSPROG*, write MAPS Coordinator, The Institute for Bird Populations, P.O. Box 1346, Pt. Reyes Station, CA 94956-1346; or e-mail: ddesante@birdpop.org.

### 12.6. Note For File (Canadian)

In Canada, a "Note For File" is submitted along with the Banding Schedules. It tabulates and summarizes the numbers and types of bands used and the species and numbers banded (Fig. 27). If you are using computer-generated schedules, you need not include a hard copy of the Note for File because it will be generated by the Banding Office's computer program. Because of its usefulness, however, you will want to generate the Note for your own records. The Note for File is used only by Canadian permittees.

### 12.7. Recovery Information

All encounters of birds banded by people other than the Master Permit holder or subpermittees should be reported to the Banding Offices. Banders also can submit this form on behalf of members of the public who report band recoveries. The Banding Offices issue "Certificates of Appreciation" to everyone who reports bands. This states the original banding information and gives the name and address of the bander, in case the observer wishes to obtain additional information.

The following types of encounters are to be reported:

(1) A **control** recovery is a bird recaptured by someone other than the master bander and his or her subpermittees.

(2) A **foreign** recovery is a bird that is encountered outside of the 10-minute latitude-longitude block in which it was banded.

(3) **Returns** are birds recaptured alive in the same 10-minute block in which they were first banded at least 90 days from the date of banding. Banders should keep track of these returns, but reporting them to the Banding Offices is optional, and only if significant.

(4) If a banded bird was found dead, and it was banded in the preceding 90 days, within the same 10-minute block, and before a schedule has been submitted, then the banding data should be deleted and the band destroyed. "Band Destroyed" should be recorded on the Banding Schedule. If the schedules have been already submitted, inform the Banding Offices; these records will be deleted from the data base.

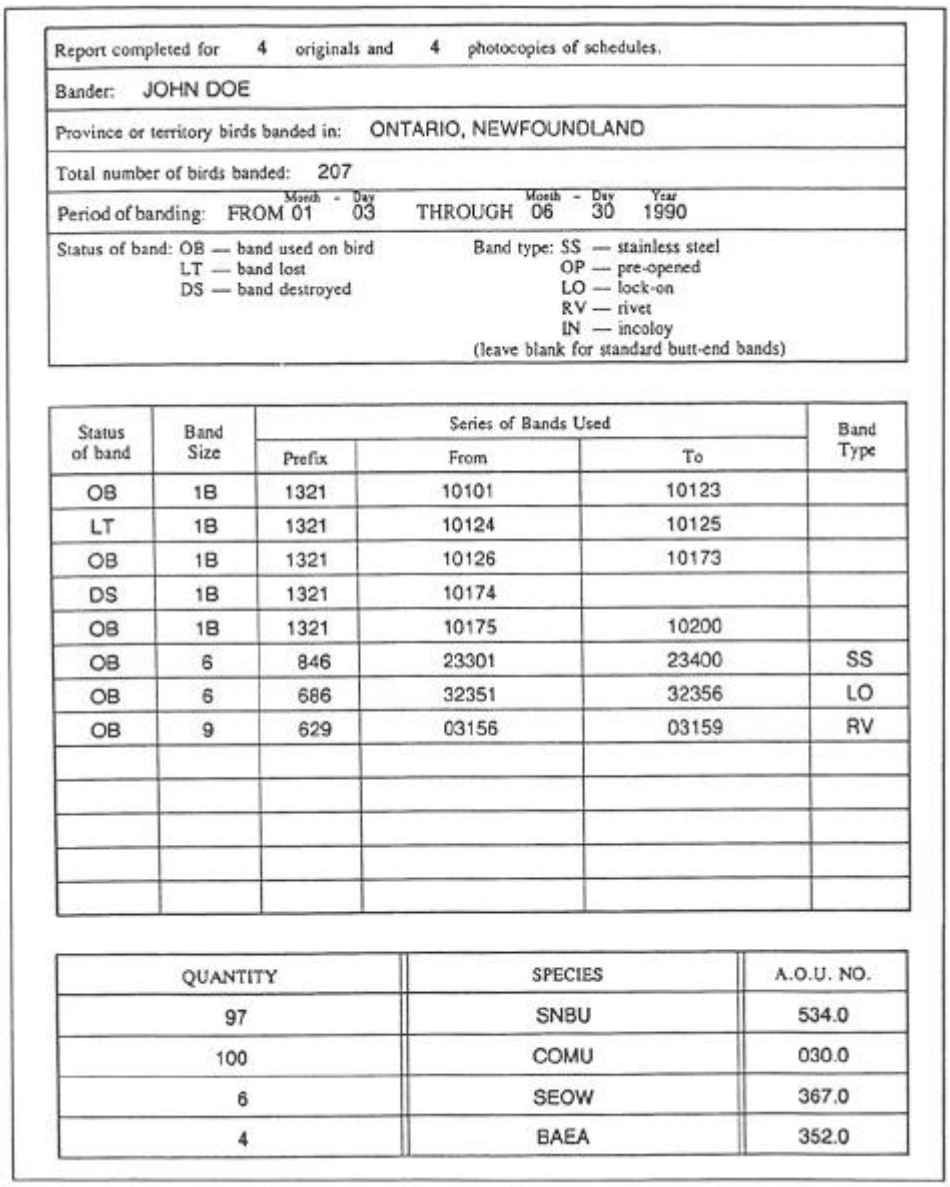
(5) Color-marked birds should be reported to the Banding Offices. Information to be reported includes the type of marker and its position, color combination and code, age and sex if known, date and location of sighting. If a metal band was on the bird's leg, its presence and position should be noted even if the band number could not be seen.

If someone has reported a band encounter but no schedule for that band number has yet been reported, the bander will receive a notice requesting data for that particular band number and all unreported bands on that string. This should be returned as soon as possible to the Banding Offices, but the data still must be reported on a Banding Schedule.

## 13. PREVENTING BIRD INJURIES AND FATALITIES

A "casualty" is defined here as any debilitating injury or death. Such casualties are rare in any good banding operation, but birds can be injured or die in even the most careful banding operation. While the **goal** is **zero** casualties, in fact the risk can never be completely eliminated, if only because predation is always a risk. Although they are rare, every casualty must be judged not only as an unfortunate and deeply regrettable accident, but also as an important learning experience. You never really get accustomed to casualties, and even the most experienced banders are shaken by these events.

Banding casualties are usually caused by predators, bander



Report completed for 4 originals and 4 photocopies of schedules.

Bander: JOHN DOE

Province or territory birds banded in: ONTARIO, NEWFOUNDLAND

Total number of birds banded: 207

Period of banding: FROM Month 01 - Day 03 THROUGH Month 06 - Day 30 Year 1990

Status of band: OB — band used on bird; LT — band lost; DS — band destroyed

Band type: SS — stainless steel; OP — pre-opened; LO — lock-on; RV — rivet; IN — incoloy; (leave blank for standard butt-end bands)

| Status of band | Band Size | Series of Bands Used | | | Band Type |
|---|---|---|---|---|---|
| | | Prefix | From | To | |
| OB | 1B | 1321 | 10101 | 10123 | |
| LT | 1B | 1321 | 10124 | 10125 | |
| OB | 1B | 1321 | 10126 | 10173 | |
| DS | 1B | 1321 | 10174 | | |
| OB | 1B | 1321 | 10175 | 10200 | |
| OB | 6 | 846 | 23301 | 23400 | SS |
| OB | 6 | 686 | 32351 | 32356 | LO |
| OB | 9 | 629 | 03156 | 03159 | RV |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

| QUANTITY | SPECIES | A.O.U. NO. |
|---|---|---|
| 97 | SNBU | 534.0 |
| 100 | COMU | 030.0 |
| 6 | SEOW | 367.0 |
| 4 | BAEA | 352.0 |

Figure 27. An example of a Note for File printout.

inexperience, bad practice, or faulty equipment. A simple combination of common sense, forethought, and awareness minimizes the risk of casualties. For example, when approaching a net or trap, you must quickly assess the risk of injury to the captured birds. Always remove either the largest or smallest birds from a trap first (depending on which are fewer in number), because the larger birds could injure the smaller ones. Priority also must be placed on removing any bird that seems to be experiencing difficulty.

The following sections provide of other points that will help focus your attention on preventing casualties. See also the *Mist-Netter's Bird Safety Handbook* (Smith et al. 1999) for extensive discussion of the material covered in this section. The treatment or euthanasia of injured birds may be covered by various federal, state, and provincial regulations. Banders who may encounter such a situation should consult their appropriate law enforcement authorities.

### 13.1. Safety Considerations for the Use of Mist Nets

#### 13.1.1. Mist net selection and use

Mist nets must be of the proper mesh size, of good quality, in good condition, and monitored correctly. Mesh size is important. A small bird in a large-mesh (e.g., > 36 mm) net, particularly if left for any length of time, can get very tangled and requires considerable expertise in extracting. If your main target, however, is jay-sized birds or shorebirds, and few smaller birds are nearby, a slightly larger mesh size would be better. Your catch will be much higher and you will not have birds flying along the pocket, not only escaping but also getting caught by their bands.

The quality of a mist net is likewise important; a main consideration is material. The choice is usually between nylon and

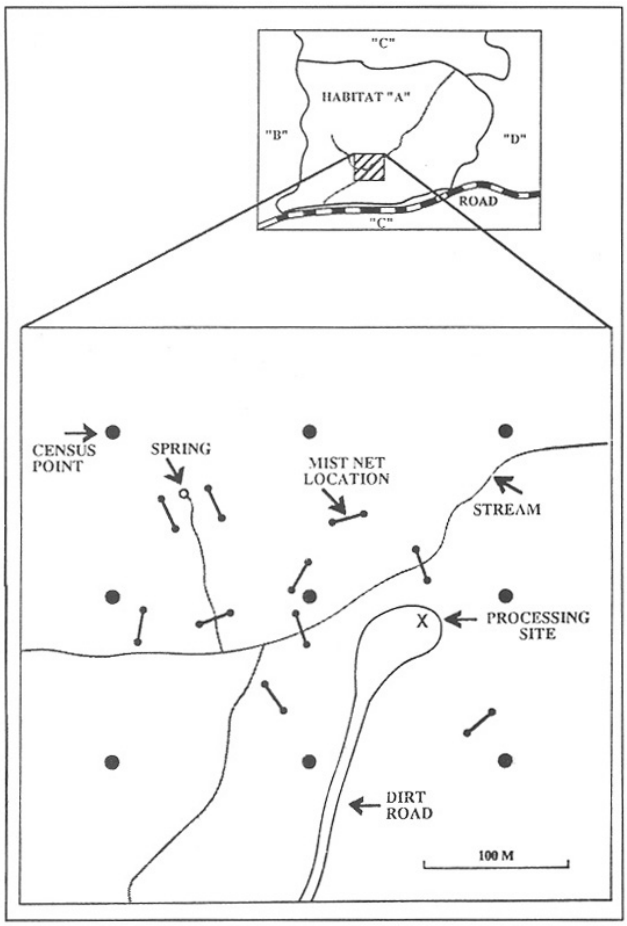



Figure 28. An idealized capture station of about 40 acres (16 ha) set in an area of more than 250 acres (100 ha) of habitat "A." Nine census points are set at uniform spacing of about 150 m (490 ft) to estimate population levels. Ten net locations are placed in sites where high capture rates are likely, along a stream, near a spring, and other areas where vegetation is dense, to monitor population and demographic parameters.

polyester (or terylene, as it is known in Europe). Polyester nets are a little more expensive than nylon (at least in the short term), but they are finer and stronger, stretch less, are more resistant to damage by sunlight, and last longer. Because of their durability, they are more resistant to developing holes and thus safer to use.

Although monofilament nets are durable and effective, they can injure birds unless the bander is exceptionally skilled and tends the nets at extremely short intervals (e.g., every 10 minutes). Special training in the use of monofilament nets is highly recommended.

