



Canadian Council on Animal Care Conseil canadien de protection des animaux

The species-specific recommendations are intended to complement the CCAC *guidelines on: the care and use of wildlife* by providing information on 'best practices' for various species groups. These recommendations are to be viewed alongside the more general guidelines on wildlife. Additionally, investigators should consult species-appropriate literature and seek the advice of persons experienced with the particular species of interest. We expect the recommendations listed here to evolve as new information becomes available and encourage those working with wildlife to submit any relevant information they encounter to the CCAC. All information received will undergo peer review before being added to the species-specific recommendations.

CCAC species-specific recommendations on: Birds

These recommendations are intended to give animal care committees (ACCs) and investigators a brief overview of the issues that need to be considered in the preparation and review of protocols involving the use of wild birds. It is difficult to synthesize into one document all of the capture, handling and marking techniques, and other research methods for all bird species, as each species and situation presents particular considerations and cautions. It is recommended that the Ornithological Council *Guidelines to the Use of Wild Birds in Research* (Gaunt & Oring, 1999, available at www.nmnh.si.edu/BIRDNET/GuideToUse/index.html) also be consulted, as well as relevant experts and the appropriate literature for the species and techniques under consideration. It should be kept in mind that investigators should not perform techniques without adequate practical (hands-on) training that is specific to the techniques and species involved.

1. Killed Specimens

Where killed specimens are required, the birds should be: 1) collected using appropriate live capture methods (see Section 2. Live Capture), and then killed using an approved method (see Section 7. Euthanasia); or 2) shot by a competent individual using the appropriate firearm and birdshot for the species. In all cases, investigators must obtain the appropriate federal, provincial or territorial permits. Information on permits may be

obtained from the Canadian Wildlife Service for migratory birds, and from the appropriate provincial or territorial wildlife agency for birds under their jurisdiction.

2. Live Capture

It is imperative that those capturing birds are knowledgeable about the biology and behaviour of the species they are capturing, as well as the conditions under which the capture is to take place, and plan the captures and releases accordingly. For example, species that are flightless during moult should be captured and released in ways that do not affect the growth of their feathers or their survival during this vulnerable stage. As well, diurnal birds should not be released at night as they may have difficulty finding suitable roosts and may be vulnerable to nocturnal predators.

The North American Banding Council, whose objective is to promote sound and ethical banding practices, has issued a study guide for banders, as well as manuals for banding passerines and near passerines, raptors, hummingbirds, shorebirds and waterfowl (www.nabanding.net/nabanding/pubs.html), available through the Canadian Bird Banding Office. Bub (1991) also discusses capture methods and means of avoiding injury to the birds, and should be consulted for detailed information on capture techniques.

Live capture of any migratory bird requires a permit from Environment Canada's Canadian Wildlife Service. Capture of migratory birds for banding with metal or plastic bands requires a permit from the federal Bird Banding Office (www.cws-scf.ec.gc.ca/nwrc-cnrf). Applicants must provide a project description detailing capture and banding protocols, and demonstrate that they have adequate knowledge, training and experience with the trapping methods and species with which they propose to work. Banders are also expected to follow a code of ethics (*Bander's Code of Ethics*, available at www.nabanding.net/nabanding/ethics.html).

Scientific permits are also required for the live capture of migratory birds for scientific purposes other than banding, particularly for the attachment or insertion of markers or devices, or the collection of food or tissue samples, such as feathers, nails or blood. Application must be made to the appropriate regional office of the Canadian Wildlife Service, with a project description detailing capture and manipulation protocols, the need for the proposed activity, steps taken to reduce impacts on the birds, and confirmation that personnel involved have adequate knowledge, training and experience to undertake the project effectively. Capture of birds that fall under provincial jurisdiction, such as hawks, eagles, owls, crows, cormorants and most blackbirds, requires similar permits from the respective provincial/territorial wildlife or natural resource department.

The method of capture must be chosen to minimize the possibility of injury or death to captured individuals, and to cause a minimum amount of stress. There are many trapping methods for birds, including mist nets, dip nets, cannon nets, funnel traps, cage traps, drop nets, aerial clap nets and bow nets, and each has specific considerations that need to be taken into account to ensure the welfare of the birds. When planning the capture of wild birds, investigators must also consider factors such as the time of day,

time of year, weather conditions, number and condition of birds to be captured, number and training of personnel required, and the possibility of predation.

Where caged or tethered live bait is used, investigators must ensure that the lure animals are protected as much as possible from injury, and provided with food and water as necessary.

