Module 14 – Care and Use of Birds

The Objectives of this module are:

- To provide an introduction to the legal, ethical and safety issues for those working with captive migratory and non-migratory birds in research,
- To outline the steps needed to take prior to commencement of any field study involving wild birds. It represents the ***first step*** in investigator training, and must be complemented with specialized and practical training.

Introduction

The use of animals in research and teaching is acceptable only if contributing to the understanding of fundamental biological principles or development of knowledge expected to benefit humans, animals or the environment.

Researchers must be familiar with all CCAC guidelines and policies relevant to their studies including the three R's described below. Also, researchers must have any required Federal, Provincial and Territorial Permits (e.g., Canadian Wildlife Service "Species at Risk Permit", "Tissue Collection Permit", "Bird Banding Permit" etc. to name a few).

In planning a study several key points must be considered including:

- knowledge of the species to be studied,
- inclusion of a pilot study whenever necessary,
- use of least invasive practice possible,
- minimal disturbance to the animals and their habitat,
- maximize information obtained,
- know and minimize causes of stress (from weather, predators, type of restraint, disease)
- evaluation of capture and handling methods,
- evaluation of planned endpoints,
- knowledge of anatomy of birds and proper holds for different species,

- training in the correct sampling techniques if samples are to be collected,
- be familiar with the CCAC guidelines on “Care and Use of Wildlife”.

The Principles of the Three R’s in Wildlife Research

Replacement: Animals may be used only if the researcher’s best efforts to find a replacement by which to obtain the required information have failed. The *CCAC guidelines on: the care and use of wildlife* encourage formal reporting of results from wildlife studies and literature review prior to initiating a study to ensure that animals are not used unnecessarily. In the context of field studies to understand the ecology, ecophysiology, or behaviour of wildlife, replacement by a non-animal method, or even replacement of one species with a less sentient species will likely not be an option. Replacement of a rare or threatened species with a more common species is desirable in terms of conservation impacts; however, it will not affect the welfare implications of the work, as the replacement species is likely to be closely related and of a similar sentience. In addition, research involving endangered or threatened species may be necessary in support of the species conservation or the habitat.

Reduction: The fewest animals appropriate to provide valid information and statistical significance should be used. Good study design and an understanding of the life history of the focal species are the primary means of minimizing the number of animals required to demonstrate experimental outcomes in field studies, as in laboratory-based animal studies. Prior statistical evaluation of sample size is necessary, even when sources of variation can only be estimated roughly. Familiarity with the literature on similar studies regarding sample size and study design is equally important. Animal use can also be minimized by better sharing of data and publication of results in generally accessible formats. The *CCAC guidelines on: the care and use of wildlife* recommends that, if possible, studies should be designed so that specimens are used for multiple purposes/projects, or so that they can be combined with samples from additional field seasons to maximize the use of specimens. This also includes the collection of biological and genetic samples for archiving whenever possible, providing that this does not increase the concomitant level of pain and distress for the animal.

Refinement: The most humane, least invasive techniques must be used. The refinement of animal care and use guidelines is a continuous process. It should be noted that investigators

frequently adopt practices that are believed to improve animal welfare. These practices are often based on anecdotal evidence, largely unpublished, but passed on through informal training or informal discussions. The *CCAC guidelines on: the care and use of wildlife* recommend that investigators use opportunities to publish refinement techniques to improve welfare outcomes for study animals. Investigators are also encouraged to share their best practices with the CCAC so that these can be subject to peer-review and incorporated
into the species-specific recommendations as regular updates.

Categories of Invasiveness

Approval of an AUPP by the Animal Care Committee requires that researchers denote the category of invasiveness for their research on wildlife. Of the five categories given on the AUPP, a description of categories B, C and D, which are the most commonly used in wildlife research, are described below.

Category B. Experiments which cause little or no discomfort or stress. Possible examples include: observational studies in which there is some disturbance to the animals but not to the point that individuals habituate or otherwise modify their behaviour; census or other surveys which disturb animals but which do not involve capture or marking individuals; and short periods of food and/or water deprivation equivalent to periods of abstinence in nature.

Category C. Experiments which cause minor stress or pain of short duration. Possible examples include: capture, using methods with little or no potential to cause injury and marking of animals for immediate release; long-term observational studies on free ranging animals where the behaviour of individuals is altered by repeated contact; brief restraint for blood or tissue sampling; short periods of restraint beyond that for simple observation or examination, but consistent with minimal distress; short periods of food and/or water deprivation which exceed periods of abstinence in nature; and exposure to non-lethal levels of drugs or chemicals. Such procedures should not cause significant changes in the animal's appearance, in physiological parameters (such as respiratory or cardiac rate, or fecal or urinary output), in social responses or ability to survive. **Note**: During or after Category C studies, animals must not show self-mutilation, anorexia, dehydration, hyperactivity, increased recumbency or dormancy, increased

vocalization, aggressive-defensive behaviour, or demonstrate social withdrawal and self-isolation.

Category D. Experiments which cause moderate to severe distress or discomfort. Possible examples include: capture using methods that have the potential to cause injury (e.g. net gunning, etc.); maintenance of wild caught animals in captivity; translocation of wildlife to new habitats; major surgical procedures conducted under general anaesthesia, with subsequent recovery (e.g., implantation of internal telemetric devices; remote monitoring devices or hormonal pellets/capsules; prolonged (several hours or more) periods of physical restraint; induction of behavioural stresses such as maternal deprivation, aggression, predator-prey interactions; and procedures which cause severe, persistent or irreversible disruption of sensorimotor organization. Other examples in captive animals include: induction of anatomical and physiological abnormalities that will result in pain or distress; the exposure of an animal to noxious stimuli from which escape is impossible; and exposure to drugs or chemicals at levels that impair physiological systems. Procedures used in Category D studies should not cause prolonged or severe clinical distress as indicated by marked abnormalities in behavioural patterns or attitudes, the absence of grooming, dehydration, abnormal vocalization, prolonged anorexia, circulatory collapse, extreme lethargy or disinclination to move, and clinical signs of severe or advanced local or systemic infection, etc.

Permits and Permissions

The management of wildlife in Canada is shared by the federal and provincial / territorial governments, often in partnership with landowners and local people. This section reviews the most common permit requirements. All investigators working with wildlife must contact relevant provincial and/or territorial authorities for additional local permit requirements.