Other factors that affect the way netting behaves are the diameter (denier) of the component thread and the ply number (the number of threads that are braided into each strand). The bulkier the strand, the less tangled birds get and the easier they are to extract. As a rule, it is advisable to use a heavier strand (e.g., 75 denier, 3-ply rather than 70 denier, 2-ply). The catching rate will be a little lower than for lighter-weight material, but extraction will be quicker and the likelihood of injuries less.

### 13.1.2. Setting up a net array

Operating a capture array of mist nets is a complex undertaking, but very rewarding. Much useful information can be gained from reading Bleitz (1970), Keyes and Grue (1982), McClure (1984), Ralph et al. (1993), or Burton and DeSante (1998). In some areas with concentration of migrants, net batteries (several nets in a row) may be better. When netting for target species (shorebirds, grassland birds, birds banded at oases or watering holes), the process of net placement is entirely different. We outline below some guidelines for operation of nets and their placement (Fig. 28). While especially applicable for landbirds, the guidelines apply to other birds as well.

How many nets and banders depends on the site, likely capture rate, type of bird targeted, and intended data collection. For basic studies, a field crew of two people can usually set up and monitor an array of 8-12 mist nets. We suggest 10 or fewer as an appropriate number. If the biologists are especially skilled, or the bird density quite low, a few more nets may be operated.

It is critical that nets be close enough to each other so that a person can visit all nets within 15 minutes of walking, and less if no birds are caught. This will ensure that birds are never left in a net for much more than 30 minutes. On level terrain, this array would be about 800-1000 m (0.5-0.6 mi) in length. If 10 nets are placed in a circle or rectangle, this would allow an average of 75-100 m between nets and cover approximately 5-10 ha. In steep or rough terrain, nets should be closer and the area covered less. In all cases, nets should be spread out as uniformly as possible.

In areas of relatively high human impact, capture arrays must be located with care. In some areas nets can be left in place (but closed) between capture days if the chance of encounter by visitors is extremely low. In most areas, it is advisable to rig the nets to allow easy removal at the end of a day's effort.

### 13.1.3. Net maintenance and disposal

Check frequently that guy lines are tight and that the net is clear of vegetation and other debris. Protect net loops with a wrap of shrink tubing, silver duct tape, or black electrical tape; they will last much longer and will be unlikely to fail and potentially injure a bird. Wrap any loose ends of the loop with tape to prevent snagging.

If a panel support or shelf string (trammel) breaks, weave an entirely new line with thick nylon thread in place of the old one, anchoring it to the proper loops using an overhand stitch. Do not keep a net open and running with a broken main trammel; side trammels should be fixed on the spot. A large, blunt embroidery needle will help immensely. If possible, do not simply tie two broken ends of a shelf string together or the resulting line will be shorter and the net will not hang properly. Moreover, the mesh will have a propensity to get tangled and torn on any knots.

If strands break, repair the hole immediately with thin, nylon thread. To fix a hole in the mesh, cut the loose ends of the broken mesh back to about 3-5 mm. Using simple knots, such as a single or double sheet bend so the knots will not slide, and

a piece of wood or plastic the width of the mesh to keep the right spacing, you will be able to repair the mesh by tying knots in the right spots, the right distance apart (Fig. 29).

If nets must be taken down when they are wet, hang them to dry at your earliest convenience. This will prevent fungus and mold from weakening the net. Nets do not last forever, but bits and pieces can be salvaged before a net is discarded. For example, a four-panel net with holes in only one panel can be converted easily into a three-panel net. Loops can be salvaged for the repair of other nets. Old nets should be **burned** rather than thrown in the garbage. This ensures that no unauthorized person will use them and that no animals will get entangled accidentally.

### 13.2. Trap and Catching-box Design

Well-designed traps usually are safer to use than mist nets but, even so, several factors must be considered to minimize casualties. Most traps are made from welded wire mesh or plastic netting. Chicken wire has a tendency to injure birds and should not be used. In general, the material selected should be of the largest mesh size that will contain the target species and of the best-quality material. Welded wire mesh measuring 1x½ inches (2.5x1.2 cm) is generally considered to be optimum for songbirds and larger species as well. If birds regularly scuff their foreheads, consider coating the wire with a suitable plastic coating. Edges of wire traps that birds can contact should be cut and bent back in such a way as to eliminate sharp points; this not only is safer for birds but also reduces snagging by hands and clothing. Alternatively, large, framed traps should be clad with plastic netting, which is inexpensive and easy to install. It will not withstand a snow load when used as a roof, nor will plastic walls take heavy abuse; still, in the interest of bird safety, plastic mesh clearly is the best material. Some banders have found that plastic mesh should not be used for ground traps, as mammals chew through it easily.

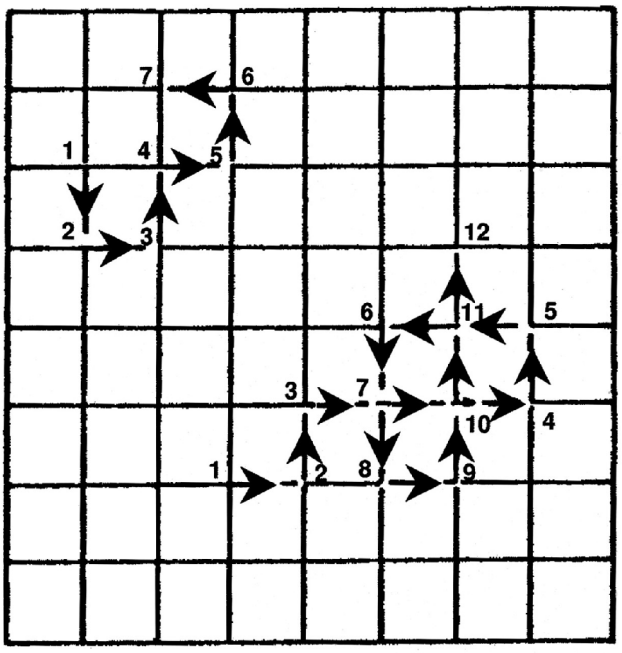



Figure 29. Repairing small holes in a mist net. Arrows show the direction of the movement of the needle (from McClure 1984).

Large traps should incorporate a catching box in the design to help extract birds quickly and safely. Angle the top plate at 45° to deflect fast-moving birds. Make the transparent surfaces of thin plexiglass or (better yet) heavy plastic sheeting instead of glass. The flexibility of the plexiglass and plastic sheeting relative to glass, especially if installed loosely, will further reduce injuries. You also should place a branch or two just in front of the box to slow birds down. Finally, arrange some grading device in the holding box to keep large birds from trampling smaller ones. A simple method is to install a middle shelf inside the holding box. If this shelf is recessed away from the plexiglass by a distance of about 40-50 mm, sparrow-sized birds will slip between the gap down to the lower compartment, leaving larger birds in the upper compartment.

### 13.3. Bird Numbers and People on Hand

When deciding how many nets or traps to open, balance the number of birds you anticipate catching against the number and skill levels of available helpers. You should be especially cautious when operating at a new site, particularly if it is one likely to concentrate migrants. Some or all nets and traps must be closed in response to large numbers of birds. You are **not** out to set records. Whenever a situation develops in which you cannot safely band the number of birds being caught, you must release some unbanded and close down some or all catching devices. Options to consider when faced with large numbers of birds include closing particular nets temporarily, reallocation of personnel, making more frequent net rounds, taking minimal data, and releasing birds unbanded, especially if you have already processed a good sample of that species that day.

It is imperative that all banders always be aware of the number of birds left to be processed. We suggest the following guidelines:

(1) Birds should be removed from nets as quickly as possible; they can remain healthy in shaded bags for up to 2 hours, although preferably no more than 1 hour, given that they are not subjected to excessive heat or cold. Different considerations **must** be given in the breeding season—you do not want to keep a bird off a nest for very long, certainly less than 0.5 hour. Consideration also should be given to how large a fraction of the birds' feeding day is impacted—e.g., 1.5 hours of a 12-hour day is a rather high percentage.

(2) If too many birds are encountered in nets for processing before the next round, take minimum data until the capture rate slows down. Be sure to maintain data quality, especially of species, age, and sex determinations. If a good sample, perhaps more than 10 birds, of one species is captured in a day, some researchers suggest that the remainder be released without banding. Try to age and sex these birds,

if possible, and record them on the "Unbanded Birds" sheet. Some, however, feel that it is better to shut nets than to release birds, particularly with constant-effort mist netting, to avoid harassing birds and wasting human effort.

(3) If too many birds are captured to process even with minimum data, then close two to four nets, including those with high and low capture rates, and in different habitats, if possible. Often it is best to close the most distant nets, thus shortening the net run.

(4) With many birds being caught, try to do net rounds as quickly as possible (every 15-20 minutes is not too often) to minimize net time and degree of entanglement.

(5) Use personnel effectively; two people can process much more than twice the number of birds as a single person, assuming one records for the other. If it is time for another net round, and birds still remain to be processed, many banders feel it is best for both people to go on the net round, rather than just one, because birds are safer and less stressed in the bags than in nets. However, untended birds in bags should be kept safe from predators and visitors.

(6) If more than about 10 birds still are waiting in bags or holding cages after 1½ hours, close further nets.

(7) Once the number of backlogged birds is reduced to about 10, nets can be reopened, depending upon the banders' abilities.

### 13.4. Injuries and Their Causes

Small cuts may bleed profusely for a short time (as with humans), despite their nonsevere nature. Because of birds' relatively high metabolism, their blood clots quickly and fights infection efficiently. Although cuts and scrapes are not life-threatening, it is your responsibility to ensure that birds are treated as humanely as possible. Below are some possible sources of injury to try to avoid.

*Forehead abrasion in traps.*—When birds enter a trap, they eventually discover that they are caught and then try to get out through the mesh. If the mesh is made of metal, this sometimes results in forehead abrasions. These are not serious injuries but should be minimized by selecting the most-appropriate-sized mesh and plastic-coating it, replacing or lining metal mesh with plastic mesh, and by checking traps frequently.

*Cut legs.*—Small cuts to legs (usually shanks and toes) can result from rough handling or inattentiveness during mist-net extractions. Thicker and/or extra-ply nets reduce abrasions. Monofilament nets are especially hazardous.

*Cut feather bases.*—As with legs, this is the result of rough handling or inattentiveness during net extraction. Less-abrasive nets reduce these injuries. Recently-fledged juveniles and molting birds are especially vulnerable because the bases of their incoming feathers are soft and blood-filled. The netting is apt to get tangled around these incoming feather shafts, which are easy to break.

*Tongues.*—Birds sometimes get tongue-caught with minor injuries in mist nets. Some species (e.g., thrushes) are more prone than others. A tongued bird usually looks much worse than it really is. Usually, it is best to extract the rest of the bird and leave the tongue until last. Nets can often be teased off with fingers only. The netting is pulled to the back of the mouth and over each fork of the tongue. If the netting is wrapped around the tongue, a toothpick or, failing that, a small twig or grass stem can be used to free the loops of netting. Heavier netting reduces tongue injuries and is easier to tease off.

*Broken legs.*—Very rarely, a bird in a net breaks a leg. Usually this is caused by some external force applied to the net, effectively stressing the leg at the wrong angle. The external force can originate from high wind or from another (usually larger) bird that is caught in the same panel of the net. Less often, it is a result of a mist-net strand slipping under a band and straining the leg. The last risk can be reduced by ensuring that bands seal when they are put on. Frequently inspect your banding pliers to make sure that they are not so badly worn as to prevent full band closure. If they are worn, they must be repaired or replaced. Always check the bands of recaptures to make sure they are properly closed. Broken legs also can occur during mist-net extraction, especially if the tarsi are held too low; these occurrences are inexcusable.

*Dislocated leg.*—Leg dislocation, which can occur at any of the joints, is rare, but some species (e.g., White-throated Sparrow) seem more prone than others. Most dislocations can be treated quickly by straightening the leg and popping the joint back into its socket, although they will sometimes have limited use thereafter.