A plan for dealing with birds that are injured or killed during the trapping process must be in place prior to any trapping taking place. The plan should include specific endpoints, such as criteria for euthanasia, and how euthanasia will be performed. If avian rehabilitation facilities are available in the area, the plan should include establishing contact in advance of the trapping, and should detail the criteria for transfer of birds to these facilities. Subsequent use or disposal of carcasses should also be detailed, including procedures for properly bagging and labeling mortalities. All incidents of injury or mortality should be logged and reported according to the requirements of the trapping permit.

When selecting a method for trapping birds at nests, investigators should aim to cause minimal disturbance to the birds, their eggs and young, and the vegetation around the nest, to minimize the attraction of predators (Gratto-Trevor, 2004). Consideration should be given to minimizing the risk of nest abandonment and nestling abandonment of the nest, and ensuring any eggs remain viable. Mist nets, hand nets, nest traps and noose nets are all commonly used methods for trapping birds on or near nests. The use of these methods for shorebirds is outlined by Gratto-Trevor (2004).

Traps for nesting birds should be monitored at least every 20 minutes under favourable weather conditions, and birds should be removed, processed and released as soon as practical. Particular care should be taken when handling possible gravid females.

Bird trapping operations should be reassessed if the combined injury and mortality rate exceeds 0.5% (1 in 200), as recommended by McCracken, et al. (1999); however with some techniques (e.g., cannon nets), the casualty rate may be higher (i.e. 2-3%). All serious injuries and mortalities, and the circumstances surrounding them, should be recorded in a logbook. Serious injuries are those that could impair the bird's chance of survival, and include instances of hypothermia, hyperthermia, capture myopathy, fractures, dislocations, major feather loss, lacerations, concussions and wing strain.

The use of stupefying chemicals in bait for capturing birds is not recommended, and may only be used if alternative capture methods are unavailable (Caccamise & Stouffer, 1994). A permit is required for use of such agents. The person responsible for using and disposing of the agents should be identified, and a report should be made on the usage and disposal of the agent. The investigator must be properly trained and prepared to administer antidotes and care for anesthetized birds until they recover. Adequate personnel should be available to prevent accidental injury or death to the affected birds. In addition, investigators using chemically-treated baits must dispose of any dead birds and remaining baits by incineration or other methods that will prevent chemical residues from entering the food chain.

2.1 Nets

Mist Nets

Mist nets are most commonly used for live trapping passerines, but may also be used for capturing raptors, water birds and shorebirds (Keyes & Grue, 1982). The use of mist nets to capture migratory birds requires a federal (CWS) banding or scientific permit, and in some cases, a provincial/territorial permit. For mist netting species under provincial/territorial jurisdiction, provincial/territorial permit requirements should be consulted.

The mesh size of mist nets should be carefully chosen to maximize the efficiency in capturing the target species, and to minimize the stress and risk of injury to both target species and non-target birds which are likely to be captured by the nets. The mesh size of the net will affect its catching efficiency, and this will differ for each species.

Mist nets capture a wider variety of species than most traps, and as with cannon or rocket nets, they require more training, dexterity, skill and experience to use safely and effectively (McCracken et al., 1999). Personnel using mist nets must be adequately trained in the proper techniques for removing trapped birds in ways that minimize stress and injury to the birds.

Efforts should be made to extract birds from mist nets as soon as possible. They should be placed in appropriate holding devices (e.g., covered pens for shorebirds, and cloth bags or cages for temporary holding of other small birds) to avoid stress, over-heating and capture-related injuries, such as capture myopathy (Gratto-Trevor, 2004).

The maximum time for retaining birds in the net should be predetermined, based on such variables as species, type of trap, risk of predation and weather conditions. In general, if there are more birds captured than can be removed within 20-30 minutes, the net should be closed. If it is anticipated that the removed birds will be held for more than one hour, some birds should be released immediately to shorten the processing time for those retained.

Experience is important when determining the order in which to extract birds from the net. In general, birds that are dangling by a limb or at risk of drowning or strangling should be removed first. The Bird Banding Office guidelines for Species at Risk recommend extracting and processing Species at Risk as a priority. In general, long-legged species should be removed quickly, followed by larger birds, and then smaller ones. Other birds that may be removed as a priority include small, less robust species (e.g., kinglets and warblers), species that may tangle quickly or are susceptible to injury (e.g., White-throated Sparrows), and local breeders that need to return to their nest or young. Birds lower in the net should be removed before those higher up, as they may become more tangled (or even drown if the net is over water) when the upper part of the net is pulled down to remove birds trapped high in the net.

It is important to erect mist nets correctly and tend them regularly to minimize the possibility of injury or death to captured birds. The nets should be closed during periods of rain, snow or sleet, and at night, unless attempting to capture nocturnal species or shorebirds. If nets are left open at night, they should be checked as frequently as during

the day, and suitable headlamps should be worn to assist in extracting birds from the net.

