THE NORTH AMERICAN BANDERS' MANUAL FOR BANDING AT NEST BOXES

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PREFACE

The purpose of the publications of the North American Banding Council (NABC) is to provide bird banders in North America with basic best practices for safe and ethical capture, handling and banding of birds. This guide contains specific information on how to safely and productively conduct bird banding at nest boxes.

The information in this guide complements the North American Banders' Study Guide (North American Banding Council 2001) and augments it with information specific to species that use nest boxes. It is assumed that the person reading this manual has already read the fore-mentioned guide, which contains more general information on bird handling, banding and processing.

Information in this guide is specific to banding adults and nestlings at nest boxes. However, some of this information also applies to banding breeding adults and nestlings in other nest situations. The first section of this guide contains information that is generally applicable to all nest box banding. The second section contains specific information for the more commonly banded nest box species such as Bluebirds, Purple Martin, cavity-nesting owls, and cavity-nesting ducks.

We encourage all banders who work with nest box species to read this guide. 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 NABC 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 encapsulated in this publication.

This North American Manual for Banding at Nest Boxes has been approved by the North American Banding Council's Publications Committee for use throughout North America. This guide is the product of many years of collective experience on the part of many banders. Much of the information in this guide is a compendium of material taken from other sources including the North American Bird Banding: Volume I (Canadian Wildlife Service and U.S. Fish and Wildlife Service 1991) The North American Banders' Manual for Banding Shorebirds, the North American Bird Banding Techniques: Volume II (Canadian Wildlife Service and U.S. Fish and Wildlife Service 1977) (see also http://www.nabanding.net/other-publications/), and the Canadian Council on Animal Care's Migratory Birds Training Module.

http://www.ccac.ca/en_/education/niaut/wildlife/wl-migratory-birds).

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INTRODUCTION

The Bird Banding Manuals and NABC guides are considered required reading for anyone who wishes to band birds in North America. The guides are designed to complement each other. All banders and prospective banders should be familiar with the information presented in the North American Banders' Study Guide.

This guide contains basic information on banding birds at nest boxes in North America. It is not intended to supplant the Bird Banding Manuals or the relevant NABC manuals but is supplementary to these manuals.

The target audience for this guide includes banders and investigators interested in conducting field studies that involve banding adults and/or nestlings at nest boxes, or similar artificial cavities. While many of the techniques and procedures discussed here can be applied to birds nesting within natural cavities, this manual does not cover the specific challenges of working at natural cavities. Thus, this manual is limited to nest boxes where the investigator has more control over the structure, placement, access, etc.

Section 1 deals with more general information on banding at nest boxes while Section 2 provides more specific guidelines for selected species. Information on nest monitoring is not included in this guide as it is available elsewhere (see Appendix A).

THE BANDER'S CODE OF ETHICS

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

The Bander's Code of Ethics applies to every aspect of banding. The bander's essential responsibility is to the bird. Nothing matters more than the health and welfare of the birds you are studying. Every bander must strive to minimize stress placed on birds and be prepared to accept advice or innovation that may help to achieve this goal.

Methods should be examined continually to ensure that the handling time and types of data to be collected are not prejudicial to the birds' welfare. Be prepared to streamline procedures of your banding operation, for example, 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. While there are circumstances beyond the bander's control, some mortality should not be considered inevitable or acceptable when banding. Every injury or mortality should result in a reassessment of your operation. Action is then required 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 of the North American Banders' Study Guide.

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 and publish innovations. Banders have other responsibilities too. They must submit their banding data to the Banding Offices each year, reply promptly to requests for information, and maintain an accurate inventory of their band stocks. Banders also have an educational and scientific responsibility to the public to make sure that banding operations are explained carefully and are justified.

It is the responsibility of those leading projects to ensure that data are archived for analysis in a data repository, and for publishing. Banding data that are not analyzed or available for analysis do not contribute to science and are of little value. Finally, banders banding on private property have a duty to obtain permission from landowners and ensure that any concerns are addressed.

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.*

SECTION ONE

TRAINING

It is recommended to train with an experienced bander in order to obtain competence in capturing and handling wild birds. It is advantageous to obtain hands-on experience with identification, ageing, sexing, moult, banding, and measurement of your study species. This is best done at the appropriate season, because plumages can vary greatly between seasons and between or within age groups. 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 will likely require the same basic skills.

The amount of training required depends on the nature of your project, the permit type you want to acquire, your learning speed, 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 for most permits, and you should plan for this.

It is possible to apply for a banding permit for use on a specific project involving banding a single species at nest boxes. However, such a permit requires that you provide evidence that you have received appropriate training from qualified banders.

Bander trainers should have extensive experience with using various methods of capture and identification of nest box species in the hand. All banders should clearly understand the responsibilities involved in handling wild birds, and have experience in handling and banding birds. Additionally they should be familiar with this manual and other key reference material.

NABC maintains a complete listing of NABC-certified trainers in specific geographic regions. For information on NABC, visit the NABC website.

PLANNING YOUR STUDY

When planning any research project it is important to have clear objectives and testable, scientific hypotheses. Because they are relatively easy to work with, many nest box species have been studied extensively. Many nesting studies can be accomplished without the need to capture or band, reducing the level of disturbance to birds. However, there is still much that can be learned from a well-designed banding project with species that utilise nest boxes.

The purpose of the study is the first and most important consideration. Clear objectives and knowledge of the planned statistical methods will help to define the study protocol and identify the species, season, location, number of individuals, and types of marking methods that will best test the hypotheses.

Rather than, or in addition to, developing novel research questions, participation in collaborative projects or networks provide additional opportunities and often maximize data use, and provide opportunities for excellent training. Project protocols must be followed and data collected to specific standards. Examples of nest box banding projects at the time of writing include: Tree Swallow breeding study by Bird Studies Canada, Western/Mountain Bluebird research by the Puget Sound Bluebird Recovery Project, the BC Purple Martin Stewardship and Recovery Program and the Nest Watch program of Cornell University's Laboratory of Ornithology (also see Appendix A).

Ethical treatment of animals and a high standard for bird welfare improves the scientific validity of the research data by contributing to high quality data. Collaborative, standardized projects allow data from a variety of sources to be analyzed separately to address local issues as well as data can be pooled to address landscape or continental scale issues. In all cases, investigators need to consider the following points when planning a study that includes wild birds:

- Know your target species, including how procedures may affect data quality and/or the species' ecology, biology, migratory behaviour, anatomy and physiology.

- Maintain bird safety as a high priority.
- Consult with a veterinarian or other experts as necessary (e.g. to gain experience with specialized techniques and protocols).
- Conduct a pilot study when attempting new approaches, methods, or products.
- Use the least invasive practice possible in either indirect or direct manipulation.
- Ensure that procedures will not have a detrimental effect on the population.
- Have a plan and protocol in place should you capture non-targeted species.
- Assess carefully your hypotheses, statistical analysis and probable results within a framework of future publication.

Investigators handling wild birds for research purposes should maximize the information obtained during handling, while minimizing detrimental effects to the individual. Investigators must be aware of potential causes of stress or discomfort to the bird. If you are handling adult or nestling birds as part of your study, then banding these individuals can be done with little additional effort on your part or stress to the birds. However, just because you 'can' band a bird is not sufficient justification for doing so.

Factors to consider when designing your project include:

- potential to capture target and non-target species;
- sample size and number of nest boxes needed;
- number of sites (having multiple sites allows for greater usefulness of the data, while avoiding pseudoreplication is usually important for the study to be meaningful);
- study duration;
- whether a species is single or double-brooded;
- required and potentially useful measurements;
- frequency of nest visits/nest monitoring procedures;
- frequency of capture and handling of individuals;
- the need to band the nestlings;
- the need to identify individual adults and/or nestlings;
- the need to collect tissue samples, blood, infertile eggs, etc.; and
- requirements for additional training or permits.

It is imperative that data archiving, and analysis and publication by you or a network be the end goals of your project. Data that are not analyzed and published do not contribute to conservation and science and are therefore of little value. It may even be considered unethical to handle birds with no intention of using the data.

Permits

Research involving migratory birds requires a federal scientific permit in Canada and in the USA. Permit conditions are different in each country so contact the proper authorities to ensure you have all the permits that are required in order to carry out your research. Note that research on certain species (e.g., raptors or species-at-risk) may necessitate additional permits. To ensure the safety and welfare of birds and maintain a high standard for collected and shared banding data, field training is required before a banding permit will be issued in North America.

The management of wildlife is generally a shared responsibility among federal, provincial/ territorial or state governments, and often in partnership with landowners. In addition to federal permits you must contact other authorities for the permits you may require. It is the responsibility of investigators to ensure that they have all the necessary permits and authorizations to carry out their research. Most permits come with reporting requirements that must be fulfilled annually or upon termination of the protocol. Ensure careful documentation of all steps taken during the protocol for clear and comprehensive end-of-activity reporting.

What to Carry with You

To reduce the likelihood of injury, field staff should be familiar and comfortable with all equipment. Not all equipment listed here is required for all field operations; however, this list is intended to get you thinking of what you will require for your field work. No list is complete – plan ahead for your nest box visits:

- a clean bird bag for each nest that you intend to visit
- bucket or container to hold the nestlings.
- bands
- banding pliers
- band removal pliers (circlip pliers)

- colour bands and applicators
- ruler
- weighing device (scale or balance)
- small scissors/penknife
- pens/pencils
- data sheets
- clipboard
- first-aid kit
- leg gauge or calipers
- nest box traps
- screwdrivers (and spare screws)as well as pliers to pull nails (and spare nails)
- rubber boots
- fishing tackle/tool type box (to carry all of the above)
- step ladder and/or extending ladder and/or footstool
- handy wipes to clean up after banding.

Collecting Biological Samples

In Canada, a federal permit is required when collecting biological samples such as blood, feathers, nails, cloacal, buccal, and oropharyngeal swabs from migratory birds protected under the Migratory Birds Convention Act (MBCA). For bird species not listed under the MBCA, provincial permits may be required. Animal Care Committee (ACC) approval of the protocol is required for permit issuance for all activities other than banding and colour banding.

