Live Animal Capture and Handling Guidelines for Wild Mammals, Birds, Amphibians & Reptiles

Standards for Components of British Columbia's Biodiversity No.3

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Ministry of Environment, Lands and Parks
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Resources Inventory Committee

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Preface

This manual presents standard methods for Live Animal Capture and Handling Guidelines for Wild Mammals, Birds, Amphibians and Reptiles in British Columbia. The manual was compiled by the Elements Working Group of the Terrestrial Ecosystems Task Force, under the auspices of the Resources Inventory Committee (RIC). The objectives of the working group are to develop inventory methods that will lead to the collection of comparable, defensible, and useful inventory and monitoring data for the species component of biodiversity.

This manual is one of the Standards for Components of British Columbia's Biodiversity (CBCB) series which present standard protocols designed specifically for groups of species with similar inventory requirements. The series includes an introductory manual (*Species Inventory Fundamentals No. 1*) which describes the history and objectives of RIC, and outlines the general process of conducting a species inventory according to RIC standards, including selection of inventory intensity, sampling design, sampling techniques, and statistical analysis. The *Species Inventory Fundamentals* manual provides important background information and should be thoroughly reviewed before commencing with a RIC species inventory. RIC standards are also available for vertebrate taxonomy (No. 2), animal capture and handling (No. 3 - this manual), and radio-telemetry (No. 5). Field personnel should be thoroughly familiar with these standards before engaging in field inventories which involve any of these activities.

Standard data forms are required for all RIC wildlife inventory. Survey-specific data forms accompany most manuals while general wildlife inventory forms are available in the Species Inventory Fundamentals No. 1 [Forms] (previously referred to as the Dataform Appendix). This is important to ensure compatibility with provincial data systems, as all information must eventually be included in the Species Inventory Datasystem (SPI). For more information about SPI and data forms, visit the Species Inventory Homepage at:
http://www.env.gov.bc.ca/wld/spi/ric_manuals/

It is recognized that development of standard methods is necessarily an ongoing process. The CBCB manuals are expected to evolve and improve very quickly over their initial years of use. Field testing is a vital component of this process and feedback is essential. Comments and suggestions can be forwarded to the Elements Working Group by contacting:

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The Resources Inventory Committee consists of representatives from various ministries and agencies of the Canadian and the British Columbia governments as well as from First Nations peoples. RIC objectives are to develop a common set of standards and procedures for the provincial resources inventories, as recommended by the Forest Resources Commission in its report “The Future of our Forests”.For further information about the Resources Inventory Committee and its various Task Forces, please contact:

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Terrestrial Ecosystems Task Force

All decisions regarding protocols and standards are the responsibility of the Resources Inventory Committee. Background information and protocols presented in this document are based on Version 1.1 of this manual and the unpublished government report, *Live Animal Handling Guidelines for Mammals, Birds, and Amphibians and Reptiles*, prepared for the Resources Inventory Committee by Helen Schwantje, with helpful suggestions and reviews by Malcolm McAdie and Patrick Gregory.

This manual was edited to its present form by Malcolm McAdie, Leah Westereng and James Quayle.

1. Introduction

The inventory and/or management of free-living wild mammals, birds, reptiles and amphibians may require their capture and handling for the application of marking or telemetry devices, the collection of genetic material, the identification of specific characteristics as well as for other purposes. The following Guidelines present a standardized approach to the justification and ethical considerations research and operational wildlife workers should consider when planning and performing the capture and handling of any wild animal. It is to be considered as a dynamic document as procedures and techniques change and improve.

1.1 Treatment of Wild Animals in Research

The humane treatment of all wild vertebrates in the field is essential for scientific as well as ethical reasons. Animals that are traumatized from the actions of researchers are less likely to exhibit normal behavioural, physiological and ecological responses than untraumatized animals. In addition, they are less likely to survive due to an increased susceptibility to predation and subsequent injury. The disturbance of animals or microhabitats may compromise research data by altering observations and animal survival. It is important that animals that are captured and marked are returned to the wild without injury to resume normal activities, and that habitats essential for these activities are not damaged during the course of research activities.

1.2 Ethical Considerations when Using Wild Animals in Research

When handling wild animals for scientific purposes, researchers should maintain the highest standards in their work and conduct their activities in accordance with a basic Code of Ethics.

Researchers or investigators should:

1. Be familiar with the current literature and seek the advice of experienced peers before initiating a research project.

2. Uphold all regulations pertaining to the species with which they are working.

3. Ensure the safety and welfare of the animals they study and handle, and treat all study animals with care and respect.

4. Avoid or minimize distress and pain and reduce risks of injury or death to the study animal(s)

5. If they occur, promptly treat all injuries to research animals in the most appropriate and humane manner.

6. Reassess experimental methodology whenever an injury or mortality occurs.

7. Maximize the research potential of animals which are handled or sampled during the course of a study.

8. Use the smallest number of study animals necessary to satisfy the goals of the investigation.

9. Assess the impact of their research on study populations and the environment, and minimize such impacts.

10. Continually assess their methodology to ensure it is consistent with sound research design.

11. Receive constructive criticism from colleagues and be willing to offer honest and constructive assessment of the work of others. This includes providing feedback of any instances of mistreatment of animals.

12. Ensure that data generated from their work is accurate and complete.

13. Publish any innovations in capture, handling or research techniques.

14. Train and supervise all research assistants to follow the same ethics and standards as the primary investigator.

1.3 General Considerations for Use of Wild Animals in Research

1. Before initiating any field research or handling exercises, the investigator should correctly identify the species to be studied and determine whether or not it is suitable to answer the question(s) posed by the study. The investigator should also become familiar with current knowledge pertaining to the study species, including, where applicable, its response to disturbance, its sensitivity to capture and restraint, and its requirements for captive maintenance, if it is to be held for any length of time.

2. The investigator is encouraged to have the study design conform to Canadian Council on Animal Care (CCAC) standards and to use peer and institutional animal care committees when available.

3. The investigator must have full knowledge of all local, provincial and federal regulations pertaining to the animals under study, and must obtain all necessary permits that are required for carrying out the proposed studies. Researchers working outside Canada should be aware that regulations may vary with each country and must ensure that they comply with all wildlife regulations of the country in which their research is being conducted. Work with many species is regulated by the provisions of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

4. Prior to the removal of animals from the wild, the investigator should make every effort to ascertain the population status (abundant, threatened, rare, etc.) of the taxon to be studied. In general, members of endangered or threatened taxa should not be removed from the wild except in collaboration with conservation efforts, nor imported or exported, except in compliance with applicable regulations. This statement should not be interpreted as discouraging the study and/or collection of uncommon species, because these activities may help to determine why a species is rare or uncommon. The committee on the Status of Endangered Wildlife in Canada (COSEWIC) provides information on threatened species.

5. Although the number of research specimens required for each study will vary greatly, researchers should minimize the number of study animals used. Certain types of study will entail the collection of large numbers of specimens, (e.g. diversity over geographic range or delineation of variation of new species) although in most cases this will represent a relatively

small percentage of the total population. The use of an adequate sample size in the study will help to prevent any unnecessary repetition or waste in the future. Consultation with statisticians or epidemiology references may help to determine an appropriate sample size.

6. Special consideration should be given when study animals have dependent young. As a general principle, the removal or disturbance of study animals from the wild during sensitive periods, such as breeding and egg-laying periods, should be avoided, unless justified for scientific reasons.

7. When study animals are being trapped or collected, they should not be exposed to excessive or extended handling, conspecific aggression, predation, adverse weather, or temperature extremes. Trapping and handling equipment should be routinely inspected, maintained and repaired as necessary. Traps should be monitored as often as is considered appropriate for each trap type and species involved. At the end of each collecting period traps should be properly closed or removed.

8. Even at field locations, the living conditions of captive research animals should maintain them in an adequate state of health and well-being. Captive conditions should satisfy the standards of hygiene, nutrition, group composition and numbers, refuge-provision, and protection from environmental stress, that are considered to be appropriate for the species in question. The housing, feeding and non-veterinary care of the animals should be directed by the investigator who should be knowledgeable in the proper care, handling, and research use of the species being maintained.

9. Any procedure that may cause more than momentary or slight pain or distress to research animals should be performed with appropriate sedation or analgesia, except when justified for scientific reasons.

10. Any research animals that will suffer from severe or chronic pain as a consequence of a research procedure should be euthanized at the end of the procedure or, if appropriate, during the procedure.

11. Methods of euthanasia should be consistent with recommendations of the CCAC Guide to the Care and Use of Experimental Animals Volume 1, American Veterinary Medical Association (AVMA) Panel on Euthanasia (Smith *et al.* 1986) and Guidelines for Euthanasia, J. Longair *et al*. in Chemical Immobilization of Wildlife Training Manual 1996, unless deviation is justified for scientific reasons.

12. In the case of accidental mortalities, it is desirable to save specimens for use in ancillary studies or for deposition in museum collections.

13. Investigators should be aware of, and prepared to avoid, the potential risks of a variety of transmissible diseases and parasites to other animals and humans, as well as other hazards associated with the handling of wild vertebrates. To this end, animal care review of the proposed study, where appropriate, should include a veterinarian, experienced with wildlife disease.

2. Mammals

2.1 Investigator Impact

2.1.1 General Considerations

Investigators have an obligation to identify and assess the consequences of their research activities on wild animals, populations and the environment. Whenever possible, action should be taken to avoid, alleviate or minimize any adverse effects. Research activities should include the collection of adequate samples to ensure valid research results, yet be balanced to minimize adverse effects. Investigators should always weigh potential gain in knowledge against the negative consequences of disturbance. Although short-term detrimental effects may result from research activities, research can ultimately yield long-term positive effects for the affected population.

Observer-related disturbance can be characterized in at least two ways. First, disturbances may create biases that affect both the gathering and analysis of data, if the actual process of measurement acts to alter the parameter being measured. Second, research activities might effect the status and well-being of the study subjects themselves. Both effects vary along a continuum from those that are overtly obvious to those that are subtle and difficult to detect.

Although they are usually less severe, many of the effects of field investigations are similar in nature to those that result from non-scientific human activities such as tourism and other general recreational pursuits.

The following provides general guidelines for minimizing the impact of research activities in the field:

1. Researchers should only approach study subjects as closely as is required to satisfy the goals of the study without biasing data. Blinds, telescopic lenses, and other remote sensing devices can be used to gather information about an animal or a sensitive area without actually entering it. Where possible, the entrance to blinds should be concealed or camouflaged to further reduce disturbance.

2. Researchers can time visits or activities to avoid the disturbing the animals during their most sensitive periods, such as when they are breeding or tending to young.

3. Because there are interspecific variations in response to research activities, investigators must be able to reasonably predict the level of tolerance and the reactions of their study species to certain field activities by reviewing the pertinent literature and by consulting with others.

4. Because some habituation to investigator disturbance is possible, maintaining consistency in the timing and intensity of visits may help to alleviate some problems.

5. The selection of a study population that is already habituated to human activity may sometimes help to reduce or eliminate the unwanted side effects of scientific research.

2.1.2 Approach and Nearness to Sensitive Areas

Investigators must also take into consideration the response research animals may have to the sounds, the behaviours and the simple presence of humans. In addition, species that are not under study may be disturbed.

2.2 Collecting and Trapping

2.2.1 Humane Considerations

Whether one is collecting study animals for eventual release or for museum preparations, the same humane considerations should apply. These animals should not be exposed to excessive or inappropriate handling, conspecific aggression, predation, temperature extremes, or undue suffering.

2.2.2 Habitat and Population Considerations

Each investigator should observe and pass on to students and co-workers a strict ethic of habitat conservation. Because many essential details of life history may remain unknown until a study is well along, collecting should always be conducted so as to leave the population and habitat as undisturbed as possible.

The permanent removal of large numbers of animals from any wildlife population should be avoided, unless justified for very specific scientific reasons. Similarly, the collection of large numbers of females from any population for destructive sampling should be avoided. Systematists should investigate extant collections for suitable specimens before conducting any field work. If the purpose of an experiment is to alter behaviour, reproductive potential or survivability, the interference should be no more than is determined necessary by the investigator to accurately test the hypotheses under question.

2.2.3 Compliance with Laws and Regulations

Investigators must obtain and comply with all permits required for the capture, handling and collection of those mammals which are of the correct species and in the appropriate jurisdiction. In addition, they must be familiar with the current list of threatened and endangered species and must comply with all rules and regulations pertaining to these and all other categories of mammals.

2.2.4 Live Trapping

Investigators should be familiar with traps and trapping techniques and should choose a trap type that is best suited to the species and type of study. Capture techniques should prevent or minimize injury or damage to the animal. Care should be exercised to avoid accidental capture of non-target species. Special consideration should be given to the setting of capture devices in areas that are frequented by pets and children. Trapping and handling equipment should be routinely inspected and maintained in good working order. At the end of each collecting period traps should be properly closed or removed.