Closed nets should be furled and securely tied to avoid inadvertent, partial re-opening in windy conditions, which may result in birds being caught incidentally.

Netting Over/In Water

Trapping birds in or over water, using baited dive traps, net gunning, heavy mist nets and other procedures, should be undertaken only if other techniques would not be effective, and adequately trained personnel are present to prevent losses due to drowning.

Dip nets, as well as submerged mist nets and monofilament floating gill nets, are sometimes used to capture birds from the water. Dip nets must be used carefully by trained personnel; the procedure involves closely approaching the birds by boat, extending the net under the water and quickly raising the net once the bird is positioned centrally over it.

Due to the high risk of drowning or injuring captured birds, proper training in the use of submerged mist nets or floating gill nets is essential. Proper site selection and maintenance and use of these nets will reduce the risk of casualties. Nets must be constantly monitored from shore or boat, used only on days with no wind, and placed in locations where trapped birds can easily be detected. Birds must be removed, processed and released as soon as practical. Monofilament floating gill nets are preferred to submerged mist nets as they will not absorb water (Breault, pers. comm.). As these nets pose high risks to birds, investigators must justify the selection of this technique, identify the person responsible for set up and monitoring, and identify their experience and training with the technique. Authorization on a banding permit is required in advance from the Bird Banding Office for operations deemed to be high risk, such as the use of submerged or floating nets.

Nets and Rocket Nets

Hand-held net guns, which fire weighted nets over flocks of birds by propulsive force, should only be used by highly trained and experienced personnel, to avoid injury to both birds and equipment operators. If the number of birds captured is very large relative to the number of people available to process them, nets should be propped up from underneath to allow birds to move freely, instead of being pinned down on the ground.

Use of heli-nets, nets fired from helicopters over flocks of birds such as moulting waterfowl, should follow the general rules for net gunning. In addition, special preparations are required for the use of heli-nets over water to reduce the risk of drowning: nets must be able to float or have floats attached to them, and boat crews must be present nearby to remove birds from nets as quickly as possible.

Cannon nets are used more frequently than rocket nets, which require special explosive flares that are difficult to obtain. Cannon nets propel heavy, cylindrical metal projectiles

by the explosion of a charge. These charges can be made by trained personnel using commercially available firing caps and ammunition powder, following the manufacturer's instructions. The use of cannon or rocket nets must be authorized by the Bird Banding Office and listed on banding permits, and personnel storing, using or transporting explosives must have appropriate training and facilities. Due to the high risk of injury, field operations must be conducted by people with training and experience. Required precautions include: ensuring that cannons do not point toward roads or houses; securing the area so that no one will be near or in front of nets; and securely fastening cannons to nets so they will not break loose upon firing. Allowance must be made for a large secure area, as projectiles can travel 1-2 km if the ropes break.

2.2 Traps

The use of traps should follow approved Standard Operating Procedures (SOPs), where available.

When choosing a trap to catch birds, the following features should be considered:

- the size of any mesh should be small enough to minimize the possibility of birds becoming entangled, and the mesh must be constructed from material that will not cut or abrade birds attempting to escape;
- there should be no sharp edges that might injure birds or investigators;
- trap openings should be positioned to allow the investigator to reach all parts of the trap and remove birds easily; and
- for units with trap doors, the trigger and door mechanism should operate smoothly, and the trigger or treadle should be far enough to the rear of the trap so that birds will not be hit by the closing door.

Baited traps, such as walk-in traps and large decoy enclosures, are used to capture ground-feeding and seed-eating birds, including dabbling ducks. Birds may remain in these traps for several hours, providing they are not subject to injury from other birds or from struggling to escape, they have sufficient food and water, the weather is favorable, and there is no risk of predation. Frequent checks should be made to ensure that these conditions continue to be met.

Some traps, such as the Bal-chatri trap, are baited with a live mouse, bird or beetle as a lure to attract raptors or shrikes (NABC, 2001a). These traps must be monitored constantly as the nooses or other devices intended to capture birds may injure captured birds that struggle to escape. Continuous checking will also reduce the level of stress of the lure animal by limiting the amount of time a predator remains close by.

Large permanent Heligoland funnel traps may be used at banding stations for some species. Although traditionally constructed of weld-wire, plastic netting is preferred as it is less likely to injure birds. Since the birds only enter the holding box when being driven by banding personnel, these traps do not have to be closely monitored if the doors are kept closed (NABC, 2001a). However, birds may get trapped in the holding box if the door is left open, and in this case, checks should be made every 30 minutes.