Federal permits are required by those working with birds protected by the *Migratory Birds Convention Act* (MBCA) and the *Species at Risk Act* (SARA). Additional federal permits may be required if work is to be conducted on federal lands, if birds or samples are to be transported, or if transmitters or drugs will be used.

Provincial/territorial permit requirements vary with province and territory, the species involved (i.e. the study subjects and any mammalian predators or lure species that are to be

trapped according to the protocol, and whether these are protected species) and the activity (i.e. killing, capture, holding, marking, transport, trade, and sometimes release of birds). Permits may also be needed to conduct research in provincial/territorial wildlife areas, refuges, game sanctuaries, ecological reserves, wilderness areas, parks, or other specially designated lands. Permits may also be required for active habitat manipulation or other activities on any provincial/territorial land. Many provinces and territories require permits for the use of firearms. Investigators must apply for the appropriate permits to all provinces and/or territories where work will be conducted. Both federal and provincial/territorial permits come with reporting requirements that must be fulfilled annually or upon termination of the protocol. All steps taken during the protocol should be carefully documented for clear and comprehensive end-of-activity reporting.

All Band Councils and other landowners must be contacted and asked permission to access private land. Formal applications may be required for access to First Nations land. If veterinary drugs are to be used in a research project, depending on whether they are currently marketed in Canada, a permit from the Veterinary Drug Directorate of Health Canada may also be required. For more information, please visit www.hc-sc.gc.ca/index_e.html. If samples or carcasses are to be collected under the protocol, lab biosafety permits (at the necessary biosafety level) should also be acquired. This mainly applies to labs within academic or research institutions; however, in the future government labs will likely be required to hold such permits as well.

The Canadian Wildlife Service (CWS) (www.cws-scf.ec.gc.ca/index_e.cfm), Environment Canada, is Canada's national wildlife agency and is responsible for the protection and management of migratory birds and nationally important wildlife habitat, federally listed species at risk, and control of international trade in endangered species. CWS issues the permits listed below. More information is available through the CWS website.

Scientific Permits: The *Migratory Birds Convention Act* was created to protect all migratory birds, their eggs and nests. Any work using migratory birds requires a scientific permit. Scientific permits to capture and band are required for all bird marking. Scientific collection permits are required for activities such as the collection of live and dead birds, blood or feather collection, clipping nails, egg collection and collection of nest materials.

Species at Risk Permit: The *Species at Risk Act* (SARA) was created to protect designated wildlife species found on federal lands and their critical habitat (i.e. the habitat necessary for the survival or recovery of a listed wildlife species) and identified as such in the recovery strategy or action plan for the species. A SARA permit may be required for those working on federally listed species in addition to the *Migratory Birds Convention Act* permits.

Access to Federal lands: Authorization to work in federal Migratory Bird Sanctuaries or National Wildlife Areas can be requested from the CWS Regional Office.

Hunting Permit: A hunting permit is required if firearms will be used.

CITES Permit: The *Convention on International Trade in Endangered Species* (CITES, www.cites.org) controls the international trade of selected species. All import, export, re-export and introduction of species covered by the Convention have to be authorized through a licensing system. The species covered by CITES are listed in the above web site according to the degree of protection assigned. Also, the CITES website lists the types of permits required, and provides application forms. Within Canada, the implementation and administration of CITES are shared among federal and provincial/territorial agencies, and therefore both should be consulted.

WAPPRIITA: *Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act* (WAPPRIITA) is the enabling legislation for CITES in Canada. WAPII PRIITA also provides the authority to protect Canadian ecosystems from the introduction of listed harmful invasive species by requiring permits, and makes it an offence to transport an animal/plant from one province/territory to another or export from a province/territory without the required provincial/territorial permits. CWS is responsible for federal permitting issues, but impacted provinces/territories must issue appropriate permits as well.

National Parks: The Parks Canada Agency is responsible for protecting and preserving heritage areas for present and future generations. Research and collection permits are required for any research within Canada's National Parks. Information and applications can be found on their website: www.pc.gc.ca.

Industry Canada: If the use of radio transmitters is planned, investigators must contact the regional office of Industry Canada to enquire about licences that may be required.

Capture

Federal and provincial/territorial permits may be required for capture of migratory birds. Permits must be in hand before capture begins.

The chosen method of live trapping birds must minimize the possibility of injury or death to captive individuals and cause a minimum amount of stress. Investigators need to consider the time of day, time of year (moult or breeding status of the birds), weather, number of birds to be captured, number and training of staff required, and the possibility of predation. They must be familiar with the biology and behaviour of the species they are capturing, and plan all captures and releases accordingly. For example, some species are flightless during moult and should be captured and released in a way that does not affect their survival during this vulnerable stage. Breeding birds (e.g., incubating females) must be released as soon as possible to avoid prolonged absence from the nest (<1 hour, depending on the species). Diurnal birds should never be released after nightfall as they may have difficulty finding a suitable roost for the night and be vulnerable to nocturnal predation.

In general, when deciding on a capture method, the following should be considered:

- mesh size of net or trap should be appropriate to the species targeted so that birds are not able to escape, become entangled or injured;
- traps should have no sharp edges that might injure birds or investigators;
- the opening of a trap should be positioned to allow the investigator to reach all parts of it to remove birds easily;
- for units with trap doors or moving parts, all mechanisms should be in good working order and be safe for trapped birds and investigators;
- techniques should avoid disturbance to vegetation, as flattening of vegetation may affect concealment and result in increased predation; and
- non-target species may be captured, and procedures to deal with them should be predetermined and followed should this occur.

Bird capture should be reassessed if the combined injury/mortality rate exceeds 0.5% (1 in 200); however, with some techniques (e.g., cannon nets), the casualty rate may be higher

(i.e. 2-3%). Before trapping begins, investigators must have management plans in place for birds injured or killed during capture. The plan should include information on endpoints when evaluating the animal, how endpoints will be applied, and the method of carcass disposal. The *CCAC guidelines on: laboratory animal procedures* should be consulted (www.ccac.ca/en/CCAC_Programs/Guidelines_Policies/GDLINES/Guidelis.htm).