In the USA, authorization to collect blood, feathers, buccal and oropharyngeal swabs may be added to the federal banding permit. Collecting any other type of avian tissue samples will also require a Migratory Birds Collecting Permit issued by the U.S. Fish and Wildlife Service.

In some cases, additional state, provincial or territorial permits are also required. Consult with your local authorities for the most up to date information.

In all cases, it is important to receive training in the proper sampling procedure to ensure that birds are not harmed and a good sample is obtained. Appropriate biosafety measures should be followed when handling blood, feacal, or tissue samples. A discussion of techniques for the collection of biological samples exceeds the scope of this manual.

Auxiliary Markers

Markers in addition to federal bird bands may be necessary if you need to identify banded birds without recapturing them. The use of auxiliary markers requires authorization on your banding permit and most markers require regional, national, or international coordination. In Canada any project using auxiliary markers other than colour bands requires Animal Care Committee review. Institutional Animal Care and Use Committee (IACUC) review is not required by the Bird Banding Laboratory (BBL) for permits in the USA.

Common auxiliary markers include colour-bands, microchips (RFID, PIT)*, patagial tags, paint or dye, coloured tape tags, plastic collars, nasal discs, web tags, nape tags, geolocators and telemetry tags. Each marker has specific considerations including weight, attachment method, load, and life expectancy, effect on bird behavior and survival, and general appropriateness for various species. In depth discussion of the variety of auxiliary markers is beyond the scope of this manual, however, it is critical that marking methods be selected considering the biology of the species and the purpose and time span of the study. *(RFID = radio-frequency identification, PIT = passive integrated transponder)

When selecting a marking method for your study consider whether you need to:

- mark all birds in your study or just a subset;
- identify individuals without recapturing them;
- mark or re-sight birds at multiple locations or in multiple years; or
- require sightings from members of the public outside your area.

In general there are two types of marking systems:

1. Cohort marking: large numbers of birds are marked with the same pattern and colours. This type of scheme is usually created to identify the location of banding, year, age or sex of the bird or call attention to another marker type such as a geolocators or transmitter. Often these are studies marking large numbers of chicks by brood, year or location for migration or movement studies.
2. Individual marking: unique combinations of bands or codes are used when it is important to

identify the individuals without recapture. This marking system is common for breeding and/or behavioural studies.

The importance of considering the purpose of your study when deciding how to mark birds cannot be over-emphasized. If your chosen materials and protocols are not appropriate for your study species or project, are not easily seen in the field, deteriorate too quickly, or overlap with those of others studying the same species then results may be compromised.

Resighting rates of birds, particularly small species with small markers, increase with the visibility of the marker. However, because increased visibility may also result in higher predation rates, this must be taken into account when designing marking protocols.

A standardized re-sighting protocol should be developed and followed to standardize and maximize data collection.

Investigators should be aware of problems and new developments associated with the type of marker used. If using a novel marking technique or using a marker for the first time on a species, a pilot study may be recommended. Results of studies showing the effectiveness of the marker type or design, including any negative impacts, should be published for the future reference of other investigators.

Colour bands

Several factors should be considered when creating a colour-banding marking protocol. First, is to place a consistent number of bands on study birds, at least in a specific species. This increases accurate resighting of study birds by recognizing when a band is missed or lost. Other than for studies of nestling dispersal, consider banding nestlings with a metal and/or a single or cohort colour band only. Nestling return rates to the breeding ground are lower than adults and this conserves individual colour band combinations for adults more likely to return (Greenwood and Harvey 1982).

The number of colour bands used should be the minimum number necessary to provide the essential information and may depend on the number of birds expected to be marked during the duration of the study, and the number of banders marking the target species. Consistency in band patterns used is essential to separate colour combinations from one bander to another working on the same species. Unnecessary use of colour bands results in excessive bands per bird and loss of useful sequences for others to mark the same species. When used systematically, several colors can generate a few thousand combinations.

The interior diameter of colour bands used should be very similar to the interior diameter of the appropriate recommended federal metal band. Be aware that the internal diameter of colour bands might not always correspond with federal band size. There might also be variation in band size between colours. Hence, banders should carefully examine colour bands prior to their use on birds to confirm that the internal diameter is appropriate for each colour that is used on the species. Ensure that the colour band size you are planning to use is appropriate for the species and will not cause injury by slipping over the foot or over the intertarsal joint.

Because colour bands of plastic are generally lighter than metal bands, they should always be put above the latter bands on a leg, otherwise the metal band can compress the band, and subsequently the leg.

Colour bands are not appropriate for all species. Short tarsal length of some species (e.g. Tree Swallow) makes it inappropriate to place more than one band on each leg. Colour bands can be difficult to detect on species with feathered tarsi and species where their tarsi are not visible while at rest. In these cases other markers may be more appropriate for the study. Anecdotal information suggests that white colour bands are not appropriate for nestlings where parents remove faecal sacs.

NEST BOX SPECIFICS

The success of your project will depend on the target species occupying and safely breeding in your nest boxes. Important considerations include choosing an appropriate nest box design for your target species, placing the nest boxes in appropriate locations, and ensuring that they are adequately protected from nest box predators such as raccoons and snakes. Potential predators range from fire ants to black bears, so it is important to be aware what predators are problems for nest boxes in your area and take appropriate measures to prevent predation. Avoid attracting predators to the nest and use barriers to prevent predators from accessing nest box contents.

A general consensus among the scientific community is a need for greater standardization and reporting of studies using nest boxes (e.g., Møller 1992, Lambrechts et al. 2010). Variable nest box characteristics are often unreported in research publications; and as such, the significance of the variation may be overlooked or undervalued (Lambrechts et al. 2010). The four main sources of variation in most studies using nest boxes are: (1) failure to provide details of nest box characteristics when reporting results, (2) lack of certain properties of natural cavities (e.g. multiple exits), (3) variation in nest box designs and protocols among investigators, and (4) failure to account for nest box variation prior to statistical analysis (Lambrechts et al. 2010). Investigators are encouraged to search the relevant literature prior to establishing their research methods. Specifically, they are urged to include the following recommended information (Lambrechts et al. 2010) in their future publications or as supplemental information:

- nest box dimensions, including: size, position of entrance hole, thickness and material of walls, and width, breadth, and height of internal chamber;
- location of nest boxes, including: position, height, supporting structure, average distance between nest boxes and density;
- maintenance of nest boxes;
- protections from predators;
- monitoring protocol; and
- study site characteristics.

Rather than setting up nest boxes in a new study area or establishing a new nest box trail, it may be worth checking to see if there are established nest boxes that you can use for your study. Be sure to obtain permission of the nest box owner before checking its contents or attempting to band the birds. However, existing nest boxes may need to be replaced or modified to allow safe access.

Next box Design

Numerous plans for building nest boxes are available in books and online. There are also many commercial sources of nest boxes and ready-to-assemble kits. It is important to realize that many standard nest box designs are not suitable for research purposes. The first consideration in selecting a nest box design is to ensure that it meets the needs of the intended species and will allow them to safely rear their young.

In addition to the usual concerns such as ensuring the nest box size and entrance are appropriate for your target species, other important considerations include:

- Is it easy to monitor nest contents with minimal disturbance to adult birds?
- Is it possible to safely capture adult birds?
- Is it possible to safely access nestlings for banding and processing?
- Are the nest boxes too accessible to the public, such that vandalism or unauthorized checking might be a problem?

To facilitate access, nest boxes used for banding projects should be side-opening or front-opening, with the box side rotating on a hinge or pins, and the box kept closed with a clip, hook, or other device. Some investigators find that top-opening boxes make it easier to keep adults from flushing and young from prematurely fledging by partly blocking the opening with a hand. In all cases, nest box design details will differ between species to facilitate bird safety, quick access, and handling of the contents.

Nest box Placement

Nest boxes are generally better placed on a metal post or T-bar rather than on a fence post or tree. This allows for proper predator proofing and systematic placement. Depending on the situation and the study design, nest boxes may be placed systematically (i.e. linear or grid array) or opportunistically where conditions appear favourable. Depending on your

research question, you may opt for a systematic or randomized placement approach. As with nest box design, the foremost consideration is bird safety: nest boxes should be protected against predation, extreme weather, disturbance, and other hazards such as busy roads. To ensure the target species will inhabit the nest boxes, consideration should be given to what other cavity nesting species are present and their habitat requirements. For example, nest boxes established for research on the Tree Swallow (*Tachycineta bicolor*) or the Eastern Bluebird (*Sialia sialis*) should be placed a distance from field edges to prevent occupation by House Wrens (*Troglodytes aedon*) (Willner et al. 1983).

Bander safety and convenience are also important considerations. Nest boxes should be located at sites that don't pose a hazard to the bander (e.g. not near high-voltage electrical lines or along roads where it isn't safe to pull off the road). Nest boxes should be accessible from the ground, or by using a step stool or ladder safely. Nest boxes in wetlands or along streams should be situated so they can be safely accessed during breeding season, when water levels may be high. It is preferable if the bander or monitor is able to see the box entrance.

Lastly, nest boxes should be cleaned out after birds have fledged at the end of each season and any repairs necessary should be made. Cleaning of nest boxes and removal of old nests drastically reduces the parasite load of the cavities, an important artifact to be considered for breeding success and productivity studies (Møller 1989). Only inactive nests (after the breeding season has passed) should be removed from nests boxes, as the nest and eggs of native bird species are protected federally or provincially/territorially, or by state in both Canada and the United States. **Therefore it is important to understand that non-target native species may not be evicted once nesting has begun**.

Predator Proof Your Boxes

Setting up nest boxes creates an artificial situation that does not exist in the wild. Nest boxes that are properly protected against predators may increase breeding success due to decreased predation and parasite loads (Møller 1989).