Wild animals are sensitive to heat, cold, thirst, energy deprivation and stress, and investigators must make every effort to avoid trap deaths from such factors as temperature extremes, stress, shock, and capture myopathy. Animals should not be left in traps longer than is absolutely necessary, although this will vary with the species, weather, objectives of the study, and trap

type. Traps should be shaded or positioned to avoid full exposure to the sun and, where possible, trapping or netting should be avoided in windy, cold and rainy weather. Captured animals can injure themselves trying to escape, even from metal walk-in traps. These injuries reduce the specimen's scientific value and cause needless suffering. Under extenuating circumstances there may be a need to position traps a long distance from the researcher. In these instances the traps should only be set when weather stresses can be minimized and they should be checked as frequently as possible.

Dependent Young: The trapping of wild animals with dependent young should, as a general principle, be avoided. When this is unavoidable, it must be accompanied by a program to either remove or kill the dependents if the parent cannot return. Every effort should be made, in advance of trapping, to locate lairs and nesting areas to minimize the inadvertent capture of these animals.

Bat Trapping: The capture of bats poses special problems which do not apply to most other mammalian species. Mist netting, in which the animals become entangled in a very fine net, is the most commonly used technique. Because the captured bats will struggle and increase their chances of serious entanglement or injury, these nets should be monitored continuously. In addition, they should be set away from large concentrations of bats, so that an unmanageable number of animals is not captured at a single time. Harp traps are preferable whenever a large number of bats is likely to be caught at a roost or cave entrance because they help to avoid the trauma that is often associated with the use of mist nets. These traps have two parallel frames supporting a series of vertical monofilament lines. For some unknown reason the bat becomes trapped between the vertical lines and is subsequently funneled into a holding bag.

Any form of trapping around maternity colonies should be avoided. In addition, researchers should avoid excessive or repeated disturbances of roost sites.

2.2.5 Collection of Specimens

In some instances, wildlife research may necessitate the judicious collection of whole animal or tissue specimens in the field. This may be done to provide information on species identification, genetics, population structure and dynamics, comparative anatomy and physiology, evolutionary relationships, behaviour, parasites and diseases, economic factors, geographic and microhabitat distributions, and ecology in natural or disturbed habitats. The knowledge that results from these studies may be applicable to other biological sciences and may help to facilitate decisions involving management policies for all species, whether endangered or economically important, for the conservation of habitats, ecosystem analysis, pest and disease control, retrospective studies, predator control and domestication of species.

Many specimens removed from the field are used collaboratively and deposited in the collections of natural history museums or biological data banks for future studies. Museum collections are curated repositories for whole specimens and their parts, whereas biological banks are collections of histologically or cryobionically preserved organs, tissues (including live cultures), cells (including sperm and ova) or embryos. Both kinds of repositories allow qualified researchers access to study collections. It is strongly recommended that, when appropriate, voucher specimens and biological samples be retained at the conclusion of field investigations, so that they will be available for use by future investigators. Communication with researchers in other jurisdictions is recommended in order to maximize the use of and information gathered from biological samples.

2.2.6 Methods for Collecting Whole Specimens

Humane methods of kill trapping and shooting are techniques that kill the animal instantaneously while avoiding damage to the body parts that are required for the investigation.

Shooting may be the most effective and humane method to collect larger mammal species, but it is rarely justified or required. Researchers planning to use firearms must be experienced in their proper and safe use and must comply with laws and regulations governing their use. The firearm and ammunition load should be appropriate for the species to be collected. Every effort should be made to avoid wounding animals, not only to minimize suffering, but also to maximize the probability of retrieving rather than losing the specimen. In the event of accidental wounding, the animal must be tracked and recovered. In most cases, shooting is reserved for the collection or euthanasia of terminally ill or severely injured animals.

For smaller animals, the use of kill-traps for collecting scientific specimens must be carefully and appropriately justified. If they are to be used, they should be checked at least once daily and positioned so they avoid or minimize the inadvertent capture of non-target species. For example, snap traps, which are usually set for nocturnal animals, should be sprung early in the day in order to avoid the accidental capture of any diurnal species. Methods commonly used for kill-trapping include snap traps (e.g. Victor trap), Museum Specials (snap trap, modified to reduce skull damage), Macabee traps for pocket gophers, Harpoon traps for moles and Conibear traps for medium sized mammals. Considerable review of trap design and installation techniques is advised prior to the start of a study.

The use of steel jawed traps as kill-traps is not considered to be appropriate because these devices hold the animal rather than killing it immediately. If such traps must be used, they must be checked very frequently in order to minimize the animal’s suffering. With this live trapping method, it is the investigator's responsibility to safeguard the trapped animal against the effects of heat, cold, thirst, energy deprivation and stress, and ensure appropriate methods are available to treat injuries, restrain, and release animals.

See 2.10.2 Euthanasia of Study Animals

2.3 Restraint and Handling

The nature of restraint will depend upon the procedure and the mammal species involved. Restraint techniques can range from confinement in an enclosure through various types of physical restriction, to chemical immobilization. Any decision to use physical or chemical restraint in a research project should be based upon an understanding of the behavioural and physical characteristics of the species to be restrained, the field conditions under which the procedure will occur, the knowledge and skill of those persons handling the animals, the goals of the investigation, and the availability of appropriate equipment and facilities. Investigators must use the least restraint that is necessary to do the job in a humane and effective manner, with least stress to the animal.

2.3.1 General Principles of Physical Restraint

Because many species of mammals are capable of inflicting serious injury to themselves or those handling them, some form of restraint is usually necessary. The well-being of the animal under study is of paramount importance and it must be emphasized that improper restraint, especially of frightened or stressed animals, can lead to major physiological disturbances, including hypothermia, hyperthermia, stress, shock and capture myopathy. In addition, the capture of some

species of animals may alter their behaviour and predispose them to predation . Many species of mammals do not tolerate physical restraint and in some cases there is a great potential for animal or handler injury. Investigators should not allow unsupervised, inexperienced persons to handle any animal species until adequately trained to restrain, manipulate and release the animals properly. The specific handling characteristics of each taxonomic group is beyond the scope of these guidelines. The researcher should consult the current literature and experienced peers before handling an unfamiliar species. The following are general guidelines that must be considered when a researcher physically restrains a wild species:

6. Wild animals should be handled quickly and without sudden movements, utilizing the minimum number of personnel that are required to safely and efficiently perform the task.

7. Darkened chambers and/or blindfolds alleviate stress and subdue animals. They should be used whenever possible. Excessive noise from loud equipment, vehicles, or talking should be minimized. In addition, the handlers should be aware of the negative responses wild animals may have to touching of any kind.

8. Excessive struggling or stress in the restrained animal can lead to hyperthermia and muscle damage (capture myopathy), especially during warm or hot conditions. In some cases the time of day will also be an important consideration with handling efforts focused during cooler periods (dawn/dusk).

9. The time of year can be an important consideration when handling and restraining wild mammals. For example, bison and elk tend to be less aggressive and more easily handled in the wintertime. Many animals may be more readily baited into traps and holding areas when the natural conditions are at their poorest.

10. If possible, researchers should avoid capturing and restraining animals which are pregnant, tending young or breeding.

11. When restraining an animal by hand, the force applied and technique should be appropriate for the species in question. The use of gloves may reduce the dexterity of the handler.

12. If muzzles, hoods or holding bags are being used as part of the restraint, the investigator must ensure that the animal’s breathing or thermoregulatory ability are not compromised.

13. The mesh size and construction of nets must ensure that the animal cannot force its head through the mesh or easily chew through the net material.

14. Many unconditioned animals will fail to recognize chain link or wire as a barrier. Therefore, any corrals or run fences that are constructed of these materials should be draped with burlap or opaque plastic to act as a visual barrier.

15. In some species there is a natural tendency to follow and move as a group. This behaviour can be used to facilitate movement through corrals and run-ways.

16. Movement through solid-sided chutes will be facilitated if the chute is constructed with a curved path and provides a visual escape pathway (i.e. light at the end).

17. When animals are confined in chutes or corrals, stress can be reduced by providing visual barriers which will allow the animals to conceal themselves from handlers and conspecifics.

18. If corrals or chutes are used for confining animals they should be equipped with drop hatches or escape doors to permit the emergency release of animals that become injured, cast or seriously distressed.

19. If body squeezes are used to restrain and handle wild ungulates, they should be adequately constructed and/or padded in order to avoid animal injury.

20. If circumstances increase the potential for human or animal injury to an unacceptable level, the researchers will terminate the exercise.

Prolonged, distressful restraint should not occur. Administration of a tranquillizer or sedative to an animal that is physically restrained for longer periods of time may help to prevent injury to both the animal and the handlers. In some circumstances, it is advisable to use general anaesthesia for restraint in the field, particularly for larger or dangerous species. Invasive procedures may require some form of physical restraint initially, but usually require subsequent analgesia and/or chemical immobilization (see General Principles of Chemical Restraint Section).

2.3.2 General Principles of Chemical Restraint

The administration of anaesthetics to wild animals for restraint purposes can be accomplished safely; however, the use of chemicals do present risks to both animal and investigator. Field immobilization is almost always performed in less than ideal conditions. Only rarely can the investigator examine animals prior to anaesthesia, give accurate dosages in a controlled environment, and intensively monitor animals during anaesthesia events.

Although some wildlife projects may involve the use of oral or intravenous agents, most field situations utilizing chemical immobilization require the intramuscular administration of drugs. In some cases these are administered with a hand-held or jab-stick syringe to an animal which is physically restrained or confined. In other instances the drugs are given remotely with a projected syringe or dart. Drugs administered by projectiles can seriously wound or kill the target animal if a vital organ, a major blood vessel or a non-target area of the body is penetrated. Therefore, heavily muscled areas must be targeted when darting wild animals.

Researchers should be capable of monitoring an anaesthetized animal and providing general support measures should an anaesthesia emergency occur. Researchers must take great care in selecting a drug or drug combination for field use. Every anaesthetic agent has specific advantages and disadvantages, and there is no single agent that is suitable for the chemical immobilization of all mammalian species under all circumstances. Safe and effective drug dosages will vary with the species, age, sex and body condition of the animal. In addition, there can be individual and seasonal variations in the response to agents. It should also be realized that drugs used for wildlife immobilization have the potential to seriously affect both animals and humans involved.

It is essential the researcher and all field personnel be familiar with the consequences of drug exposure and be trained to take appropriate action in the event of an accident with animals or humans. The immobilization of wild animals should only be performed by trained personnel who

have successfully completed a Ministry Chemical Immobilization Training Course (see Ministry Chemical Immobilization of Wildlife Policy).

Immobilizing Agents

There is tremendous taxonomic variation in the response to the pharmaceuticals used for chemical restraint, and dose extrapolation from one species to another should not be attempted. An outline of the numerous drug and drug combinations used for wildlife is beyond the scope of these guidelines. Detailed and current information on the recommended immobilization procedures for most North American species are published. Pertinent literature, experienced professionals, and the Ministry of Wildlife Veterinarian should be consulted before a researcher initiates a project involving the immobilization of wildlife species. Where possible, investigators should consider studies on the effects of new immobilization chemicals and procedures on captive individuals before incorporating them into field studies. (See Chemical Immobilization of Wildlife Manual).

2.4 Marking Procedures

2.4.1 General Considerations

Many studies require individual animals to be marked for identification. Marking techniques can cause effects ranging from short-term discomfort, to long-term influences on breeding and survival. It is essential, for the welfare of the animal and the integrity of the research results, that the marking procedure not adversely affect the normal behaviour, physiology, ecology or survival of individuals. In choosing an acceptable marking technique, the investigator must consider the nature and duration of the restraint that is required for its application, the amount of tissue that is removed or damaged, the amount of momentary or prolonged pain that is involved and the potential risk for infection. In many cases it has been possible to reduce the harmful effects of the mark by careful design, with special consideration to colour, attachment position, mass and the season in which it is applied.

In general, investigators should not assume that marking procedures will have no adverse effects on their study subjects and should make efforts to evaluate any such influences. Where possible, investigators should assess the effects of new marking procedures on captive individuals before incorporating them into field studies.

It is desirable for the scientific community to encourage ancillary research that specifically addresses the effects of marks and devices. Preferably, such research, which makes comparisons between marked individuals and controls, can be initiated in association with current studies. Because of the difficulty of providing appropriate controls, there are few systematic studies that assess the potential adverse effects of marking procedures. Many of the cautions mentioned here are based on unpublished observations.

In general, for a marking procedure to be effective, it should meet as many of the following criteria as possible:

1. The animal should experience no immediate or long-term hindrance or irritation from the mark or marking procedure.

2. The animal should suffer no adverse effects on its normal behaviour, physiology, longevity, social life, ecology or survival.

3. The mark should be able to be applied quickly, easily and with minimal pain.

4. The mark should have readily visible and distinguishable digits and/or colours in order to identify individuals or groups as required.

5. The mark should be effective in allowing the researcher to meet the objectives of the study and persist on the animal until research objectives have been fulfilled.

2.4.2 Permanent Marking

Branding

Hot branding has been used in a number of instances to imprint identification numbers on the horns and skin of wild mammals. This method produces third-degree burns which lead to the production of visible scar tissue. Because of the pain associated with this procedure, this method is not commonly recommended.

