Canadian Council on Animal Care
Conseil canadien de protection des animaux

CCAC species-specific recommendations on:

BATS

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

1. General Considerations

There are about 1,000 different species of bats in the world, ranging in size from 2 grams to 1,500 grams. While some species use echolocation, others do not. Bats play a number of trophic roles; some species eat animals (usually insects), others fruit and leaves, nectar and pollen, and still others blood. While some bats are homeothermic, others are heterothermic. The combinations of size, feeding behaviour, thermoregulation strategy and use of echolocation makes it vital to know as much as possible about a study species before embarking on research with these animals. Some species are at risk and should be the subjects of research only after careful deliberation (Hutson *et al.*, 2001).

Hibernating bats are sensitive to the presence of humans and respond by an increase in activity (Thomas, 1995). Visits to sites where bats hibernate should therefore be minimized. In *Myotis lucifugus*, one arousal from hibernation (for example, in response to disturbance) costs the bat the same amount of energy that it would use during 60 days of hibernation (Thomas, 1995).

Female bats often aggregate in maternity colonies, places where young are born and raised. In these areas, bats are extremely sensitive to disturbance which can lead to young being dropped by their mothers or the bats being forced to move to an alternate (perhaps inferior) site.

2. Killed Specimens

Where samples from previously killed specimens are used, investigators are not required to submit a formal protocol to an animal care committee (ACC). However, the ACC should be informed of the study so that the potential for disease transmission, etc. is understood. In addition, investigators should be aware that, even for previously killed organisms, many journals will not accept papers unless the study has been subject to ethical review by an ACC.

3. Live Capture

Bats are sensitive to thermal changes and dehydration, and minimal handling is recommended to limit the period of stress. Individuals should not be taken from maternity colonies during the parturition and lactation period unless necessary to accomplish the goals of the study.

Mist nets, hand/hoop nets and harp traps, when properly used, are humane methods for the capture of bats (Tuttle, 1974; Kunz & Kurta, 1988). Mist nets need to be monitored regularly and captured bats removed immediately to avoid injuries caused by net entanglement or predators. Care must be taken when removing bats from mist nets, and special attention paid to the removal of their wings. Since bats fly into nets with their wings spread and fold them after capture, successful removal of a bat from a mist net often means spreading its wings. Allowing the bat to bite something, such as a cloth bag or loose part of a glove, may help prevent it from chewing the net while being removed (Kunz & Kurta, 1988). As a precaution, investigators should carry small scissors for cutting the net in cases where a bat has become severely entangled.

Harp traps, instead of mist nets, should be used where large numbers of bats need to be captured. Harp traps do not need to be tended as frequently as mist nets; however, one must be aware of the possibility of predators entering the trap bag, as well as the potential negative consequences of keeping several bats in the same bag (e.g., biting, predation, and rabies transfer) (Kunz & Kurta, 1988). Many designs of harp traps only provide limited protection from the weather. Heavy rain or other adverse weather could result in bats becoming wet, affecting their thermoregulation and hence their energetic balance. Also, if bats are trapped in the morning, they need to be protected from the sun. Harp traps must be checked with sufficient frequency so that feeding patterns are not severely interrupted. In many areas, bats are most active shortly after dusk, so checking should be more frequent during this period.

Roosting bats can be successfully captured by hand. When extracting bats from roosting sites, investigators must be careful not to damage the delicate wing bones and membranes (Kunz & Kurta, 1988). Hand nets are also used, but should not be employed unless the user is very adept. Investigators must exercise particular caution so as not to injure the

bats, as the risk of wing injury is high (Kunz & Kurta, 1988). In many cases, the combined speed of the bat and the net are sufficient to stress or break fragile finger bones. It is best to bring the net up from behind the flying animal as opposed to scooping at it head on.

4. Physical Restraint and Handling

Captured bats bite in self-defense. The great variation in the size of bats means that while some species can deliver painful bites, others rarely break the skin. People handling bats or removing them from nets should consider wearing gloves of appropriate weight to reduce the risk of bites. Some bat biologists wear one glove when removing bats from a mist net, using the gloved hand to secure the bat and the bare hand to disentangle it from the net. If gloves are used, however, they must be thin (e.g., golf gloves or thin synthetic diving gloves) so that the handling of bats is not made more difficult and the bats are not subjected to an increased risk of injury. Additionally, due to the difficulty of handling bats properly, an individual knowledgeable about appropriate techniques should be present.

5. Chemical Restraint and Anesthesia

The use of chemical restraint is recommended whenever a procedure will cause undue stress or pain to a bat. Isoflurane and sevoflurane are the anesthetics of choice. The use of halothane or methoxyflurane are not recommended because induction time is prolonged, and these anesthetics are stored in body fat for long periods of time (Kemmerer, in preparation).