Conversely, several studies without predation exclusion measures have demonstrated higher predation rates in nest boxes than natural cavities due to high visibility (Evans et al. 2002), learned exploitation by predators via search image development, or long-term spatial memory (Miller 2002). Investigators should be prepared to ensure boxes are fully protected from predators by installing metal cone guards, stove pipe baffles or an application of grease to the metal pole. This is especially important when working with species in population decline, to prevent the creation of an ecological trap (Schlaepfer et al. 2002). Where arboreal snakes such as rat and fox snakes are present, some kind of wire screen should be used in combination with stovepipe baffles or cone guards. Annual application of grease to metal poles is effective against raccoons, but at least some arboreal snakes will remain undeterred.

When approaching a nest to check its contents or to band birds, avoid attracting aerial or terrestrial predators. If possible, use a different route each time you access a nest box to minimize the development of trails leading to the nest site. This may not be practical for projects that require frequent nest box visits. However, proper predator proofing should deter most predators (Bill Read pers. comm.) Additional information can be found on the NestWatch 'Nest Monitor's Code of Conduct' (see Appendix B).

BANDING ADULT BIRDS

Banding nesting adults can be very important to your project. The banding of adults at nest boxes requires planning to minimize disturbance to the birds and the nest site.

(a) Timing

Depending on the species, adults may abandon nests unless trapping is delayed until incubation is well under way, or even until chicks hatch. Banding chicks immediately after release of captured adults, before they resume feeding, will minimize overall disturbance.

Delay capture and banding for the first hour or so after sunrise to allow young to be well fed. This will also help chicks to settle in the box when you install the nest-trapping device. Stop capture and banding activities at least one hour before sunset to allow the adults to feed the chicks before nightfall. Be aware of

weather conditions, as adults will feed less frequently when it is hot and increase brooding activities when it is cold. Avoid trapping on days when food availability is likely to be low (e.g. rain or high winds). Remember the safety and welfare of the birds comes first.

Minimize your time of disturbance while attempting adult bird banding. Ideally, unless normal feeding activities continue, you should limit your trapping to 30-min or less per visit. Adult birds may abandon the nest if kept too long from the box by your presence or nets. If adult birds are perched with food in their bills do not visit the nest box for lengthy periods of time, immediately remove traps and attempt banding at a later date. If trapping adults in a colony (e.g. Tree Swallows or Purple Martins (*Progne subis*)), keep in mind that the adults from nearby boxes may also be kept from their boxes as well. Ensure that banding activities are not disturbing other birds unnecessarily or preventing the feeding of young.

Avoid resetting traps at the same box immediately following unsuccessful capture since this may result in eggs being improperly incubated and increase risk of abandonment. Breeding and incubating birds must be released as soon as possible to avoid prolonged absence from the nest (<30 minutes depending on the species). Bird capture methods should be reassessed if any injury or mortality occurs. All serious injuries and mortalities, and the circumstances surrounding them, must be recorded and reported to the authorities as required. If death occurs, subsequent use or disposal of carcasses must also be recorded.

(b) Capture

Incubating birds of certain species will remain motionless when the box is opened and can be simply lifted off the eggs (see species-specific section for more information). Alternatively, it is sometime possible for the investigator to capture an adult in the box by blocking the entrance hole, and then carefully reaching in through the door to quickly catch the bird inside. Most commonly, adults are captured using a nest box trap device, particularly when they are feeding well-grown young. This is due to frequent visits and low chances of nest abandonment. Nest box traps contain a mechanism to block the nest hole that is triggered shut when the bird enters the box. A variety of traps have been described in the literature; and include those that are automatically triggered when the bird enters (Stewart 1971, Stutchbury and Robertson 1986, Yunick 1990, Friedman et al. 2008), those operated remotely from a distance with a string (Fisher 1944) or via a radio controller (Lombardo 1983). Remotely-operated traps are useful in targeting specific "hard-to-trap" individuals (which often include males), without disturbing already-banded birds.

Nest box traps or other traps near the nest should be constantly monitored from a reasonable distance and the bird removed and banded immediately after capture. Adults feeding young should not be kept for longer than 20 minutes after capture. Holding the banded bird in a clean bird bag for a short period avoids its repeated capture while attempting to capture its mate. If the mate is not captured within 20 minutes, the attempt should be abandoned and rescheduled.

A very simple but effective design for a nest box trap involves taping a flap of heavy cardboard or plastic above the nest hole and then using a piece of grass stem to prop it open (Stutchbury and Robertson 1986). Ideally the box should lean forward slightly to ensure the flap closes tightly.

There are also a number of commercially available nest box traps (Fig. 1), most of which are designed to capture and remove unwanted species such as House Sparrows or European Starlings from particular box types but are effective for other species as well (Richard et al 1969, see also Appendix B). Other trap designs include using a swing door that drops shut after the bird enters the box (Yunick 1990), and a cage that surrounds the nest box hole and is triggered shut when bird enters (Fig. 2). However, some species are very sensitive to any change in the box appearance once nesting has begun, so external traps may have to be put in place well before trapping is to occur.

Putting a white or contrasting-coloured dot on the face of the closed trap makes it easy to tell from a distance whether a trap has been set off. For units with trap doors or moving parts, orientation should allow easy removal of the bird, and all mechanisms should be in good working order, with no sharp edges, to make them safe both for investigators and trapped birds.

Figure 1– (Top) Gilbertson nest-trap (bottom) Inside view of a nest box with the nest-trap set. Photos credits: http://juliezickefoose.blogspot.ca.

A third option for trapping adults at the nest box is to use a loose net directly over the hole to capture birds as they leave the nest box. This method can be used at elevated nest boxes, or natural cavities that have several exits or are difficult to access directly (Bull and Pederson 1978, Bull and Cooper 1996). The netting can also enclose the nest box within a larger box frame, called a box-net trap (te Marvelde et al. 2011).

There are also several techniques that can be used to capture adults away from the nest box. Adults can be fearful of the box for a period after being captured there, such that capture away from the nest may cause less disturbance. The type of trap used will vary depending on the species involved and the circumstances. Some birds such as Eastern Bluebirds will readily go into a Chardonneret trap (Harding 1925) baited with mealworms that has been set below a frequently-used perch. Mist nets may be used to capture adult passerines and owls as they arrive or depart the nest box (Gutzke 1981). Mist nets are set on the approach or departure route to the nest box. Nets should be set without damaging the vegetation in the vicinity of the box. Watching the adults enter the box a few times should give you a good idea of the flight paths of the birds, the net should be placed in this path, Bear in mind that the other bird of the pair may have a different flight path and need to have a net set in a different place to catch it. Nets should be monitored closely once set and birds removed promptly. One drawback to using mist nets is when the bird hits the net; any food that has been collected is lost to chicks. If this happens repeatedly then the young are deprived of food for a longer period and the adults will have to work harder to feed the young.

Extracting birds from mist nets is a skill that must be developed through rigorous training and supervised practice. Nets that are not set properly, not monitored sufficiently or not monitored by skilled extractors have the potential to injure and kill birds. Mesh size must be appropriate for the targeted species or species group so that birds are not able to escape, become excessively tangled or injured. Birds should be safely extracted from nets and placed in cotton or paper bags. If nets are open at night to trap breeding owls, they should be checked as frequently as during the day, and suitable headlamps should be worn by banders to extract the birds from the nets. When not in use, mist nets must be taken down or furled and secured at the end of each session

Figure 2 – Adult Tree Swallow in banding trap. Photos credit: Michigan State University Wildlife Toxicology Laboratory.

(c) Handling and Processing

Captured birds can be held temporarily in cloth bags prior to banding. Bags should be an appropriate size for the species with no exposed threads on the inside to tangle birds and closed using drawstrings. Bags are normally made of breathable cotton and must be washed frequently. Burlap bags work well for ducks and larger owls. Information on general bird handling and banding techniques is presented in the North American Banders' Study Guide (NABC 2001) and the taxa-specific guides (e.g. passerine and near-passerine guide).

Training from an experienced handler is required to ensure that field personnel are confident handling birds. For example, birds must be able to move their whole keel during respiration. Too tight a grip may cause the bird to suffocate. Field personnel should be familiar with several grips i.e. wing wrap, body grip, photographer's grip, bander's grip, ice cream cone grip (NABC 2001) that ensure the safety of both the bird and the handler. Not all grips are suitable or safe to use on all species. For example photographer's grip should not be used when handling birds with short legs such as swallow species. Ice cream cone grip is not appropriate to use on females during egg-laying.

Adult breeding birds should be handled the same way as non-breeding adults with the following additional precaution. It is best to avoid handling females while they are laying eggs as they may abandon the nest as a result. If you suspect a bird you have captured has a developing egg, be extremely careful not to put any pressure on the lower abdomen. Egg-laying birds, if they must be captured at all, should be handled and banded delicately and promptly and then released immediately. Capture and handling time should be minimized through proper planning.

In general, the bander's grip should be used for removing birds from nest boxes. When lifting an incubating adult off a nest or removing a bird that has been trapped in a box, make sure that the bird is not gripping the nest, the nest lining, or a chick. The correct band size must always be used. The recommended band size(s) for each species of North American bird can be found in the Bird Banding Manual or on the BBL's website and in Bandit. Modifications are occasionally published in the periodical Memoranda to Banders issued by the Bird Banding Office and the Bird Banding Laboratory.

Individual variation may require that field personnel use a leg gauge or set of digital calipers to ensure that an appropriately-sized band is used. Banders must be able to correct or remove an overlapped or otherwise misaligned or poorly fitting band in the field.

The nature of your project will determine the data collected. At a minimum the age and sex of the adults should be determined as accurately as possible. Additional biometric information such as the wing chord measurement or weight may be relevant. For example, capture of breeding birds can provide measurements on known local birds for separating races or populations. Consult the North American Banders' Study Guide (NABC 2001) and the North American Banders' Manual for Passerines and Near Passerines (NABC 2001) for standard measurements or biometrics and instructions.