Freeze branding (cyro-branding) appears to be more acceptable than hot branding for marking wildlife because it is less painful and the possibility of infection is minimized. This technique, which was originally developed for the identification of livestock, has been used with varying results in several wildlife species.

Tattooing

Tattooing is a common method of identification and has been used successfully in many species. Tattoos have been applied to the inside of the lip, the ear, and the thinly-haired area of the groin. The location and proper application of the tattoo will influence its future readability. In most cases, the animal must be recaptured or examined after death in order to read this type of mark.

Toe, Ear and Tail Clipping

Techniques that involve the removal or damage of tissue, such as toe, tail, or ear clipping are forms of mutilation. These procedures may have adverse effects on the behaviour and survival of wild animals and their use in marking free ranging wild species cannot generally be condoned. It is strongly recommended that alternative marking techniques be used in field research. However, in those few instances where removal of tissue is not judged to impair the normal activities and survivability of the marked animal and does not cause bone damage, pain or severe blood loss (e.g. ear notchings of small rodents), these marking techniques can be utilized. When toe or tail clipping are felt to be the only methods that can meet the requirements of a particular study, their use should be appropriately reviewed and approved by a review or animal care committee before implementation.

The removal of toes must never be performed on animals that use them for activities such as burrowing (ground squirrels) or climbing (red squirrels), or on animals where important bone structures have to be removed. When toe clipping is used is used as a marking technique, no more than one toe per foot should be removed.

2.4.3 Semi-Permanent Marking

Ear Tags

Ear tags are used to mark many different mammalian species and are usually made of plastic, aluminum, or plated steel. These tags are available commercially in a variety of materials, sizes,

configurations and colours. Care must be exercised so that a tag of appropriate size is applied. This will help to reduce potential problems, including heat loss as a result of increased temperature conductance through a metal tag or snagging of excessively large tags. By tagging both ears the researcher will help to reduce the chances of a lost identity in the event that one tag is torn out. Application of ear tags during fly seasons or using unhygienic techniques may predispose to localized infections. Researchers should understand the ear anatomy to avoid blood vessels and the appropriate application technique before use.

Wing Bands (bats)

Consideration should be given to the size of the bat and the type of material used in the band in order to minimize the risk of injury. Tattoo needles have been used to mark wing membranes of bats as an alternative to banding, however, these marks were not always visible after five months. The researcher should contact active bat researchers and/or the literature for the most appropriate marking techniques.

Neck Bands

Adjustable and/or expandable neck collars or bands, in a variety of materials with visible colour bands and numbers, are a common method of identifying wild mammals in field studies. These have been used successfully to mark bighorn sheep, deer, elk, moose, bison, and antelope. The size of the collar must be carefully selected in order to allow for normal growth and activity of the study animal.

Modifications to neck bands have been introduced in order to improve their visibility in the field. These alterations include the addition of vinyl coated nylon flags, bells, and battery operated neon lights or light emitting diodes which allow for night observations of species such as deer and beaver. Because these modifications may attract predators and interfere with the normal behaviour and social interactions of the marked animal, their use is justifiably limited.

Fluorescence and Radiation

Tetracycline, a fluorescent marker, has been administered orally or as an injectable to permanently label bones and teeth of several species. Other fluorescent or dye markers have been used in oral baits to temporarily identify the individual animals which consume them.

The use of radioisotopes as markers in natural systems may be valuable. However the application of these agents should only be undertaken with caution. Researchers are required by law to have special training and to observe certain precautions. In addition, a licence is required which outlines the safety procedures, the disposal of waste material, and the release of isotopes into natural systems. The potential use of these agents must be evaluated with consideration to the possible deleterious effects that these agents may have on the study animal, its predators and the public.

Radioisotopes have been injected into captured mammals prior to their release. This method has allowed researchers to estimate population size by counting radioactive droppings.

A chemoluminescent tag, using Cyalume® injected into hollow glass spheres as a light source, has been cemented to the mid-ventral fur of bats allowing their flight to be tracked at night. The light resulting from this tag lasts from two to three hours and is visible from a distance of 200 m.

Beta lights are another light source useful in tracking small fossorial mammals. They consist of glass capsules coated with phosphor and filled with tritium gas. Beta lights last up to 20 years and can be seen up to 400 m. However, their use must be approved by radiation authorities.

2.4.4 Temporary Marking

Hair Dyes

Dyes have been used to colour the hairs in numerous species of mammals, including bears, elk, deer, mountain goats, wolves, ground squirrels, bighorn and Dall sheep, peccary, and snowshoe hares. Some of the dyes used are Nyanzol A, Nyanzol D, blackpowder, clothing dyes, human hair dyes, red and orange aniline dyes, and picric acid. The method of application of these materials has varied from simply painting the dye on the animal to the use of compressed air sprays or paint balls. They have been administered from the ground, helicopter carried paint ball guns or from aircraft rigged with crop spraying devices. Care must be taken to use non-toxic dyes.

Horn Markers

Paint has been used to mark horns of bighorn sheep and bison and has also been sprayed directly on the hide. A commercial paint pistol is available that can propel paint pellets up to 15 m. Coloured plastic adhesive tape has been successfully used as a temporary mark on the horns of bighorn sheep. This material is durable and it is easily applied to immobilized animals. Horns have also been permanently marked with heat branding or the insertion of metal pins.

Ear Switches

Coloured ear streamers and ear switches are temporary markers that have been used on larger mammals. The most durable material appears to be vinyl coated nylon. Streamers are usually attached through slits in the ear or by metal tags. The same criticism and limitations to the acceptability of this method exists as for neck bands. In addition, consideration must be given to the behavioural effects of streamers. In general, ear switches have not been found to be any more valuable than ear tags.

Passive Integrated Transponders

Passive integrated transponders or microchips have been used to mark study animals permanently and can be used as an ancillary method of identification. These devices are implanted subcutaneously or intraperitoneally with complications reported rarely. However, animals must be recaptured and special equipment used to identify marked individuals. In addition, the transponders may migrate if applied subcutaneously, and this can make reading them more difficult in larger species. Microchips are most frequently used for the identification of individual animals where external marking is not desired (i.e., anti-poaching projects).

Radio Transmitters

The attachment of small radio transmitters to free-roaming mammals has become a routine method of monitoring the location and movement of individuals, and is used successfully in a wide variety of mammalian species. There is little direct evidence that when transmitters are of appropriate size, and are properly attached, they adversely affect research subjects. Transmitters are applied most frequently to the larger species, but with the development of units weighing less than 2 g, they also have applications in the study of smaller species such as bats and rodents.

A wide variety of attachment methods for transmitters are currently in use. The methods for attaching transmitters to a wide variety of taxa are reported in the literature. It is mandatory that investigators who are intending to utilize telemetry in their investigations access those sources which are relevant to their study species. A review of the pertinent literature will help to identify any potentially adverse effects that transmitters may have upon the behaviour, survival and well-

being of their study animals. It is strongly recommended that prior to being used in the field, new attachment techniques are reviewed and, if appropriate, evaluated on captive individuals.

Radio transmitters vary in size, longevity and range characteristics, and are available from several commercial suppliers. The researcher should choose a transmitter and method of attachment that harmonizes with the anatomy and behaviour of the study animal. Neck collars are the most common method of attachment in larger mammals.

The addition of an external mass to an animal's body can have an adverse effect on its energetics. Therefore, it is recommended that the combined weight of the transmitter and neck collar does not exceed 4 % of the animal's body weight. Special consideration must be given to the attachment of neck collars in those individuals who will undergo significant musculoskeletal growth and in those species that have marked seasonal fluctuations in body condition.

Proper collar width is also critical. If the collar is too narrow excessive undue pressure is applied to the animal's neck, resulting in abrasion and pressure necrosis. If too wide, the animal's neck movements may be impeded. Rubber-impregnated nylon webbing (machine belting) and non-impregnated seatbelt type webbing are materials that are most often used for neck collars. Plastics are often used for smaller species, but their durability and flexibility are affected by temperature and age. The use of collars with protruding or whip antennae is avoided in species which chew on them, such as carnivores. Inserts of degradable material which allow collar drop-off are strongly advised. Consideration should be given to the recapture and removal of collars at the end of the study period.

Special attention must be given to the attachment of transmitters in fossorial and arboreal species. Surgically implanted radios have been used on medium sized mammals such as marmots, furbearers and ground squirrels with similar neck and head width where collars are easily removed. General anaesthesia and veterinary assistance is recommended for the implantation of abdominal transmitters. These devices may have a limited range and short battery life, but if properly installed can be successful. In bats, transmitters have been successfully attached to the fur. As a general rule, this type of transmitter should not exceed 4% of the bat's total weight.

Solar operated ear tag mounted transmitters and subcutaneous transmitters have recently become available for larger mammals in situations where collars are undesirable for esthetic reasons (wildlife viewing).

For more information on this topic, consult the RIC (Resources Inventory Committee) manual entitled *Wildlife Radio-telemetry, Standards for Components of British Columbia's Biodiversity No. 5*.

2.5 Transport

It may be necessary to transport animals as part of an experimental protocol or to move them from capture sites to holding facilities. Transport containers and methods of shipping animals will vary widely from species to species. The live traps that are used for capture are usually adequate for transport over short distances. However, if the animals are large or are to be confined for a longer period, these traps may not be suitable. In general, the containers used in transportation must protect the occupants from injury and allow the individual sufficient space so that it can assume a normal posture and engage in comfort and maintenance activities unimpeded by conspecifics. In most cases, animals should be separated. Containers should be padded in those instances where excitable animals or species with delicate bone structures are to be shipped. Adequate ventilation must be provided. For longer journeys, water and food should be provided. The inside of containers should be as dark as possible, while still allowing them good

ventilation, to find food or water, and to move about. It is recommended that transport vehicles be equipped so that the transported animals are not exposed to excessive noise, movement or temperature extremes. Proper arrangements should be made to ensure that animals arrive at destinations during normal working hours, rather than on weekends or holidays. Further information and regulations on animal transport and appropriate caging are available from Transport Canada and Canadian Food Inspection Agency.

2.6 Housing and Captive Breeding

Wild animals used in captive studies should be as healthy and free of trauma as possible. Some exceptions to this rule include investigations into the effects of environmental stress and disease. Housing standards should follow CCAC guidelines and/or institutional animal care standards.

2.7 Manipulative Procedures: Tissue Sampling, Injections and Implants

2.7.1 Tissue Sampling

Only trained, experienced personnel should take tissue or blood samples from live mammals. The use of local or general anaesthetics may be required if the anticipated pain from the procedure is more than mild or momentary. Investigators should develop a sampling protocol, including sample processing and storage, prior to commencing the study to ensure that appropriate samples are taken, the opportunities are maximized and waste is minimized.

2.7.2 Dental Extraction

The estimation of mammal age can be made by examination of antlers, horns or dental eruption and wear, although for some studies, cementum analysis is required for accuracy. The specific tooth most suitable for cementum analysis may vary with species; however, vestigial teeth such as maxillary premolars are usually extracted. These teeth generally have short roots and can be removed quickly with experience and the appropriate instruments. The removal of permanent incisors in ungulates is extremely painful due to large nerve roots and can subsequently impair feeding on a permanent basis. The scientific literature favourably compares the estimation of age by non-invasive techniques and cementum analysis in ungulates, thus removing the necessity for incisor removal. Extraction of these teeth should only be done, if justified by review, by experienced personnel and with full analgesia under general or local anaesthesia.

2.7.3 Collection of Blood Samples

The most common method for the collection of blood from mammals is venipuncture. Many sites are accessible, but preferred veins vary with species (e.g., femoral vein in bears, cephalic or jugular in cervids). Blood may be withdrawn by needle and syringe and decanted into blood tubes or removed directly into blood tubes using double ended needles. Training and experience in venipuncture can ensure a rapid and painless procedure.

In general, it is advised that no more than 10 - 20 % of the animal’s blood volume (approximately 1.5 - 2.5 % of lean body mass) be collected during sampling. Following blood sampling, hemostasis can usually be achieved by applying direct digital pressure to the collection site for several minutes. The bleeding should stop before the animal is released.

Proper processing and storage of blood samples is vital to ensure its subsequent analysis. Investigators should contact a veterinarian and/or a laboratory for recommended techniques.

2.7.4 Collection of Other Tissues

In addition to blood, study protocols may require the collection or biopsy of other tissues such as fat, muscle, liver, and skin. Before initiating a project involving invasive biopsy techniques, the researcher should conduct an adequate peer and literature review. Investigators should only collect the minimum amount of tissue that is necessary to reliably satisfy the research goals. In some instances, analgesia or anaesthesia may be required to effectively and humanely obtain the necessary sample. The survival of animals that are released following a biopsy procedure should not be compromised. It should be noted that non-invasive sampling is the preferred alternative.

2.7.5 Collection of Food Samples

Diet information may be gathered as part of ecological and nutritional studies. The sacrifice of animals for stomach contents is rarely justified. Instead, it is preferable to collect prey remains or fecal material for analysis.