6. Banding and Tagging

Bats should only be banded if necessary to the goals of the study, as the stress of handling can affect the animals' well-being. Furthermore, all bands are injurious to bats to varying degrees, and the bats have been known to obliterate the identifying numbers by chewing on the bands (Barnard, 1989). Banding is not appropriate for all species of bats. Adverse problems have been found for some species, including infections in the membranes around the band, which could in some cases affect survival. Investigators should check the literature to ensure that the marking technique is acceptable for their species and their research question.

Any detrimental effects of banding on bats will be greatest during times when their energy levels are most critical (e.g., during hibernation or when females are caring for young) (Barclay & Bell, 1988), and thus banding should be avoided during these times. Additionally, it is recommended that the capture of bats for marking take place away from their roosts, as bats may permanently abandon sites where they have been captured

(Barclay & Bell, 1988).

Bands, whether aluminum or plastic, are an acceptable means for permanently marking bats, if applied correctly. Aluminum bands should have a recurved opening, if possible, to avoid chafing on the membrane. For small insectivorous bats, or those with narrow antebrachial membranes, bands can be placed over the forearm with the opening facing posteriorly (i.e. with the opening overlying the flight membranes or patagia). In species where the antebrachial membrane is wide, two small incisions may be made through the membrane just anterior and posterior to the forearm, allowing the bands to surround the forearm without affecting the shape and position of the membranes. In general, bands must be sized to allow for continued growth, but not so large as to slide over wrist or elbow joints and hinder movement (Barclay & Bell, 1988).

Bead-clasp and plastic ratchet style necklaces have been used successfully to mark bats (Barclay & Bell, 1988). Investigators must exercise extreme care in fitting bats with necklaces, as an improper fit can lead to open wounds and infection (Barclay & Bell, 1988). Additionally, necklaces should not be used on growing juveniles or species with sternal, gular or shoulder scent glands (Barclay & Bell, 1988).

7. Tissue Marking

Ear or toe clipping and notching are not acceptable methods for marking bats. Alterations to the ears can affect their important role in orientation and locating prey, while changes to the toes can hamper the bat's ability to roost or groom itself (Barclay & Bell, 1988).

Wing membranes of bats have been marked with tattoos for short-term studies (Barclay & Bell, 1988). Care must be taken, however, to avoid causing any tears in the wing web membrane, as tears that extend to the margin of the web usually will not heal and result in a non-releasable bat.

8. Radio Transmitters

The use of transmitters should be carefully considered, especially at times when prey are not abundant, given that they may affect the bat's maneuverability and foraging habits. Aldridge and Brigham (1988) found an inverse relation between increased mass of a bat (such as from the attachment of a radio transmitter) and the bat's ability to maneuver. They further suggest that a decrease in maneuverability is likely to result in bats choosing open sites over cluttered sites for foraging (Aldridge & Brigham, 1988). A study by Hickey (1992) indicated no significant impact on the foraging success of bats in open areas when transmitters of approximately 3% of the body mass of the bat are used, but the author acknowledged that this may differ for bats in cluttered habitats. Aldridge and Brigham (1988) recommend that radio-telemetry studies be only conducted when prey is abundant and the animal can maintain a positive energy balance. When possible, bats

should be recaptured to remove the transmitters once the required data is collected.

Transmitters and other tags should be as small as possible and not exceed 5% of the bat's body mass. This means that a 0.47g transmitter (the smallest available in 2002) can be attached to a bat weighing 10g, provided that the attachment mechanism does not add more than an additional 0.03g to the package.

There are two options for attaching radio transmitters to bats. The first option is to attach the transmitter to the interscapular region using a surgical adhesive. Depending on the care taken in attaching these packages and the grooming habits of the bat, the packages will remain in place for days to months (Wilkinson & Bradbury, 1988). This method works best if the fur is clipped with fine scissors first; however, if the skin is nicked by accident, the radio tag must not be attached. Additionally, repeatedly attaching radios to the same bat may cause permanent reduction in the thickness of the pelage (Wilkinson & Bradbury, 1988). The second option is to attach the transmitter by the use of a collar (e.g., Fenton *et al.*, 1998).

9. Medical / Surgical Procedures

In bats, blood can be obtained from: 1) venous puncture of the vein running along the anterior edge of the propatagium or antebrachial membrane; and 2) venous puncture of the major vein in the interfemoral membrane (Kunz & Kurta, 1988; Watt & Fenton, 1995). When blood samples greater than 30µL are required, it may be advantageous to do the blood letting over both of these sites in order to obtain the necessary sample and to avoid multiple punctures on the same vein. Researchers should ensure that bleeding has stopped after drawing blood and before releasing the bat.