Herding flocks of flightless waterfowl into corral traps, by helicopter or personnel on foot, should be conducted slowly and with sufficient personnel to reduce stress and prevent birds from escaping into unsafe areas. Menu et al. (2001) provide an evaluation of this technique and recommend the following:

- Whenever possible, birds should be herded from the ground rather than by helicopter, to reduce the stress on the birds and minimize the risk of a bird flying into the helicopter blades while trying to escape. Personnel should be dropped by helicopter at a distance from the birds to drive them into the corral on foot.
- Large numbers (100-600) of flocking birds, such as snow geese, may be captured together, providing there are enough people to process the birds efficiently. Birds should be held for no more than 5 hours under good conditions, and for shorter periods if conditions are stressful (e.g., high temperatures, direct sun, rain, etc.). If conditions deteriorate, the birds should be released immediately.
- The capture site must be dry and clean to avoid the birds' plumage becoming water-logged or soiled by mud. Down-covered goslings are highly susceptible to plumage wetting when kept under the rain in corral traps.
- If young are captured with adults, they must be separated as soon as they enter the corral and kept separate until release, in order to avoid trampling by adults.
- When capturing moulting geese, it is preferable to retain all birds until the end of the processing period, and to release them together to avoid breaking up family groups. Young should be released first and pushed approximately 100m away, and adults then released in the direction of the young. Released birds, and especially the young ones, should be directed by banding personnel to avoid splitting the flock and family groups.

Additional concerns should be addressed when using traps such as bow-traps to capture ground-nesting birds. These may have a metal arch supporting a net that springs up over the bird on the nest. It is recommended that the trigger mechanism be released by the investigator rather than by the bird itself, to ensure the trap is released at the most appropriate time. If there is any risk that the eggs may be cracked or broken by the action of the trap or by the struggling of the bird, they should be replaced with identical dummy eggs and kept warm in an incubator during the trapping and holding of the adult bird, and replaced on the nest when the bird is released.

Birds that nest in cavities can be passively or actively captured in nest boxes. In passive trapping, a mechanism is triggered that closes off the entrance as the bird enters the box. Passive traps should be checked several times a day to avoid leaving a bird trapped in the box for more than a few hours. In active trapping, the investigator triggers a trap to capture a bird roosting or incubating a box. If the box has a side or front door, the investigator can block the entrance and slide a hand through the door to catch the bird inside. The bird must be quickly grasped and removed to avoid damage to the eggs by the bird struggling in the box. Alternatively, a dip net may be placed in front of the entrance, and the bird flushed from the nest into the net.

Injuries with birds trapped on nests are rare. However, birds trapped on nests should be captured as close as possible to the time of hatching in order to minimize nest desertion,

regardless of the trap type. Precautions should be taken to minimize the risks of attracting predators to the nesting sites.

3. Restraint

3.1 Physical Handling and Restraint

As birds must be able to expand and contract their chests when breathing, restraint must be applied in such a way to permit chest movement. Birds should not be restrained by overlapping the wings across the back or bringing them forward below the line of the body, as this may strain muscles or result in tissue damage (NABC, 2001a). Birds also must not be allowed to flap their wings while being held by hand as it can result in wing strain. Particular care should be taken when handling female birds during the breeding season, as they may be carrying delicate unlaidd eggs which, if broken, can lead to the bird's death.

Care should be taken to prevent any damage to feathers, as even minor feather damage can be debilitating and could make the birds more susceptible predation. The hands of those handling birds should be clean and free of all oils, lotions, etc. Mosquito repellent must not be used on the palms of those handling birds as it is corrosive and will damage feathers.

Small birds may be restrained in the hand by holding them in the appropriate grip. The bird-bander's grip involves placing the bird's back against the palm of the hand, with its head positioned between the bander's 1st and 2nd fingers, with those two fingers closed loosely around its neck, and the other fingers lightly holding the bird's body. This constrains movement of the wings and legs to prevent damage to these limbs, while providing easy access to the legs for banding. The photographer's grip involves holding the top of the bird's legs (as close to the body as possible) between the fore and middle fingers in a scissor-like grip, and pinching the bird's tarsi between the thumb and the fore and middle fingers (NABC, 2001b). This grip may be used for relatively robust birds, but is not suitable for those with short or delicate legs such as hummingbirds, flycatchers, nightjars, swifts, terns and kingfishers.

Shorebirds that are too large to be held in one hand should be held with two hands around the bird's body. When performing procedures on these larger birds, such as banding, they should be placed on the investigator's lap facing up with their head toward the investigator (Gratto-Trevor, 2004).