BANDING NESTLING BIRDS

(a) Timing

The nestlings of cavity-nesters are readily captured in the nest box. Nestling banding should take place between the minimum banding age (dependent on leg size) and a few days prior to fledging (since banding of older nestlings can cause premature fledging). Depending on the species, this time-period may be a few days up to a few weeks. Nestling banding windows (days since hatching) for certain nest box species are provided in the species-specific information in Section Two. In some cases it may be possible to safely capture young immediately before or after fledging but this is generally riskier and more difficult. Timing of banding is also highly dependent on the tarsus size of the nestling (see Handling and Processing page 14 for more details). During monitoring, nests should be checked late in the morning or early afternoon to avoid missing the hatch data (Jongsomjit et al. 2007). Avoid banding young during the critical feeding times of early morning and late afternoon and during inclement weather (unusually hot, cold or wet days) (Jongsomjit et al. 2007).

(b) Capture of Nestlings

Most nest box species can be banded at a later age relative to fledging than open-cup passerines, but they should not be handled within a few days of the expected fledging date.

If your actions cause the young to fledge, follow the ensuing instructions:

1. Close the nest box and block the hole while monitoring to see where the fledged young have gone.
2. Quickly capture the fledged young and place them together in a cloth bag. Next collect the remaining young from the box and then band them all, returning them to the bird bag after banding.
3. Carefully return young back to the blocked nest box ensuring that no fledglings remain outside the box. The darkness inside the box will settle the fledglings.
4. Leave the bag in the hole, plugging the nest box, for 5–10 minutes to ensure the young have settled down, then carefully and without jerking the box, remove the plug and step away quickly and quietly monitor the box to make sure the young don't leave.
5. If necessary, repeat steps 1 to 5.

Newly fledged young that have not yet been banded can sometimes be captured before they become proficient flyers. They can often be captured on the ground or from nearby branches by hand or using a small net. This must be done with caution and care, and may not be advisable in all situations. Banders must a) be sensitive to the stress of both the adults and fledgling birds, b) avoid attracting predators (as young birds may be very vocal when captured or chased), and c) must not chase fledglings to exhaustion.

(c) Handling and Processing

As some species are reported to abandon nests if they return to an empty nest box, either: (a) remove all nestlings and remain beside the nest box to prevent adults from returning, or (b) remove half the nestlings at a time and process them away from the nest box so that adults can continue feeding the remaining young.

All nestlings should be carefully identified in case of egg dumping by another species. Use the correct band size as recommended for the species by the Bird Banding Program; be aware that leg size may vary in some populations. It is the bander's responsibility to ensure the appropriate band size is used on each individual. Serious injury may result from bands that are too tight or too loose on the leg either before or after fledging.

If the band size differs between adult males and females and the sex of the nestling cannot be determined, the larger of the recommended band sizes must be used. However, if the band can pass from upper to lower leg of the nestling, or over the foot, the band is too large for the nestling and *no* band should be placed on the bird.

Another special consideration is that altricial nestlings may have especially thick tarsi as young nestlings due to increased water content in the growth and development of tissues. As the leg develops, the contractile proteins in the muscle increases, resulting in a drying trend in mature tissues, leading to the tarsus width shrinking (Ricklefs 1979). Banding should occur once the swelling has subsided and the tarsus is roughly the size of adult legs.

For each species, the timing for banding between the minimum leg size of the nestling and prior to the fledging period will vary. A subset of North American cavity nesting species breeding ecology is delineated in Section 2 – Species Specific Recommendations. For those species not covered in this manual it will be the responsibility of the bander to obtain the pertinent information. For many passerine birds fledging typically occurs 12-15 days after hatching; banding prior to 6-8 days after hatching may result in high percentages of band loss (Kaczynski and Kiel 1963). Nest disturbance beyond 9-11 days after hatching can elicit early fledging (Jongsomjit et al. 2007). Nestlings handled during monitoring activities may fledge earlier than normal (Pereyra and Morton 2001). Prior to banding a nestling, the bander must verify using a leg gauge that the recommended band fits correctly by: (a) rotating the band freely around the thickest part of the nestling's tarsus and (b) checking that it does not slide down and over the foot. For passerine birds, the unsheathing of the alar pins (feather tract on nestling wing, see Fig. 3) may

coincide with the beginning of the banding window for the nestling (Jongsomjit et al. 2007).

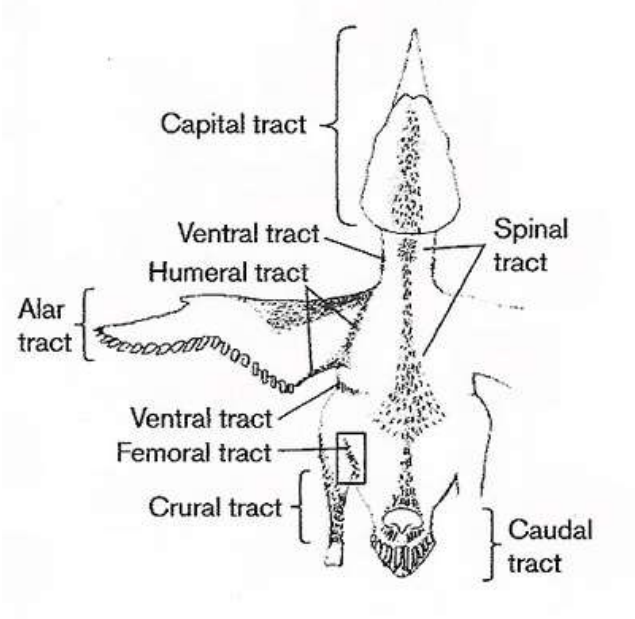

Figure 3 – Feather tracts (From: Chuong et al. 2000)

(d) Ageing and Sexing Nestlings

The ageing of nestlings can be accomplished using a variety of visual characteristic, measurements, and behavioural cues. The exact age of nestlings is achieved by regular monitoring and accurate and up-to-date record keeping. Well-studied species may have extensive information documenting nestling growth; thus it is useful to read the existing literature for each species, including the Birds of North America accounts. The U.S. Fish and Wildlife Service Guide to Nestling Development and Ageing in Altricial Passerines (Jongsomjit et al. 2007) is an excellent and readily available resource (see Additional Resources). Widely used ageing characteristics include: feather tract development, wing chord length, weight, tarsus length, culmen length, and date of eye opening (Jongsomjit et al. 2007). It is advisable to use several characteristics in concert, as food restrictions may influence certain characteristics.

If good accurate aging criteria are not available, it is highly recommended that you document characteristics of known age nestlings (those found on the day they hatch), using digital photos of feather tracts and other visual characteristics. Place nestlings on a plain background (e.g. sheet of paper) with the written nestling ID, nest date, and a ruler, and take a picture from above and the side (Jongsomjit et al. 2007). Photos such as this are excellent records and serve as a study-guide prior to and during the field season.

Most altricial passerine nestlings have asynchronous hatching, in that the eggs of a clutch do not hatch at once but over a period of one or more days (Clark and Wilson 1981). For many passerines, incubation begins at the laying of the penultimate egg, resulting in the last egg hatching 24-48 hours later than the rest of the clutch. Asynchrony typically increases with clutch size, and as a group, cavity-nesting birds are highly asynchronous (Clark and Wilson 1981). Nevertheless, some species are nearly synchronous in hatching, such as bluebirds (Hussell 1972). Banders should be prepared for one or more of the nestlings in a clutch to be younger than the rest, and plan banding activities accordingly (i.e. either ensure the youngest nestling is at or beyond minimum banding age, or leave some young unbanded. Alternatively, multiple visits may be needed to band nestlings that were too small at first visit.)

Nestling birds of many species are difficult to sex as they seldom have sex-linked morphologic traits or colouring while in the nest (Griffiths et al. 1998). Monomorphic adult birds may be sexed using measurement calculations, but these indices, such as those in Identification Guide to North American Birds (Pyle 1997) are not suitable references for sexing biometrics for nestlings. DNA testing is required for reliable nestling sexing of most bird species (Griffiths et al. 1998). Today numerous labs will run analysis or provide commercial sexing kits.

DATA MANAGEMENT

It is invaluable to have specific scientific objectives/hypothesis/predictions when planning research methods and protocols. This research plan should identify the target species, required sample sizes, trapping and marking techniques to be utilized, planned measurements, appropriate timing for handling/banding adults and/or young birds, etc. Depending on site conditions, data may be entered on a computer or tablet, onto data sheets, or into a field book. Data should always be backed-up and replicated at least once (i.e., from field book to data sheets, from data sheets to computer, computer backed onto external drive or online data storage). Data for each individual should include: band

number, species, age, sex (if known), date, time, location (and nest site if applicable), trapping method, exact marking scheme, measurements, and known injuries or abnormalities, etc. The program "Bandit" (from the U.S. and Canadian banding offices) can be used to enter these sorts of data onto computer. Note that **for the purpose of reporting to the banding offices, the correct age for nestlings is "LOCAL" (L), not "HY"**. Banding information must be reported to the Canadian or U.S. banding office as soon as possible after the field season, in a prescribed format.

If you are not certain of a bird's species, age or sex, **do not guess!** Guesswork destroys the reliability of your data. Unidentified species should not be banded but photos taken to document the capture. Add "remarks" or "notes" on your banding sheet to document how you arrived at a particular decision or were not able to provide a more accurate result.

BANDER SAFETY

As with any fieldwork, banding birds at nest boxes has inherent risks and precautions should be taken. Always inform a supervisor or colleague of your planned route/location and return time. If working remotely, carry a cell phone or other communication device with you.

When visiting new nest boxes or during your first visit of the season, be aware that other species can be found resting or nesting inside boxes, including bats, mice, flying squirrels, snakes, bees, wasps and hornets. First, approach the front of the box and from a few feet away look through the hole to the top of the inside roof of the box for signs of hornet or wasp nests. Next, knock on the side or bottom of the box to elicit a response from a possible occupant. Lastly, use a mirror or camera to view the contents of the box prior to opening it.