*Crushed tarsi.*—Tarsi can be crushed if the band is too small, if the bander has failed to notice that the band is starting to overlap during band closure, or if the band is closed on rather than around the leg. Banders and trainees must be meticulous in band selection and application. If a choice of band sizes is given, use a leg gauge before selecting a band. Do not guess. Since this injury is usually a result of inattention in applying bands, it critical to hold the tarsus immobile during band application.

*Wing strain.*—Occasionally on release, birds flutter along the ground, appearing to be incapable of flight. Such symptoms are commonly referred to as "wing strain." The condition is popularly believed to result from slight muscular strain or bruise. It probably is caused while the bird is in the net when one wing is free but the other is tangled and exerting a lot of pressure against the net. It also can occur during the extraction process. Hidden strands of netting where the wing joins the body that are unnoticed by banders can cause strain. X-rays of some cases have shown a fracture of the coracoid bone. It is thought by some that this fracture is caused during release, when wing-strained birds are released too high over hard ground, causing them to land on their sternum. Others may be caused by a too-loose grip by the bander. For these reasons, small birds must be released carefully and from a minimal height.

It seems that small birds (up to thrush size, such as Catbird and Ovenbird) are the most susceptible to wing strain. All banders and trainees must be aware of the anatomy of birds' wings and how they may and may not be manipulated. Any bird caught primarily by one wing must be restrained immediately in the Bander's Grip.

Unless a joint has been dislocated, most cases of wing strain are temporary and the bird recovers its capacity to fly within an hour, although some may take several days or more. Because of the risk of predation, however, wing-strained birds should be recaptured and held in a quiet, warm, dark place until they recover. If you suspect wing strain, you usually can gauge a bird's flight capability by holding it in the photographer's grip and gently moving it up and down, making it flutter.

Wing strain injuries can be minimized by using a net with smaller mesh and checking the nets more frequently.

*Stunning.*—Provided the appropriate steps are taken to minimize the chance and severity of impact with catching-box surfaces (see Section 13.2), stunning should never occur in traps. Stunning more commonly happens when a bird escapes in a banding lab and hits a window. For this reason, banding labs should be small and not have opposing windows. Plastic netting can be installed over windows to reduce this hazard. It also is good to leave outside doors open so escapees are able to find their way outside quickly and unharmed.

*Stress and shock.*—Very small birds (e.g., kinglets, gnatcatchers, chickadees, titmice, and sometimes warblers) occasionally appear to go into a state of shock, especially if they have been overhandled. It is usually only a temporary phenomenon, provided the bird is suitably treated. Shock can be minimized by ensuring that birds are not overhandled and being alert for signs of distress. Try to revive and release such birds as quickly as possible, unbanded if necessary.

Some telltale signs will alert you to a bird in distress. These are: fluffing the feathers; opening and closing the bill ("panting"); gaping; closing the eyes; and limpness, especially of the neck. Birds showing any of these signs should be handled as little as possible, assessed as to their capacity for flight, and released immediately if flight is likely. More often than not, the bird will surprise you and fly away normally. If flight is judged unlikely, then distressed birds should be put in a warm, dark, quiet place and checked periodically. As a general rule for passerines, if recovery is to occur, it usually happens spontaneously within an hour. Reassess the situation if the bird has not shown signs of recovery after this time. The Hummingbird Manual, suggests that every hummer be offered a dose of sugar water (1:4) before release.

*Tail loss.*—As part of a bird's strategy to avoid predation, tail feathers are not firmly anchored. Not surprisingly, tail loss is probably the most common mishap when handling birds. Usually it happens when you try to grab an escaping bird, although it also can occur when placing birds in bags and not ensuring that they are in the bottom of the bag before tightening and looping the drawstring. The appearance is certainly worse than the condition; however, tail loss places additional energetic stress on a bird and is easily minimized with careful handling.

*Damaged feathers.*—Feathers can be frayed or broken during removal from nets or traps and during handling. The most frequent cause of this is applying too much pressure in trying to get net strands over a wrist joint that also is caught on several primary tips (the solution is to carefully push the primaries through the mesh in the direction of their natural bend, and then to slip the mesh over the wrist). Experience with careful handling can minimize these damages. Also be aware that the natural oils on your hands may gum up feathers. Keep your hands clean and dry; you can use climber's chalk or talcum powder. Never handle birds if you have applied insect repellant to your hands! It may be toxic and corrosive.

*Eye injury.*—Sharp wire projections can puncture or abrade a bird's eye. Also, while trapping in sub-zero temperatures, an eye can freeze to the wire mesh. Eye damage can be prevented easily by ensuring that no sharp projections exist on traps and/or by covering traps with plastic coating.

### 13.5. Causes of Death

*Predators.*—It is not sufficient merely to treat predation as an acceptable "natural phenomenon." The effect of predators on a mist-netting operation is twofold. The most serious result is that birds are injured or killed. In addition, the predator often damages the net, posing a threat to subsequent captures unless repaired immediately. As in other matters, anticipation, alertness, and swift action by a good bander minimize the risk.

If present, hawks and owls will try to take birds caught in mist nets. Other species, including herons, rails, jays, magpies, shrikes, and grackles may be equally dangerous. Therefore, banders must watch continually for avian predators. Should one be noticed, nets should be checked more frequently and, if the threat persists or increases, nets should be closed. No bander can prevent occasional predation by an itinerant raptor or jay, but if several predators are known to be in the banding area, and particularly if one or more individuals learn what mist nets can provide, no alternative exists to closing some or all of the nets until the problem has gone away. Sites that regularly concentrate raptors at certain times of the year may have days when mist-netting for songbirds is essentially precluded, unless nets are tended constantly.

Numerous mammals (e.g., fox, weasel, raccoon, bobcat, and skunk) prey on birds in nets and traps. Other mammals, too, occasionally harm birds in nets. Squirrels, chipmunks, and even deer and porcupines have been known to nibble at birds. As with avian predators, banders always must be alert to the presence of known or potential predators. If a problem occurs, steps must be taken immediately to prevent its recurrence, such as making exceptionally frequent checks of traps and nets or raising the nets so that captured birds are out of reach. If the problem cannot be contained, bird trapping should cease until the predator has departed. You may need to trap and relocate repeat offenders.

Some species of snakes, such as the Eastern Fox Snake, also prey upon trapped birds, as do larger frogs. Their reach can be surprisingly high, and they can climb poles. You should be alert to this possibility and take action (e.g., make frequent net checks, raise nets well above the ground, capture and relocate offending species) should snakes be seen near nets. Killing the snake is not an acceptable option.

In the South, fire ants can be a serious problem at banding stations, even with half-hour net runs. To ensure the safety of birds, vegetation must be meticulously cleared all around the nets and the net hung high enough to avoid contact with the grass or

ground, even when heavy birds like Bobwhite are caught. Destroying colonies of this invasive insect from the net lanes and paths with a machete or spade can help protect banders during extractions and birds caught in the nets.

Occasionally, wasps and bees kill trapped birds. For the safety of both birds and banders, avoid placing nets or traps near active wasp nests or bee hives. Do not to destroy these nests and hives; these insects have an important role in the ecosystem. safety of banders may, however, necessitate removal of a nest or hive. Bees are inactivated when sprayed with sugar solution.

*Strangling.*—It is rare for a bird caught in a net to strangle. In general, it happens only if the bird's head and neck are somehow pulled taut by the netting or when nets are not checked frequently enough. The likelihood increases when the net has many holes or if the mesh size is incorrect. It also increases during large catches at one time, when a heavy bird is captured under a smaller one, when the bag setting is too generous, or when it is too windy. Thrushes are apt to get their heads through the mesh and continue to struggle with their long legs, occasionally strangling themselves. Pay particular attention to birds captured and missed in the bottom panel; check the entire length and height of the nets. Strangling also can occur from careless handling during extraction, which is inexcusable.

Be aware that a particularly dangerous potential for strangling occurs when a high shelf string is stretched down to extract a bird and then accidentally released. To reach birds in nets safely, shelf strings should be pulled down at the loop on the net pole. Close lower shelves too, to avoid the bird's double-bagging itself. Special attention should be taken to **replace** the loop or loops to the correct position after removing a bird. When two people are extracting birds from the same net at the same time, each must be aware of the other's actions and be careful not to pull any netting away from the other's bird.

*Hemorrhage.*—Birds have higher blood pressure than do mammals, and birds have been reported to die from ruptured blood vessels during prolonged territorial disputes. Excitement from excessive handling may be sufficient to produce hemorrhaging, manifested as traces of blood in the mouth or as a slight wheezing. If symptoms are detected, cease handling immediately and put the bird in a sheltered, secure place where it can calm down and depart at leisure. This may take only a few minutes. Subsequent retrapping indicates that some birds behaving this way suffer no lasting impairment. If a bird that has exhibited wheezing still has not departed after half an hour or an hour, and if the bander has access to suitable rehabilitation facilities nearby, it may be taken into temporary care.

*Heat exhaustion.*—Birds can overheat in mist nets and bird bags. Cold-adapted species such as Snow Buntings can suffer heat exhaustion even on cold days. Heat exhaustion can be avoided with forethought and alertness. Avoid opening nets in direct sunlight on hot days, or be prepared to check them every 10 minutes. On very hot days, particularly if combined with high humidity, monitor the captures closely and be prepared to close nets or traps, release birds waiting to be processed, or reduce the processing time. Give water to panting birds (see Section 13.6., Shock or Torpor) .

Never leave occupied bird bags or holding boxes in full sun and always allow ample space between bags holding birds to allow air to circulate among them. Keep bags clean and dry so that air can circulate through them. If birds have been doubled up in bags, transfer them to empty bags as soon as possible so they do not heat up one another.

*Cold exhaustion.*—Birds are prone to cold exhaustion if they have little or no fat—their metabolic fuel. Even on cool days, early-morning captures of small birds with no fat should be monitored closely. As with heat exhaustion, be prepared to close nets or traps, release birds waiting to be processed, or reduce the processing time if exhaustion is apparent.

All birds with wet or even damp feathers are prone to cold exhaustion at any time. For this reason, mist netting in rain or even a heavy mist usually is unacceptable. Following overnight dew, nets should be shaken as dry as possible before starting to capture. If a bird gets wet, keep it in a warm, dry place out of the wind until dry. For the same reason, banders may need to forego using skulling water on small birds on very cold mornings, or use a minimal amount and pat dry. Encouraging a bird to ingest sugar water may be helpful to a stressed hummingbird.

*Punctured trachea and crop.*—Occasionally, seed-eating birds suffer punctured trachea. This can occur if a well-filled crop is pressed too hard against the windpipe. Banders using baited traps should be alert to this possibility. There are also occasions when corn-fed waterfowl caught in large clover leaf traps occasionally rupture their crops against the side of the trap. Reducing the size of the trap and/or using plastic or fiber netting will eliminate the risk.

*"Natural causes."*—Occasionally, a bird is found dead in a net that was checked recently or in a bird bag that was not held overly long before processing, with no sign of injury or other indication of what may have been the cause. Birds have short life spans and, for stations banding thousands of birds annually, it is likely that one occasionally dies from "natural causes," such as a bacterial infection like Salmonellosis (see Section 14.2), or old age. If mysterious deaths are anything more than extremely rare (e.g., more than 1 in 1,000), however, you must reassess your entire banding operation. This pertains to any individual source of mortality.

### 13.6. Treatment of Injured Birds

Because substantial numbers of birds live near human populations, injured birds are often found along roadways, power lines, adjacent to large glass doors and windows, and beneath tall television and microwave towers, especially those supported by a system of guy wires. Bird banders also occasionally encounter injured birds as part of their normal banding operation, although the numbers of such injuries are dwarfed by the numbers of birds injured and killed by flying into plate glass windows or doors, moving vehicles, telephone and power lines, and tall transmission towers. Nevertheless, all banders and other individuals interested in birds should know what to do when they encounter an injured bird.

In some cases, the most humane way to deal with an injured bird is to release it. This is best done by placing it in a warm,

sheltered, and secure place away from any further disturbance. If it has not recovered in half an hour to an hour, consider attempting rehabilitation. Minor wounds can be treated with antiseptic cream or an iodine solution.