If avian rehabilitation facilities are available in the area, they should be contacted in advance of the trapping, and the criteria for the transfer of birds to these facilities should be established. All serious injuries and mortalities, and the circumstances surrounding them, must be recorded. If deaths occur, subsequent use or disposal of carcasses must also be recorded. It should not be assumed that there is not underlying illness, even in seemingly straightforward capture mortalities. Sick birds may be more likely to injure themselves when captured, although they may seem outwardly healthy (it is common for prey species to mask illness when captured). Knowing the cause of death can help refine capture protocols and alert handlers to the presence of zoonotic diseases.

Mist nets may be used for capture of passerines, raptors, waterbirds and shorebirds. The use of mist nets requires a federal permit. When using mist nets the following should be noted:

- Rigorous training is required; extracting birds from mist nets is a skill that must be developed. Mist nests have the potential to capture a large number of birds in a short amount of time. Occasionally, a bird may become highly tangled, requiring an experienced extractor who knows how to handle these occurrences.
- The appropriate mesh size for the targeted species or species group should always be used. Inappropriate mesh size can lead to injury and reduced trapping efficiency.
- Experience is important when determining which birds to extract from the net first, and how to deal with accidental trapping (dragonflies, insects, bees, bats, etc.) and the potential for rabies, which is why extraction training is critical when using mist nets. Additional information on extraction is available at www.migrationresearch.org/mbo/extraction.html and www.fs.fed.us/psw/topics/wildlife/birdmon/landbird/body_grasp.pdf.
- Birds should be safely extracted from nets and placed in safe holding devices (e.g., pens for shorebirds, and cotton or paper bags for passerines) as soon as possible.

- If there are more birds captured than can be removed within 20-30 minutes, the net should be closed. If birds will be held for more than one hour, some birds should be released at the net to shorten the processing time for those retained.
- Mist nets should be closed during precipitation or high winds, and during the night unless attempting to capture nocturnal species or shorebirds. If nets are left open during the night, they should be checked as frequently as during the day, and suitable headlamps should be worn to extract birds from the net.
- When not in use, mist nets should be taken down or closed and securely tied.

Dip nets, submerged mist nets, and floating gill nets are used to capture birds in the water. The use of dip nets 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. Dip nets may be effective for capturing incubating waterfowl on nests, particularly during the last stages of incubation (e.g., < 1 week prior to egg hatching).

Floating mist-nets are regularly used to capture migratory waterfowl and occasionally passerines in submerged habitat.

Bal-chatri and **dho-ghaza** traps use live bait (usually rodents or small birds) as lures for raptors. These traps must be constantly monitored as the bal-chatri leg nooses have the potential to injure birds struggling to escape, and the time during which the lure animal is exposed to its predator should be minimized. Investigators must ensure that lure animals are protected from injury, and provided with food and water. Some investigators are now using either static or remote controlled moving specimens, rather than live lure animals.

Bow traps are typically used for ground-nesting birds; however, they may be used throughout the year on a variety of species. A metal arch supporting a net springs up over the bird. The mechanism should be triggered by the investigator rather than by the bird itself, and the trap should be watched continuously. The bird must be removed immediately to avoid injury. When used over a nest, eggs should be replaced with dummy eggs and kept warm by the investigator until being replaced in the nest after trapping is completed.

Net guns are used for capturing individual birds, and cannon and rocket nets are mainly used for flocks and shorebirds. These should be operated only by highly trained and experienced personnel to avoid injury to birds or field personnel.

Cannon and **rocket nets** use projectiles that are propelled by the explosion of a charge. These explosive charges can be made by trained personnel using commercially available firing caps and ammunition powder, following the manufacturer's instructions. The use of projectiles must be authorized on banding permits, and must be conducted only by trained people with experience.

Heli net scooping of swans and geese during moult should follow the general rules for net gunning. Herding flightless waterfowl into corral traps by helicopter or other means should be conducted slowly and with an adequate number of personnel to reduce stress and prevent birds from escaping into unsafe areas. Whenever possible, birds should be herded by personnel on the ground rather than by helicopter. This reduces the stress on the birds and minimizes the risk of non-moulting (i.e. still capable of flight) birds flying into the blades of the helicopter while trying to escape.

Heligoland or **J-traps** are generally permanent structures. Since the birds do not enter the holding box unless someone drives them in, these traps do not have to be closely monitored providing the cage door is kept open (i.e. the trap is not set). When the cage door is closed, checks should be made every 30 minutes, driving birds into the holding box and immediately removing them. When selecting a method to capture birds at nests, investigators should ensure minimal disturbance to the birds, their eggs, and the vegetation around the nest to avoid attracting predators. For endangered species, the importance of minimizing disturbance is critical as the stakes for them are very high. It is also important that the biology of the species is known to ensure there is minimal risk of nest desertion. Where little is known about the species, a pilot study should be conducted first. Mist nets, hand nets, nest traps and noose nets are all commonly used methods for trapping birds on or near nests. These traps should be monitored at least every 20 minutes under good conditions, and birds should be removed, processed and released as soon as practical. Nest traps should not be reset on the same nests immediately following an unsuccessful capture since this may result in the eggs being improperly incubated and increase the risk of nest abandonment.

Nest box traps contain a mechanism that is triggered to shut the box when the bird enters. Birds nesting in cavities can usually be captured in nest boxes. Alternatively, the investigator can capture a bird in the box by blocking the box entrance and sliding the other hand

through the door to quickly catch the bird inside. All birds trapped on nests, regardless of type of trap, must be captured as close as possible to egg hatching to minimize desertion of the nest by the female. Investigators must also endeavour to remove birds quickly and carefully to avoid damage to the eggs.

Restraint

Training in restraint from an experienced handler and practice in handling birds of multiple sizes is required to ensure that field personnel are confident and capable in appropriate methods of handling birds. Because birds must move their whole keel during respiration, a grip that is too tight 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 and ice cream cone grip) and their suitability to different species of birds to ensure the safety of both the bird and the handler. When handling birds with short legs (e.g., Swallow species, Belted Kingfisher, etc.), the bander's grip is preferable. Hummingbirds should be held in a body grip. Larger species may need to be restrained with gloves, towels and blankets, and where such protective measures are used, it is critical that the handler is properly trained so that the bird is not suffocated and the handler is adequately protected. Handlers must be prepared for the inevitable escape of the bird during handling and they should be aware that trying to restrain the individual to prevent escape may cause permanent damage to legs and wings.