2.7.6 Injections and Insertion of Implants

Injections of appropriate solutions, whether subcutaneous, intramuscular, intraperitoneal or intravascular, may usually be made with very little effect on survival or normal animal behaviour. The personnel performing these procedures should be properly trained. Some solutions may be irritating or dangerous to the subject if they are not properly injected. Implants may require major surgery under general anaesthesia and may migrate or become inactive if they are not properly inserted. Proper sterile procedures are required for intraperitoneal transplants.

Before being used in the field, it is strongly recommended that new techniques are evaluated on captive individuals. A review of the pertinent literature will help to identify any potential adverse effects that injections or implants may have upon the behaviour, survival and well-being of the study animals.

2.8 Major Manipulative Procedures: Surgery

When performing major manipulative procedures, humane principles should always be the first priority. There is no justification for accepting substandard care of study animals due to a lack of knowledge or expertise.

The conditions governing the choice of procedures may depend upon the intended fate of the subject. In general, four categories of subjects can be distinguished:

1. Wild animals in the field that are to be released immediately upon recovery.

2. Wild animals brought into a holding facility that will be released after recovery.

3. Wild or captive bred animals that are to remain captive permanently or for an indefinite period after the procedure.

4. Animals that will be euthanized without recovery.

For any animal that is to be released to the wild, the prime consideration should be that the procedure will have a minimal effect on its subsequent survival and reproductive potential. No

animal should be released to the wild until it is deemed to be sufficiently recovered to perform normal behaviours, including predator evasion and feeding. If the purpose of the experiment is to alter survivability or reproductive potential, then the interference should be no more than is necessary, as judged by the investigator, to test the issue in question. Even animals that are to be held as permanent captives or ultimately euthanized should not be subjected to pain or suffering.

The acceptability and practicality of a procedure will vary with the experience and skill of the investigator. Procedures should only be performed after consultation with and preferably under the guidance of an experienced wildlife veterinarian. For any invasive procedure that is more complicated than a simple injection there should be supervised practice on a model or a carcass before it is attempted on a living subject. The ultimate goal of practice is to be able to perform the technique quickly and efficiently with minimal tissue trauma.

A major portion of surgical trauma for many wild animals is the physical or chemical restraint that is associated with the procedure. Anaesthesia can be physiologically stressful and many animals are severely stressed by prolonged handling. Therefore, a technique will be more successful if it can be performed rapidly, but not hastily. Invasive procedures, if performed correctly, need not affect the survival or reproductive potential of the subject.

2.9 Disposition of Research Animals

2.9.1 Release of Study Animals

Whenever it is practical, researchers should release field trapped animals following the completion of their studies. However, there are exceptions to this and, as a general rule, field trapped animals should be released only:

1. At the site of the original capture (unless conservation efforts dictate otherwise).

2. Where it can be reasonably expected that the released animals will re-establish their former social status.

3. When the weather conditions and the season are conducive to survival.

4. If it is in the best interest of the study subjects, and if their ability to survive in nature has not been impaired.

5. When the released animals are not a health hazard or are otherwise detrimental to the existing populations in a specific geographic area (*e.g.*, when they do not jeopardise the genetic integrity of a population or carry a potentially infectious disease).

6. When the animals' release is compliant with federal, provincial or local laws.

2.9.2 Euthanasia of Study Animals

Captive animals that cannot be released should, whenever possible, be distributed to colleagues for further study. However, if the animal is in chronic distress or pain, or if release or rehabilitation is neither feasible nor likely to succeed, then euthanasia may be the only alternative. If animals must be destroyed subsequent to a study, then it should be done using a method of euthanasia which is humane, instantaneous and considered acceptable (see Reference section). In addition, the method of euthanasia should not interfere with any future research

potential of the carcass or any specific post mortem analyses. In both the field and the laboratory, the investigator must be careful to ensure that euthanized animals are dead before disposal. Disposal of carcasses must be in accordance with acceptable practices as required by municipal or institutional regulations. Animals containing toxic substances or drugs should not be disposed of in areas where they may be scavenged or become part of the natural food chain.

3. Birds

3.1 Investigator Impact

3.1.1 General Considerations

Investigators have an obligation to identify and assess the consequences of their research activities on wild animals, populations and the environment. Whenever possible, action should be taken to avoid, alleviate or minimize any adverse effects. Research activities should include the collection of adequate samples to ensure valid research results, yet be balanced to minimize adverse effects. Investigators should always weigh potential gain in knowledge against the negative consequences of disturbance. Although short-term detrimental effects may result from research activities, research can ultimately yield long-term positive effects for the affected population.

Observer-related disturbance can be characterized in at least two ways. First, disturbances may create biases that affect both the gathering and analysis of data if the actual process of measurement acts to alter the parameter being measured. Second, research activities might effect the status and well-being of the study subjects themselves. Both effects vary along a continuum from those that are overtly obvious to those that are subtle and difficult to detect.

Although they are usually less severe, many of the effects of field investigations are similar in nature to those that result from non-scientific human activities such as tourism and other general recreational pursuits.

In bird research, adverse effects are most commonly associated with nest visits, aircraft surveillance, working in or passing through sensitive areas, approaching the birds too closely or the trapping, handling, marking and collecting of birds.

3.1.2 Nest Visits

The potential for detrimental effects arising from nest visits are well documented, and may include decreased reproductive success in both terrestrial and aquatic birds and the collection of biased data by the researcher. All studies of avian breeding biology should consider the potential consequences of nest visitation and should strive to minimize the number of visits as long as sound scientific results are not compromised.

The following provides general guidelines for checking the nests of colonial bird species that will minimize investigator disturbance, and maximize data yield. Some of the principles can also be applied to visits involving solitary nesting species or groups of birds in sensitive locales:

1. Blinds, telescopic lenses, and other remote sensing devices can be used to gather information about a colony or sensitive area without actually entering it. Where possible, the entrance to blinds should be concealed or camouflaged in order to further reduce disturbance.

2. Researchers can time visits or activities (within and between days) so that they avoid the disturbance of nests during their most sensitive phenological stages (such as egg laying), avoid the separation of chicks from their parents, and minimize the loss of regurgitated food by young birds.

3. Because there are interspecific variations in response to nest disturbance, investigators must be able to reasonably predict the reactions of their study species to certain field activities by reviewing the pertinent literature and by consulting with others.

4. Because some habituation to investigator disturbance is possible, maintaining consistency in the timing and intensity of visits may help to alleviate some problems.

5. The selection of a study population that is already habituated to human activity may sometimes help to reduce or eliminate the unwanted side effects of scientific research.

3.1.3 Aircraft Overflights

Low flying aircraft are often used in avian censusing, and have the potential to disrupt bird activities, especially in those species which nest in colonies or open nests. Regular and census related movements of fixed and rotary winged aircraft have had negligible or minimal effects on cliff nesting and wading bird colonies. However, other species have shown moderate to severe effects when disturbed by aircraft, indicating a sensitivity to chronic disturbance.

The following procedures have been recommended for aircraft overflights:

1. The approach should be gradual with the aircraft initially circling the study subjects from a distance.

2. Flights should be directed around the periphery of a sensitive area rather than directly over it.

3. Flights should be slow with continual attention for signs of disturbance.

3.1.4 Approach and Nearness to Sensitive Areas

Investigators must also take into consideration the response birds may have to the sounds, the behaviour and the simple presence of humans. In addition, species that are not under study may be disturbed.

3.2 Collecting and Trapping

3.2.1 Humane Considerations

Whether one is collecting study birds for eventual release or for museum preparation, the same humane considerations should apply. These birds should not be exposed to excessive or inappropriate handling, conspecific aggression, predation, temperature extremes, or undue suffering.

3.2.2 Habitat and Population Considerations

Each investigator should observe and pass on to students and co-workers a strict ethic of habitat conservation. Because many essential details of life history may remain unknown until a study is well along, collecting should always be conducted so as to leave the population and habitat as undisturbed as possible.

The permanent removal of large numbers of birds from any breeding or roosting aggregation should be avoided, unless justified for very specific scientific reasons. Similarly, the collection of large numbers of females from any population for destructive sampling should be avoided.

Systematists should investigate extant collections for suitable specimens before conducting any field work. If the purpose of an experiment is to alter behaviour, reproductive potential or survivability, the interference should be no more than is determined necessary by the investigator to accurately test the hypotheses under question.

3.2.3 Compliance with Laws and Regulations

Investigators must obtain and comply with all permits required for the capture, handling and collection of those birds of the correct species and in the appropriate jurisdiction. In addition, they must be familiar with the current list of threatened and endangered species and must comply with all rules and regulations pertaining to these and all other categories of birds.

3.2.4 Live Trapping

Investigators should be familiar with traps and trapping techniques and should choose a trap type that is best suited to the species and type of study. Capture techniques should prevent or minimize injury or damage to the bird. Care should be exercised to avoid accidental capture of non-target species. Special consideration should be given to the setting of capture devices in areas that are frequented by pets and children. Trapping and handling equipment should be routinely inspected and maintained in good working order. At the end of each collecting period traps should be properly closed or removed.

Birds can be sensitive to heat, cold, thirst, energy deprivation and stress, and investigators must make every effort to avoid trap deaths from such factors as temperature extremes, stress, shock, and capture myopathy. Birds should not be left in traps longer than is absolutely necessary, although the time can may vary with the species, weather, objectives of the study, and trap type. Traps should be shaded or positioned to avoid full exposure to the sun and, where possible, trapping or netting should be avoided in windy, cold and rainy weather. Nets and traps should be watched or checked at least every 20 minutes during the nesting season or when the weather is unfavourable (intense sun or inclement weather), and at least every 30 minutes during the rest of the year. Captured birds can injure themselves trying to escape, and these injuries reduce the specimen's scientific value and cause needless wounds and suffering. Under extenuating circumstances there may be a need to position traps a long distance from the researcher. In these instances the traps should only be set when weather stresses can be minimized and they should be checked as frequently as possible .

Dependent Young: The trapping of wild birds with dependent young should, as a general principle, be avoided. When this is unavoidable, it must be accompanied by a program to either remove or kill the dependents if the parent cannot return. Every effort should be made, in advance of trapping, to locate nesting areas to minimize the inadvertent capture of these birds.

3.2.5 Collection of Specimens

In some instances, avian research may necessitate the judicious collection of birds in the field. This may be done to provide information on species identification, genetics, population structure and dynamics, comparative anatomy and physiology, evolutionary relationships, behaviour, parasites and diseases, economic factors, geographic and microhabitat distributions, and bird ecology in natural or disturbed habitats. The knowledge that results from the science of ornithology may be applicable to other biological sciences and may help to facilitate decisions involving management policies for all species, whether endangered or economically important, for the conservation of habitats, ecosystem analysis, pest and disease control, retrospective studies, predator control and domestication of species.

Many bird specimens removed from the field are used collaboratively and deposited in the collections of natural history museums or biological data banks for future studies. Museum collections are curated repositories for whole specimens and their parts, whereas biological banks are collections of histologically or cryobionically preserved organs, tissues (including live cultures), cells (including sperm and ova), eggs, or embryos. Both kinds of repositories allow qualified researchers access to study collections. It is strongly recommended that, when appropriate, voucher specimens and biological samples should be retained at the conclusion of field investigations. These specimens should be deposited in collections that meet the minimal standards of maintenance established by the American Ornithologists' Union, so that they will be available for use by future investigators. Communication with researchers in other jurisdictions is recommended in order to maximize the use of and information gathered from biological samples.

3.2.6 Methods for Collecting Specimens

Humane kill trapping and shooting kills the bird instantly while avoiding injury to the body parts required for the investigation. Shooting may be the most effective and humane way to collect some species, but its use is rarely justified or required.

Researchers planning to use firearms must be experienced in their proper and safe use and must comply with laws and regulations governing their use. The firearm and ammunition load should be appropriate for the species to be collected. Every effort should be made to avoid wounding birds, not only to minimize suffering, but also to maximize the probability of retrieving rather than losing the specimen.

Wounded birds should be killed promptly by either thoracic compression (cardiopulmonary) or pithing in the case of small birds, and cervical dislocation of large birds. Other methods of euthanasia are reviewed (see section on Euthanasia), but some may not be practical under certain field conditions.

Mist nets can be used to collect specimens in those situations where there is dense vegetation, where shooting is difficult, where the specimens may be damaged by shooting or where the use of firearms is prohibited. Mist nets must be checked frequently. The number of nets set up should reflect the amount of people available to check them. Net sets for diurnal species should be closed at dusk to avoid accidental capture of nocturnal species and vice versa.

3.3 Restraint and Handling

The nature of restraint will depend upon the procedure and the bird species involved. Restraint techniques can range from confinement in an enclosure through various types of physical restriction, to chemical immobilization. Any decision to use physical or chemical restraint in a research project should be based upon the knowledge and skill of those persons handling the birds, the goals of the investigation, and the availability of appropriate equipment and facilities. Investigators must use the least restraint that is necessary to do the job in a humane and effective manner, with the least stress to the bird.