As with all fieldwork, carry a well-stocked first aid or emergency kit with you at all times. Ensure you have a valid epinephrine auto injector (e.g. EpiPen) and that all team members know its location and how to use it. Small cuts or abrasions may easily get infected from faeces and should be cleaned properly and promptly. Wounds should be covered to prevent further infection or re-infection. Lastly, for the safety of the bander and the birds, banders should disinfect their hands as often as practical, with soap and water or an alcohol based antibacterial gel that works well without water. Note that you should never handle birds with any oil-based residues on your hands, such as perfumes, sunscreen, moisturizer, soap or insect repellant, as this could affect bird health or feather structure (LaBlonde 1995, Association of Avian Veterinarians 2011).

AVIAN DISEASES

Field workers should be familiar with avian diseases that may occur in their local area. If birds appear sick (possible symptoms include discharge around the eyes, nares or beak, pox, swelling of the head and eyelids, or ruffled feathers), release the bird, thoroughly wash your hands and disinfect any equipment that came into contact with the bird. Enter the bird's condition on your data sheet. We suggest that you disinfect your hands, clothing, and footwear as often as possible and practical to minimize disease transmission between birds.

Do not assume that there is no underlying illness even in seemingly straightforward capture mortalities. Sick birds may be more likely to be injured during capture, although they may seem outwardly healthy. Knowing the cause of death can help refine capture protocols and alert handlers to the presence of zoonotic diseases. Consider having a veterinarian examine capture mortalities to determine underlying causes. If unusual numbers of dead or sick wildlife are observed, report the occurrence to appropriate authorities. In Canada, mortality reports and dead birds may be submitted to the Canadian Wildlife Health Cooperative (CWHC), and in the USA disease events should be reported to the Wildlife Data Integration Network (WDIN).

Zoonoses are diseases that can be transmitted from animals to humans. Although most avian diseases do not pose a serious threat to most people, a variety of diseases are transmissible from birds to humans. These include chlamydiosis, salmonellosis, tuberculosis, and colibacillosis. It is important to be aware of the possibility of contracting a disease. Seek medical assistance if necessary.

Basic preventative care includes not eating, drinking or smoking while handling or cleaning contaminated equipment. Always wash your hands with warm soapy water when finished. Use appropriate disinfectants to wash equipment and any potentially contaminated surface. Always work in a well-ventilated environment. When working outdoors, try to stay upwind of birds or nest boxes to avoid inhaling dust or other potential irritants.

Emergent diseases such as avian influenza must also be kept in mind and as well as any zoonotics in your region. All those who work with birds should have current tetanus vaccinations. Field workers should also take appropriate precautions against mosquito and tick-transmitted diseases, such as eastern equine encephalitis virus, West Nile virus, and Lyme disease. Where there is potential for zoonotic transmission, project leaders must ensure that all team members are informed about the possible routes of disease transmission and exposure, and are trained in the use of protective equipment, safety procedures and medical interventions. It is a wise precaution to investigate any illness that cannot be readily explained, especially those that appear unusual or persistent. Ensure your health care provider is informed that you have been in contact with wild birds. (See also the relevant section in the North American Banders' Study Guide, pg. 46-47).

SECTION TWO:
TAXA SPECIFIC RECOMMENDATIONS

The following is a list of common nest box species and recommendations for banding adults and nestlings, as well as a list of special considerations. The information provided is meant to help banders decide the best times for banding adults or nestlings in order to minimize negative effects on birds during this crucial time period when they are most sensitive. Behaviour before, during, and after nesting differs among species. As much information should be obtained about nesting times and behaviour as possible prior to banding.

Guidance for banding adults includes information on the number of broods, roles of male and female in incubation and feeding, adult sensitivity to disturbance (i.e. abandonment), and best methods of capture. For banding nestlings, one should know the best times to band, based on the age and time of natural fledging.

Lastly, special considerations include specific details related to bird behaviour; primarily risk of adults' attacking banders due to territorial activity and nest defence. Also included is information on whether sex determination is possible, and what the common predators are at both egg/nestling and adult stages. Banders should be aware of predators so as to take appropriate precautions during nest box checks and banding.

For an overview of banding information on the species listed in this section, see Table 1, following the specific accounts.

AMERICAN KESTREL (AMKE)
(*Falco sparverius*)

BANDING ADULTS

American Kestrels are double-brooded (depending on latitude); lay 4-5 eggs, with an egg laid typically every other day but with a range of 1-3 days (Bird and Palmer 1988, Smallwood and Bird 2002). American Kestrels promptly lay a replacement clutch if the first is lost, typically within 11-12 days (Bowman and Bird 1985). Incubation begins with the penultimate egg and lasts 26-32 days with an average of 30 days (Bird and Palmer 1988). Incubation is primarily performed by the female, with male contribution varying according to individuals and/or weather conditions (Bird and Palmer 1988, Martínez-Gómez 1991). Adult birds may be captured: (1) using a nest box trap during the incubation period 1-4 weeks after clutch completion and prior to hatching (Strasser 2010), (2) using a remotely-operated nest box trap shortly after hatching (> 5 days old) while adults still enter the box for feeding (Plice and Balgooyen 1999) or employing a bal-chatri trap in the target pair's territory (Berger and Mueller 1959). Flap traps set up inside the box may also prove suitable to capture adults on the nest or attending to nestlings.

BANDING NESTLINGS

American Kestrel clutches take 2-3 days to hatch after pipping is first heard; with individual eggs

hatching 48-52 hours (Smallwood and Bird 2002). Occasional brood reduction occurs via cannibalism of the youngest and weakest nestling by stronger siblings or the parents (Bortolotti et al. 1991). American Kestrels nestling period is from 28-31 days (Smallwood and Bird 2002). The recommended nestling-banding window is from 10-23 days (Katzner and Robertson 2005) following the tarsus criteria of 'Banding Nestling Birds' (Section 1 page 13). Peak feeding period for young kestrels is from 9:00-12:00 and 16:00-17:00 (Smallwood and Bird 2002). Banding or monitoring activities should be avoided at these times. Beyond day 24, nestlings should not be handled due to risk of premature fledging (Smallwood and Bird 2002). American Kestrel nestling growth and development has been extensively studied and described (Roest 1957, Smallwood and Bird 2002).

Special considerations:

Both male and female American Kestrels may show aggression to humans who approach the nest during incubation and nestling periods (Smallwood and Bird 2002, Strasser 2010). Otherwise, American Kestrels make ideal study species in captivity and in the wild, and are little disturbed by monitoring activities. Females may sit tightly on eggs during incubation and may have to be lifted off the clutch for an egg count (Smallwood and Bird 2002).

Surprisingly there is little information on American Kestrel nest predators; known nest predators include: fire ants (*Solenopsis invicta*), yellow rat snakes (*Elaphe obsoleta quadrivittata*), and corn snakes (*E. guttata guttata*) (Smallwood and Bird 2002).

CHICKADEES

All chickadees are ecologically and reproductively very similar, thus equivalent techniques in monitoring the nest, as well as banding the adults and young can be used. However, specific phenology, suggested banding windows, and band sizes may vary.

BLACK-CAPPED CHICKADEE (BCCH) (*Poecile atricapillus*)

BANDING ADULTS

Black-capped Chickadees are generally single brooded, with a clutch size of 6-8 eggs (Foote et al 2010). Incubation is solely by the female, for 12-13 days beginning with the penultimate egg (Foote et al 2010). The male will regularly bring food to the incubating female (Foote et al. 2010); when she leaves the nest to forage during the incubation period the female will cover the eggs with nest lining material (Kluyver 1961). Although nest monitoring activities have not been associated with abandonment, naturally higher rates of nest abandonment by Black-capped Chickadees occurs during the incubation period (Fort and Otter 2004); thus it is advised that capture and banding of adults takes place during the nestling period. Adult birds can be captured using nest box traps during the breeding period and with mist nets in the non-breeding period (Smith 1976, Waterman et al. 1989, Desrocher 1990).

BANDING NESTLINGS

Black-capped Chickadee eggs typically hatch in the order in which they were laid, within a 12-30 hour period (Odum 1941). Black-capped Chickadee nestling growth and development has been extensively studied and described (Odum 1941, Kluyver 1961). The recommended nestling-banding window for Black-capped Chickadee is from day 7-12 after hatching (Smith 1976, Fort et al. 2004, Foote et al 2010), following the tarsus criteria of 'Banding Nestling Birds' (Section 1 page 13). Nestlings from undisturbed nests fledge on day 16; nestlings in disturbed nests may fledge as early as day 12 (Fort et al. 2004, Foote et al. 2010). Therefore, nestlings should not be handled from day 12 onward.

Special considerations:

When the nest is approached, adult Black-capped Chickadees may mob investigators (Clemmons and Lambrechts 1992). Known Black-capped Chickadee nest predators include: raccoons (*Procyon lotor*), squirrel (*Sciurus* and *Tamiasciurus* spp.), common opossum (*Didelphis marsupialis*), snake spp., wood-

pecker spp., and House Wren (Howitz 1986, Christman and Dhondt 1997, Foote et al 2010).

BOREAL OWL (BOOW)
(*Aegolius funereus*)

BANDING ADULTS

Boreal Owls are single brooded in North America, and typically will not replace a failed clutch (Hayward and Hayward 1993). Prior to laying, the female will occupy the cavity for 1-19 days (6 day average), during which time food will be provisioned by the male (Hayward and Hayward 1993). Clutch size ranges from 2-5 eggs, with clutches of 3 eggs most common (Hayward et al. 1993). Eggs are laid at 2-day intervals (Korpimaki 1981). Incubation, by the female only, begins with the second egg laid and continues for an average of 29 days (26-32 day range), (Hayward and Hayward 1993). The female continues to be fed by the male during the laying and incubation period, and leaves the nest only once or twice a night for short periods (Hayward and Hayward 1993).

Boreal Owl adults may be captured before or during the nestling period. Females may be trapped in the nest box during the incubation period (Koopman et al 2007) or while brooding the nestlings (Hayward et al. 1992, Koopman et al 2007). The female will remain in the nest box and brood the nestlings until the oldest is 20-24 days old (Hayward and Hayward 1993). Males can be captured throughout the breeding period using mist nets or dip nets as they visit the nest box (Hayward et al. 1993), or captured at the nest box during food provisioning the female and nestlings (Koopman 2007).