Tissue sampling for DNA analysis can be achieved via a small wing punch using a biopsy punch. This heals quickly. The biopsy should avoid major blood vessels in the wing and again any bleeding should have stopped before the bat is released. Procedures for wing punches are well described by Rossiter *et al.* (1999; 2000), Kerth *et al.* (2001) and DeFanis and Jones (1996).

10. Transportation

When intending to transport bats, they should be captured soon after they have fed and taken water (Kunz & Kurta, 1998), and then moved during the day. The bats should be protected from temperature extremes, overcrowding and other forms of stress, and should be provided with fresh food as required. Kunz and Kurta (1998) note that when bats are removed from their natural environment, they are prone to becoming dehydrated and overheated, thus care should be taken to guard against these conditions. Some bats roost solitarily in the open in nature while others are extremely gregarious and roost in tight crevaces. The number of bats held together and the choice of cages or bags should reflect their natural roosting behavior. Colonial bats readily accept being held in groups of 5 to

10, while solitary bats should be held separately.

In general, holding containers for bats should be darkened and well ventilated, and should contain perching structures. A number of devices have been used successfully for this purpose, including nylon mesh or muslin bags, the Myers bag, metal or plastic minnow buckets, and modified plastic trash containers (see Kunz & Kurta, 1988 for descriptions of these containers). Barnard (1995) provides a number of designs for containers to transport bats which take into account the size and habits of the bat. Suitable designs for containers are also given in the International Air Transport Association (IATA) *Live Animal Regulations*. For short periods of time, a simple cloth bag may be the best holding container to transport bats, with the exception of *Lasiurus borealis*. This species can become seriously injured in such containers (Constantine, 1986). The best method for transporting *L. borealis* is in a styrofoam container (Barnard, 1995).

Bats that are normally geographically separated should not be housed together in cages because of the potential risk of disease transmission (Constantine, 1988). Additionally, disposable cages, or cages that have been autoclaved or fumigated between uses, should be used to further prevent the accidental transmission of diseases (Constantine, 1988).

Investigators should always be mindful of the risk of rabies transmission when moving bats.

11. Husbandry

Because of the variation among species of bats, literature on the particular species to be kept in captivity should be reviewed. Barnard (1995) and Wilson (1988), two such sources of information, discuss the nutritional requirements for various groups of bats and how these might be met in captivity, as well as important considerations for housing.

12. Translocation and Release

Where possible, bats should be released into their original habitat to avoid unnecessary expenditures of energy in meeting their needs or in attempting to return to their former habitat (Barnard, 1995). Barnard (1995) recommends that prior to the release of a bat, particularly in the spring and fall, it should be fed for a few days to one week in order to build sufficient fat reserves for survival.

Care should be taken to avoid releasing bats during the daytime, as they can be very susceptible to raptor predation. Weather conditions should also be considered prior to release. Following the release of a bat, it is necessary to visit the release site the next morning to determine if the bat has gone; if the bat has not left, it should be recaptured and released again at dusk (Barnard, 1995).

13. Euthanasia

For small bats (<30g), cervical dislocation and inhalant anesthetics are the preferred methods; whereas for larger bats, only an overdose of inhalant anesthetics should be used.

14. Human Safety Considerations

Rabies pose a risk to those handling bats. Investigators must be immunized against rabies and ensure that they have a protective response determined by antibody titre prior to handling any bats.

Histoplasmosis can also pose a health threat when researchers must either enter or open confined roosts and generate airborne particles. For the prevention of histoplasmosis, investigators should wear a mask to filter the air they breathe or have a self-contained air supply when entering potentially contaminated bat roosts (Constantine, 1988). Histoplasmosis is not a health problem when bats are captured and handled outside roosts.

As a further precaution for the protection of both investigators and other bat colonies against the spread of diseases, all clothing, boots and equipment should be decontaminated following a visit to a bat roost (Constantine, 1988).

15. References

Aldridge H.D.J.N. & Brigham R.M. (1988) Load carrying and maneuverability in an insectivorous bat: A test of the 5% “rule” of radio-telemetry. *Journal of. Mammology* 69(2):379-382.

Barclay R.M. & Bell G.P. (1988) Marking and observational techniques. In: *Ecological and Behavioral Methods for the Study of Bats* (ed. T.H. Kunz), pp. 59-76. Washington DC: Smithsonian Institution Press.