Ducks should generally be restrained by using two hands to hold both the wings firmly against their body, keeping the wings from flapping and causing injury. Ducks may also be held by grasping both wings with one hand, over the back close to the body. This technique is best used when first catching a duck or removing it from the capture or holding device.

Fully-feathered adult geese should be held firmly, with both hands and arms around the body of the bird. The wings of geese must be controlled, as flapping can cause injury to people working with them. Geese can be restrained by grasping the wings with one

hand over the back close to the body of the bird, if the handler is relatively strong. Alternatively, both wings of a goose can be grasped close to the body using two hands; the goose can then be turned upside down and grasped by the kneeling handler's legs and knees for purposes of sexing.

A cloth bag, sack or hood may be used to restrain birds for short periods of time, but care must be taken to avoid hypothermia, hyperthermia, or damage to the plumage or legs. Each bird should be held in a clean bag to minimize transmission of disease and ensure an adequate oxygen supply. Cloth bags are preferred to burlap, as they are easier to keep clean, and bags of tightly-woven or waterproof material such as plastic should never be used. Extreme care must be taken to ensure a bird cannot escape while wearing a hood.

3.2 Chemical Restraint and Anesthesia

It is essential to consult an expert in avian anesthesiology when considering the use of chemical restraint or anesthesia, particularly with regard to injectable agents. There are special considerations that limit the practical use of certain agents and equipment in the field, and some agents should never be used under field conditions. In many cases, it is preferable and more ethical to use specific rapid procedures without the use of anesthetics.

Birds are particularly prone to complications from anesthetics. They do not tolerate apnea or hypoxemia, and often require respiratory support during anesthesia.

Although administering anesthetics by injection may be appropriate for some species, in most cases anesthesia is best accomplished by using appropriate techniques to administer volatile agents such as sevoflurane or isoflurane.

In general, the principal investigator should be responsible for maintaining a log of drug use and for any security procedures in relation to controlled substances, as outlined in the federal *Food and Drug Act* and *Controlled Drugs and Substances Act* and applicable provincial or territorial Acts. Investigators should be aware of the potential for misuse of anesthetic agents, as well as liability issues for themselves and their employer or institution if standards for control of narcotic substances are not maintained. For more information, the Office of Controlled Substances, Health Canada should be contacted.

4. Marking

4.1 Tissue Marking

Feather imping and notching of feather vanes are acceptable marking techniques, provided such modifications do not impair normal flight. These markings, however, are only temporary, lasting only until the feather is moulted, and may not be visible on some birds (Neitfeld et al., 1996). Feather imping and notching may be of limited use in wild birds, which are not always seen again or are not seen clearly.

Painting or coloring feathers with aniline dyes or lacquers, or commercial hair bleaches and coloring dyes, are useful short-term marking techniques. A scientific permit from CWS is required for all capture and marking of federally-protected migratory birds. The Bird Banding Office coordinates the use of colour markers and tags at an international level to prevent project overlap, and must provide advance permission for any colours used on bands or other markers. Any material used must be nontoxic as it may be ingested through preening. Care must be taken to allow dye on feathers to dry completely before releasing birds, in order to avoid feather matting and consequent impairment of flight or loss of water-proofing. Behavioural changes due to marking feathers may be avoided or minimized by colouring only small areas in locations, such as the back of the head, which are not likely to be involved in intra-specific signaling.

The Bird Banding Office discourages the use of picric acid as a marker for health and safety reasons. There is a risk of explosion during use, particularly if the acid is old and has been stored in a sealed container, and is shaken before opening. Picric acid is also toxic to the skin and when inhaled. For more information, see <http://www.nmnh.si.edu/BIRDNET/GuideToUse/MARKING.HTM>.

4.2 Banding and Tagging

Federal scientific permits issued by CWS are required for all marking of federally-protected migratory birds. In addition, many provinces/territories have permit requirements for marking birds under their jurisdiction, particularly raptors.

As a general caution, no marker should impair walking or flight, be loose enough to become entangled in vegetation, or lead to chafing of the skin or erosion of feathers. Investigators should research, and be conversant with, species-specific marking techniques before undertaking any projects requiring individual identification of study animals. The North American Banding Council manuals should be consulted for information on techniques. These manuals are available through the Canadian Bird Banding Office.

When properly designed and applied, leg bands (metal and coloured plastic), wing and tail streamers, back tags, neck bands, web tags and nasal discs have been used successfully in numerous studies. Investigators should be aware, however, that in some instances and with certain species, these auxiliary markers may be potential hazards and may lead to changes in behaviour (e.g., they may interfere with feeding or reproduction, or increase the risk of predation). As several studies have demonstrated negative effects of neck collars on survival, it is important to assess the risks to birds before their use. Waterfowl that over-winter in northern latitudes are particularly at risk of ice build-up on markers such as neck collars.