BANDING NESTLINGS

Boreal Owl nestlings are semi-altricial, hatching asynchronously in the order laid on an average of 1.3 nestlings per day (Korpimaki 1981). Boreal Owl nestling growth and development is described in Hayward and Hayward (1993). The recommended nestling-banding window for Boreal Owls is during the second or third week of the nestling period following the tarsus criteria of 'Banding Nestling Birds' (Section 1 page 13). The young owls fledge between 28-36 days old, and will remain in a loose group in the natal area being fed by adults for 3-6 weeks after fledging (Korpimaki 1981, Hayward and Hayward 1993).

Special considerations:

The most common nest predator of Boreal Owl nestlings and incubation and brooding females is the pine marten (*Martes americana*) (Hayward et al 1993). Another possible nest predator during the egg stage is the pine squirrel (*Tamiasciurus hudsonicus*) (Hayward and Hayward 1993).

EASTERN BLUEBIRD (EABL)
(*Sialia sialis*)

BANDING ADULTS

Eastern Bluebirds are typically double-brooded, lay 3-7 eggs immediately after nest completion and begin incubation with the penultimate or ultimate egg (Gowaty and Plissner 1998). Incubation lasts 11- 19 days with an average of 14 days, but clutches laid in the summer or those at lower latitudes have shorter incubation periods then those laid in spring or at higher latitudes (Butcher 1988). Incubation and brooding is performed solely by the female, with feeding of nestlings by both the male and female (Gowaty and Plissner 1998). Adults may abandon the nest if captured during egg laying or incubation; thus adult banding should take place during the early nestling stage. Kibler (1969) recommends waiting until about day 6, but Bill Read (pers. com.) has found that banding adults is safe at nestling day 3-4. Adults may be successfully captured using next-box traps, Chardonneret traps, and/or with a mist net near the nest box. If you hear distress calls of adults you are too close to the trap or net and will need to monitor from further away. Bluebirds will readily habituate to a nest box trap during the nestling feeding period, particularly the females (Pinkowski 1978). Males may be easier to capture early in the season when acquiring territories and visiting multiple nest boxes (Pinkowski 1978).

BANDING NESTLINGS

Eastern Bluebirds have a relatively long nestling period for a passerine bird (16-22 days, 19-day average). Nestling growth and development have been

extensively studies and described (Pinkowski 1975, Gowaty and Plissner 1998). Similar to seasonal variation in incubation period, nestling period for spring nests is longer than for late-season nests (Pinkowski 1975). The recommended time to band nestlings is day 6-11, following the tarsus criteria of 'Banding Nestling Birds' (Section 1 page 13). Older nestlings can be sexed by day 12/13 using plumage colours; attempting sexing of younger nestlings often incurs errors (Pinkowski 1974, Gowaty and Plissner 1998). By day 9 young birds can crawl and by day 14 short distance flights are possible (Gowaty and Plissner 1998). Disturbance at this time should be minimized.

Special considerations:

Despite individual variation, Eastern Bluebirds have been anecdotally reported to abandon nests if they find the nest empty while young have been removed for banding. Follow recommendations outlined in section Banding Nestling Birds under 'Capture of Nestlings' (Section 1 page 13) to prevent this. Adult Eastern Bluebirds may swoop low or 'buzz' when approaching or monitoring the nest box.

Eastern Bluebird nest predators include: eastern chipmunk (*Tamias striatus*), flying squirrel (*Glaucomys* spp.), House Sparrow, European Starling, black rat snake (*Pantherophis obsoletus*), black racer (*Coluber constrictor*), fire ant, feral cat (*Felis* spp.), black bear (*Ursus americanus)*, raccoon (Gowaty and Plissner 1998) deer mouse (*Peromyscus maniculatus*) and Eastern fox snake (*Pantherophis gloydi*) (Bill Read pers. comm.).

MOUNTAIN AND WESTERN BLUEBIRD (MOBL AND WEBL)

(*Sialis currucoides* and *S. mexicana*)

The Mountain Bluebird *(Sialia currucoides*) and the Western Bluebird (*Sialia mexicana*) are ecologically and reproductively very similar to Eastern Bluebirds, thus equivalent techniques in monitoring the nest, as well as banding the adults and young can be used. See Table 1 for specific phenology, suggested banding windows, and band sizes.

GREAT-CRESTED FLYCATCHER (GCFL)

(*Myiarchus crinitus*)

BANDING ADULTS

Great-crested Flycatchers are single brooded but will readily re-nest after failure of a first nest (Miller 2002). Clutch size can range from 4-8 eggs (Harrison 1975), with clutches of 5 eggs most common (Bent 1942, Taylor and Kershner 1991). Incubation begins with the penultimate egg, and is performed solely by the female for 13-15 days, although there are rare accounts of males with brood patches (Taylor and Kershner 1991). Although there are no reports of nest abandonment due to research activities, apply the general rules for timing, and methods of capturing adult birds detailed in Section 1 (page 10).

BANDING NESTLINGS

Great-crested Flycatcher nestlings hatch asynchronously, typically over a 2-day period (Lanyon 1997). Both adults will feed nestlings, with the female commonly returning to the nest cavity to brood nestlings up to 6 days old (Lanyon 1997). Great-crested Flycatchers have a short recommended nestling-banding window from age 7-8 days (Taylor and Kershner 1991, Lanyon 1997), following the tarsus criteria of 'Banding Nestling Birds' (Section 1 page 13). Young birds should not be handled from nestling day 9 onwards due to the high likelihood of premature fledging. Normal fledging is at 13-15 days (Lanyon 1997). Fledged young and adults remain together for approximately 3 weeks, with adults feeding and defending young (Lanyon 1997).

Special considerations:

Great-crested Flycatchers establish large territories which they will defend aggressively (Taylor and Kershner 1991), and may show aggression when the nest is approached by mobbing investigators.

Known Great-crested Flycatcher nest predators include: squirrel spp., yellow rat snake, corn snake, indigo snake (*Drymarchon corias*), and Blue Jay (*Cyanocitta cristata*) (Taylor and Kershner 1991, Lanyon 1997, Miller 2002).

HOODED MERGANSER (HOME)
(*Lophodytes cucullatus*)

BANDING ADULTS

Hooded Mergansers are single-brooded and initiate nests much earlier in the season than passerine cavity nesters (Dugger et al. 2009). Males are very difficult to capture during the breeding season, as females prospect cavities alone, with the male abandoning the female and breeding site shortly after incubation has started (Dugger et al. 2009). Hooded Mergansers have a typical mean clutch size of 13 eggs; but this can range from 5-44 eggs with large clutches due to egg dumping by other females (Zicus 1990). Females typically lay an egg every second day, and may abandon the nest if disturbed early in the laying period (Dugger et al. 2009). Incubation 33 days, with a range of 26-41 days (Morse et al 1969, Peck and James 1983). Females incubate day and night with several breaks during the day for feeding (Dugger et al. 2009). Cavity-nesting ducks species are readily caught using nest-traps in two different manners:

1. Females may be captured at the nest during the incubation period by blocking the nest hole on approach or employing an automatic nest box trap (Zicus 1989).
2. During the prospecting, laying, and incubation period, females can be captured in automatic multi-capture nest boxes placed in a population of nesting ducks (Blums et al. 2000). Multiple females will enter the nest box trap during prospecting and/or during egg dumping attempts (Blums et al. 2000).

BANDING NESTLINGS

Hooded Merganser young are precocial and leave the nest within 24-hours of hatching (Dugger et al 2009). Tapping noises and peeping can be heard from the eggs 72 hours prior to hatching, cracks in eggshell 30-48 hours prior to hatching, and a first hole 12-24 hours prior to hatching (Dugger et al 2009). Banding the brood requires careful nest monitoring and timing of visits. As standard leg bands are too large for the newly hatched ducklings, alternative marking techniques such as web-tags (Grice and Rogers 1965, Haramis and Nice 1980) or plasticine-filled leg bands (Blums et al. 1999) can be used. The banding offices provide guidelines on the use of plasticine-filled bands to minimize risk to birds. Depending on the bander's needs or objectives, these choices should be evaluated prior to their use.

Special considerations:

When females are captured on the nest, they may hiss while being handled (Bouvier 1974). When disturbed from the nest or with young, females will perform the Broken Wing Distraction Display (Mallory et al. 1998). Known Hooded Merganser nest predators include: raccoon, mink (*Mustela vison*), black rat snake, black bear, pine marten, European Starling, Northern Flicker (*Colaptes auratus*), and Red-headed and Red-bellied Woodpeckers (*Melanerpes erythrocephalus*; *M. carolinus*) (Bellrose 1976, Fendley 1980, Kennamer et al. 1988, Zicus 1990, Dugger et al. 2009).

WOOD DUCK (WODU)
(*Aix sponsa*)

The Wood Duck (*Aix sponsa*) is ecologically and reproductively similar to Hooded Mergansers; thus, you can use equivalent techniques for monitoring the nest, and banding the adults and young. See Table 1 for specific phenology, suggested banding windows, and band sizes.

HOUSE WREN (HOWR)
(Troglodytes aedon)

BANDING ADULTS

House Wrens are double-brooded throughout most of their range except far north. Clutch size is 4-8 eggs (Johnson 1998), declining seasonally; the first clutch is typically 6-8 eggs with replacement nests and/or second broods 4-6 eggs (Kennedy and White 1991, Robinson and Rotenberry 1991). Incubation is solely by the female averaging 13 days but can be highly erratic (9-16 day range; Kendeigh 1952). The female may begin incubation for a few hours on the day the first egg is laid; increasing the regularity and bout length over the egg laying period (Kendeigh 1952). House Wrens are typically tolerant of disturbance at the nest but the female may desert if trapped in the first half of the incubation period (Johnson 1998). Adult birds may be captured using external next-box

traps, but because wrens tend to fill nest boxes with nest material, there is little room for interior traps (Johnson 1998). Adult birds can also be mist netted near the nest box (Drilling and Thompson 1988).