If chemical restraint is to be used, this must done under the supervision of a licensed veterinarian, as chemical side effects may include hypothermia and other physiological changes which may or may not be known or anticipated. Excitatory stimulation, physiological depression and other adverse reactions to a drug may exacerbate stress in the bird. A more in-depth look at general and topical anaesthetics and analgesics is included below.

Health Evaluation

Once the bird is restrained, it is necessary to know if it is healthy before marking or conducting any other procedures. Bird care and condition is a consideration not only from an ethical point of view, but also from a research perspective: a compromised animal will not make a good study animal. During a health evaluation, the investigator should consider the following

aspects:

- **Respiration rate**: open-mouthed breathing is not always linked to the stress of capture
- and handling, but should be considered. If prolonged or noisy, this can indicate disease.
- **Gasping/Choking:** since bird crops store food, choking can occur via regurgitation of food or if a full crop presses on the trachea during handling. This may be especially prevalent when baited traps are used to capture birds.
- **Temperature of exposed body parts:** many seabirds breeding in cold environments are very well insulated. The stress of capture can cause an increase in body temperature and their primary means of dumping excess heat is via the feet. Excessively hot feet can therefore be an indication of an individual beginning to overheat.
- **Feather condition**: feathers should be intact, relatively parasite-free and waterproof.
- **Messy vent**: staining or clumping of vent feathers with droppings may be caused by diarrhoea or other illness, or may be due to injury and inability to void properly.
- **Pectoral muscle mass**: loss of pectoral muscle mass indicates emaciation which can indicate disease, injury or lack of fitness.
- **Cardiac function**: tachycardia (rapid heartbeat) or bradycardia (slow heart beat) may indicate underlying disease or toxic state. Although extremely difficult to evaluate in small birds (some passerines' heart rates are > than 400 bpm), it still may be valuable to assess in larger species.
- **Capture myopathy**: stress during capture can result in capture myopathy, which can be indicated by muscle tremors and a catatonic state. This can be reduced by effective trapping, reduced handling time, low light conditions, and ensuring ambient temperature does not exacerbate hyperthermia induced during capture. A hood or blindfold made of breathable materials, using a cover, or working in a box, depending on the species, may also minimize stress. If myopathy occurs, the bird will enter into a catatonic state. This may be remedied by keeping the bird in a quiet, warm environment. A veterinarian or licensed bird rehabilitation centre should be consulted. Severe capture myopathy is grounds for review of restraint techniques and euthanasia if necessary.

Bird Banding and Marking

Capture and banding of migratory birds requires a scientific permit issued by the Bird Banding Office (BBO) of the Canadian Wildlife Service. The BBO also tracks encounters and recoveries banded in Canada, and provides banding and recovery information upon request. In addition to application forms and testimonials, applicants must provide the BBO with a project description detailing capture and marking protocols and demonstrate that they have adequate training, knowledge and experience with capture, handling, identification, ageing, sexing and marking for species with which they propose to work. Application forms and more information are available online atwww.cws-scf.ec.gc.ca/nwrc-cnrf/default.asp?lang=En&n=B197CA34-0. All field personnel banding birds should be familiar with the appropriate North American Banding Council (NABC) guides. Those with extensive experience capturing, handling, banding, ageing and sexing birds may apply for a permit for specific groups of birds, or investigators may apply for species-specific 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. Anyone applying for a banding permit must have demonstrated competence with the following:

- capture and extraction;
- handling birds using a variety of grips;
- safely opening the mouth of a bird;
- correcting an improperly applied band;
- removing a band safely;
- identifying target species;
- determining the age and sex of species of interest using a variety of methods and appropriate ageing and sexing guides;
- taking accurate morphometric measurements and recording data clearly and accurately;
- understanding the ethics of banding and how banding fits into scientific studies; and
- knowing their own limits, including when to close nets and release unbanded birds if more birds are captured than can safely be processed in a reasonable amount of time.

The correct band size must be used or serious injury may result. Recommended band sizes for all species of North American birds can be found in the *Bird Banding Manual* (www.pwrc.usgs.gov/BBL/manual/manual.htm) and in periodic *Memoranda to Banders* issued by the Bird Banding Office. However, individual variation may require that field personnel use a leg gauge to ensure that an appropriately sized band is used. Also, investigators in marine environments may wish to use stainless steel (or Nickel alloy) as opposed to aluminum bands.

All field personnel banding birds should be familiar with the appropriate NABC guides. The NABC manages a voluntary bander certification program. Certification requires passing a written test and field evaluation of banding skills. Certification is available at three levels: assistant bander, bander and trainer. The *Bander's Code of Ethics* is available online at www.nabanding.net/nabanding/ethics.html. Manuals are available free of charge through the Bird Banding Office (www.nabanding.net/nabanding/pubs.html), which can provide further information and access to other training materials.

Marking is crucial for identifying individuals within a study protocol. This can be achieved in a number of ways, such as banding, micro-chipping, patagial tagging, colour-marking, etc. Each of these methods has its own considerations and longevity, which must be addressed in each protocol. Pilot studies are particularly important when marking techniques are being used for the first time on a species. Capture and marking of migratory birds requires a scientific permit issued by the Bird Banding Office of the Canadian Wildlife Service. Some markers may require regional, national or international coordination. Marking methods must be selected according to the biology of the species, and the purpose and time span of the study. In choosing an acceptable marking technique, the investigator must ensure that:

- the nature and duration of restraint is appropriate;
- a short amount of time is taken to mark the bird;
- the marker will not impede movement, hinder and/or irritate the bird (e.g., markers attached to diving birds will not increase chances of the bird being caught on submerged vegetation);
- the marker will not compromise the bird’s camouflage;
- the marker allows for seasonal changes and growth in juveniles;

- the marker does not impact reproductive success, social interactions, longevity, migration or vulnerability to predation;
- moult chronology is considered;
- the marking code (digits or colours) is readily visible and distinguishable, and persists until research objectives have been fulfilled;
- pain is minimized;
- the amount of tissue removed or damaged (if any) is negligible;
- the risk of infection is minimized;
- accurate records of the marking procedure are kept; and
- they are prepared to respond to concerns from the public in an informed and helpful manner.