Birds that need to be kept for a short while (e.g., for recovery or because weather is unsuited for immediate release) can be kept inside in a well-ventilated box (e.g., a shoebox). The box should be placed in a dark, warm (80E F; 25EC) and quiet spot until release. Most species remain calm under these conditions. This can be done with a small igloo cooler, with vent hole or lid slightly raised, and hand warmers under a towel.

Provided the bander has the facilities and the appropriate permit, an attempt can be made to rehabilitate small birds. All that may be needed is a suitably sized cage in a quiet, warm place, equipped with a perch, a plentiful supply of water, and appropriate food. If you know nothing about the care and feeding of wild birds, however, send the bird to a professional rehabilitator. All banders should make a point of getting to know rehabilitators in their area. Note that banding permits do not allow holding a bird for more than 24 hours.

*Shock or torpor*.—Birds that appear to be in a state of shock or have gone into torpor usually can be "jolted" gently back to reality. This can be done in several ways. The birds can be held in the photographer's grip and moved up and down a couple of times, just an inch or so at a time. This coaxes them to flap their wings, which often seems to rouse them, as movement of the powerful pectoral muscles causes blood flow to the brain and can raise the metabolic rate. Hummingbirds should be cradled in the hands for this procedure. Blowing a couple of puffs of air on the bird's head may help, too. Torpid birds may even be revived using mouth-to-mouth resuscitation. If a hummingbird is suspected of heat exhaustion, it can be offered a little 1:4 sugar:water solution. This can be done by moving the tip of the bill into a drop on the back of a pencil or eye dropper. Keep the bird upright and make sure that no liquid enters its nostrils.

*Broken leg or foot*.—If the break is shallow, a small "bend" or crack, release the bird without further ado. (If you will have an opportunity to see its progress, you may wish to band the other leg quickly first.)

If the break is causing the tarsus to bend at an askew angle, but it is not "hanging from a thread," you can either take the bird to a qualified, licensed rehabilitator or attempt to re-fuse the leg. In making this decision, you must assess the situation. How far is the nearest rehabilitator from you? Is the bird in breeding condition, possibly with nesting in progress? Is the bird highly stressed, in need of professional attention?

If you decide to re-fuse the leg yourself, there are a few things that can be tried. You can hold the tarsus straight, firmly but gently, with tweezers or two small sticks, and apply a small dot of superglue to re-fuse the leg. Some have successfully made "scotch tape splints" by wrapping a small piece around the break. You also can try splinting the broken tarsus with a hollow gull or duck feather shaft.

If the broken tarsus is "hanging by a thread," snip the leg at the break cleanly with a small, sharp pair of scissors.

*Euthanization*.—If a badly injured bird is found, either in a banding operation or elsewhere, and rehabilitation is either not feasible or not likely to succeed, consider euthanization of the bird. Important points to assess when considering euthanizing are: (1) What are the chances that the bird will survive the injury if left alone? (2) Is the bird suffering and in pain? If the answer to the first question is "No, essentially no chance exists that the bird will survive if left alone," the answer to the second question is "Yes, the bird is suffering greatly and is in real pain" and rehabilitation of the bird is not possible or not likely to succeed, then the only recourse is to euthanize the bird **quickly** and **painlessly**. This is always a difficult decision and always a heart-wrenching task. The currently accepted guidelines for humane euthanization of birds can be found in Gaunt and Oring (1999), *Guidelines on the Use of Wild Birds in Research*, published by the Ornithological Council. To receive a copy, contact the Ornithological Council at 1725 K Street, Suite 212, Washington, D.C. 20006-1401, or at their web site: http://www.nmnh.si.edu/-BIRDNET.

### 13.7. Disposition of Dead Birds, Record Keeping, and Reporting

Any bird found dead in a net or trap should be fully processed (but not banded), as if it were a live bird. Next, the condition of the bird should be assessed to determine whether it is suitable for preparation as a museum specimen. If so, either it should be skinned or placed in a plastic bag and frozen. Remember, many birds can provide a useful skeleton, even if the rest of the skin can not be salvaged. Full collecting details, of which locality and date are most important, must be recorded on an attached label. Adding the name of the species sometimes allows labels that have become dissociated from the specimen to be sorted properly, and including the name of the collector sometimes allows additional information to be obtained. Any other information, such as the degree of skull pneumatization, fat condition, size and condition of the gonads, and body weight can be useful. Prepare the label with pencil or waterproof ink. Send dead birds to a museum; instructions are supplied in the Banding Manual and on the back of your banding permit. Unless you obtain a special permit, it is unlawful for you to possess specimens other than during transport.

In Canada, all casualties must be recorded in a logbook. Date, species, type of fatality, likely cause, and treatment are recorded. At the end of the year, all casualties must be tabulated and reported to the Banding Office on the appropriate form.

## 14. PREVENTING BANDER INJURIES AND DISEASES

### 14.1. Physical Risks

Herons, cormorants, and loons are able to strike with the bill at incredible speed, often targeting the intruder's eye. Banding these birds is often best done with two people, one to secure the bill while the other bands. Failing this, ensure that the bill is securely tucked under your arm and wear protective eyegear before commencing banding.

Swans, particularly male Mute Swans, can be violent during the breeding season, even if you are not attempting to catch them or their young. The attack consists of a full frontal assault with open wings. They are very powerful birds, and banding is a two-person process.

Most species of gulls, terns, boobies, and jaegers can be surprisingly aggressive near the nest. A typical attack is to dive on the intruder and strike with the bill. These birds can inflict considerable pain. A hard hat can be worn, but this is uncomfortable on hot days. An alternative is to carry a stick over one's head, perhaps with an object on top. The birds will focus on the higher object.

Some species of hawks and owls (especially Northern Goshawk and Great Horned Owl) can be extremely aggressive near their nests. A hard hat and safety glasses are strongly recommended when attempting to band nestling raptors, and a leather or very thick jacket could offer some protection against those species that like to rake intruders with their talons.

Most hawks and owls can inflict varying amounts of damage to your hand from their bills or talons. In general, accipiters, buteos, and owls are more dangerous with the talons, while falcons rely more on their bills. To put the potential danger in perspective, the Great Horned Owl, admittedly the most powerful North American raptor, has been demonstrated to possess talon-grasping power of 170 kg/sq. cm (2400 lbs/sq. inch) which, in a press, is sufficient to bend 6-mm (0.25-inch) steel plate!

It is impractical (and often ineffective) to use leather gloves to handle raptors. When extracting a raptor from a mist net, the bird's attention should be diverted while the legs are grabbed. This can either be done by a second person or by the bander's waving a hand so the bird looks away from the hand that is to grab the legs. From this point on, the bander must concentrate on not releasing, or even easing, the grip on the legs while the bird is freed from the net. Once out of the net, rather than putting the bird in a bag and having to grab the legs a second time, it is better to hold the bird, effectively immobilizing it so it cannot strike with its talons, flap its wings, or bend down to bite you. Some species of raptors, including Barn and Long-eared owls, are best held by holding the legs as close to the body as possible and cradling the bird in your other arm, rather than grasping the wings.

For sharp-taloned birds, the banding process is best done either by inserting the bird head-first into an appropriate-sized can with air holes, or by placing it on its back on the bander's thighs (with the talons away from the body) and covering the head with a cloth. Some banders recommend giving raptors a stick to hold in their talons, but this can lull you into a false sense of security, since the bird can drop the stick and grab you at any time.

With the exception of shrikes, which can and will draw blood, most songbirds are quite harmless. Large-billed seed-eaters (e.g., cardinals and grosbeaks) can inflict painful bites, although they rarely draw blood. One way to reduce their mobility is to use the "straitjacket" grip. This is a variation on the standard Bander's Grip in which the head is held nearer the tips of the first and second fingers, which are then straightened somewhat.

Several species, such as jays, starlings, and most icterids and woodpeckers, have strong toes and sharp claws. Banding numbers of these can take its toll on banders' hands. Scratches can be lessened by using another variation on the Bander's Grip in which legs are immobilized between the third and fourth fingers for most of the banding operation.

An injury to a bander in the field is unfortunate for the person concerned, as well as the rest of the birds in the traps or nets. If the bander is alone (which is generally discouraged), it may be difficult, if not impossible, to remove any remaining birds from nets and to close down. At all times, steps should be taken to minimize the chance of trips or falls. Clear logs and branches off paths around the netting area, cut any stumps down to ground level, and mark any guy lines with flagging tape.

### 14.2. Diseases and Disorders

Birds may suffer from a number of infections. Most of these, fortunately, are peculiar to birds, but some may be shared with other animals, including humans. Some of the more likely candidates are discussed below, but the list is by no means complete. Banders contracting curious complaints are strongly advised to inform their doctor of their contact with wild birds. As a general precaution, regular washing of the hands with carbolic acid, other germicidal soap, or at least plain soap, is recommended, especially before eating or smoking. Never place bird bags in the mouth and avoid inhaling dust from bird bags or boxes, which should be washed or cleaned out regularly.

While Chlamydiosis (Ornithosis and Psittacosis) is primarily associated with imported cage birds, evidence exists that it is widespread in wild birds in some regions. It can be communicated to humans, causing a fever with lung inflammation.

Salmonellosis is a bacterial infection, common in mammals and birds. In humans, it is most likely to be contracted from the feces of birds that frequent garbage dumps, feed lots, and bird feeders. Because it is commonly found in dead birds that are simply "found dead," personal hygiene is especially important after handling dead birds. Symptoms are acute enteritis and diarrhea.

All field workers should be immunized against polio and tetanus, the more so if they are working with birds near garbage dumps, sewage plants, or potentially polluted water. In recent years tuberculosis cases have increased in Canada. Birds can be carriers of the human form of this disease. All banders should be immunized against tuberculosis.

Lyme Disease is caused by a bacterial spirochaete that is transmitted by a bite from the deer tick, which birds sometimes carry. Banders operating in an area known to harbor the disease should be aware of the danger and alert to the first signs of an infected deer tick bite. Any sign of a bull's-eye rash around a tick bite should be investigated immediately, as the sooner the disease is confirmed and treated, the greater the chance of a complete recovery. Learn to recognize what a deer tick looks like; if you are bitten by one, consult a doctor.

Rabies is potentially communicable, not via birds, but from bats. Any bander suffering a bite from a bat is advised to seek

medical treatment. In high risk areas, banders may be advised to become immunized against rabies.

Banders should be aware of poisonous plants occurring in their banding area. In much of Canada and the U.S., poison ivy and poison oak are the most likely species to be encountered, especially when banders are clearing undergrowth for net lanes. "Grackle Pox" is a rare affliction, essentially a case of subcutaneous poison ivy. It is characterized by intensely itchy, weeping blisters on the backs of the hands and fingers. It can result in a bander's hands becoming so swollen as to preclude further activity. It is caused by the skin being punctured by the claws of strong-footed species such as grackles and jays that have been foraging in patches of poison ivy, allowing the toxin to penetrate under the skin. Treatment is with cortisone cream. Sunlight exacerbates the condition considerably. Prevention is effected by care during handling and by frequent hand washing, preferably using a carbolic soap.

## 15. VISITORS AND PUBLIC RELATIONS

Banding operations often have visitors, and some operations are very public. Banding should never be a secretive, "hush-hush" operation. Instead, banding provides many opportunities to educate the public about birds, research, and conservation. Many people go away with a new-found appreciation and sensitivity towards birds after seeing a banding operation. Still, it is important to understand that problems can arise if the operation is not well thought out and if it is in any way sloppy.

### 15.1. Problems

Unless you exercise control, the negative impacts resulting from large numbers of visitors at a banding station can outweigh the positive ones. These range from increased bird stress to parking problems.

Bird stress can be heightened in several ways by large numbers of visitors. First, the time it takes to process birds can be dramatically lengthened due to staff time being spent interacting with visitors. Under such circumstances, birds could be held for inordinate periods of time. Also, net checks are apt to be delayed, meaning that birds become more entangled and more stressed by weather and other factors. The sheer presence of visitors creates stress on the birds because birds simply view people as frightening. Some visitors even go so far as to try to free birds from mist nets! Do not let these things happen!