BANDING NESTLINGS

House Wren eggs hatch in the order in which they were laid, with some clutches hatching synchronously over a 24-hour period, while others are asynchronous and hatch over 2-4 days (Harper et al 1992). House Wrens have a short recommended nestling-banding window, from age 7-9 days (Whittingham et al. 2002), following the tarsus criteria of 'Banding Nestling Birds' (Section 1 page 13). Young birds should not be handled from nestling day 10 onwards due to high likelihood of premature fledging (Whittingham et al. 2002). Normal fledging occurs at 15-17 days, typically within a few hours of each other (Johnson 1998). The youngest asynchronously hatched young or 'runts' may be abandoned and perish in the nest (Johnson 1998).

Special considerations:

House Wrens have been known to strike humans who attempt to approach the nest but are generally quite tolerant of occasional disturbances at the nest site (Johnson 1998). Known House Wren nest predators include: feral cat, rat (*Rattus* spp.), raccoon, mouse (*Peromyscus* spp.), opossum, squirrel, weasel (*Mustela* spp.), woodpecker (*Melanerpes* spp.), bear (*Ursus* spp.), and a variety of snake species including garter (*Thamnophis* spp.), milk (*Lampropeltis* spp.), gopher/bull (*Pituophis* spp.), and rat (*Elaphe* spp.) (Kendeigh 1942, Neill and Harper 1990, Johnson 1998). If potential predators are present in the area, do not disturb adults or approach nest box.

NORTHERN SAW-WHET OWL (NSWO) (*Aegolius acadicus*)

BANDING ADULTS

Northern Saw-whet Owls are generally single-brooded but will readily replace an early failed or abandoned nest (Rasmussen et al. 2008). Clutch size ranges from 4-7 eggs, with laying at two-day intervals and incubation beginning typically with the first egg laid (Cannings 1987, Rasmussen et al. 2008). Incubation is performed solely by the female for 27-29 days, with the male feeding the female throughout the egg-laying and incubation period (Cannings 1987, Rasmussen et al. 2008). The female will rarely leave the nest box during that period, except for short periods in the early evening (Rasmussen et al 2008).

Female Saw-whet Owls captured on the nest prior, during, or after egg-laying may abandon nests due to disturbance, while those captured during the late incubation period or while brooding young (nestling day 1-17) are unlikely to desert the nest (Cannings 1987). Adults may be captured passively by employing mist nets in the study area (Walkimshaw 1965), or using nest box traps during provisioning of the young birds (Marks et al. 1989, Hinam and Clair 2008). A nest trap designed for Tawny Owls (*Strix aluco*) (Saurola 1987), which blocks the female and young inside until the trap is triggered by the male bringing food, has recently been successfully employed for capturing Saw-whet Owls during the early nestling period (Hinam and Clair 2008).

BANDING NESTLINGS

Saw-whet Owls are semi-altricial as nestlings, hatching asynchronously at 2-day intervals, except that the first and second egg may hatch on the same day (Cannings 1987). Saw-whet Owl nestling growth and development is described in Cannings (1987). The female remains in the nest brooding nestlings until the youngest is 18 days old, after which the female helps to feed the young and roosts elsewhere, or disappears from the area (Cannings 1987, Rasmussen et al 2008). The recommended nestling-banding window for Saw-whet Owls is approximately 21-25 days after hatching (R. Lauff, pers. comm.), following the tarsus criteria of 'Banding Nestling Birds'(Section 1 page 13). Young fledge over a period of several days, typically 1-2 days apart (Cannings 1987), approximately 30 days after hatching (Hinam and Clair 2008). After fledging, young birds remain loosely together, and continue to be fed by the male for a minimum of 1 month (Cannings 1987).

Special considerations:

There is surprisingly little information on Saw-whet Owl nest predators (Rasmussen et al. 2008). A single

study suggests red squirrels (*Tamiasciurus hudsonicus*) may depredate eggs and young (Brinker and Dodge 1993).

PROTHONOTARY WARBLER (PROW)
(*Protonotaria citrea)*

BANDING ADULTS

Prothonotary Warblers lay 3-7 eggs usually starting 2-3 days after nest completion (Petit 1999, Walkinshaw 1941), and begin incubation with the penultimate egg (Walkinshaw 1938). Incubation lasts 12-14 days and is performed solely by females, although males often inspect the nest and feed incubating females on the nest Walkinshaw 1938).

Female Prothonotary Warblers are easily caught on the nest during incubation, and though they may become wary after first capture, some individuals can be captured multiple times without a great need for stealth (Walkinshaw 1938). Males can be challenging to capture at the nest as they tend to feed the brooding female or young without entering the nest box (Walkinshaw 1938). Therefore a trap that requires the male to enter the trap in order to reach the nest hole is recommended. An alternative method to catch both sexes is mist netting near the nest; although this should not be done before nestlings are three days old, to avoid disturbing parental feeding activities (McCracken 2005). After fledging, both adult and young birds move to the forest canopy, and are therefore difficult to capture (McCracken 2005).

BANDING NESTLINGS

Prothonotary Warblers nestlings have a relatively short nestling period of 10 days. At disturbed nests, young may fledge on day 9 but young are poor flyers at that time (Petit 1999). The recommended nestling banding timing is nestling day 6-8, following the tarsus criteria of 'Banding Nestling Birds' (Section 1 page 13) (Podlesak and Blem 2002, McCracken 2005). Beyond day 9, nestlings should not be handled due to the risk of premature fledging (McCracken 2005). Prothonotary Warblers nestling growth and development have been extensively studied and described (Petit 1999, Podlesak and Blem 2002).

Special considerations:

Prothonotary Warblers are reported as tolerant of monitoring and research activities; permissive of cameras, temperature recorders, and other data-gathering devices at the nest (Adair et al. 2003). Despite the species' tolerance, investigators are encouraged to spend < 8-min at each nest site visit to minimize stress and disturbance to the birds (Adair et al. 2003).

Prothonotary Warbler nest predators include: American Crow (*Corvus brachyrhynchos*), Common Grackle (*Quiscalus quiscula*), House Wren, squirrel spp., rat snake, milk snake, long-tailed weasel (*Mustela frenata*), and mink (Walkinshaw 1938, 1953, Brush 1994, Petit 1999). Blue Jays may prey on recently fledged young (Petit 1999). If potential nest predators are in the area it is advisable not to disturb adults or approach the nest box.

PURPLE MARTIN (PUMA)
(*Progne subis*)

BANDING ADULTS

Purple Martins are typically single-brooded, but replace a failed nest in the early part of the nesting season (Tarof and Brown 2013). Primarily the female undertakes nest construction, although the male may initiate the process. Nest building takes as long as 28 days (Tarof and Brown 2013). Clutch size ranges from 3-6 eggs, with one egg laid per day (Tarof and Brown 2013). Incubation is predominately by the female and typically starts by the penultimate egg, yet the female may incubate intermittently throughout the laying period following the laying of each egg (McEwen and Hill 1992). The male may enter the nest box during the female's absence and sit on the eggs until the female returns and dislodges him (McEwen and Hill 1992). The incubation period may range from 15-18 days (Allen and Nice 1952, Finlay 1971). To avoid possible nest abandonment that may occur when adults are captured during the nest construction, egg laying, or incubation period, it is recommended to capture adults during the nestling period (Morton et al 1990). Both adults feed the nestlings and the female will brood the young with decreasing frequency until 10 days after hatching (Allen and Nice 1952, Tarof and Brown 2013). Adult

Purple Martins may be captured in the nest box using various traps or via mist nets (Morton and Patterson 1983, Hill 2002).

BANDING NESTLINGS

Purple Martins have a relatively long nestling period for a passerine bird (27-36 days, but 28-29 days is more typical) (Allen and Nice 1952). Growth and development have been studied and described (Allen and Nice 1952, Dellinger and Rogillio 1991, Tarof and Brown 2013). Purple Martin eggs typically hatch asynchronously within a 24-26 hour period (Tarof and Brown 2013). The recommended nestling banding window is 12-20 days after hatching; prior to this time the leg may be too fleshy to band (see the tarsus criteria of 'Banding Nestling Birds' Section 1 page 13) and beyond this time nestlings may be prone to early fledging (Hill 2002, Tarof and Brown 2013); thus disturbance at this time should be minimal and only as necessary. The recent introduction of the size 1D band may allow for earlier banding. It is larger than band size 1A and smaller than band size 2. All three band sizes are recommended by the banding offices for use on Purple Martins.

Special considerations:

Known Purple Martin nest predators include: Great-horned Owl (*Bubo virginianus*) (Dipietro 1988), magpie (*Pica* spp.) (Moore 1989), American Crow (Bowditch 1990), Greater Roadrunner (*Geococcyx californianus*) (Green 1994), Blue Jay, snake, and occasionally raccoon, squirrel, and house cat (Tarof and Brown 2013). Owls and snakes are the most common and significant predators of both adult and nestling Purple Martins at nest boxes (Tarof et al. 2011, Tarof and Brown 2013).

TREE SWALLOW (TRES)
(Tachycineta bicolor)

BANDING ADULTS

Tree Swallows are single-brooded in the north, and double-brooded in the southern part of their range (Winkler et al. 2011). The complex (for a cavity nester) nest-cup construction is undertaken primarily by the female and lasts anywhere from 4-30 days (Stutchbury and Robertson 1987). Clutch size ranges from 1-9 eggs, with 4-7 most common. Eggs are typically laid once a day, but laying may be arrested by females for 1-7 days during periods of inclement weather (Kuerzi 1941). Incubation is predominately by the female and although typically initiated with the penultimate egg, this may be highly variable (Zach 1982). The incubation period may range from 11-20 days (13-14 days most common), with its length a dynamic process driven by various environmental processes and female behaviour (Ardia et al. 2006, Ardia and Clotfelter 2007). Female Tree Swallows may abandon the nest if captured during the nest construction or egg laying period. It is recommended that adult birds be captured during the late incubation or nestling period (Burtt and Tuttle 1983, Lombardo 1989). Both adults feed the nestlings and the female will brood the young until at least 3 days after hatching (Kuerzi 1941, Winkler et al 2011). Adult Tree Swallows may be captured in the nest box using various traps or via mist nets (Rendell and Verbeek 1996, McCarty 2001). In addition, Tree Swallows may be easier to capture at night, when birds are less apt to leave the nest (Burtt and Tuttle 1983). The species readily accepts modifications to the nest box, so traps can be installed and removed in the short-term without undue disturbance to the nest.