3.3.1 General Principles of Physical Restraint

Because some species of wild birds are capable of inflicting serious injury to themselves or those handling them, some form of restraint is usually necessary. The well-being of the bird under study is of paramount importance and it must be emphasized that improper restraint, especially of frightened or stressed birds, can lead to major physiological disturbances, including hypothermia or hyperthermia, stress, shock and capture myopathy. In addition, the capture and/or marking of

some species of birds may alter their behaviour and predispose them to predation . Investigators should not allow unsupervised, inexperienced persons to handle birds until adequately trained to restrain, manipulate and release the birds properly. Special training and experience is required for the handling of large birds such as raptors, cranes, ratites, large anatids and galliforms.

It is best to handle wild birds quietly and without sudden movements, utilizing the minimum number of personnel that are required to safely handle the bird. When birds are restrained by hand, the hold must include the wings and legs in order to prevent damage to these appendages. Certain species may have specific requirements for physical restraint, including those with long legs and necks. Birds breathe by a bellows-like action of the ribs and sternum. Therefore, care should be taken so that the method of restraint does not interfere with the ventilatory movements of the sternum or impede the respiratory air flow. Birds that are allowed to struggle excessively can potentially injure handlers, injure themselves and/or become hyperthermic.

Darkened chambers and/or blindfolds tend to alleviate stress and subdue birds and should be used whenever possible. For relatively innocuous procedures, large species can often be calmed by enclosing the head in an opaque hood. Hoods are also useful for reducing struggling during pre-surgical evaluation, preparation, induction and post-operative recovery. Small to medium sized birds can be enclosed in cardboard or fabric tubes or comparable devices. When using a cloth bag, sack, tube or hood to restrain and settle a bird, care must be taken to prevent both hyperthermia and excessive damage to the plumage. Severe loss or disruption of the feathers may result in the death of the bird following release, due to hypothermia or a reduced ability to fly.

Gloves are appropriate for handling certain species such as raptors, to reduce the potential for handler injury. In addition, gloves will help to reduce the risk of transmission, between humans and birds, of potentially harmful bacteria such as *Staphylococcus aureus*, which affects raptors, or *Salmonella* spp. which affects humans. However, in general, the use of gloves is discouraged because they may promote the spread of disease between birds and/or reduce the tactile sensitivity of the handler.

Safety goggles should be worn when handling birds with long beaks, and ear protectors or plugs should be used when working near species capable of loud calls.

Prolonged distressful restraint should not occur. In some cases, it may be advisable to use general anaesthesia for restraint in the field. If so, the anaesthetic chosen should be one that permits a rapid return to a normal physiological and behavioural state. The bird should be kept under observation until complete recovery occurs. Invasive procedures require initial physical restraint but usually require analgesia and/or chemical immobilization (see Chemical Restraint Section).

3.3.2 General Principles of Chemical Restraint

The administration of anaesthetics to wild animals for restraint purposes can be accomplished safely; however, the use of chemicals do present risks to both animal and investigator. Field immobilization is almost always performed in less than ideal conditions. Only rarely can the investigator examine animals prior to anaesthesia, give accurate dosages in a controlled environment, and intensively monitor animals during anaesthesia events.

Every anaesthetic agent has specific advantages and disadvantages, and there is no single agent that is suitable for the chemical immobilization of all bird species under all circumstances. Safe and effective drug dosages will vary with the species, age, sex and body condition of the bird. In addition, there can be seasonal variations in their response to certain agents. A prolonged recovery time or need for special equipment may make some choices impractical for use in the field. The effects of drugs on many avian species have not been determined. When information

concerning the effect of an anaesthetic drug on the study species is unavailable, it is recommended that pre-experimental testing using low dosages of the drug is initiated under the supervision of a veterinarian experienced in avian anaesthesia.

Researchers requiring chemicals for restraint of birds should have the appropriate training prior to use, as well as training in monitoring and general medical care of birds. In general, it is advised that birds are only anaesthetized under the supervision of a veterinarian experienced in avian anaesthesia. Researchers should consider the following when using chemical restraint in birds:

1. Birds tend to have a higher metabolic rate and oxygen consumption relative to mammals. Therefore, birds may have a greater requirement for oxygen supplement and assisted respiration than mammals.

2. Birds have far less functional residual capacity than mammals and therefore, apnea (cessation of breathing), will result in death far more quickly.

3. The avian respiratory system, which consists of a pair of relatively fixed lungs and a group of mobile air sacs, is more efficient at gas exchange than mammals. Therefore, birds will often demonstrate a more rapid response to the effects of inhaled anaesthetics.

4. Inhalation anaesthesia, specifically isoflurane, is presently considered to be the method of choice for most procedures which require general anaesthesia in birds.

5. Because of the large volume of stored gases in air sacs, birds can be inefficient at eliminating inhaled anaesthetics. Recovery from anaesthesia can be facilitated by maintaining the bird in lateral recumbency and turning it every few minutes.

6. In general, injectable anaesthetic agents are a poor choice in birds and are used with limited success. Many agents have an unpredictable duration, a rough and prolonged recovery period and serious metabolic effects when used in birds. Birds have a renal portal system and therefore agents injected into the legs may be excreted or metabolized before reaching the systemic circulation. This may act to increase the variability of response to injectable agents.

7. Debilitated or stressed birds are very susceptible to the effects of hypoglycemia which can complicate an anaesthetic procedure.

8. Birds have a high body surface to volume ratio and this will act to exacerbate hypothermia during an anaesthetic procedure. Surgery and recovery areas should be sufficiently warm to counteract heat losses.

9. The most reliable indicator of depth of anaesthesia in birds is respiratory rate and character. Heart rate varies inversely with the size of the bird and should also be monitored closely.

3.4 Marking Procedures

3.4.1 General Considerations

Many studies require individual birds to be marked for identification. Marking techniques can cause effects, ranging from short-term discomfort, to long-term influences on breeding and survival. It is essential, for the welfare of the birds and the integrity of the research results, that

the marking procedure not adversely affect the normal behaviour, physiology, ecology or survival of individuals. In many cases it is possible to reduce the harmful effects of the mark by carefully designing it, giving special consideration to its colour, its attachment position, its mass, and the season in which it is applied.

In general, investigators should not assume that marking procedures will have no adverse effects on their study subjects and should make efforts to evaluate any such influences. Where possible, investigators should assess the effects of new marking procedures on captive individuals before incorporating them into field studies.

It is desirable for the scientific community to encourage ancillary research that specifically addresses the effects of marks and devices. Preferably, such research, which makes comparisons between marked individuals and controls, can be initiated in association with current studies. Because of the difficulty of providing appropriate controls, there are few systematic studies that assess the potential adverse effects of marking procedures. Many of the cautions mentioned here are based on anecdotal observations.

In general, for a marking procedure to be effective, it should meet as many of the following criteria as possible:

1. The bird should experience no immediate or long-term hindrance or irritation from the mark or marking procedure.

2. The bird should suffer no adverse effects on its normal behaviour, physiology, longevity, social life, ecology or survival.

3. The mark should be able to be applied quickly and easily and with minimal pain.

4. The mark should have readily visible and distinguishable digits and/or colours.

5. The mark should persist on the bird until research objectives have been fulfilled.

The CWS (Canadian Wildlife Service) permitting system requires that researchers planning to band birds attend a training course given by a qualified trainer before banding permits will be issued. All banders and prospective banders must familiarize themselves with the information in the Study Guide. A video, Banding Together, is also available. More information is available on special topics from the Banding Office, the Bird Banding Manual (US Fish and Wildlife Service 1976), or field specialists.

3.4.2 Semi-Permanent Marking

Leg Bands

Metal or plastic bands have been used successfully to mark many species of birds. However, certain species, such as vultures, storks, and terns, defecate on their legs and the resulting build-up of material around the bands may result in injury. The ice build-up on metal bands in cold climates has been recorded as another potential hazard, especially in waterfowl. In a few cases, adult birds, reacting to the sight of foreign objects in nests, have attempted to eject banded nestlings. It is also possible that banding may affect the sexual success of some birds.

Aluminum Bands: Numbered aluminum bands are issued through permit by the Banding Office, Canadian Wildlife Service, Ottawa, Ontario. These are the most widely used method of individually marking birds. Birds must usually be recaptured to read the band numbers. It is

imperative that bands of the correct size be used; bands that are too small for the species in question may cause serious injury to or even loss of the banded leg. Recommended band sizes for all species of North American birds can be found in the Bird Banding Manual (US Fish and Wildlife Service l976). In general, when appropriate sizes of aluminum bands are used on study birds, there are few indications that they produce adverse effects.

Coloured Plastic and Celluloid Leg Bands: One or more coloured leg bands are often applied to the legs of a bird. They provide a means of individually recognizing birds in the field without recapturing them. They are being used increasingly in studies of bird behaviour and ecology which involve large numbers of individuals. The application of colour bands requires special permission from the Banding Office. When used in combination with aluminum bands, plastic bands must be of the same size. In general, when bands of the proper size are used, few adverse effects of colour bands have been reported.

Leg Streamers: Coloured plastic legs streamers have proven useful in some studies. However, it must be taken into consideration that streamers, particularly if they are too large, or are attached to metal bands, may inhibit flight, cause abrasion to the leg of the bird, or produce behaviour changes.

Back Tags

These may be attached by a clip to the skin, or held in place by loops around the wing bases, to mark waterfowl and grouse. They cannot be used on small birds because they interfere with flight. Back tags on ruffed grouse apparently increased their vulnerability to avian predation to a greater extent than coloured leg bands.

Neck Bands

Properly applied plastic neckbands or collars may be used on geese and swans. Smaller waterfowl are liable to get their bills stuck in the collar as a consequence of their attempts to dislodge it. It has also been suggested that the use of neck bands on Black Brant can interfere with reproduction.

Wing Streamers

Patagial wing streamers of coloured plastic have been used with some success in birds ranging in size from passerines to eagles. However, eider ducks have demonstrated an adverse reaction by sucking markers. The size and shape of the streamer should be adjusted so that it does not interfere with flight. Most birds apparently treat the streamer as a "feather" and preen it into position.

Nasal Markers

Nasal saddles or discs are commonly used to mark waterfowl. Coloured plastic markers are held in place with nylon monofilament or metal wire which passes through the nasal opening. Improved design has reduced entanglement in aquatic foliage; however, recaptured geese have often been reported to have ripped nares. Male Ruddy Ducks marked with nasal discs were reported to be unable to obtain mates, possibly because of interference with brightly coloured bills and their role in courtship.

3.4.3 Temporary Marking

Feather Dyes

The application of non-toxic paint or dye directly to the plumage has been used successfully, although marks last only until the colour fades or the plumage is moulted. Care should be taken to avoid excessive matting of the plumage from the application. Behavioural aberrations may usually be avoided or at least minimized if the marking involves only small areas of the body, in locations that are not thought to be important in intra-specific signaling. For example, there are reports that Red-winged blackbirds whose red "epaulets" had been dyed, experienced difficulty maintaining territories, and that pair bonding in mourning doves can be disrupted by head painting.

Passive Integrated Transponders

Passive integrated transponders or microchips have been used to mark study birds permanently and can be used as an ancillary method of identification. These devices are implanted subcutaneously or intraperitoneally with complications reported rarely. However, birds must be recaptured and special equipment used to identify marked individuals. In addition, the transponders can migrate if applied subcutaneously, and this can make reading them more difficult in larger birds.

Radio Transmitters

The attachment of small radio transmitters to free living birds is a routine method of monitoring the location and movement of individuals. There is little direct evidence that when transmitters are of appropriate size, and are properly attached, they adversely affect birds. Transmitters are applied most frequently to larger species, but the development of units weighing 2 g or less has made them useful for smaller passerines. The addition of an external mass to a bird's body could have an adverse effect on its energetics, and this will increase with the percent body mass of the transmitter. In the case of large birds, transmitters are often less than 1 % of the body mass and the effects are negligible. However, in smaller birds the transmitters may be 5-10 % of the lean body mass. Where possible, transmitters should not exceed 5 % of body mass and those weighing more than 10 % of body mass should not be applied to birds released into the field. Since many birds, including some small passerines, accumulate migratory fat deposits that may equal up to 5 % of their body mass, for specific, short-term purposes this weight guideline could be relaxed. Excellent discussions of methods used in radio tracking studies can be found in Amlaner and Macdonald l980, Cochran l980 and Kenward l987.

A wide variety of attachment methods for transmitters are currently in use, including body harnesses, adhesives or suture materials which attach to the skin or feathers of the back or tail, neck collars, and leg mounts. In diving birds, surgically implanted internal transmitters have been used successfully in order to reduce the physical interference that is associated with external units.

The methods for attaching transmitters to a wide variety of taxa are reported in the literature. It is mandatory that investigators who are intending to utilize telemetry in their investigations investigate those sources relevant to their study species. A review of the pertinent literature will help to identify any potential adverse effects that transmitters may have upon the behaviour, survival and well-being of their study birds. It is strongly recommended that prior to being used in the field, new attachment techniques be evaluated on captive individuals.