Investigators should be aware of problems and new developments associated with the type of marking used, and are encouraged to publish results of studies showing the effectiveness of the marker type or design, including any negative impacts, so that this can be taken into account by other investigators.

In addition to the uniquely coded metal leg bands issued by the Bird Banding Office, auxiliary markers may be used for individual or cohort identification in the field without recapture. The use of such markers requires authorization on the banding permit. Certain colours, especially those similar to plumage or soft parts involved in social signalling, may affect mating attractiveness, dominance status, or aggression in some species, so knowledge of the study species is critical. Also, depending upon the duration of the study, it may be important to consider that some colours fade and may become unrecognizable. Ultra-violet (UV)-stable bands are available from several suppliers.

Examples of auxiliary markers include: lacquers, commercial hair bleaches, colouring dyes, coloured tape tags, patagial tags, plastic collars, nasal discs, web tags, nape tags, telemetry, etc. All material must be non-toxic as the bird may ingest it while preening. Dyes applied to birds' plumage are commonly used on colonial water birds and waders. Waterproof, felt-tip markers are useful for short-term markers, as are tattoo inks, wax cattle-marking sticks, and non-lead paint. Rhodamine B and Malachite Green are also frequently used.

Investigators must be very careful when applying dye, especially when contour feathers are extensively coloured. The colorant may act as a wetting agent, leading to loss of waterproofing. It is important to ensure that dyed birds are thoroughly dry prior to release. Dyed birds may be treated differently by conspecifics, and may experience an increased predation risk. These risks should be evaluated as they may influence not only the welfare of the subjects, but also the research results. Mass-marking of birds in roosting or nesting colonies using aerial and ground spraying with fluorescent markers has been done. However, recent evidence indicates that some birds have the capacity for UV vision, and may use fluorescent plumage for mate selection. Until this is further defined, mass marking of birds with fluorescent markers is not recommended. In addition, as with any spray application, the composition of the spray formulation should be examined for potential environmental concerns.

Plastic neck bands or collars, mainly used for marking geese species, are effective, although some negative effects have been documented. Nasal discs or saddles (numbered and/or coloured plastic discs or plates applied to each side of the bird's bill and fastened together through the nasal opening) are used for tagging waterfowl. Responses differ among species (diving versus dabbling, etc.), and investigators should systematically evaluate any possible negative effects. Where possible, and if identification is only required within a particular life-history stage, disks should be applied using degradable attachment materials so that they will not be retained during periods when researchers will not be observing the animals.

During the past three decades, the attachment of small transmitters to free-living birds has become a routine way of monitoring the location and movements of tagged individuals. Radio and satellite telemetry is becoming increasingly popular for remotely monitoring avian physiology, behaviour, habitat use, survival and movement. Transmitters should be as small as possible and must not exceed 5% (including the weight of the battery and any other tracking material being used) of the pre-feeding/fasted body mass of the animal. It is important not to overestimate the bird’s weight due to recent feeding, as birds can consume a large portion of their body weight at a time. Transmitters can be glued to the back of the bird, placed on the back with a harness over the legs, attached to a metal leg band, prong-and-sutured into the back (involves a small incision to attach a transmitter), implanted into the back (involves a subcutaneous or abdominal incision), glued onto tail feathers, or attached to neck bands.

Investigators must search the relevant literature to ensure that the method they propose is the most appropriate and can be safely applied to their study species. Radio transmitters can have significant adverse effects on survival, reproductive success, energetic and behaviour, so the use of transmitters should be undertaken with caution and only when the data cannot be obtained in any other way. Depending on existing information, it may be necessary to conduct a pilot study to test for behavioural effects. Assuming a transmitter of appropriate size is used, most negative effects are usually limited to the attachment method. Investigators should try to use external transmitters that break away within a pre-planned time period (e.g., with moult) or when remotely triggered by using biodegradable ties or specially-designed attachments that quickly and completely "self-remove". An exception would be the use of archival data loggers where units must be retrieved from returning birds to download data.

Medical and Surgical Procedures

Surgical interventions, including laparotomies, radio transmitter implants and other invasive procedures that expose the abdominal cavity or other deep tissues, should be done only by a veterinarian or under a veterinarian's close supervision. These should be planned in advance, with sterile techniques and emergency procedures in place. In order to use radio transmitters, a permit or license may be required from Industry Canada, depending on the frequency used. Industry Canada should be consulted for frequency allocations, legislation and permitting issues (www.ic.gc.ca).

A newer telemetry system referred to as harmonic radar and/or PIT tags, uses a microwave pulse detector on a tag that emits a VHF signal only when it detects a specific microwave pulse from a radar transmitter. These tags, each containing an individual digital code, are injected under the skin or glued to the back. They offer the advantage that, if the tagged bird can be induced to enter the field of a scanner, various data can be automatically recorded and assigned to specific individuals, thus eliminating the need for additional handling.

Federal, and in some cases provincial or territorial, scientific collection permits are required when collecting tissue samples for research. However, swabs can be authorized on banding permits. For any invasive tissue collection (e.g., biopsy), the protocol must employ measures to ensure pain is managed at the time of sampling and for a period after the procedure.

Collecting feather pulp samples or tail or body feathers samples is a relatively innocuous technique; however, pulling major flight feathers may require anaesthesia or analgesia.

Collecting swabs is a minimally invasive procedure, and samples may be collected from the cloacal, choanal, buccal, and oropharyngeal regions, resulting in very little discomfort to the bird. Cloacal swabs are collected by opening the cloaca and gently swabbing the inner surfaces. Choanal swabs are collected from the slit in the palette in the roof of the mouth. Buccal swabs are collected from inside the cheek and over the tongue. Tracheal/oropharyngeal swabs are collected from the mucosa in the tracheal region

Blood sampling. The best site for blood sampling depends on the species. Knowing the species and the impact sampling may have on the individual is crucial. The blood volume of birds ranges from 5 to 20 ml per 100 g. In most birds, up to 1% of body weight (e.g., 1.0 ml per 100 g bird) can be collected with few negative effects, and no more than 2% over a two-week period.