Consideration should also be given to the implications of banding nestlings. For example, passerine nestlings should not be banded with white bands as they resemble fecal sacks, and may cause nestlings to be removed from the nest by the parents.

Injury and death may occur when birds attempt to dislodge or remove tags or markers. Patagial (wing) tags are not considered appropriate markers for shorebirds, as they have

been shown to increase mortality of these birds in several studies (Howe, 1980; Lank, 1979), although they may be suitable for other species.

Conspicuous collars and tags may make birds more susceptible to hunters and predators, and should be evaluated. Markers may also have subtle effects on the birds' behaviour (e.g., on flight abilities or body condition) that increase the risks to the birds (e.g., being alone or at the tail of a flock).

Nasal discs and saddles can have a high rate of loss, which can lead to lost data as well as the need to increase the number of birds marked. There is also a risk of these markers becoming entangled with submerged aquatic vegetation and fishing nets, resulting in the death of the birds. Ice accumulation on nasal discs is a problem for water birds, although special coatings may reduce the risk. Where these tags are used, they should be biodegradable and adhesive, and only used in situations where there is no risk of icing or entanglement in fishing nets.

Nape tags pierce the skin and can be quite visible. They are permitted by the Banding Office, providing there is sufficient justification for the need of this marking method. Investigators should consider alternative marking techniques where possible.

Investigators planning to use bandettes (usually applied to young birds of particular species) should provide justification for their use. The Bird Banding Office suggests alternatives such as web tags or plasticine bands. If used, bandettes should be reverse spiraled, to reduce the risk of injury from the tightening bands. These markers can constrict and damage the leg of a fully grown goose.

4.3 Radio Transmitters

Radiotelemetry is a well-developed method of tracking the movements of birds; however, investigators should be aware of the potential adverse effects on the survival and behaviour of birds. Study design should include a means of comparing behaviour and survival of birds with and without radios where this information is not known.

Investigators must use the smallest and lightest telemetry package suitable for the purposes of the study, and ensure that the package does not exceed 5% of the bird's body weight. The mass and weight of the transmitter and battery is a major consideration for use on birds, as aerodynamic balance is crucial for maintaining optimal flight.

Investigators must choose the method of radio attachment that is most suited to the species, the habitat and the objectives of the study, based on the available literature and/or consultation with experts. Where sufficient knowledge is not available on the species and conditions of the study, a pilot study should be conducted.

Radios can be attached in a variety of ways, such as: glued to the back or tail feathers; placed on the back with a harness; attached to a metal leg band (for large sea and shore birds, see Gratto-Trevor, 2004 for references on this method) or a neck collar; or implanted under the skin or in the abdominal cavity. These methods vary in terms of potential risks to the birds and their suitability to particular studies.

Harnesses for telemetric devices should fit tightly without chafing the skin or eroding the feathers. Wing harnesses are not well suited to most shorebirds due to their long migratory flights. It has also been suggested that the use of harnessed backpack transmitters on waterfowl can have a greater negative effect on nesting behavior than sutured backpacks or implanted transmitters (Rotella et al., 1993).

Transmitters glued to tail feathers should be small enough to minimize any interference with flight.

Investigators should avoid using transmitters equipped with an antenna that is bulbous at the tip, longer than 16cm and limp, as these may lead to entanglement and possibly death of the study individual (Dougill et al., 2000).

Where possible, there should be provision for the removal of transmitters at the end of the study. Biodegradable attachment methods can be used to enable the transmitter to fall off after a specific amount of time, corresponding to the battery life. The release should be rapid, as a loosely attached transmitter can negatively affect the movement of the bird and increase the risk of predation (Gaunt & Oring, 1999). Alternatively, the transmitter can be attached with a biodegradable glue or to feathers that will moult at the end of the study. Batteries that are not recoverable should be chosen for minimal environmental impact, consistent with the required battery life for the study.

5. Medical/Surgical Procedures

5.1 Blood and Tissue Sampling

Investigators must choose the most appropriate sampling site, based on the species and the quantity of sample required for the study. For smaller species in the field, most blood sampling is done from the brachial wing vein, the brachial vein or the feet. In species where the jugular vein is visible in the neck, particularly large species, blood samples can be taken from this vein because of the relative ease with which a sample can be obtained. Use of the jugular vein also reduces the risk of hematoma formation. Other sites that may be considered include the medial-metatarsal vein of the leg and the brachial vein of the wing.

Investigators should conform to the 1% blood volume rule (i.e. no more than 1% of the body weight should be removed).