An increase in the number of casualties may occur if all of the above stress factors are not wisely considered. Injuries and mortalities must be kept to an absolute minimum in any banding operation, but even more so in public surroundings. Needless to say, any hint of injury creates enormous public relations difficulties. It is best that **every** banding station have a written protocol on hand for banding in case visitors raise any issues.

An average encounter with a visitor can easily last 10 minutes. Hence, if you have lots of visitors, you can spend considerable time dealing with them, meaning that you will need more personnel on hand to get the banding job done. You might choose to hire a special person to deal with visitors. On the other hand, the presence of such a person, and a beefed-up educational program, can wind up heightening public demand.

Be aware that visitors provide an easy form of distraction during the banding operation, increasing the number of errors in data recording and causing general mix ups (e.g., putting the wrong sized band on a bird, forgetting to weigh the bird, etc.). And dealing with large numbers of visitors is tiring and stressful for your station personnel. Visitors also can interfere with station logistics.

Training of personnel can be greatly impeded by a lot of visitors. Students are not able to get the hands-on, one-on-one supervision they require because of public scrutiny and interruptions.

Finally, you also must pay attention to the needs and privacy of any neighbors you might have, regarding increased vehicular traffic, noise, and people wandering onto their properties.

### 15.2. Some Solutions

One trick is to limit the number of visitors your operation can accommodate. To do this, post times of the day when your site is open to the public, and prearrange any group visits well in advance. Also think carefully before you decide you want to advertise your station. You may well be swamped by busloads of tourists.

Many operations do not allow public access to their net lanes. Others post a large sign at the site to inform the public about what goes on, the fact that nets and traps are checked every 20 minutes or so, and politely ask visitors to abide by a few rules regarding pets, the fragility of nets, and birds in nets. It is a good idea to approach all members of the public who might stumble upon your nets or banding sites when you not there, to prevent any problems.

It is sometimes necessary to scale back the banding operation during peak visitor periods (e.g., on weekends and holidays). In general, on any day you are open to the public, both the bird and the visitor situation should be gauged. If you have many birds and/or visitors, the banding operation **must** be scaled back accordingly. It will be a daily judgment call.

Under no circumstances are you to sacrifice a bird's safety to provide showy banding demonstrations. All banding operations put the bird's safety first and foremost. If this simple rule is followed, visitors will sense where your priorities are and few if any conflicts will occur. If your netting area is open to the public, you must keep a constant vigil and make exceptionally frequent net checks (as often as every 15 minutes). Apart from minimizing any danger or stress to captured birds, this also will reassure visitors that you are indeed concerned and very much on top of the situation. At times, you must be strict and tell visitors that you can not talk with them until you have completed the birds you have, after which you will be able to explain your techniques.

### 15.3. Banding Demonstrations for the General Public

Formal banding demonstrations should be done in a special area of your banding lab, during certain hours only (e.g., from 10:00 a.m. to 12:00 noon), or by special arrangement. Visitors

should not be permitted inside the portion of the room where the banders are working, if only to give the banders room to work and to prevent any jostling. The banders and visitors should be separated by some kind of divider—a counter top works fine. Visitors should remain quiet, speaking in low tones at all times, as noise stresses birds. The banding lab can have two doors—one for "employees only" and another for visitors. This directs the visitor traffic into the right part of the room.

Only well-trained, experienced banders should give demonstrations; students can record and generally help out until they are sufficiently adept at the entire process. The demonstrator runs through the process slowly at first, describing everything as it occurs, as well as interesting facts about the bird itself. The bird's safety should be stressed at all times. If you think that the demonstration is using up valuable time that should be devoted to a net check, get someone to do a net run. Remember that, especially with visitors, nets should be checked very often.

While some banders feel that one should never let visitors handle or touch birds, others feel that, when the bird is ready for release, a few seconds of a bird in an open (not grasping) hand heightens people's appreciation of birds as living creatures. Visitors may, however, photograph the birds while you hold them, if it is done quickly and does not get out of control. Emphasize that your program is always sensitive to the physical and emotional health of the birds. You never put birds through more stress than absolutely necessary. Your visitors will understand and appreciate your concern and your careful handling.

### 15.4. Group Visits

Group visits (e.g, seniors, children, nature clubs, etc.) can be educational and even fun. Groups can be booked in as circumstances permit, generally on dates or times when the site is closed to members of the general public. Group size should be limited to a maximum of 30 people; 15 or fewer is a better size to work with at one time.

Groups may be handled for about 1 hour, during which time they can be given a brief introduction about the banding station, its programs, and the role of bird banding. This may be followed by a guided walk around the net lanes and finished off with a banding demonstration. Again, only the most experienced banders should be doing most of the hands-on work in front of groups.

When groups are scheduled, make sure that not too many nets are open, keeping in mind that groups take time and that you do not want to get a back-log of birds. Consider scaling the typical netting operation back by one-half, or add trained personnel to help out so it does not affect your banding operation.

At least two people are required to handle a group, and three are better. When taking a tour of the net lanes, remind the group frequently to not touch the nets or the birds. Take charge. Visitors should watch that their buttons do not get caught up in the nets. Warn the group in advance that, if someone gets snagged by a net, they should stop immediately and ask for help.

During the net-lane tour, an experienced person acts as the leader, does most of the talking, and does most (or all) of the bird extractions. Another person generally helps out, often bringing up the rear to make sure that no visitor lags behind and to keep an eye on persons who might get buttons caught on the nets, or poke at the birds or nets, or try to venture off by themselves. While the leader is stopped for a while at a particular net, the other person should take the opportunity for a quick solo dash around some upcoming nets, to make sure no problems exist. Any upcoming difficulties can then be relayed (quietly) to the leader, who might choose to avoid a particular net. If the other person can extract difficult birds quickly before reporting back to the leader, so much the better. At times it is best if the assistant takes over the removal of a particularly difficult or fragile bird, allowing the group to go on with the leader, thus reducing stress for all. As an alternative, a few nets can be the educational or demonstration nets.

The helper also should be alert for nets that are catching too many birds, and should start to extract the birds and/or close more nets if necessary. Again, it is important that not too many nets are open when visitors are present and to remember that visitors are going to slow you down so that you will not be able to process nearly as many birds as quickly as you could otherwise. Plan ahead and you will minimize problems.

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## APPENDIX A. ASSOCIATIONS AND BIRD OBSERVATORIES

**1. Ontario Bird Banding Association (OBBA)**

The OBBA covers the province of Ontario, but because it is the only Banding Association operating from Canada, it is of special interest to all Canadian banders. Address: OBBA secretariat, Mississauga Valley Boulevard, Suite 804, Mississauga, ON L5A 3S9. Publications: *Ontario Bird Banding Association Newsletter* (quarterly), *Ontario Bird Banding* (annually). Web site: http://sites.netscape.net/tntcomm/obba/OBBA.htm.

**2. Eastern Bird Banding Association (EBBA)**

The EBBA includes the eastern U.S., Ontario, Quebec, and the Maritime Provinces. Membership information can be solicited from the Treasurer of the Association. Publication: *North American Bird Bander* (quarterly). Web site: http://www.pronetisp.net/~bpbird.

**3. Inland Bird Banding Association (IBBA)**

The IBBA covers the central U.S., Manitoba, and Saskatchewan. Membership information can be solicited from the Treasurer of the Association. Publication: *North American Bird Bander* (quarterly). Web site: http://aves.net/inlandbba.

**4. Western Bird Banding Association (WBBA)**

The WBBA covers the western U.S. and Canada east to the Northwest Territories, Alberta, Montana, Wyoming, Colorado, and New Mexico. Membership information can be solicited at http://thecity.sfsu.edu/snfc/western.htm or by writing to WBBA, P.O. Box 716, Inverness, CA 94937. Publication: *North American Bird Bander*.

**5. North American Bird Observatories That Have Bander Training**

For more information about training opportunities in Canada, contact the Ontario Bird Banding Association or the Banding Offices.

- **A. Alaska Bird Observatory** P.O. Box 80505, Fairbanks AK 99708. Phone 907-451-7059, FAX 907-451-9723. E-mail: birds1@ptialaska.net.
- **B. Beaverhill Bird Observatory** 18624 70th Avenue, Edmonton AB, T5T 2V8. E-mail: jduxbury@pop.srv.ualberta.ca.
- **C. Braddock Bay Bird Observatory** P.O. Box 12876, Rochester, NY 14612. Phone 716-324-3525. E-mail: brookser@infoblvd.net.
- **D. Colorado Bird Observatory** 13401 Piccadilly Road, Brighton CO 80601. E-mail: cobirdobs@aol.com.
- **E. Golden Gate Raptor Observatory** Bldg. 201, Ft. Mason, San Francisco, CA 94123. Phone 415-331-0730, FAX 415-331-0851. E-mail: ggro@ggnpa.org.
- **F. Humboldt Bay Bird Observatory** 7000 Lanphere Road, Arcata, CA 95521. Phone 707-822-2015. E-mail: cjralph@humboldt1.com.
- **G. The Institute for Bird Populations** P.O. Box 1346, Point Reyes Station, CA 94956. Phone 415-663-1436, FAX 415-663-9482. E-mail: ddesante@birdpop.org..
- **H. Lesser Slave Lake Bird Observatory** P.O. Box 726, Slave Lake, AB T0G 2A0. Phone 403-951-8689, FAX 403-849-4147. E-mail: birds@lslbo.org.
- **I. Long Point Bird Observatory** P.O. Box 160, Port Rowan ON, N0E 1M0, Canada. Phone: 519-586-3531 FAX: 519-586-3532. E-mail: lpbo@bsc-eoc.org.
- **J. Manomet Center for Conservation Sciences** Box1770, Manomet, Massachusetts, 02345, U.S.A. Phone: 508-224-3559. E-mail: jatwood@manomet.org.
- **K. Point Reyes Bird Observatory** 4990 Shoreline Highway, Stinson Beach, California, 94970, U.S.A. Phone: 415-868-1221. E-mail: gballard@igc.org.
- **L. Powdermill Bird Observatory** HC 64, Box 453, Rector, Pennsylvania, 15677-9605, U.S.A. Phone: 724-593-7521. Fax: 724-593-6570. E-mail: mulvipnr@westol.com.
- **M. San Francisco Bay Bird Observatory** Box 247, Alviso, California, 95002, U.S.A. Phone: 408-946-6548. E-mail: admin@sfbbo.org.
- **N. Thunder Cape Bird Observatory** c/o Sleeping Giant Provincial Park, RR #1, Pass Lake, Ontario P0T 2M0. E-mail: escott@loon.nornet.net.
- **O. Whitefish Point Bird Observatory** HC 48, Box 115, Paradise, Michigan, 49007. Phone: 906-492-3954. E-mail: bskeith@iserv.net.

**6. Other Stations**

More bird observatories and banding stations in North and South America are listed in "Migration Monitoring Network: Banding Stations and Observatories," available on the internet at "http://www.rsl.psw.fs.fed.us/pif/mnstalst.html" or by writing C. John Ralph at the USDA Forest Service, Redwood Sciences Laboratory, 1700 Bayview Drive, Arcata, CA 95521; phone 707-825-2992. An additional listing of stations can be found in conjunction with the Bird Banding Manual at http://www.pwrc.usgs.gov/bbl/manual/birdobs.htm.

## APPENDIX B. SOURCES OF BANDING EQUIPMENT[1]

A comprehensive, updated list is available at http://www.pwrc.-usgs.gov/bbl/resources/supply.htm.