As with all procedures, all necessary equipment should be assembled and organized prior to handling the first bird. Investigators must ensure they have appropriately sized sterile blood-collecting equipment (e.g., correct gauge of needles) and containers for disposal of sharp and contaminated materials. The type of container the blood is collected in depends on the protocol (i.e. what is the sample being collected for?) and size of the bird. It is critical that the appropriate container be used, or the samples may go to waste. The investigator should also be aware of any idiosyncratic reactions of the samples. For example, corvid blood will hemolyze in CaEDTA, so heparin should be used if whole blood is needed. The bird must be comfortably and safely restrained. A light towel or loose-fitting hood can be placed over the head of the bird to reduce visual stimulation and reduce stress. The venipuncture site should be prepared by gently swabbing with an **extremely small amount of alcohol** (excessive amounts may result in the vein shutting down). Use of soaps or disinfectants (e.g., chlorhexidine) is discouraged due to the potential loss of waterproofing in the feathers.

There are several collection sites that can be used, depending on size and species. The jugular vein is a useful site for a venipuncture, since there is often a featherless area of skin overlying this vessel and the vein can clearly be seen through the skin. It is imperative that bleeding is stopped immediately after sample collection to avoid haematoma formation

(leakage of blood from the vein into surrounding tissues). Blood lost into a haematoma is also lost to the circulatory system, and it is possible for a small bird to die from losing too much blood this way. Applying gentle digital pressure (10-30 seconds) is essential to control the formation of haematomas. Holding the bird in an upright position (with its head higher than its heart) also aids in haemostasis.

The brachial or wing vein and medial-metatarsal vein are also useful venipuncture sites. For haemostasis, digital pressure is applied over the site of the needle puncture, taking care not to break the fragile bones (e.g., for small birds, the limb is pinched between thumb and forefinger over the site of the needle puncture). Blood stop powder (iron sulphate powder) or tissue glue may be used if absolutely necessary. Collection of blood by nail-clipping should be avoided since it is painful and can be associated with significant haemorrhages. It is therefore not an acceptable technique in modern avian medicine.

Collection of food samples. The use of neck ligatures on nestlings and emetics (chemicals that induce vomiting) for collecting food samples should be used only if no other methods of obtaining 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 are dangerous and can cause death if not properly administered. Small doses of some emetics (e.g., potassium antimony tartrate) can be toxic because they will not induce vomiting. An overdose is less dangerous than under dosing because it will cause vomiting and loss of the emetic. 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. Current research suggests that a technique using the over-the-counter drug ipecac (ipecacuanha) is considered a preferable non-toxic alternative. 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.). Adequate time to access certain veterinary drugs should be allowed, as some of these may require weeks or months to obtain via an Emergency Drug Release from the Veterinary Drug Directorate.

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 since it can also extract isotope information, involves using

DNA extracted from a tissue or blood sample. Feathers can also be used to obtain DNA, often with less risk to the bird and less logistical problems. However, if accurate sex determination is a priority for the protocol (e.g., in capture breeding and release programs), then a laparotomy is preferable. Laparotomies should be undertaken only by experienced personnel under the supervision of a veterinarian, and require general anaesthesia. When a small puncture is made for a laparoscope, it may not be necessary to seal the wound with methods including tissue glue. However, it is prudent to close all wounds to reduce postoperative complications.

Anaesthesia. Research protocols involving invasive procedures must address the issues of anaesthetic technique, the possibility of pain and its management, and the long-term impact sampling may have on the individual. Anaesthesia, the induction of a loss of sensation either locally or generally (unconsciousness), may be induced by several means and must be thoroughly explained in the research protocol. In wildlife studies, most drugs will be used 'off label' (any pharmaceutical that is used in a species that the company has not sought approval for is considered to be used 'off-label') and species tolerances and differences in reaction may not be widely understood. Local anaesthetics are fast-acting but not very useful for birds, unless used with extreme caution. Overdosing is a potential problem, with possible toxicity if given intravenously. Topical anaesthetics can destroy waterproofing and damage feathers, and there is the potential for toxicity if preened or licked. General anaesthesia with inhaled or injected anaesthetic agents induces unconsciousness in birds. Analgesia, a temporary relief of pain without unconsciousness, should be used in conjunction with, or following, anaesthesia if a procedure inflicts post-operative pain. Further information is available at: www.iwrc-online.org and www.cvmbs.colostate. edu/ivapm. The International Wildlife Rehabilitation Council (IWRC) offers an on-line training course on pain in wildlife, and the International Veterinary Academy of Pain Management offers annual meetings and information relating to pain in animals. Anyone performing wildlife anaesthesia and immobilization is encouraged to take a course offered by the Canadian Association of Zoo and Wildlife Veterinarians (www.cazwv.org/workshops.htm).

Short-Term Housing

If holding is necessary to the protocol, investigators are responsible for ensuring all species-specific needs are addressed. Holding cages should be protected from direct sunlight, wind and precipitation, and be kept at a temperature appropriate for the species. Birds should also be held at a density appropriate for the species (see Chapter VI and Appendix I of the *CCAC Guide to the Care and Use of Experimental Animals*, volume 1). Conspecific housing is always preferable to having multiple species/ages in the same cage. All housing should be well ventilated, easy to clean, adequately lit, and safe for the bird in terms of eliminating risks of predation and disease transmission. Care should be taken to minimize psychological stress by shielding cages from excessive light, noise, predators and human activities. Food must be appropriate for the species, and each bird should be observed eating. Aside from observation, weight checks and the presence of fecal matter are ways to monitor food intake. Clean water must be available at all times. Temperature and light must be maintained appropriately depending on the protocol and the study objectives.

For long-term housing, see the *CCAC Guide to the Care and Use of Experimental Animals*, volume 1, as this topic exceeds the scope of this introductory module.

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. 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 (i.e. 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), waterfowl can be transported in a covered truck that is adequately ventilated and lined with a thick layer of straw. While targeted at shipping of domestic farm animals, investigators are also referred to the Canadian Food Inspection Agency (CFIA) and National Farm Animal Care Council guidelines for humane transport (www.inspection.gc.ca/english/anima/heasan/transport/indexe.shtml and www.nfacc.ca/code.aspx).