BANDING NESTLINGS

Tree Swallows have a relatively long nestling period (18-22 days) for a passerine bird, and their growth and development has been extensively studied and described (Zach and Mayoh 1982, Quinney et al. 1986, Winkler and Adler 1996, McCarty 2001). Tree Swallow eggs typically hatch asynchronously and in the order in which they were laid within a 2-70 hour period (Clotfelter et al. 2000). The recommended time to band nestlings is day 12; prior to this time the leg may be too fleshy to band (see the tarsus criteria of 'Banding Nestling Birds' Section 1 page 13) and beyond this time nestlings may be prone to early fledging (Winkler et al 2011), thus disturbance at this time should be minimal and only as necessary.

Special considerations:

Despite individual variations, Tree Swallows have been anecdotally reported to abandon nests during the fledging period should they detect an empty nest

box while nestlings have been removed for banding. Follow recommendations outlined in section Banding Nestling Birds under 'Capture of Nestlings' (Section 1 page 13) to prevent this. Adult Tree Swallows may swoop low or 'buzz' investigators as they approach or monitor the nest box.

Known Tree Swallow nest predators include: rat snake (Eakin 1983), raccoon (Chapman 1955, Yunick 1971), black bear (Zach and Mayoh 1984) American Kestrel (Weydemeyer 1935) Common Grackle (Buckelew 1983), American Crow (Stocek 1970), Northern Flicker (Rendell and Robertson 1991), chipmunk, weasel, deer mouse, and feral cat (Winkler et al 2011).

OTHER SPECIES

There are other species that readily use nest boxes and have been subject to nest box studies. We encourage banders who work with nest box species to become familiar with the phenology, recommended banding windows for adult and nestling birds as well as any special considerations for the species. New information should be published and we invite you to provide updates to this manual or submit additional species accounts that are not covered here to further improve this reference manual.

Table 1 - Overview of species-specific band size, phenology, and recommended banding windows for adult and nestling birds.

Species	Band size	Incubation (days)[1]	Adult Banding	Nestling (days)[2]	Nestling banding[3]
American Kestrel	3B	26-32	Incubation or nestling period	28-31	Day 10-23
Black-capped Chickadee	0	12-13	Nestling period	12	Day 7-12
Boreal Owl	5-6 Lock-on	26-32	Incubation or nestling period	28-36	Week 2-3
Eastern Bluebird	1B-1	11-19	Later nestling period	16-22	Day 6-11
Great-crested Flycatcher	1A-1B	13-15	Later incubation or nestling period	13-15	Day 7-8
Hooded Merganser	5-5A-6[b]	26-41	Incubation period	Precocial	Day of hatch
House Wren	0-0A	9-16	Later incubation or nestling period	15-17	Day 7-9
Mountain Bluebird	1B-1A	13	Later nestling period	18-21	Day 6-11
Northern Saw-whet Owl	4-3A[b]	27-29	Incubation or nestling period	30	Day 21-15
Prothonotary Warbler	0	12-14	Later incubation or nestling period	10	Day 6-8
Purple Martin	1A, 1D, 2	15-18	Nestling period	28-29	Day 12-20
Tree Swallow	1	13-14	Later incubation or nestling period	18-22	Day 12
Western Bluebird	1B	12-17	Later nestling period	18-25	Day 6-11
Wood Duck	5A-6[a]	25-37	Incubation period	Precocial	Day of hatch

[1] Number of days that birds are incubating eggs
[2] Number of days from eggs hatching to fledging of young
[3] Nestling banding window: Days are counted starting with nestling day one being date of hatch
[a] Ducklings are banded with plasticine-filled bands or web tag
[b] Ensure they are the 4 short specifically made for NSWO

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APPENDIX A: COLLABORATIVE NEST MONITORING PROJECTS

- General nest monitoring projects
  - Bird Studies Canada Project Nestwatch - http://www.birdscanada.org/volunteer/pnw/
  - Cornell Lab of Ornithology Birdhouse Network/NestWatch - http://nestwatch.org
  - University of Montana BBird http://www.umt.edu/bbird

- Bluebird species
  - North American Bluebird Society - http://www.nabluebirdsociety.org
  - Ontario Eastern Bluebird Society - http://www.oebs.ca
  - Southern Interior Bluebird Trail Society - http://www.bcbluebirds.org/SIBTS/Welcome.html
  - North Carolina Bluebird Society - http://www.ncbluebird.org/html/ncbs_monitoring.html
  - Michigan Bluebird Society - http://www.michiganbluebirdsociety.org/monitoring-forms

- Purple Martin
  - The Purple Martin Conservation Association - http://purplemartin.org
  - BC Purple Martin Stewardship and Recovery Program - http://www.georgiabasin.ca/puma.htm
  - The Ontario Purple Martin Association - http://essexpurplemartins.ca/

- American Kestrel
  - The Peregrine Fund: American Kestrel Partnership - http://kestrel.peregrinefund.org
  - Hawk Watch International: American Kestrel CS Project - http://www.hawkwatch.org/news-and-events/latest-news/405-american-kestrel-citizen-science-project
  - Northern Michigan American Kestrel Nest box Program - http://landtrust.org/wordpress/wp-content/uploads/2013/02/infosheet.pdf

- Prothonotary Warbler
- MRPA Prothonotary Warbler Project - http://www.mpra.org/projects/WildlifeConservation/warbler/warbler.html

- Saw-whet Owl
  - Rocky Point Bird Observatory - http://rpbo.org/reports.php?pgm=nswo
  - Project Owlnet - http://www.projectowlnet.org/df.htm/

APPENDIX B: ADDITIONAL RESOURCES

- Monitoring, handling or banding nest box species:
  - NestWatch Code of Conduct -http://www.livingbird.org/bbimages/PDFs/CodeOfConduct.pdf
  - NestWatch control of House Sparrows and European Starlings – http://nestwatch.org/learn/all-about-birdhouses/managing-house-sparrows-and-european-starlings
  - Instruction for banding nestling Tree Swallows - http://www.treeswallowprojects.com/bandyng.html
  - How to monitor a bluebird route - http://www.prescottbluebird.com/manuals/MonitorMnl.Monitoring.pdf
  - Sialis nest box monitoring - http://www.sialis.org/monitoring.htm
  - Tree Swallow project instructions - http://www.treeswallowprojects.com/boxcheck.html

- Commercially available nest boxes and nest box traps:
  - Gilbertson nest-trap - http://www.gilbertsonnestbox.com
  - Van Ert traps - http://www.vanerttraps.com/products.htm
  - Sialis review of traps - http://www.sialis.org/traps.htm

- Instructions for construction and maintenance of nest boxes:
  - USGS Eastern Bluebird Box design - http://www.npwrc.usgs.gov/resource/birds/eastblue/enestbox.htm
  - Ontario Eastern Bluebird Society design page - http://oebs.ca/nestboxes/
  - Audubon American Kestrel nest box plan - http://ny.audubon.org/sites/default/files/documents/american_kestrelnest_plan.pdf
  - Cornell University multi-species nest box plans - http://nestwatch.org/learn/all-about-birdhouses/
  - Duck Unlimited Canada Nest box guide for Waterfowl – http://www.ab-conservation.com/go/tasks/sites/default/assets/File/pdfs/03Programs/01Wildlife/DU_NESTBOXGUIDE_forWEB.pdf
  - Fish and Wildlife Compensation Plan Saw-whet Owl nest box plans – http://www.fwcpcolumbia.ca/version2/forms/screech-owl/media/nest box-plans.pdf
  - Audubon Society nest box overview - http://audubon-omaha.org/bbbox/nestbox/nestbox.htm

- Example data sheets:
  - Ontario Eastern Bluebird Society nest box survey – http://oebs.ca/nestboxes/Ontario2011EasternBluebirdNestboxSurvey.pdf
  - Tree Swallow project data sheets - http://www.treeswallowprojects.com/sheets.html
  - NestWatch data sheets – http://nestwatch.org/learn/how-to-nestwatch/nest-check-data-sheet
  - Peck, G. K., M. K. Peck, & C. M. Francis. 2001. Ontario Nest Records Scheme Handbook. ONRS, Toronto, Ontario. http://www.birdsontario.org/download/ONRSHandbook.pdf

APPENDIX C: THE NORTH AMERICAN BANDING COUNCIL

The North American Banding Council (NABC) is a non-profit group encompassing bird research organizations whose members use bird banding as a tool in ornithological research, conservation, and management. The mission of the NABC is to promote sound and ethical bird-banding practices and techniques. To accomplish this, the NABC has developed educational and training materials, including manuals on general banding techniques as well as techniques manuals for specialized taxonomic groups accompanied by a three-level certification process (Assistant, Bander, and Trainer). Visit www.nabanding.net for more information.

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, The 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 nonvoting members of the NABC. The NABC was incorporated as a non-profit, California corporation in 1998.

APPENDIX D: BANDING OFFICES INFORMATION

Bird Banding Laboratory, 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: http://www.pwrc.usgs.gov/bbl

Canadian Banding Office, contact information

Bird Banding Office
Canadian Wildlife Service
Environment Canada
Ottawa, Ontario
K1A 0H3
General Information 613-998-0524
Fax: 613-998-0458
Internet Address: BBO_CWS@ec.gc.ca
Web page: http://www.ec.gc.ca/bbo/