**Mist Nets:** These are available from any of the following suppliers:

1. Association of Field Ornithologists Mist Nets, Manomet, Inc., P.O. Box 1770, Manomet, MA 02345, USA. Telephone: 508-224-6521, FAX: 508-224-9220. Web site: http://www.-afonet.org/mistnets.html.
2. Eastern Bird Banding Association Net Committee, c/o Gale Smith, R.D. #2, Box 131, Kempton, PA, 19529, U.S.A. Phone: 215-756-4311. E-mail: galew27@aol.com. Web site: http://www.pronetisp.net/~bpbird.
3. Avinet, Box 1103, Dryden NY, 13053, U.S.A. FAX and phone: 607-844-3277. E-mail: avinet@lightlink.com. Web site: http://www.avinet.com.
4. British Trust for Ornithology, The Nunnery, Nunnery Place, Thetford, Norfolk, IP24 2PU, England. Phone: 44-1842-750050; Fax 44-1842-750030.
5. Spidertech Bird Nets, The Owl Engineering Group, 1-Roobertinkatu 33 D 34 SF-00120 Helsinki, Finland. Phone: 358-(9)0-444692.
6. Ecotone, ul Slowackiego, 12, 81-871 Sopot, Poland. Phone: 48-58-514606. E-mail: ecotone@polbox.com. Web site: http://www.ecotone.polbox.com.

**Mist Net Poles:** Available from Avinet (see above) or from any electrical supply store.

**Wing Rules:** Available in three sizes (15 cm, 30 cm, and 60 cm) from Chris N. Rose, 98 Lopez Road, Cedar Grove NJ, 07009, U.S.A. (201) 256-4410, and from the British Trust for Ornithology (see above).

**Banding Pliers:** Holes in jaws to fit standard band sizes, with a split pin on top for even band opening. Available in three sizes (band sizes 0 through 1A, band sizes 2 and 3, and band sizes 3B through 4) from Avinet (see above). Pliers for larger bands are available from Lambournes (B'ham) Ltd., Unit 1, Shallowford Court, Off High Street, Henley-in-Arden, Solihull, West Midlands, B95 5BY, England, and the BTO (see above). Circlip pliers (for band removal) can be purchased from the BTO (see above).

**Scales for Weighing:** Electronic and triple beam scales are widely available from any scientific supply retailer, one of which is LabEquip, 330 Esna Park Drive, Unit 32, Markham ON, L3R 1H3. Phone: (416) 475-5880 FAX: (416) 475-1231. Pesola scales are available through Avinet (see above). Both Forestry Suppliers, Inc., P.O. Box 8397, Jackson, MS, 39284-8397, Phone: 800-647-5368; and Ben Meadows Company, 35 89 Broad St., Atlanta, GA, 30341, Phone: 800-241-6401 sell spring balances and other weighing devices (including plastic bird weighing cones), magnifiers, and lots of other equipment of possible use to banders.

**Calipers:** Available from Avinet (see above).

**Leg Gauges:** Available from Avinet (see above).

**Bird Bags:** Washable bags can be made, or cotton mailing bags can be purchased from BTO or Avinet (see above). Tyvek soil sampling bags are available from Forestry Suppliers, P. O. Box 8397, Jackson, MS 39284-8397; Phone: 800-647-5368; web site: http://www.Forestry-Suppliers.com.

**Colored Leg Bands:** Split plastic colored leg bands are available from Avinet (see above), which imports them from A.C. Hughes Ltd., 1 High Street, Hampton Hill, Middlesex, TW12 1NA, England. Leg bands also are available from Gey Band and Tag Company, 2940 Felton Road, Norristown, PA 19404-0363; Phone: (601) 277-3280, FAX: (601) 277-3282.

**Optical Device for Skulling:** A good instrument is an Optivisor, a binocular magnifier (#6353-A12, A.H. Thomas Co., Philadelphia PA, 19105, USA).

**Books of Interest to the Bander:** Publication lists are available from the American Birding Association (PO Box 6599, Colorado Springs, Colorado 80934; phone 1-800-634-7736), Avinet (see above), and the British Trust for Ornithology (see above)

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[1]The use of the name of a company does not imply that the NABC, Canadian, or U.S. government endorses this company's products. Note also that supplies may change; recent issues of banders' journals (Appendix A) should be consulted for up-to-date information and for suppliers of other kinds of markers not mentioned above.

## APPENDIX C. A WELL-DESIGNED RESEARCH PROJECT

Dr. A.L.A. Middleton of the Zoology Department at the University of Guelph, Ontario, began banding a local population of American Goldfinches in 1968. Because the duration and scope of his project, Middleton has been able to make significant contributions to the knowledge of the biology of the American Goldfinch. Many of his findings are a direct result of the analysis of his own banding and recovery data, while other results incorporate banding data requested from the Banding Offices. Some of the features that make this a well-designed study are as follows:

(1) Simple questions were asked; hypotheses were testable.
(2) The study involved a large sample size.
(3) Results were used to generate more questions.
(4) Literature was used to suggest explanations.
(5) Data were analyzed along the way to see if the question had been answered and to help define the question for the next step in the study.
(6) Middleton did not rely on other researchers to make sense or use his data.
(7) Cooperators were involved to gather more data for specific purposes.
(8) Results were published.

### 1. Molt and Plumage of the American Goldfinch and their Relation to Timing of Reproduction and Migration

Middleton (1977a) first studied the timing and sequence of molt in the American Goldfinch because little was known about it and its molt strategy appeared to be unique among other cardueline finches. The American Goldfinch is the only species to acquire its dimorphic, alternate plumage through molt of the body feathers. In addition, the prebasic and prealternate molts in the goldfinch are prolonged relative to other species of temperate zone passerines. Between 1970 and 1975, Middleton banded 3,433 American Goldfinches at Guelph, and recorded the extent of molt of these individuals. He supplemented his field studies by closely observing a captive population of 12 birds held in an aviary.

In addition to providing a detailed account of the sequence and timing of molt in the American Goldfinch, Middleton found that males molted about one week before females, that the postjuvenal molt was prolonged when compared to the prebasic molt of adults, and that the postjuvenal molt enabled sex determination of young birds after about mid-November of their hatch year. Middleton suggested that molt is initiated in males before it begins in females because the testes of males degenerate before the ovaries of the female.

In an attempt to understand the relationship that may exist between the goldfinch's late nesting and prolonged molt, Middleton suggested that, while other species of cardueline finches acquire their alternate plumage through abrasion, the American Goldfinch is the only species with the time in its annual cycle to go through a complete body molt prior to nesting. Because the energy demands of molt are so high, molt delays the development of the gonads, which then delays nesting and reproduction. The fact that molt occurs over a prolonged period suggests that the goldfinch has adapted to acquire the protein requirements necessary for molt from an exclusively granivorous diet, therefore avoiding possible nutrient stress at times of unpredictable weather and food availability.

Middleton continued his study of the annual cycle of the American Goldfinch, using molt data from the 3,433 birds banded, an additional 371 birds trapped at nests, as well as molt data from 200 birds collected for gonadal study (Middleton 1978). He found that male gonadal development slightly precedes that of the female. Therefore, males do enter into breeding condition before females. Middleton detailed the timing of molt, gonadal development, and migration and presented further results suggesting that molt itself may be controlled by photoperiod. However, it is the timing and duration of molt that affect other prominent events of the goldfinch's annual cycle. This is because energy requirements for molt are high and preclude additional energy from being expended for reproduction or migration before the flight feathers are molted.

Middleton (1977a) hypothesized that the prealternate molt enables the goldfinch to develop a less dense summer plumage, which is beneficial to a species that inhabits open areas in the hot dry months of the summer. Middleton (1986) studied the plumages of collected goldfinches and found that the basic (winter) plumage of the American Goldfinch was significantly heavier than its alternate (summer) plumage. This difference was attributed to a difference in summer versus winter feather structure. Feathers of the basic plumage were more dense and downy, giving them greater insulating qualities.

### 2. Age and Longevity of the American Goldfinch

As a result of the high mortality experienced by wild passerines living in temperate climates, ornithologists generally accept that few passerine species survive much in excess of 7 years. Their expected survival can increase when kept in captivity, however, to between 11 and 15 years, or even longer. Middleton's own records of the survivorship of color-banded American Goldfinches reflected these expected ages of survival. Although his data suggested that individuals living under natural conditions survived to between 4 and 6 years of age, Middleton (1984) analyzed data from the Recovery Retrieval File of the Bird Banding Laboratory to obtain a more accurate indication of survivorship in the North American population of the American Goldfinch. He used data from recoveries and recaptures of goldfinches recovered 5 years or more after they had been banded to formulate a survival curve. This curve showed that the majority of birds survived to between 5 and 7 years and that the oldest birds did not live beyond 11 years. Those banded or recovered in Canada did not live beyond 6 years, whereas those recovered in more southerly locations tended to live longer. Middleton noted that these results support Welty's (1982) earlier

suggestion that birds living in harsher climates have shorter life expectancies.

**3. Age and Sex of the American Goldfinch in Relation to Winter Distribution, Breeding Habitat, and Reproduction**

Using the aforementioned banding data, Middleton (1977c) used capture and recapture techniques to derive an estimate of the overwintering population of goldfinches in Guelph. These data showed that 853 to 1,816 American Goldfinches overwintered in the study area. By comparing his results to Christmas Bird Count data, Middleton was able to show that populations of overwintering goldfinches in Ontario had been steadily increasing over the years. He suggested that the increasing availability of winter food (due to an increase in the number of bird feeders) enabled goldfinches to survive long, harsh winters.

Middleton (1990) used banding data requested from the Banding Offices to examine the distributions of wintering American Goldfinches by age and sex classes. These data were requested from the Banding Retrieval File for original bandings of American Goldfinches from 1975 to 1985. Banding data were available previous to that period, but ageing techniques for male goldfinches were not known before Middleton's paper. Moreover, because ageing techniques for females were not developed until after his study was completed (Pyle et al. 1987), Middleton pooled data from all females, which precluded analysis of their distribution by age class. The sex distributions of wintering birds could therefore be analyzed. However, only the age class distribution of wintering males could be examined. Data were selected for birds banded only during January and February, when the populations are least likely to be migratory, and for birds banded east of 100$^{o}$ longitude, where the majority (over 90%) of all bandings occurred.

Middleton's own banding data suggested that Guelph's breeding population migrated south and that the city's wintering population consisted of migrants from farther north. In fact, results showed that male American Goldfinches wintered farther north than females and that young males wintered farther north than adult males. Recapture data suggested that age and sex distributions of wintering birds result from different distances flown from the breeding grounds. Currently accepted hypotheses proposed to explain differential migration (Myers 1981, Ketterson and Nolan 1983) could not explain why younger males winter farther north than adult birds. Middleton (1990) suggested that young birds are not physiologically or behaviorally able to migrate long distances from their breeding grounds.

In an attempt to discern the influence of age and sex on reproductive success and choice of nesting habitat, Middleton (1979) trapped American Goldfinches breeding in three distinct habitat types at Guelph, and placed colored leg bands on each bird. Between 1968 and 1975, breeding populations were studied in a residential area of the city, in an old-field natural habitat and in a tree nursery where cultivated saplings were evenly spaced. Observations of color-marked individuals showed that males often changed nesting sites between breeding seasons, whereas females often showed a high degree of fidelity to their original nesting site. Monogamous pair bonds lasted the duration of the breeding season but broke down during migration and wintering. Often goldfinches changed mates from year to year.

Nesting began in early July and continued until August, with a mean clutch size of 5.3 eggs. Older birds, regardless of sex, were more successful than younger birds. Older females produced larger clutches, fledged a more young per nest, and had more successful nests than known second-year or birds of unknown age. Older females were responsible for a majority of early nests. In pairs where both the male and the female were old birds, more fertile eggs were produced per clutch and more young fledged successfully than was the case for younger pairs.

The city habitat showed the highest nesting and fledging success. As well, city nests suffered a lower predation rate and fewer instances of parasitism by Brown-headed Cowbirds than nests located in the other habitats. Reproductive success was lowest in the nursery.

## APPENDIX D. MOLT CARDS

Little is known about the timing, sequence, and extent of molt in many North American species. Because this information can be extremely useful for ageing birds, banders are wise to collect and analyze these data. Moreover, because most banders do not get large enough samples of molting individuals of single species, this is a fruitful topic for cooperative studies.