When a small quantity of blood is needed, it is often taken from the ulnar or brachial vein, or vessels in the tibio-tarsi. Toe-nail clipping is also useful for small quantities, especially from chicks, as bleeding usually stops quickly or can be stopped with the application of a small quantity of cornstarch. However, interpretations of blood cell lines may be distorted when blood is taken from this site, and tests for viral DNA may show a false positive due to environmental contamination.

Tissue samples for biopsy should involve only the minimal amount required for the study.

Any unsealed wound, with the exception of a small puncture, should be sealed. Styptics should never be used on soft tissue.

5.2 Anesthetics

If handling time is longer than a few minutes, or if the procedure is complex, the use of anesthesia should be considered. However, investigators must ensure that any injected drugs do not affect the sample or study design (e.g., hormone sampling, especially cortisone stress series).

The timing of drug injections and implants must take into account the life cycle of the birds, so as not to affect critical periods, such as feather moult, migration and reproduction.

The manufacturer's information should be consulted for information on implant insertion. Drug implants should be subcutaneous and inserted under the pectoral, medial thigh or patagial skin, depending on the type of drug and volume to be administered. Drug implants should not be inserted under the skin of the flanks because of the proximity to the air sacs, nor should they be inserted on the back where the skin could be ruptured. If possible, implants should be removed as soon as the study goals have been achieved. Subcutaneous implants requiring small incisions that can be closed by a few sutures may be done by non-veterinarians that have been trained by a veterinarian, using sterile techniques.

5.3 Neck Ligatures and Emetics

The use of neck ligatures and emetics for collecting food samples should be used only if no alternative methods of obtaining the required information on diet in the field are available.

Ligatures should not interfere with normal blood circulation or tracheal function, nor result in unintentional food deprivation.

Emetics can cause death, either due to the toxic effects of the emetic or because of factors related to the resulting lower energy reserves (Carlisle & Holberton, 2006). Small birds (weighing less than 10g) are particularly at risk (Poulin & Lefebvre, 1995 in Carlisle & Holberton, 2006).

The risk of mortality from the use of emetics may be reduced by ensuring the appropriate amount of emetic is administered for the target species. Where information is lacking, pilot studies should be conducted to determine the appropriate dose by examining the effects of the emetic on the target species under the conditions of the study (e.g., time of day, time of year, etc.) (Carlisle & Holberton, 2006).

5.4 Laparotomies

Laparotomies are used to determine the stage of gonadal development or to determine the sex of some bird species when other means fail. A less invasive technique for sexing

birds, which should be used if possible, involves using DNA extracted from a tissue or blood sample (Fridolfsson & Ellegren, 1999). DNA sex identification techniques require verification of the primer used for each species via samples from known sex individuals. Feathers can also be used to obtain DNA, often with less risk to the bird and less logistical problems.

Laparotomies should be undertaken only by experienced personnel or under the supervision of a veterinarian. Laparotomies require the use of anesthetic. Xylocaine cream does not provide the necessary analgesia when used as the sole agent; however, general anesthesia will provide both analgesia and restraint. Water soluble lubricants are useful in clearing feathers away from the incision. The laparotomy wound should be sealed by sutures.

When a small puncture is made for a laparoscope, it may not be necessary to seal the wound; however, most laparoscopic procedures puncture an air sac, and it is therefore prudent to close all wounds to reduce postoperative complications.

6. Moving and Holding Birds

6.1 Transportation

The transportation of migratory birds requires a federal migratory bird transport permit.

All birds should be shipped as soon as possible after capture. When possible, diurnal species should be transported at night and nocturnal species during the day to minimize activity.

Birds should be isolated from humans and predators, kept away from windows and protected from direct sunlight. In general, they should be transported in separate cells; however, large or aggressive birds should always be transported in separate cells. Each bird should have sufficient space to assume normal postures and engage in comfort and maintenance activities. Space for flight is not recommended as birds may injure themselves.

The International Air Transport Association (IATA) *Live Animal Regulations* (<http://www.iata.org/ps/publications/9105.htm>) are a good source of information on container designs for various bird species. Floors and inside tops of shipping containers should, depending upon the species, be padded. Perches should ordinarily be provided for longer duration transport, particularly for raptors. The perches should have non-slip surfaces and be appropriately sized. Shipping containers should be kept dark and adequately ventilated. Food and water, appropriate for the species needs, must be provided in spill-proof containers so that the bird's plumage will not become soiled.