Special attention must be given to the attachment of transmitters in those species which live in dense vegetation and those that roost or nest in cavities.

For more information on this topic consult the RIC (Resources Inventory Committee) manual entitled *Wildlife Radio-telemetry, Standards for Components of British Columbia's Biodiversity No. 5.*

3.5 Transport of Wild Birds

It may be necessary to transport birds as part of an experimental protocol or to move them from capture sites to holding facilities. Transport containers and methods of shipping birds will vary widely from species to species. In general, the containers used in the transportation of birds must protect the occupants from injury and allow the individual sufficient space so that it can assume a normal posture and engage in comfort and maintenance activities unimpeded by other birds. Ideally, birds should be separated. The tops of containers should be padded in those instances where excitable birds or species with delicate bone structures are to be shipped. Space sufficient to permit flight is not usually advisable because the chances of injury are increased. In addition, it may be necessary to restrain the wings of larger species. Adequate ventilation must be provided. For longer journeys, water and food should be provided as required for some species. The inside of containers should be as dark as possible, while still allowing them to find food or water and to move about. Proper arrangements should be made to ensure that birds arrive at destinations during normal working hours, rather than on weekends or holidays.

3.6 Housing and Captive Breeding

Wild birds used in captive studies should be as healthy and free of trauma as possible. Some exceptions to this rule include investigations into the effects of environmental stress and disease. It has been shown that passeriforms require 3 - 4 weeks to acclimate to captivity. Housing standards should follow CCAC guidelines and/or institutional animal care standards.

3.7 Minor Manipulative Procedures

The collection of tissue samples, experimental manipulations using injections and implants of hormone or drugs, playbacks of tape recorded vocalizations and presentation of decoys are fundamental tools for investigations of avian biology.

3.7.1 Collection of Blood Samples

The most common method for the collection of blood from birds is venipuncture. The jugular vein, occipital venous sinus or cardiac puncture are used, however, these methods are potentially dangerous to the subject when performed by inexperienced personnel. In most cases, the alar (wing) or tibio-tarsal veins can be accessed with less danger. In larger birds (over 100 g) sampling with a syringe and small gauge needle is appropriate. The use of a heparinized needle and syringe will facilitate blood collection. For smaller species, it is recommended that the vein be punctured with a 26 gauge or smaller needle and the blood collected directly into microhematocrit capillary tubes.

In general, it is advised that no more than 10 - 20 % of the bird's blood volume (approximately 1.5 - 2.5 % of lean body mass) be collected during sampling. It has been shown that the collection of blood samples from wing and leg veins does not impair the behaviour, reproduction or survival of wild birds. Following blood sampling, hemostasis can usually be achieved by

applying direct digital pressure to the collection site for several minutes. The bleeding should stop before the bird is released.

3.7.2 Collection of Other Tissues

In addition to blood, study protocols may require the collection or biopsy of other tissues such as fat, muscle, liver, feather pulp and gonad. The effects of these biopsies in avian species are variable. In general, it is recommended that these tissue collections only be made when scientifically justified. Before initiating a project involving invasive biopsy techniques, the researcher should conduct an adequate peer and literature review. Investigators should only collect the minimum amount of tissue that is necessary to reliably satisfy the research goals. In addition, the handling time for biopsy procedures should be restricted to less than 10 minutes.

In some instances, analgesia or anaesthesia may be required to effectively and humanely obtain the necessary sample. The survival ability of birds that are released following a biopsy procedure should not be compromised. It should be noted that non-invasive sampling is the preferred alternative. For example, feather pulp may be collected for certain applications, and is less invasive than other forms of tissue biopsy. However, care must be taken to avoid feathers that would impair flight or other essential functions. In addition, the removal of growing feathers can result in marked bleeding.

3.7.3 Collection of Food Samples

Diet information may be gathered as part of ecological and nutritional studies. Neck ligatures have been used on nestlings to collect food samples. In such cases, the investigator must carefully ensure that normal blood circulation and air passage is not compromised and that the nestling is not subjected to overt food deprivation. The sacrifice of birds for stomach contents is rarely justified. Instead, it is preferable to collect feces or regurgitated pellets. Some species, such as certain types of marine birds, can be induced to regurgitate stomach contents following capture or palpation. Stomach pumps and emetics have been used, but are not recommended unless as a last resort. These methods should only be used by very experienced personnel who have consulted with an avian veterinarian.

3.7.4 Injections and Insertion of Implants

Injections of appropriate solutions, whether subcutaneous, intramuscular, intraperitoneal or intravascular, may usually be made with very little effect on survival or normal bird behaviour. The personnel performing these procedures should be properly trained. Some solutions may be irritating or dangerous to the subject if they are not properly injected. Implants may migrate or become inactive if they are not properly inserted. Proper sterile procedures are required for intraperitoneal implants.

Before being used in the field, it is strongly recommended that new techniques are evaluated on captive individuals. A review of the pertinent literature will help to identify any potential adverse effects that injections or implants may have upon the behaviour, survival and well-being of the study birds.

3.7.5 Determination of Egg Viability

Experimental protocols may require an estimation of embryonic age and the number of eggs within a clutch that have viable embryos. A common technique to detect the presence of an embryo is trans-illumination (candling). However, many species have eggs in which the shells are too thick or too heavily pigmented for candling to be useful. Under these circumstances, eggs

have been broken open to determine embryonic age and viability. This approach is only justified in extreme circumstances. Electronic devices have been developed for field use which allow for the detection of embryonic heart beats or movements.

3.7.6 Playback of Tape-Recorded Vocalizations and the Use of Decoys

Playback of tape-recorded vocalizations to free living birds causes little disturbance or trauma as long as the period of playback is kept within reasonable limits (normally less than 30 minutes). However, prolonged playback may act to distract subjects from other activities such as feeding of young or incubation, thus resulting in reduced reproductive success. If possible, the investigator should become familiar with the subject's territory to avoid placing the speaker close to the nest site. The timing of playbacks may also be an important factor in determining a bird's sensitivity to them. For example, certain species may be more sensitive to calls during the early mating, nest building and incubation periods than later on in the reproductive season.

Live decoys are frequently used in avian research, sometimes in conjunction with call playbacks. Live decoys require particular attention in the field. Birds used in this way should be habituated for a day or so prior to initiation of the experiment. An untrained bird may tend to flail around in the cage when placed in the vicinity of another bird. Obviously, such behaviour could lead to injury of the decoy and may not serve as the appropriate experimental stimulus intended for the free living resident. A decoy habituated to housing in a cage under field conditions may behave more appropriately and is subjected to less stress. The decoy must be provided with food and water at all times. In general, the decoy should not be subjected to excessive aggression, predation, or adverse weather. Never expose a decoy to full sunlight without some form of shelter being available.

3.7.7 Experimental Manipulation of Plumage

Altering the external appearance of a bird by manipulation of the size and colour of plumes, wattles, etc. has proven to be an important experimental tool in behavioural ecology. Under captive conditions, such manipulations are not usually traumatic unless they impair the experimental subject's ability to eat or drink. However, under natural conditions it is important to ensure that such manipulations do not impair flight or other types of locomotion, or that they do not increase the individual's susceptibility to predation.

3.8 Major Manipulative Procedures: Surgery

When performing major manipulative procedures, humane principles should always be the first priority. Avian medicine, anaesthesia and surgery are areas of specialization within veterinary medicine and have undergone significant advances recently. There is no justification for accepting substandard care of study birds due to a lack of knowledge or expertise.

The conditions governing the choice of procedures may depend upon the intended fate of the bird. In general, four categories of subjects can be distinguished:

1. Wild birds in the field that are to be released immediately upon recovery.

2. Wild birds brought into a holding facility that will be released after recovery.

3. Wild or captive bred birds that are to remain captive permanently or for an indefinite period after the procedure.

4. Birds that will be euthanized without recovery.

For any bird that is to be released to the wild, the prime consideration should be that the procedure will have a minimal effect on its subsequent survival and reproductive potential. No bird should be released to the wild until it is deemed to be sufficiently recovered to perform normal behaviours, including predator evasion and feeding. If the purpose of the experiment is to alter survivability or reproductive potential, then the interference should be no more than is necessary, as judged by the investigator, to test the issue in question. Even birds that are to be held as permanent captives or ultimately euthanized should not be subjected to pain or suffering.

The acceptability and practicality of a procedure will vary with the experience and skill of the investigator. Procedures should only be performed after consultation with and preferably under the guidance of an experienced avian veterinarian. For any invasive procedure that is more complicated than a simple injection there should be supervised practice on a model or a carcass before it is attempted on a living bird. The ultimate goal of practice is to be able to perform the technique quickly and efficiently with minimal tissue trauma. A major portion of surgical trauma for many birds is the physical or chemical restraint that is associated with the procedure. Anaesthesia can be physiologically stressful and many birds are severely stressed by prolonged handling. Therefore, a technique will be more successful if it can be performed rapidly, but not hastily. Invasive procedures, if performed correctly, need not affect the survival or reproductive potential of the subject.

Some of the principles of avian surgery are different from those of mammalian surgery. In part, these differences are due to differences in avian structure and physiology (see also Chemical Restraint). When performing avian surgery, special attention should be taken to address issues specific to birds such as:

1. Most birds show little evidence of pain or discomfort from punctures or incisions over much of the body with the exception of the head and bill, scaled portions of the legs, and the vent area. Many birds, however, show a strong response to pinching or pulling of the skin, and to certain manipulations of the feathers. In some cases, birds do not demonstrate an overt reaction to manipulations of certain internal organs. Some surgical procedures, including laparotomy and muscle biopsy, may be performed with little or no anaesthesia.

2. Most species of birds are remarkably resistant to infection. However, this does not provide a justification for maintaining inappropriate hygienic standards while performing invasive avian surgery. A bird’s susceptibility to infection will be increased if it is subjected to overt stress which can result from excessive or prolonged handling, hypothermia, trauma, dehydration or caloric deprivation.

3. Presurgical fasting is not advised for small birds due to their high metabolic rates, and should be only long enough to empty the crop in larger birds to reduce the possibility of aspiration.

4. In preparing a surgical site, care should be taken to remove as few feathers as possible, so that the thermoregulatory abilities of the bird are not compromised. In general, feathers should be plucked and not cut when preparing a surgical site. Plucked feathers are replaced quickly as long as the feather follicle is not damaged. Special consideration should be given to the use of surgical soaps which contain surfactants. These agents can disrupt the water repellency of feathers in diving birds.

5. Ophthalmic ointment should be used to lubricate the eyes as necessary.

6. Avian blood vessels are less protected by surrounding tissues than in mammals, and there is a greater potential for haemorrhage. In addition, avian blood may not clot as quickly as mammalian blood.

7. Wound closure may require special suture materials or tissue glues. In some instances, incisions can be closed with tissue adhesive glue rather than sutures, which can pull through delicate avian skin.

3.9 Disposition of Research Birds

3.9.1 Release of Study Birds

Whenever it is practical, researchers should release field trapped birds following the completion of their studies. However, there are exceptions to this and, as a general rule, field trapped birds should be released only:

1. At the site of the original capture (unless conservation efforts dictate otherwise).

2. Where it can be reasonably expected that the released birds will re-establish their former social status.

3. When the weather conditions and the season are conducive to survival.

4. If it is in the best interest of the study subjects, and if their ability to survive in nature has not been impaired.

5. When the released birds are not a health hazard or are otherwise detrimental to the existing populations in a specific geographic area (*e.g.*, when they do not jeopardise the genetic integrity of a population or carry a potentially infectious disease).

6. When the birds' release is compliant with federal, provincial or local laws.

3.9.2 Euthanasia of Study Birds

Captive birds that cannot be released should, whenever possible, be distributed to colleagues for further study. However, if the bird is in chronic distress or pain, or if release or rehabilitation is neither feasible nor likely to succeed, then euthanasia may be the only alternative. If birds must be destroyed subsequent to a study, then it should be done using a method of euthanasia which is humane, instantaneous and considered to be acceptable, (see Reference section). In addition, the method of euthanasia should not interfere with any future research potential of the carcass or any specific post mortem analyses.

As a general rule, physical methods of killing birds, such as cervical dislocation (physical separation of the brain from the spinal cord) and thoracic compression are recommended for use on small birds during field studies. In some situations, carbon dioxide (CO_2) and anaesthetic overdoses are also suitable methods of euthanasia. In both the field and the laboratory, the investigator must be careful to ensure that euthanized birds are dead before disposal. Disposal of carcasses must be in accordance with acceptable practices as required by municipal or institutional regulations. Birds containing toxic substances or drugs should not be disposed of in areas where they may be scavenged or become part of the natural food chain.

4.0 Herptiles

Due to the considerable range of adaptive diversity that is demonstrated by amphibians and reptiles, no concise or specific compendium on approved methods in field research is practical or desirable. Rather, these guidelines are intended to advise the investigator, who may already be an authority on the biology of the species under study, on the current field techniques that are considered to be humane and effective in amphibian and reptile research. The researcher has the ultimate responsibility for the ethical and scientific validity of his/her work and for the methods that are employed. To those who adhere to the principles of careful field research, these guidelines will simply be a formal statement of precautions already in place.