Molt can be recorded in several different ways. The following system was developed by the British Trust for Ornithology (BTO). Molt cards (Fig. 30) are completed for each bird to show active molt, even if it is only partial. Many juveniles show only partial body and/or flight feather molt, and banders cannot afford to lose information on the timing and extent of molt for any age class of any species. One card is filled out for each bird. Recaptures are treated as new birds and given a new card each time molt is recorded, unless they are captured more than once on the same day. Naturally, cards from the same individual should be filed together. Cards can be filed by band number or by band number within each species.

Certain species throughout their life, and most passerines in their first fall, do not undergo a complete molt; instead, their molt is limited to certain portions of various feather tracts. Thus, they retain some of their older feathers, typically on the wing, until a subsequent molt. Contrasts between the various generations of feathers (called "molt limits"), as well as the feather retention patterns, are often detectable and of great assistance in ageing birds. Many of the ageing criteria presented in Pyle's (1997a) *Identification Guide* are based on the detectability of these retention patterns. Because much variation exists within and among populations in the extent of these incomplete molts, and because these patterns are poorly described for many individual populations, banders proficient in detecting multiple generations of feathers can make a substantial contribution by not only recording molt patterns in actively molting birds but also noting the absence of active molt. Recording molt limits for just a few common species at a banding station, and publishing the results, will greatly improve the information on molt patterns of populations across North America. The traditional BTO molt scoring system shown below can easily be expanded for use with molt limits. When two feather generations are present, old and new generations can be distinguished with the same codes used for old and new feathers on wings with active molt ("0" and "N"). When three or more feather generations are present, these may be distinguished from "0," old feathers, by using letters, "A" and "B" for example. The BTO molt scores are often used additively, with new feathers scoring "5." A completely molted wing thus scores highest, and a wing without active molt scores 0. To maintain the usefulness of this system, As and Bs should count as 0, just as Ns count as 5.

Conventionally, the primaries are numbered in ascending order, beginning with the **innermost** feather, in accordance with the sequence in which the feathers are normally replaced. Likewise, secondaries are numbered in ascending order, beginning with the **outermost** secondary and proceeding towards the body. Tertials are numbered as part of the secondary row because these feathers are morphologically of the same origin. Tertial molt is most difficult to master; it takes practice to detect which feathers are missing and to find tertial pin feathers.

Figure 31 shows a typical passerine wing in active molt, with

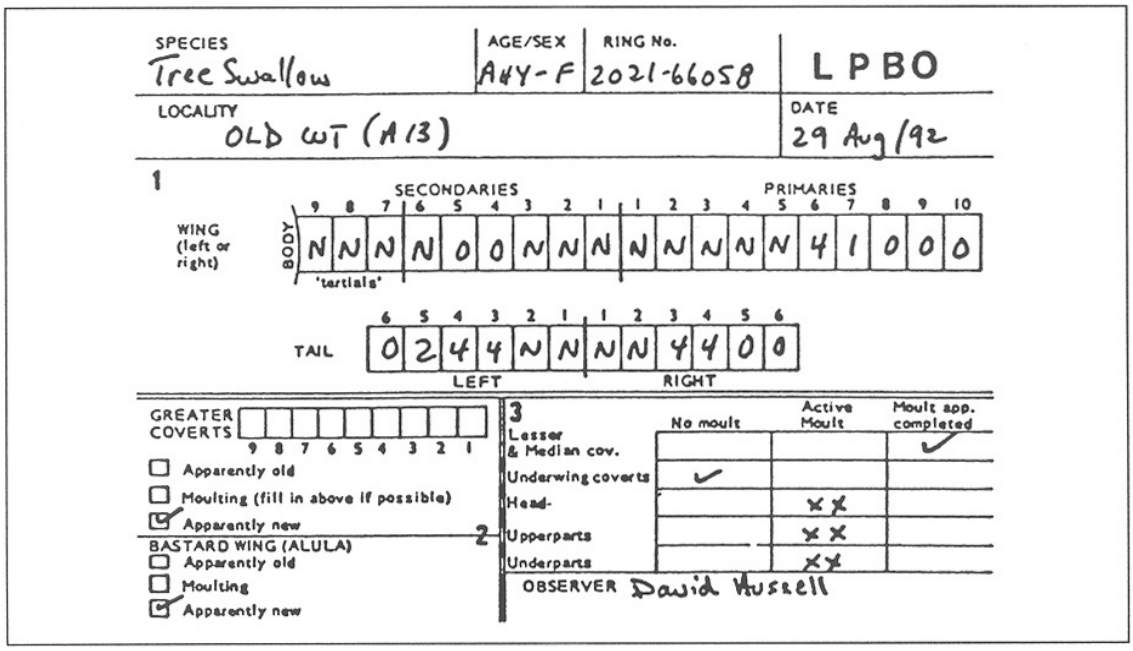


Figure 30. An example of a correctly filled in molt card.

all feathers numbered conventionally. Sections 1, 2, and 3 of the molt card are to be filled out in numerical order. If time is short, some data are more useful than no data. In these cases, it may be more useful to complete section 1 for many birds than to complete entire cards for only a few.

**Instructions for Completing Molt Cards**

**Wing and Tail ("Flight Feathers")**

Use the following notation:

**0** old feather
**A, B** when three or more feather generations are present
**1** feather missing or new feather in pin
**2** new feather up to one-third grown
**3** new feather up to two-thirds grown
**4** new feather nearly fully grown
**N** new feather that is fully developed

Molt in the wings and tail should proceed symmetrically. If molt is not "in-phase" in the two wings, divide the squares with an oblique stroke (/). Use the space above the stroke to represent the left wing, and the space below the stroke to represent the right wing.

**Greater and Primary Coverts and Alula (or "Bastard Wing")**

Notation to describe molting coverts is identical to that used to describe flight-feather molt. Each covert overlies its corresponding flight feather.

**Lesser and Median Coverts and Body Molt**

Appropriate boxes are marked with a check mark. Active molt in the head, upper parts and underparts may be further qualified as follows: **X** slight molt; **XX** moderate molt; and **XXX** heavy molt.

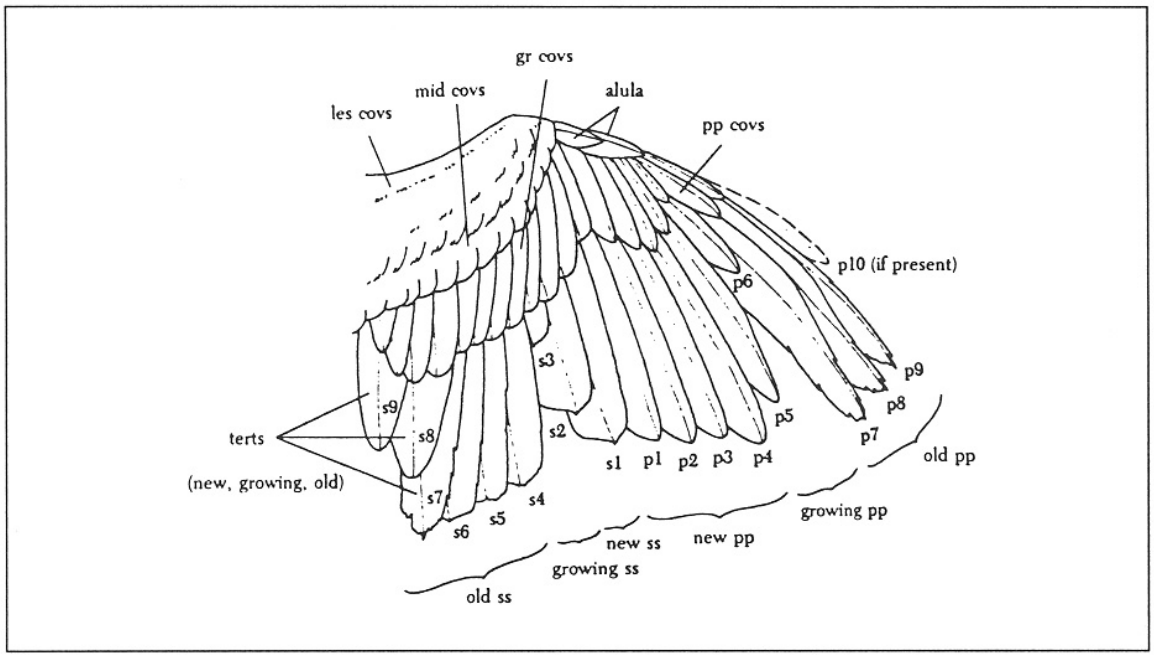


Figure 31. A passerine wing in active molt (from Pyle 1997a).

## APPENDIX E. THE BANDER'S REPORT CARD

Not all categories need to be checked for a certification. Some categories are usually considered fundamental, however, and will probably need to be assessed for all prospective banders. These are identified by an asterisk (*). Items with double asterisks are likely to be essential elements.

**BACKGROUND MATERIAL**

* **Understand the ethics of banding birds**

* **Understand how banding fits into scientific studies**

**CHECKLIST OF PRACTICAL SKILLS**

**PROCESSING**

**Identification and handling**

* Recognize all target species and release a bird unbanded if identification cannot be made with virtual certainty

* Appreciate the importance of minimizing handling time while not compromising safety

* Use the Bander's Grip on a variety of species

* Use the Photographer's Grip safely

* Safely transfer a bird from hand to hand

Open a bird's bill reliably

* Handle a variety of "awkward" species

* Correctly release a variety of species

Effectively deal with escaped birds in an enclosed space

**Banding**

* Select correct band size

* Read band numbers correctly

* Apply a band correctly

Correctly apply a lock-on band (if appropriate)

Correctly apply a color band (if appropriate)

* Recognize when and how to correct an improperly applied band

* Know when and how to remove a band safely

**Storing and carrying birds**

* Use the appropriate method of storage for particular species

* Place birds in bags and carry and hang them correctly

* Recommend when bags or boxes need cleaning

**Field data collection**

* Record data clearly, legibly, and accurately on field sheets

* Be able to recognize and take descriptions of or photograph rarities or unusual birds

* Maintain complete and accurate daily logs

**Biometrics**

* Use and accurately read measuring devices (wing rule, balances, calipers, dividers)

* Correctly and accurately measure various anatomical features

Assess simple wing formulae

Accurately assess and record molt on a molt card

Accurately score fat deposits

**Ageing and sexing**

* Correctly use guides for ageing and sexing

Accurately score skull pneumatization (if appropriate)

Correctly use other characteristics for age determination

Understand and assign correct age codes

Correctly use color, size, brood patch, and cloacal protuberance for sex determination

***SPECIAL AUTHORIZATION FOR MIST NETTING**

**Erecting, opening, and closing nets**

Choose an appropriate netting site and appropriate net

Correctly set up nets unaided

Properly furl and unfurl nets

Properly take in and store nets and associated equipment

**Operation and extraction**

Judge how many nets to use safely and check them frequently and carefully

Demonstrate an astute, accommodating approach to extraction

Extract a variety of species quickly and safely

Deal proficiently with tricky situations

Recognize and repair nets that are in poor condition

**TRAPS**

Have knowledge of range of traps and their target species

Operate traps properly and safely, if appropriate

**NESTLINGS** (IF APPROPRIATE)

Follow species and date and age guidelines in Banding Manual

Approach nests responsibly and remove, handle, band, and replace nestlings safely

**ETHICS AND INJURIES**

* Know and practice the Bander's Code of Ethics

* Show excellent awareness of injury prevention

* Show familiarity with the most common injuries and their causes

* Demonstrate ability to treat minor injuries

* Recognize and demonstrate the necessity for euthanasia

* Assess whether a specimen is worth preserving

* Record details of all injuries and casualties

**HEALTH AND SAFETY OF BANDERS**

* Demonstrate a responsible attitude towards potential injuries from birds

* Demonstrate a responsible attitude towards physical hazards in the banding area

**DATA MANAGEMENT**

* Proof and correct banding sheets

Know how to complete banding schedules properly

Handle other paperwork correctly and promptly

**PUBLIC RELATIONS**

* Communicate effectively with the public about banding

Communicate effectively using banding data (reports, articles, etc.)