For short trips (e.g., 10 minutes or less), birds of the same size and of non-aggressive species can be transported together; however, there is the risk of disease and/or parasite transmission. If it is necessary to carry birds over short distances to holding pens (e.g., a nearby barn with suitable enclosures), geese can be transported in a covered truck that is adequately ventilated and lined with a thick layer of straw.

6.2 Short-term Housing

The information provided in this section should be supplemented with additional species-specific information obtained from the literature and/or from people experienced with the housing requirements of the species of interest, particularly if the birds are to be housed for a longer term. Birds may be kept for up to 24 hours on a bird banding permit, but if housed for a longer period, an additional federal permit is required.

Aggressive birds must not be mixed with other birds.

Birds must not be housed or held in direct view of predators as the resulting stress can be fatal. An enclosure design that allows the birds to “escape” the predator should be provided. Large outdoor aviaries should have a screened area, natural vegetation and/or sheltered area where the birds can avoid inclement weather, hot sun and predators. Measures must also be taken to keep predators from entering enclosures, particularly predators that can climb or dig, such as cats, rats, foxes, snakes and raccoons.

Small carrying boxes for transport or short-term holding of birds may be constructed of peg board (to provide ventilation) with fine wire mesh floors. Depending on the size of the boxes, they may be designed to contain 2 to 3 separate compartments. These boxes are especially useful for birds requiring temporary shelter during recovery (McCracken *et al.*, 1999).

Long legged shorebirds that need to remain standing while housed should be kept in tall boxes (Gratto-Trevor, 2004). Constructing these boxes with mesh tops, as opposed to solid tops, will encourage the birds to stand (Gratto-Trevor, 2004).

7. Euthanasia

CCAC guidelines on euthanasia (in prep.) should be consulted for general advice concerning euthanasia. Details of various methods are provided by the American Veterinary Medical Association (AVMA) *Guidelines on Euthanasia* (AVMA, 2007, www.avma.org/issues/animal_welfare/euthanasia.pdf), one of the key references on which the CCAC guidelines are based.

Cervical dislocation may be used on birds up to 2kg. This technique involves quickly stretching the neck to cause separation of the cervical vertebrae from the skull.

There has been considerable discussion about the use of thoracic compression for euthanasia for small birds. This method is rapid and maximizes carcass use for analytical/contaminant studies. However, the degree of stress associated with the procedure is unknown, and it should be used only where other methods are not acceptable for the scientific goals of the study, and with the approval of the local ACC. Thoracic compression must not be used for larger birds or diving species that can tolerate high blood levels of carbon dioxide and relative anoxia for longer periods of time than other species.

Overdoses of an anesthetic, either injected or gaseous, or administration of a specific euthanasia compound (barbiturates) are acceptable methods in the laboratory but may pose problems in the field, such as portability of equipment and the disposal of animals to prevent contaminated carcasses from entering the food chain.

8. Human Safety Considerations

Caution must be exercised to avoid injury from the bills of herons, bitterns, loons, grebes, etc. Herons, cormorants, loons, and especially swans, should be handled by two people for safety reasons. Safety glasses should also be worn when working with these species.

In general, talons of birds of prey can be dangerous, and those of great horned owls and eagles particularly so. While using leather gloves may provide some protection, they might be impractical under some circumstances. If so, predatory birds may be held by grabbing the legs, then holding the thighs, tail and wings firmly in the other hand. Additionally, appropriately sized hoods may be used to calm some birds of prey, but their use does not provide adequate protection from the bird's grasping reflex.

When working with hawks and owls, a hard hat, safety glasses and a thick jacket should be worn for protection. When entering nesting colonies, investigators should consider wearing headgear appropriate for protection from aggressive birds, as well as hearing protection where appropriate.

Investigators should avoid inhaling dust from bird bags or boxes. Allergic disorders such as "pigeon handlers lung", resulting from the chronic inhalation of feather dust in susceptible individuals, can lead to chronic obstructive pulmonary disorder (COPD). Various respiratory fungal diseases, along with various ornithoses, psittacosis, Pasteurella, Salmonella, and Cryptosporidiosis pose significant threats.

Field workers should receive tetanus vaccinations and be aware of other possible threats, such as tuberculosis, lyme disease, avian influenza and West Nile virus. To reduce the risk of spreading transmissible disease between birds and humans, especially in light of the threat of Avian Influenza, the federal Bird Banding Office, Canadian Cooperative Wildlife Health Centre (CCWHC) and Environment Canada (EC) recommend that banders and others handling wild birds wear gloves (<http://www.cws-scf.ec.gc.ca/nwrc-cnrf/default.asp?lang=en&n=85DA56D5#targ4>). In selecting gloves for this purpose, consideration should also be given to choosing a material that will allow the handler to sense the appropriate pressure to use in handling the birds.

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