4.1 Investigator Impact

4.1.1 General Considerations

Investigators have an obligation to identify and assess the consequences of their research activities on wild herptiles, populations and the environment. Whenever possible, action should be taken to avoid, alleviate or minimize any adverse effects. Research activities should include the collection of adequate samples to ensure valid research results, yet be balanced to minimize adverse effects. Investigators should always weigh potential gain in knowledge against the negative consequences of disturbance. Although short-term detrimental effects may result from research activities, research can ultimately yield long-term positive effects for the affected population.

Observer-related disturbance can be characterized in at least two ways. First, disturbances may create biases that affect both the gathering and analysis of data, if the actual process of measurement acts to alter the parameter being measured. Second, research activities might effect the status and well-being of the study subjects themselves. Both effects vary along a continuum from those that are overtly obvious to those that are subtle and difficult to detect. In addition, researchers should realize that disturbance also can occur to those species that are not under study.

4.2 Collecting and Trapping

4.2.1 Humane Considerations

Whether one is collecting study animals for eventual release or for museum preparation, the same humane considerations should apply. These animals should not be exposed to excessive or inappropriate handling, conspecific aggression, predation, temperature extremes, or undue suffering.

4.2.2 Habitat and Population Considerations

Each investigator should observe and pass on to students and co-workers a strict ethic of habitat conservation. Because many essential details of life history may remain unknown until a study is well along, collecting should always be conducted so as to leave the population and habitat as undisturbed as possible.

The permanent removal of more than 50% of the animals from any breeding or hibernation aggregation should be avoided, unless justified for very specific scientific reasons. Similarly, the collection of large numbers of females from any population for destructive sampling should be avoided. When permanent, destructive human alteration of a specific habitat is imminent (construction, water impoundment, etc.), the removal of entire populations may be justified. Systematists should investigate extant collections for suitable specimens before conducting any field work. If the purpose of an experiment is to alter behaviour, reproductive potential or survivability, the interference should be no more than is determined necessary by the investigator to accurately test the hypotheses under question.

4.2.3 Compliance with Laws and Regulations

Investigators must obtain and comply with all permits required for the capture, handling and collection of those amphibians and reptiles of the correct species and in the appropriate jurisdiction. In addition, they must be familiar with the current list of threatened and endangered species and must comply with all rules and regulations pertaining to these and all other categories of amphibians and reptiles.

4.2.4 Live Trapping

Field research on amphibians and reptiles frequently involves the capture of live specimens for data recording, marking, temporary confinement, or relocation. Investigators should be familiar with herpetological traps and trapping techniques and should choose a trap type that is best suited to the species and type of study. In some cases, the use of a variety of traps is required to obtain an unbiased sample, particularly when secretive, nocturnal or inactive species are being targeted. Capture techniques should prevent or minimize injury or damage to the animal. Care should be exercised to avoid accidental capture of non-target species. Trapping and handling equipment should be routinely inspected and maintained in good working order. At the end of each collecting period traps should be properly closed or removed.

Amphibians and reptiles are sensitive to heat, cold, dehydration, energy deprivation and stress, and investigators must make every effort to avoid trap deaths from causes such as exposure, drowning, shock, and desiccation. Animals should not be left in traps longer than is absolutely necessary, although this may vary with the species, weather, objectives of the study, and trap type. In general, traps should be checked at least once daily. Traps should be shaded or positioned to avoid exposure to direct sunlight and care should be taken to reduce predation in pitfall traps. Where possible, trapping should be avoided when weather conditions threaten the survival of trapped animals. Pitfall traps set during extremely dry periods should have some moisture provided in order to prevent desiccation of captured amphibians.

4.2.5 Collection of Specimens

In some instances, research may necessitate the judicious collection and preservation of specimens in the field. This may be done to provide information on species identification, genetics, population structure and dynamics, comparative anatomy and physiology, evolutionary relationships, behaviour, parasites and diseases, economic factors, geographic and microhabitat distributions, and ecology in natural or disturbed habitats. The knowledge that results from these studies may be applicable to other biological sciences and may help to facilitate decisions involving management policies for all species, whether endangered or economically important, for the conservation of habitats, ecosystem analysis, pest and disease control, retrospective studies and predator control.

Many specimens removed from the field are used collaboratively and deposited in the collections of natural history museums or biological data banks for future studies. Museum collections are curated repositories for whole specimens and their parts, whereas biological banks are collections of histologically or cryobionically preserved organs, tissues (including live cultures), cells (including sperm and ova) or embryos. Both kinds of repositories allow qualified researchers access to study collections. It is strongly recommended that, when appropriate, voucher specimens and other biological samples should be retained at the conclusion of field investigations, so that they will be available for use by future investigators. The collection of samples for museum preparation from natural populations is critical to:

1. Understanding the biology of animals throughout their ranges and over time.

2. Recording the biotic diversity over time and/or different habitats.

3. Establishing and maintaining taxonomic reference material essential to understanding the evolution and phylogenetic relationships of amphibians and reptiles.

Communication with researchers in other jurisdictions is recommended in order to maximize the use of and information gathered from biological samples.

4.2.6 Methods for Collecting Specimens

Humane kill trapping methods are those that kill the animal instantly while avoiding damage to the body parts that are required for the investigation.

4.3 Restraint and Handling

4.3.1 General Principles

The nature of restraint will depend upon the procedure and the species involved. Restraint techniques can range from confinement in an enclosure, through various types of physical restriction, to chemical immobilization. Any decision to use physical or chemical restraint in a research project should be based upon an understanding of the behavioural and physical characteristics of the species to be restrained, the field conditions under which the procedure will occur, the knowledge and skill of those persons handling the animals, the goals of the investigation, and the availability of appropriate equipment and facilities. Investigators must use the least restraint that is necessary to do the job in a humane and effective manner, with the least stress to the animal.

4.3.2 Physical Restraint

Because amphibians or reptiles, especially venomous species (including those with toxic skin secretions), may be capable of inflicting skin irritation or serious injury to those handling them, some form of restraint is usually required . The well-being of the animal under study is of paramount importance and it must be emphasized that improper restraint, especially of frightened or stressed animals, can lead to major physiological disturbances. In addition, the capture of some species of animals may alter their behaviour and cause death or predispose to predation.

Many species of amphibians and reptiles are intolerant of physical restraint and in some cases there is potential for injury to animal or handler. Investigators should not allow unsupervised, inexperienced persons to handle any animal species until adequately trained to restrain,

manipulate and release the animals properly. The researcher should consult the current literature and seek the advice of experienced professionals before handling an unfamiliar species.

The following are general guidelines that must be considered when a researcher restrains a reptile or amphibian.

Amphibians and Non-hazardous Reptiles

Most amphibians and reptiles are relatively small and slow moving, and can be restrained by hand or in a net. However, many small species are easily injured if the handler uses excessive force. Tail autotomy (tail shedding) can occur in most lizards if they are restrained by the tail. Although this is not a serious injury, it will influence future growth and reproduction by depriving the animal of fat stores as well as the integrity of the specimen. Tail loss may also affect the behaviour of the animal.

Because some reptiles may struggle excessively when manually restrained, the use of nets, hooks, tongs or handling bags may be required to reduce injury.

Hazardous Species

Venomous snakes(*e.g.*, rattlesnakes) and some large turtles are potentially dangerous and require special methods of restraint. Adherence to the following general guidelines is recommended when working with hazardous reptiles:

1. Procedures chosen should minimize the amount of handling time required, and reduce or eliminate the contact between handler and animal.

2. Those handling dangerous species should not work alone. A second person knowledgeable in capture/handling techniques and emergency measures, should be present whenever possible.

3. Only experienced personnel should handle venomous snakes . They should be familiar with standard emergency procedures that are to be initiated in the event of an accidental bite or contact. A treatment protocol and a supply of the appropriate antivenin should be available at all times. In addition, a physician or medical facility should be made aware of the nature of the studies being undertaken so that proper arrangements can be made for emergency care and examination.

4. Whenever possible, an anaesthetic and/or physical restraint should be used before physical contact with the specimen.

4.3.3 Chemical Restraint

Prolonged distressful restraint should not be occur. In some cases, it may be advisable to utilize general anaesthesia for restraint in the field. If so, the anaesthetic chosen should be one that permits a rapid return to a normal physiological and behavioural state and the animal should be monitored until complete recovery occurs. The unpredictable nature and prolonged recovery times that are associated with the use of some anaesthetic agents in reptiles and amphibians may negate their use under field conditions. Because of this uncertainty, some minor procedures may be less traumatic and deleterious when performed quickly without anaesthetics by experienced personnel. The pain perception of these species is poorly understood. What causes pain and distress to a mammal may not have comparable effects on a reptile or amphibian; however, procedures should be performed under human and ethical conditions. Consultation with an experienced herptile scientist or veterinarian is required to choose the appropriate agents and to

establish experimental protocols. Many chemicals used for restraint or immobilization of amphibians or reptiles also have the potential for deleterious effects on humans.

Where possible, investigators should assess the effects of immobilization chemicals and procedures on captive individuals before incorporating them into field studies.

4.4 Marking Procedures

4.4.1 General Considerations

Many studies require individuals to be marked for identification. Marking techniques can cause effects ranging from short-term discomfort, to long-term influences on breeding and survival. It is essential to the welfare of the animal and the integrity of the research results, that the marking procedure not adversely affect the normal behaviour, physiology, ecology or survival of individuals. In choosing an acceptable marking technique, the investigator must consider the nature and duration of the restraint that is required for its application, the amount of tissue that is removed or damaged, the amount of momentary or prolonged pain that is involved and the potential risk for infection.

In many cases it is possible to reduce the harmful effects of the mark by careful design, with special consideration to colour, attachment position, mass, and the season in which it is applied. In general, investigators should not assume that marking procedures will have no adverse effects on their study subjects and should make efforts to evaluate any such influences. Where possible, investigators should assess the effects of new marking procedures on captive individuals before incorporating them into field studies. It is desirable for the scientific community to encourage ancillary research that specifically addresses the effects of marks and devices. Preferably, such research, which makes comparisons between marked individuals and controls, can be initiated in association with current studies. Because of the difficulty of providing appropriate controls, there are few systematic studies that assess the potential adverse effects of marking procedures. Many of the cautions mentioned here are based on anecdotal or unpublished observations.

In general, for a marking procedure to be effective, it should meet as many of the following criteria as possible:

1. The animal should experience no immediate or long-term hindrance or irritation from the mark or marking procedure.

2. The animal should suffer no adverse effects to its behaviour, physiology, longevity, social life, ecology or survival. The animal should not experience a greater susceptibility to predation or a reduced ability to breed.

3. The mark should be able to be applied quickly, easily and with minimal pain.

4. The mark should be readily visible to identify individuals or groups as required.

5. The mark should be effective in allowing the researcher to meet the objectives of the study and persist on the animal until research objectives have been fulfilled.

4.4.2 General Techniques

Toe Clipping

In most amphibians and reptiles with normally developed limbs, the removal of toes has proven to be a useful method of permanent marking that is claimed to have little, if any, adverse effect on the behaviour and survival of most marked individuals. In general, no more than two non-adjacent toes per foot should ever be clipped. In addition, the specialized toes that are essential for survival activities such as burrowing, climbing, amplexus, nest excavation, or propulsion should not be interfered with. In salamanders, digit regeneration may be prevented by an application of phenylmercuric acetate solution after removal of the toe. Clipped toes should be kept for determination of age by skeletochronology, to maximize yield of data.

It is recommended that if other, less painful, permanent marking methods are available they should be used, as long as they do not influence survival in nature. If there are no feasible alternatives for toe clipping in the study species, it is recommended that the effects of digit removal be evaluated on captive individuals in order to determine whether or not animals are impaired by this technique.

When toe clipping is proposed as the method of marking amphibians and reptiles in the field, its use should be reviewed and approved by an institutional animal care committee.

Removal of Scutes / Branding

Removal of subcaudal or ventral scutes according to a standardized numerical code provides a good permanent marking system for snakes, which does not appear to increase mortality or impair locomotion. The scute is removed with small surgical scissors or by rapid cauterization. Healing is usually rapid and infection is rare. A comparable method of marking is the electrocauterization of a number or letter on the skin. In order to be effective, the deep layers of the skin must also be cauterized to prevent regeneration. In amphibians, these brand marks may not be visible after a few months. The use of a local anaesthetic (aerosols containing benzocaine, such as Cetacaine®, or injectable local anaesthetics) is strongly recommended with branding or electrocauterization. However, the skin of reptiles is relatively impermeable and this reduces the effectiveness of topical products.