**OTHER SPECIAL AUTHORIZATIONS**

Demonstrate proficiency in special authorizations (such as color marking):

## APPENDIX F. SOME EXAMPLES OF COOPERATIVE BANDING PROJECTS

The **Monitoring Avian Productivity and Survivorship (MAPS) Program** is a cooperative effort among public agencies, private organizations, and the bird banders of North America to provide long-term data on the productivity, survivorship, and population trends of dozens of target landbird species through a network of about 500 (in 1999) constant-effort mist netting and banding stations operated throughout the continental United States and Canada. A typical MAPS station consists of about 10 12-m mist nets placed at permanent locations within the central 8 ha (20 acres) of a 20-ha (50-acre) study area. Banding is done for about 6 hours, beginning at sunrise, 1 day of every 10 from May or early June (depending on latitude) through early August in most areas.

The goals of MAPS are to: (1) identify temporal and spatial patterns in productivity indices and survival-rate estimates for target landbird species at spatial scales ranging from the local landscape to the entire continent; and (2) describe relations between these patterns and (a) population trends and ecological characteristics of the target species, (b) landscape-level and station-specific, GIS-based habitat characteristics, and (c) local and broad-scale weather variables. These patterns and relationships, in turn, will be used to: (1) determine proximate demographic causes of population change; (2) construct strong, testable hypotheses regarding the ultimate environmental causes of population change; (3) suggest management actions and conservation strategies to reverse population declines that have a high probability of succeeding; and (4) evaluate the effectiveness of management actions and conservation strategies actually implemented.

A review of the MAPS Program by Biological Resources Division of the USGS concluded that MAPS is technically sound and is based on the best available biological and statistical methods. MAPS thus provides banders a unique opportunity to contribute valuable local data on landbird productivity and survivorship to large-scale, state-of-the-art, habitat-based analyses that will greatly aid management and conservation efforts for landbirds. For information on becoming part of the MAPS program, or for registration materials and a copy of the MAPS Manual, write to MAPS Coordinator, The Institute for Bird Populations, P.O. Box 1346, Pt. Reyes Station, CA 94956-1346; or e-mail: ddesante@birdpop.org.

The **Migration Monitoring Program** is overseen by the Migration Monitoring Council, a joint effort of the Canadian Wildlife Service and the Biological Resources Division of the U.S. Geological Survey. The Council was appointed after a workshop organized by the above organizations was held in 1993 to evaluate the potential of migration monitoring as a means of assessing population changes in migrant landbirds. The Council appointed two technical committees charged with establishing standards and guidelines for the operation of monitoring programs. The Extensive Monitoring Technical Committee dealt with extensive monitoring (such as checklist programs) and published "Recommended methods for regional checklist program" (Dunn 1995). The Intensive Monitoring Technical Committee was responsible for the requirements of intensively operated sites, such as bird observatories and bird-banding capture stations. It published "Recommended methods for monitoring bird populations by counting and capture of migrants" (Hussell and Ralph 1998). Both documents are available on the internet at http://www.rsl.psw.fs.fed.us/pif/pubs.html or from C. John Ralph at the U.S.F.S. Redwood Sciences Laboratory, 1700 Bayview Drive, Arcata, CA 95521; phone 707-825-2992.

The Council also solicited information on stations in North and Latin America that are actively monitoring the migration of birds by the use of capture and release, census, and other methods at intensive field sites. The responses were compiled into the "Migration Monitoring Network Banding Stations and Observatories." This document is available on the internet at http://www-.rsl.psw.fs.fed.us/pif/mnstalst.html or from C. John Ralph at the above address.

**The Birdhouse Network** (TBN) Program is a continent-wide nest box monitoring program. Participants monitor nest boxes and provide data on clutch size, calcium ingestion, nest site, and the use of feathers to line nest boxes. Advanced participants band the nestlings and capture adults for population demographic studies. TBN is administered by researchers at Cornell University. Cornell Nest Box Network researchers can be contacted at the Cornell Lab of Ornithology, P.O. Box 11, Ithaca, New York 14851, (607) 254-2414, or visit the website at http://birds.-cornell.edu/birdhouse/.

Through annual meetings and publications, regional **Banding Associations** and **Bird Observatories** provide a forum for the discussion and development of banding philosophy and theory; project design, methods and data analysis; capture and handling techniques; and so on. Most importantly, these organizations allow banders to exchange ideas and experiences and to define research needs. They are also a route to contacting potential trainers.

A list of relevant addresses is given in Appendix A. At the very least, all banders are strongly encouraged to subscribe to *North American Bird Bander* to keep abreast of research involving many banding-related topics. This journal also contains advertisements for specialized banding equipment. The *Journal of Field Ornithology* also is useful to banders seeking information on banding techniques and how banding is used as a research tool.

The **Klamath Demographic Network** was organized in September 1993, when biologists from several agencies and private organizations from southwest Oregon and northern California met to discuss the need for cooperative effort to promote the standardization of methods of monitoring landbirds and to create a regional database for the monitoring of landbird populations. Over the past 6 years, the group has evolved to make up the most concentrated network of monitoring sites in North America. Communication within the network is facilitated by the personnel of the Regional Data Center at the Redwood

Sciences Laboratory of the U.S. Forest Service. The Center acts as a repository for data collected in the region. Through the Center, cooperators in the network have access to data collected by all participants. This provides a regional database covering a broad biogeographical area from which generalized conclusions of landbird population trends and composition can be made.

Such a regional network does not supplant national programs such as MAPS, BBIRD, and the banding laboratory but, rather, constitutes a local center that cooperators can turn to for help, encouragement, materials, feedback, supplementary personnel, training, data, and other region-specific information, not as readily available from the national programs.

The **Canadian Migration Monitoring Network** (CMMN) is a program where volunteers and experienced banders can contribute. The CMMN is supported by Bird Studies Canada and involves the cooperation of many bird observatories and stations across Canada. There are currently 22 stations active in the network. For more information, contact Bird Studies Canada, P.O. Box 160, Port Rowan, ON, N0E 1M0. Their web site is: http://www.bsc-eoc.org/cmmn.html.

## APPENDIX G. BANDING OFFICES INFORMATION

Bird Banding Laboratory, USA contact information

USGS Patuxent Wildlife Research Center
Bird Banding Laboratory
12100 Beech Forest Road
Laurel, MD 20708-4037
General Information 301-497-5790
Permit Information 301-497-5799
Auxiliary Markers 301-497-5804
Fax: 301-497-5717
Internet Address: BBL@usgs.gov
Web pages: http://www.pwrc.usgs.gov/bbl

Canadian Banding Office, Canada contact information

Bird Banding Office
National Wildlife Research Centre
Canadian Wildlife Service
Hull, Quebec, Canada K1A 0H3
General Information 819-994-6176
Fax: 819-953-6612
Internet Address: BBO_CWS@ec.gc.ca
Web page: http://www.cws-scf.ec.gc.ca/nwrc/birdband.htm

## APPENDIX H. POLICY FOR RELEASE AND USE OF BANDING AND ENCOUNTER DATA

September 24, 1998

shared responsibility of
**U.S. Geological Survey,**
**Patuxent Wildlife Research Center,**
**Bird Banding Laboratory**

**Canadian Wildlife Service,**
**National Wildlife Research Centre,**
**Bird Banding Office**

**I. General:** This Policy replaces all previous documents related to release and use of banding and encounter data obtained through the Bird Banding Laboratory (BBL) and/or the Bird Banding Office (BBO). Approval of this policy has been obtained from the U.S. Geological Survey, Biological Resources Division and Environment Canada, Canadian Wildlife Service. The Policy is written in accordance with regulations in both countries. It may be subject to revisions as existing international agreements and/or federal regulations are needed.

**II. Applicability:** This Policy covers release and use of all banding and encounter data as well any other ancillary data that may be a part of the North American Banding files.

**III. Open-Data Policy:** We encourage full use of banding data in the hopes that maximum benefits will accrue to the avian resources. To promote this policy, data are available free of charge via hard copy, electronically, and on the Internet as soon as possible after the data are electronically coded. This is in keeping with the spirit of making information from federal agencies as available to the public as possible. Banding records are usually provided in summary format; raw banding records can be provided, if needed, in electronic form. To make the data easy to access, retrieve, and summarize, appropriate tools and utilities will be made available to potential users as they become available.

Having an open policy regarding distribution of banding and encounter data is not without risks. The risks are justified, however, given checks and balances and potential rewards. We recognize that many users might not know how to use banding and encounter data or associated ancillary data properly or the limitations of such data even if utilities and database tools are offered. The BBL and BBO will rely upon the scientific integrity of users and the scientific community, with its associated peer review process, to prevent data misuse and improper interpretations.

**IV. Data Use:** Record formats as well as a codes section of the Bird Banding Manual, Vol. I, necessary for data interpretation, are provided with the data to nonbanders. This information is in the Bird Banding Manual, Vol. I, supplied to all banders when their permits are issued and via the BBL Home Page. Users should be sure to check these codes before contacting the BBL or BBO with questions concerning data (e.g., inexact date codes). The staff of both the BBL and BBO will assist users as needed with code interpretation or other queries regarding the data. A user who feels that a record or part of a record is in error should provide the entire record to the BBL. BBL staff will verify the record and correct it, if necessary, as time and staff permit.

**V. Permission to Publish:** Bird banding records are maintained for use worldwide. The data have been contributed by many cooperators and government biologists at considerable public and private expense since 1908. Users of the data are expected to exhibit professional courtesy and use the data within bounds of the highest scientific integrity. We cannot, however, enforce such courtesy and instead call upon users to operate ethically. Scientific ethics dictate proper citation and crediting when significant data not collected by the author are used in publication. Users of data should be sensitive to ongoing projects by others who may be using the data, especially those who have collected the data, and should not allow the data to be used inappropriately, for example, for disturbance of endangered or sensitive species.

We encourage users of banding data to allow the bander first right of use of their data for publication purposes. As a general rule, users should request permission from those banders who wish to be contacted (as indicated in the Bander Database) for permission to publish their data if:

A. A bander's past 5 years of banding or encounter data contribute 5% or more of the total records being used for publication, and/or
B. individual banding or encounter records will be published or cited in the paper.

If the data are required by Federal, State, Provincial, or Territorial agencies in their mandate of migratory bird population management, permission to use the data is not required.

After obtaining permission from banders, the BBL and BBO will supply names and mailing addresses (including e-mail addresses when available) for permittees in a publicly available database on the Internet. This will allow data users to contact banders for permission to use and publish their data, as recommended above. In the U.S., if a bander declines to have their name and address put on the Internet site, the BBL will provide this information privately. Requests for using data of Canadian banders who do not consent to have their name and address put on the Internet site will be handled on a case-by-case basis by the BBO (in Canada, written consent must be obtained from the Canadian banders prior to releasing or supplying their name and address).

The scientific community must be the enforcer of ethical standards as it is not the purview of the BBL or BBO to legislate or enforce ethics. The user bears the responsibility of communication with the banders should questions of ethical data use arise.

**VI. Contacts for Data, Data Queries, or Data Verification:** All data are available from both the BBL and BBO. Please contact the BBL if you are a United States citizen or the BBO if you are a Canadian citizen.

U.S. Geological Survey
Patuxent Wildlife Research Center
Bird Banding Laboratory
12100 Beech Forest Road
Laurel, MD 20708-4037
301-497-5790 Fax 301-497-5717
E-mail: BBL@usgs.gov

Canadian Wildlife Service
National Wildlife Research Centre
Bird Banding Office
100 Gamelin
Hull PQ Canada K1A 0H3
819-997-1121 Fax 819-953-6612
E-mail: BBO_cws@ec.gc.ca

**VII. Liability, Indemnification, and Disclaimer Statement:** No warranty is expressed or implied regarding the accuracy or utility of the data on any system or for general or scientific purposes, nor shall the act of distribution constitute any such warranty. This disclaimer applies both to individual use of the data and aggregate use with other data. It is strongly recommended that these data are directly acquired from the Biological Resources Division (BRD) and not indirectly through other sources, which may have changed the data in some way. The BRD shall not be held liable for improper or incorrect use of the data described and/or contained.