Release

Once a researcher has collected all required information from a bird, it should be released. However, release criteria must be laid out in the research protocol. Examples of questions to be considered:

- Is this an appropriate bird for release or should it be rehabilitated or euthanized? This depends on whether the bird can survive on its own.
- Is the bird at an appropriate weight, is the pectoral muscle mass normal, and has its diet mirrored that of its species in the wild? Dietary changes with the annual cycle must be taken into consideration to ensure the optimal use of available nutrients and the body’s ability to utilize them.
- For younger animals, is their release timed to mirror the period of independence from parental care and are they prepared for it?
- Are they waterproof? Any problems with housing or diet can be reflected in poor feathering and waterproofing loss.
- Do the birds require a period of acclimation or reconditioning to prepare them for release? Were the birds housed in such a way that natural day length patterns were not maintained?

Other criteria to be evaluated:

- Weather considerations must play a role in the timing of release. Release should not occur if extreme weather patterns are forecast for several days.
- Release sites should be selected to minimize the risk of predation. Avoiding high populations of domestic cats and ensuring adequate cover from natural predators is strongly recommended.
- The carrying capacity of the site should be examined: is the site over-burdened with either wild or domestic species?
- Where possible, birds should be released near capture sites, particularly when dealing with nesting birds.
- Where possible, known pairs that are captured together should be released together (usually female first and male to follow immediately after).
- Environmental impact of the release should be assessed, e.g., a predatory bird being released in an area where endangered species live.
- In game species, has the animal received any drugs that would make it unsuitable for human consumption?
- Release should not proceed any later in fall than the usual migration period so that survival ability is optimized. Otherwise, it may be a consideration to hold the bird in captivity over winter and release the following spring.
- Release of nocturnal species (particularly storm-petrels and small owls) should be scheduled for late evening at dusk to reduce the probability of predation and/or mobbing by other avian species.

Euthanasia

The investigator must be prepared to euthanize any animal in the field that is suffering unrelievable pain and/or distress as a result of capture or handling procedures, or experimental intervention. The primary purpose of euthanasia is to terminate suffering, so speed is important. An animal that is already dying from severe trauma (e.g., from gunshot) should be terminated by the quickest available method compatible with preserving the desired portions of the specimen. All information on endpoints, including appropriate methods of euthanasia and training of animal users, must be approved by the ACC. Human psychological responses to

euthanasia should be taken into consideration when selecting the method of euthanasia, but **should not** take precedence over animal welfare considerations.

The knowledge and skill of the person applying the method of euthanasia is critical in ensuring that an animal's death is humane. The safety of the operator should be given equal consideration. The technique adopted will be considerably influenced by the planned use of the body (i.e. as a museum specimen, for tissue chemistry or disposal). See *CCAC guidelines on: the care and use of wildlife* for information on euthanasia. Consultation with a veterinarian experienced in working with birds is useful in order to select the most appropriate method for use in the field.

Regardless of whether the procedure is applied to an individual bird or to a group, it must always attempt to meet the following criteria, adapted from *CCAC guidelines on: laboratory animal procedures – adopted guidance on euthanasia* and the Ornithological Council's *Guidelines to the Use of Wild Birds in Research* (www.nmnh.si.edu/BIRDNET/GuideToUse/Guidelines_2d_edition.pdf):

- death without signs of panic, pain or distress;
- rapid loss of consciousness, with interruption of consciousness and reflexes at the same time;
- compatible with requirements and the purpose of the study, i.e. no tissue changes that might affect post-mortem diagnosis;
- reliable, consistent, reproducible and predictable;
- easily and safely administered by properly trained personnel, and not subject to abuse by humans;
- uses simple equipment that is relatively maintenance free and available;
- minimal environmental or ecological impact;
- performed at a location away from other animals, as it is often difficult to recognize evidence of stress when animals are euthanized in the presence of other animals since they can communicate through various types of signals;
- safe for the handler and personnel involved in carcass disposal; and
- inflicts minimal physiological and psychological stress on the investigator and potential onlookers.

Plans for **euthanasia in the field** must include contingency for euthanasia in case it is required. Information on techniques appropriate for the species should be researched, and necessary materials and equipment should be prepared in advance. Many recommended means of euthanasia for captive animals are not feasible in the field, but the challenges presented by field conditions do not lessen the ethical obligation to reduce pain and distress during euthanasia.

Humane euthanasia methods render the animal insensitive to pain, then cause cardiac and respiratory arrest. For this reason, pharmaceutical methods are often advised, but the use of pharmaceutical agents requires proper disposal of the contaminated carcass. Any animal euthanized in the field that may contain residues of toxic chemicals (euthanasia agents or immobilizing drugs) should be carefully disposed of, as they may enter into the food chain with potentially severe consequences. Acceptable disposal methods include incineration or liming the carcass, followed by burying it in a hole deep enough to discourage scavengers. Prior to disposal of carcasses in the field, investigators should determine the suitability of euthanized animals for preparation and use as study or teaching specimens with accompanying relevant information.

Physical Methods: These techniques, when properly applied, kill rapidly and cause minimal stress. They may offer a practical solution for field euthanasia of various sized birds and prevent pharmaceuticals from entering the food chain.

Blunt force: This method can be used on most birds and may be particularly useful for larger birds. This method requires securely holding the bird in an ice-cream cone grip, then rapidly and firmly bringing the head down on a hard surface (e.g., a rock). This method is effective in rendering the bird unconscious and/or dead. To ensure death, cervical dislocation should immediately follow the blunt force trauma.

Cervical Dislocation: This method is generally used for birds under 1 kg. This technique involves quickly stretching the neck, severing the spine. The neck should never be twisted, but pulled in a straight line away from the body. This technique is easily learned and can be used on birds as large as pheasants or small geese.

Decapitation: This technique is only acceptable for very small species.

Gunshot: While a shot to the brain produces a quick and humane death, it should only be

attempted when the animal is restrained (NOT by a human being) or as a last ditch effort for a free-ranging or escaped bird. Under the latter conditions, a successful shot to the brain may be difficult. Therefore, a shot to the heart and lung area may be more appropriate. This must be performed by skilled personnel with a firearms permit.

Pharmaceutical Methods: Investigators performing chemical euthanasia are encouraged to take a course offered by the Canadian Association of Zoo and Wildlife Veterinarians (www.cazwv.org/workshops.htm).