Tattoos and Dye Markers

Tattooing has been used with success on both amphibians and reptiles. There are two potential problems that should be resolved prior to applying tattoos:

1. The dye must contrast with the normal skin pigmentation, and

2. Loss of tattoo legibility due to diffusion or ultraviolet degradation must be minimized.

Paint should not be used to mark the moist and permeable skin of amphibians. Although reptile skin is less permeable, this varies among species, and some paints or paint solvents may be absorbed and kill the animal. Paints with non-toxic pigments, bases and solvents must be used. When the toxicity of an agent is unknown, it should be reviewed in the literature , or evaluated in laboratory trials, before being applied in the field. Very tenacious paints may, if applied across shell sutures, severely distort the normal shell growth of turtles, especially in sub-adults. In general, paint should not be applied to the sutures of turtle shells.

Banding and Tagging

The size, shape and placement of tags should allow normal behaviours in the animal that is marked. Bands and tags that project from the body may impair physical activities or cause entanglement in undergrowth or aquatic cover. In addition, projecting markers may be torn as a result of the animal's movements. Brightly coloured tags may compromise an animal's camouflage or act as predator attractants. Petersen disc-type tags have been placed in the web between the hind toes of some frogs, but only large frogs are able to accommodate even small disc tags. Peterson discs have been associated with mortality in freshwater turtles. Coloured mylar ribbon tags 1-2" long have been considered an acceptable alternative.

Shell Marking

In most species of turtles, the bony shell can be marked by cutting notches or drilling small holes in the marginal scutes of the carapace. Shell marking is permanent. Turtles have also been marked with disc-type tags and clamp-on-ear-type tags applied to the webs between the toes. However, these methods are subject to limitations previously mentioned under "Banding and Tagging".

Radioisotopes

The use of radioisotopes as markers in natural systems is a valuable study tool and may be the only means of adequately gathering information on the movements of very small species. However, the application of these agents should be undertaken only with caution. Researchers are required by law to have special training and to observe special precautions. In addition, a license is required which outlines the safety procedures, the disposal of waste material, and the release of isotopes into natural systems. The potential use of these agents must be evaluated with consideration to the deleterious effects that these agents can have on the study animal, as well as on its predators and the public.

Passive Integrated Transponders

Passive integrated transponders or microchips have been used to mark study animals permanently and can be used as an ancillary method of identification. These devices are implanted subcutaneously or intraperitoneally with complications rarely reported. However, animals must be recaptured and special equipment used to identify marked individuals. In addition, the transponders can migrate if applied subcutaneously, and this can make reading them more difficult.

4.4.3 Radio Transmitters

The attachment of small radio transmitters to free-roaming vertebrates has become a routine method of monitoring the location and movement of individuals. Transmitters vary in size, mass, longevity and range characteristics, and are available from several commercial outlets. There is little direct evidence that when transmitters are of appropriate size, and are properly attached, they adversely affect research subjects. The researcher should choose a transmitter and method of attachment that harmonizes with the anatomy and behaviour of the study animal.

A wide variety of attachment methods for transmitters are currently in use and are reported in the literature. It is mandatory that investigators who are intending to utilize telemetry investigate those sources relevant to their study species. A review of the pertinent literature will help to identify any potential adverse effects that transmitters may have upon the behaviour, survival and

well-being of their study animals. It is strongly recommended that prior to being used in the field, new attachment techniques be evaluated on captive individuals.

Many amphibians and reptiles are unsuitable for radio telemetry studies due to their small size and their habit of living in confined spaces below the ground surface. Although there is no firm consensus, it is generally recommended that the ratio of transmitter weight to animal weight should not exceed 5 %. In those cases where long transmitter life is required, most of this mass is a result of the battery. The continued miniaturization of transmitters will undoubtedly continue, and this will facilitate the future use of radio telemetry in reptile and amphibian studies, particularly with internally implanted transmitters.

Researchers intending to apply radio transmitters to amphibians or reptiles should consider the general guidelines and comments listed below. For more information on this topic consult the RIC (Resources Inventory Committee) manual entitled *Wildlife Radio-telemetry, Standards for Components of British Columbia's Biodiversity No. 5*.

Force-Fed and Implanted Transmitters

Force-fed or implanted transmitters should be coated with an impervious, biologically inert coating. Transmitters of suitable size have been sealed in an inert plastic coating and force-fed to snakes. Force-fed packages are small enough to pass through the gut without obstructing the passage of food. Residence time of up to several days in the gut has been long enough to provide useful information on movement and body temperature. However, this method can influence behaviour of study animals and is now discouraged.

Transmitters also may be surgically implanted into the body cavities of large snakes. These transmitters should not interfere with the function of the organs surrounding them. In coelomic and subcutaneous implants, it may be necessary to suture the transmitter package in place to prevent its movement and interference with vital organs. The implantation of transmitters should only be performed under aseptic conditions by properly trained and experienced investigators.

Externally Attached Transmitters

Transmitter attachments that will impair reproduction, locomotion, behavioural interactions, thermoregulation or other normal activities should be avoided. The transmitter should be shaped and attached so as to eliminate or minimize the risk of entanglement with vegetation or other obstructions.

Amphibians and reptiles, including adults, continue to grow throughout their life. Therefore, consideration should be given to the eventual removal or release of an external transmitter so it does not cause constriction or irritation.

External attachment of transmitters on a number of species is possible by using various attachment harnesses and other techniques. However, the external device may alter the appearance of an individual enough to affect its behaviour and interactions with conspecifics and predators.

Radio telemetry has also been used in studies on larger turtles. The transmitter was attached to the dorsal surface of the shell by clamps over the edges of the carapace. Telemetry signals have been received both in and out of water.

4.5 Transport

It may be necessary to transport animals as part of an experimental protocol or to move them from capture sites to holding facilities. Transport containers and methods of shipping reptiles and amphibians will vary widely from species to species. The live traps that are used for capture are usually adequate for the transport of animals over short distances. However, if the animals are to confined for a longer period, these traps may not be suitable. Proper arrangements should be made to ensure that animals arrive at destinations during normal working hours, rather than on weekends or holidays.

4.6 Housing and Maintenance at Field Sites

Wild animals used in captive studies should be as healthy and free of trauma as possible. Some exceptions to this rule include investigations into the effects of environmental stress and disease. Because of the wide variation in husbandry requirements of amphibians and reptiles, and the diversity in study objectives, only the most general recommendations on housing can be made in these guidelines.

1. In order to determine the husbandry requirements of a particular species the researcher should consult the current literature and experienced professionals.

2. When dealing with an unfamiliar species, the researcher should evaluate and compare several methods of housing in order to determine the method most appropriate for the needs of the animal and the objectives of the study.

3. Restraint and ease of maintenance by animal keepers should not be the primary determinant of housing design.

4. Normal field maintenance should incorporate, as far as possible, those aspects of the natural habitat that are deemed to be important to the survival and well-being of the animals.

5. The adequacy of captive conditions can be judged, relative to the natural environment, by monitoring a combination of factors such as changes in growth and weight, survival rates, breeding success, activity levels, general behaviour and appearance.

6. Consideration should be given to providing an environment that includes features such as natural materials, refuges, heat sources and water baths.

7. Natural foods should be duplicated as closely as possible, as should natural light and temperature conditions, unless alterations of these are factors under investigation.

8. Frequency of cage cleaning should represent a compromise between the level of hygiene necessary to prevent disease and the amount of stress that results from frequent handling and exposure to unfamiliar surroundings and bedding.

9. Housing standards should follow CCAC guidelines and/or institutional animal care standards.

4.7 Disposition of Research Animals

4.7.1 Release of Study Animals

Whenever it is practical, researchers should release field trapped animals following the completion of their studies. However, there are exceptions to this and as a general rule, field trapped animals should be released only:

1. At the site of the original capture (unless conservation efforts dictate otherwise).

2. When the weather conditions and the season are conducive to survival.

3. If it is in the best interest of the study subjects, and if their ability to survive in nature has not been impaired.

4. When the released animals are not a health hazard or are otherwise detrimental to the existing populations in a specific geographic area (*e.g.*, when they do not jeopardise the genetic integrity of a population or carry a potentially infectious disease).

5. When the animals' release is compliant with federal, provincial or local laws.

4.7.2 Euthanasia of Study Animals

Captive animals that cannot be released should, whenever possible, be distributed to colleagues for further study. However, if the animal is in chronic distress or pain, or if release or rehabilitation is neither feasible nor likely to succeed, then euthanasia may be the only alternative. If animals must be destroyed subsequent to a study, then it should be done using a method of euthanasia which is humane, instantaneous and considered to be acceptable (see Reference section). In addition, the method of euthanasia should not interfere with any future research potential of the carcass or any specific post mortem analyses. In both the field and the laboratory, the investigator must be careful to ensure that euthanized animals are dead before disposal. Disposal of carcasses must be in accordance with acceptable practices as required by municipal or institutional regulations. Animals containing toxic substances or drugs should not be disposed of in areas where they may be scavenged or become part of the natural food chain.

5.0 Personnel Safety and Health Precautions

5.1 General Precautions

Health and safety responsibilities listed in the CCAC Guide, Volume 1, apply to those involved in field studies of wild animals. It is important that investigators protect technicians, students and themselves against possible injury or exposure to potentially dangerous procedures, chemicals, animals, or animal fluids and waste. They must ensure that adequate protective measures are implemented for the humans involved during the capture of animals. The investigator also must ensure that all workers fully understand the techniques to be used for restraint and handling. Investigators should familiarize themselves with known biohazards specific to the species under study and with the methods to avoid transmission of zoonotic diseases and parasites.

5.2 Drugs and Chemicals

All drugs and chemicals used in field research should be handled in such a way as to prevent human exposure. Researchers should protect themselves against both respiratory and cutaneous exposure to drugs and chemicals as well as accidental injection . Those utilizing immobilization drugs for restraint of wild animals must have the appropriate training and information available to aid in their medical care should accidental contamination occur (see Chemical Restraint Section).

5.3 Zoonotic Diseases and Parasites

Investigators are at risk of exposure to zoonotic diseases, or those diseases and parasites transmitted from animals to humans. The degree of risk varies with the species of animal to be studied, the degree of exposure and the organisms present.

Researchers working in the field should take precautions to avoid exposure to external animal parasites such as ticks, fleas, as well as to animal feces which may contain internal animal parasite ova or larvae infective to humans.

Wild animals captured and held temporarily, cages and traps, and animals brought into holding facilities should be examined and treated for external and internal parasites which may be transmissible to other animals or humans, or can transmit infectious diseases.

Infectious organisms may be present in wild vertebrates which are a potential hazard to humans (e.g., the discovery of hantaviruses in North America). Therefore, any unusual symptoms observed in investigators, students, or technicians who handle wild vertebrates should immediately be reported to medical authorities knowledgeable about the diseases and parasites associated with wild animals.

Workers should follow the General and Specific Biohazard Precautions for handling wild animals and other special precautions as produced by the Ministry Occupational Safety Office. In summary:

1. All animal tissues, fluids and excrement should be handled so that the potential for human contact is minimized. Researchers should avoid contaminating skin and clothing with blood, body fluids or excrement. Researchers should thoroughly wash hands and any other

contaminated skin surfaces with a germicidal skin cleanser immediately after handling wild animals or their samples. Researchers should also be aware that many amphibians produce toxic skin secretions. The effects of these toxins can range from mild irritation to more severe symptoms. All personnel handling amphibians should practice good hygiene and avoid rubbing their eyes after contact.

2. Appropriate precautions should be taken in order to prevent injuries from bites, scratches and skin punctures from wild animals. Even minor injuries may become infected. Basic first aid and appropriate hygiene can prevent such complications.

3. Where there is a risk from aerosolized pathogens from saliva, feces or urine, protective gear such as gloves, eye protection, respiratory protection (masks or respirators), foot protection and protective clothing should be used as necessary. The researcher should always wear disposable gloves when handling sick or dead animals.

4. All contaminated equipment should be cleaned and disinfected immediately after use.

5. All drug containers, needles, scalpel blades, suture needles and other sharp instruments should be used and disposed of in a manner which prevents accidental human injury.

6. Those individuals who are exposed to potential vectors of rabies (e.g., skunks, raccoons, foxes, bats or animals with abnormal nervous system symptoms) should immediately report the exposure to medical authorities. Those researchers working with bats may wish to consider pre-exposure vaccination. These vaccinations may be given to investigators who routinely handle high-risk species from various sources. Researchers and their assistants should also consider vaccination against tetanus in those situations where exposure to this pathogen is possible.

5.4 Venomous Snakes

Only experienced personnel should handle venomous snakes. They should never work alone and be familiar with the emergency procedures that are to be initiated in the event of an accidental bite or contact. A supply of the appropriate antivenin and a posted treatment protocol should be available at all times. In addition, a physician or medical facility should be made aware of the nature of the studies being undertaken so that proper arrangements can be made for emergency care and examination.

5.5 Allergies

Individuals with known severe allergies associated with animals, with immune deficiency diseases, or on immunosuppressant therapy, should not engage in studies involving the handling of wild animals.

5.6 Records

Investigators should maintain a standardized record of any injuries or illnesses incurred in the field or laboratory. Such information should accompany the individual requiring examination or treatment by a medical practitioner.

Researchers should also maintain a record and pertinent product information of all immobilization drugs in their possession and their usage according to the Ministry Chemical Immobilization of Wildlife Policy.

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