Barnard S.M. (1989) The use of microchip implants for identifying big brown bats (*Eptesicus fuscus*). *Animal Keeper's Forum* 16(2):50-52.

Barnard S.M. (1995) *Bats in Captivity*. Basically Bats Wildlife Conservation Society. Electronic document, http://www.basicallybats.org/onlinebook/cover.htm

Constantine D. (1986) Introduction. In: *Zoo and Wild Animal Medicine* (ed. M.E. Fowler), pp. 650-655. Philadelphia PA: W.B. Saunders Company.

Constantine D. (1988) Health precautions for bat researchers. In: *Ecological and Behavioral Methods for the Study of Bats* (ed. T.H. Kunz), pp. 491-528. Washington DC: Smithsonian Institution.

De Fanis E. & Jones G. (1996) Allomaternal care and recognition between mothers and young in pipistrelle bats (*Pipistrellus pipistrellus*). *Journal of Zoology, London* 240:781-787.

Fenton M.B., Rautenbach I.L., Rydell J., Arita H.W., Ortega J., Bouchard S., Hovorka, M.D., Lim B.K., Odgren E., Portfors-Yeomans C.V., Scully W., Syme D.M. & Vonhof M.J. (1998) Emergence, echolocation, diet and foraging of *Molossus ater*. *Biotropica* 30:314-320.

Hickey M.B. (1992) Effect of radiotransmitters on the attack success of Hoary bats, *Lasiurus cinereus.* Journal of *Mammology* 73(2):344-346.

Hutson A. M., Mickleburgh S. P. & Racey P. A. (2001) *Global Status Survey and Conservation Action Plan, Microchiropteran bats*. 258pp. Gland CH: IUCN.

Kemmerer D.W. (in preparation) Chemical restraint and anesthesia of heterothermic bats. In: *Bats in Captivity* (ed. S.M. Barnard), 2nd ed. Malabar FL: Krieger Publishing Company.

Kerth G., Wagner M. & König B. (2001) Roosting together, foraging apart: information transfer about food is unlikely to explain sociality in female Bechstein's bats. *Behavioral Ecology and Sociobiology* 50:283-291.

Kunz T.H. & Kurta A. (1988) Capture methods and holding devices. In: *Ecological and Behavioral Methods for the Study of Bats* (ed. T.H. Kunz), pp. 1-29. Washington DC: Smithsonian Institution.

Rossiter S.J., Burland T.M., Jones G. & Barratt E. M. (1999) Characterization of microsatellite loci in the greater horseshoe bat *Rhinolophus ferrumequinum*. *Molecular Ecology* 8:1959-1961.

Rossiter S.J., Jones G., Ransome R.D. & Barratt E.M. (2000) Genetic variation and population structure in the endangered greater horseshoe bat *Rhinolophus ferrumequinum*. *Molecular Ecology* 9:1131-1135.

Thomas D.W. (1995) Hibernating bats are sensitive to nontactile human disturbance. *Journal of Mammology* 76(3):940-946.

Tuttle M.D. (1974) An improved trap for bats. *Journal of Mammalogy* 55:475-477.

Watt M.E. & Fenton M.B. (1995) DNA fingerprinting provides evidence of discriminate suckling and non-random mating in little brown bats, *Myotis lucifugus*. *Molecular Ecology* 4:261-264.

Wilkinson G.S. & Bradbury J.W. (1988) Radiotelemetry: techniques and analysis. In: *Ecological and Behavioral Methods for the Study of Bats* (ed. T.H. Kunz), pp. 105-124. Washington DC: Smithsonian Institution.

Wilson D.E. (1988) Maintaining captive bats. In: *Ecological and Behavioral Methods for the Study of Bats* (ed. T.H. Kunz), pp. 247-263. Washington DC: Smithsonian Institution.

Other Useful References

Jackson A.C. & Fenton M.B. (2001) Human rabies and bat bites. *Lancet* 357:1714.

McColl K. A., Tordo N. & Aguilar Setién A. (2000) Bat lyssavirus infections. *Scientific and Technical Review* 19:177-196. Office International Épizooties.

Nadin-Davis S.A., Huang W., Armstrong J., Casey G.A., Bahloul C., Tordo N. & Wandeler A.I. (2001) Antigenic and genetic divergence of rabies viruses from bat species indigenous to Canada. *Virus Research* 74:139-156.

Turgeon N., Tucci M., Teitelbaum J., Deshaies D., Pilon P.A., Carsley J., Valiquette L., Arruda H., Alain L., Jackson A.C. & Wandeler A. (2000) Human rabies—Québec, Canada, 2000. *Morbidity and Mortality Weekly Report* 49:1115-1116.

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