Injected pharmaceuticals: These agents should be administered intravenously at the correct dosage, with added sedation as needed to decrease fear and distress. Pre-anaesthetics (Ketamine, Xylazine and others) can be given by intramuscular injection to birds to facilitate euthanasia by another method. These drugs should not be used as sole euthanasia agents. There are potentially fatal toxic effects to scavenging animals consuming carcasses, so appropriate disposal of the carcass is required.

Inhaled gases: These are useful agents for euthanasia of small species when intravenous injection is difficult, but euthanasia with inhaled gases is slow because the inhaled gas must reach a certain concentration in the lungs to take effect. A closed chamber to hold the gas is needed, and personnel safety must be considered. Care should be taken when using euthanasia chambers because overcrowding or mixing of species can cause severe apprehension and psychological stress. The liquid state of most inhalant anaesthetics is irritating, so animals should only be exposed to vapours. Volatile anaesthetics are unsuitable for birds that have the ability to hold their breath for long periods of time (e.g., diving or burrowing species). Examples of inhaled gases include carbon monoxide, carbon dioxide and various anaesthetics.

Human Safety

Physical Risks: Many birds are capable of inflicting severe and even fatal injuries to the most experienced of handlers. It is therefore necessary to ensure adequate training for all researchers. Training should include the types of dangers posed by the species that will be handled and the way protective equipment must be used. For example, leather gloves are appropriate when handling larger raptor species such as the larger owls, hawks and eagles. Protective eye wear is appropriate for such species as the heron family, loons, grebes and

cormorants. Their beaks are capable of creating severe wounds; however, it is their potential for causing eye and facial damage that is most dangerous. Knowing the differences between groups of birds is key: in the case of large raptorial birds, the talons must be controlled first, then the head; whereas with herons, loons, grebes and cormorants, the beak must be controlled immediately. Swans are another species capable of inflicting many injuries.

All species capable of inflicting injury should be managed by two handlers, particularly if the features capable of inflicting injury cannot be easily controlled (e.g., beaks, long necks, and strong wings). Physical risks are not confined to the handler. Care must be taken to ensure the bird is not injured while handlers try to control it. Depending on the species, covering the head and reducing the bird's vision can have a calming effect. Birds defending their nests during nest checks may pose a risk to the research team. Use of protective head gear and thick jackets during nest checks must provide the necessary protection for researchers but not cause injury to the defending bird. In some cases, protective earwear may also be necessary. Where hearing is restricted, the research team should have pre-arranged communication signals to ensure safety.

Many birds and insects live in close proximity. When necessary (for example, in seasons when West Nile virus is active), field personnel should use either protective clothing or repellent applications to reduce the risk of bites. However, repellents should not be used if researchers are directly handling birds.

Chemical risks: Care must be taken to ensure safe handling and storage practices for all chemicals.

Any pharmaceuticals must be kept in appropriate containers and handled only after training and legal requirements are met. Spills must be avoided at all times. All chemicals, especially drugs, should be carried in crush-proof, leak-proof containers, and stored with absorbent material. Drugs should always be cushioned. The protocol should outline emergency procedures in case of spills, and these must be understood by all field personnel. Hazards exist not only to the research personnel, but also to the wildlife involved and the local environment. All safety data sheets must be read and carried for reference when handling any hazardous material.

Zoonoses: Infections that can be transmitted from animals to humans are referred to as zoonoses. For most people, avian diseases do not pose a serious threat; however, those working

with birds should be aware of this possibility and seek medical assistance if necessary. A variety of diseases are transmittable from birds to humans, including chlamydiosis, salmonellosis, tuberculosis and colibacillosis. Emergent diseases such as avian influenza must also be kept in mind. Investigators should be aware of any zoonotic potential in their region. It is important for all investigators to have current tetanus vaccinations and to consider rabies pre-exposure vaccinations should their field work involve potential contact with high risk mammals (e.g., bats, skunks, raccoons, foxes and domestic animals). Any illness that cannot be readily explained, especially those which appear unusual or persistent, should be followed up with medical attention, and the health care provider should be informed of any recent animal contact. 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.

Biosecurity: Investigators should familiarize themselves with the known biohazards specific to the study species. Where there is a potential for zoonotic transmission, the investigator 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, medical interventions and safety procedures. Protective clothing must be provided and disposed of appropriately to minimize spread of disease or contamination. The use of footbaths may be recommended, especially in a captive facility.

If unusual numbers of dead or sick wildlife are observed, this should be reported to appropriate authorities (i.e. provincial/territorial wildlife offices, Environment Canada/Canadian Wildlife Service offices, Canadian Cooperative Wildlife Health Centre). Within Environment Canada, there is a Significant Event Notification form and procedure, and Incident Reporting Forms available through the Canadian Cooperative Wildlife Health Centre (CCWHC) website (http://wildlife1.usask.ca/). In the case of an outbreak of a known wildlife disease (especially a zoonotic disease or a notifiable disease for domestic animals), routine bird handling procedures should be suspended unless they are specifically part of a disease investigation or carcass clean-up.

In the interest of human health and safety, it is important that all wildlife that die from unknown causes in the field or in holding facilities undergo a post-mortem examination by the Canadian Cooperative Wildlife Health Centre to determine the cause of death. Results will be

reported to the submitter and will be entered into the national database for wildlife disease (important for surveillance for diseases such as West Nile Virus and Avian Influenza). Depending on the post-mortem results, it may be necessary to obtain medical assistance to protect personnel from diseases and parasites.

Weather: Local weather reports must be followed daily, and precautions must be taken in case of potential extreme weather events, including appropriate clothing and equipment to meet any potential hazard. These must be in working condition and appropriate for the region. It is recommended that the location of staff in the field be known at all times, and that all movement plans are recorded with the field camp at the start of each day (if applicable). An emergency plan should be in place to cover any potential weather-related contingencies, which may include ice, hail, flash flooding, tornadoes, micro-burst storms, thunderstorms, forest fires or wildfires, extremes of cold or heat, and high winds. The investigator must ensure that every member of the research team understands that human life is a top priority.

Equipment: Investigators should ensure that they are familiar and comfortable with their equipment, as this reduces the likelihood of injury. Knowing what hazards are possible when working in the field is a must. For example, mist-netting over water or cannon netting flocks of shorebirds near water may represent a human drowning hazard should entanglement occur. Knives and firearms should always be properly stored and well-maintained to prevent injury.