CHAPTER THIRTEEN

HIBERNATION, RELEASE AND EUTHANASIA

Hibernation

During the winter in some parts of the world, ambient temperatures drop significantly and adequate food (i.e., insects) is not available for an extended period of time. Some species of bats simply migrate to warmer climates where food is available. Other species adapt to temperate conditions by entering hibernation, a physiological state in which metabolic activity is decreased to minimal survival levels. Many bats decrease energy demands by entering a daily state of inactivity called torpor. By allowing body temperatures to approximate the ambient temperature, they are able to decrease energy demand. Heart rates of bats in daily torpor may drop to 40-80 beats per minute, while rates as low as 10 beats per minute have been recorded in some bats during winter hibernation This is a significant decrease as heart rates of 250 to 450 beats per minute have been recorded for some bats at rest, while rates in flying bats can reach 1000 beats per minute. A little brown bat (*M. lucifugus*) has a daily energy budget of 0.89Kcal/g/day which means that a 7g little brown bat requires 6.23kcal (6230 calories) per day (Hill and Smith 1984). Because smaller mammals (such as bats) have greater surface-area-to-volume ratios than larger ones, they require more calories per gram of body weight to maintain thermal homeostasis.

Many of the bats of the family Vespertilionidae in the United States and Canada enter hibernation during winter months. Some species migrate short distances to specific hibernation sites in caves or abandoned mines where temperatures remain relatively constant. Others stay in the same location year round when the temperatures drop. Big brown bats *(E. fuscus*), a species that commonly roost in the attics of homes, sometimes hibernate there throughout the winter months.

Some bat species hibernate in tightly packed clusters. By clustering with one another they are better able to stabilize body temperatures against potential environmental fluctuations. Other species hibernate singly or in small groups. When ambient temperatures rise in the spring, hibernating bats arouse. There is an increase in both the heart rate and the respiratory rate, and a subsequent increase in body temperature. Different species of bats arouse from hibernation states at different rates, so it will take some bats longer to warm up than others.

If awakened from hibernation, bats experience an increase in metabolic activity, using up stored fat needed to survive the remainder of the winter. Although hibernating bats may arouse during winter, each arousal leads to the expenditure of almost 30 days of body fat. Hibernating bats are therefore extremely sensitive to disturbances. In addition, because some species of bats come from multi-state regions and congregate in great numbers (as many as tens or even hundreds of thousands of individuals) at a small number of hibernation sites, disruption and disturbances of any kind can result in the loss of large numbers of bats important to the agricultural interests of farmers far from the site.

Some species of bats make long migrations when colder weather arrives. The hoary bat (*L. cinereus*), the red bat (*L. borealis*), and the silver-haired bat (*L. noctivagans*) can be found as far north as Canada in the summer but are known to make long migrations to the southern United States and Mexico in the winter. Some species, such as those in the family Molossidae, are not able to tolerate cold temperatures for extended periods of time and migrate to warmer climates during cold months. In the United States, southwestern populations of Mexican free-tailed bats make long migrations to parts of Mexico where they spend the winter. A sub-species of the Brazilian free-tailed bat remains in warmer parts of the southeastern United States year round. Although the Molossidae are not true hibernators, they are capable of entering daily torpor. See Roosting and Hibernating Patterns on page 5 for additional species information.

Artificial hibernation allows a busy rehabilitator the luxury of minimizing the time needed to care for healthy bats that must remain in captivity for several months before release. If a caretaker receives dozens of bats disturbed during hibernation, artificial hibernation allows the opportunity to maintain all of the bats for the remainder of the winter, something that might not be possible if each individual required daily care. Hibernation in captivity does not appear to be necessary for the survival of a bat. Some bat care specialists hibernate bats simply because they prefer to duplicate natural conditions when possible.

Review by Wimsatt (1969), has shown that sperm storage is one facet of the complex reproductive adaptations of bats living in temperate latitudes where a period of hibernation occurs during prolonged oestrus. Females that have mated may give birth during the winter or early spring if they are kept from entering normal hibernation. Normally, fertilized ova implant when females arouse from hibernation, but artificially warm conditions, low stress, and appropriate nutrition have resulted in out-of-season births in hibernating species. Males and females housed together under artificially warm conditions may engage in mating behavior outside normal mating periods, which may also affect seasonal cycles of mating, fertilization, implantation, and gestation.

Never attempt to hibernate a non-hibernating species; nor a bat that is sick, underweight or injured. The animal is unlikely to survive, and even if it does, healing of bones and tissue will slow significantly if not altogether. Only a healthy bat of a species that normally hibernates should be artificially hibernated in captivity.

A bat that appears healthy but has been disturbed during hibernation is a potential candidate for artificial hibernation. (Renovation of buildings sometimes disturbs hibernating bats.) Bats should be rehydrated and fed for at least two days before being placed in artificial hibernation. If the bat does not approach the upper end of the weight range for its species, it should not be artificially hibernated (i.e., do not hibernate a thin bat, which is often the case with juveniles).

Hibernating bats require very specific temperatures and humidity levels. An artificial hibernaculum needs to duplicate these conditions as much as possible. Older refrigerators have been used successfully to hibernate bats; however, the use of modern, frost-free refrigerators is considered an unnatural and inhumane practice as the humidity levels are much too low (Barbosa, 1996).

The ambient temperature during the winter may allow caretakers to hibernate a bat in an unheated room, such as a garage. However, the temperature in this room should not drop below 40° Fahrenheit, and in some parts of the United States and Canada, temperatures in garages will drop far below freezing for extended periods of time. Many bats may not be able to survive such conditions. If this is the case in your area, unused rooms or basements that have some heat, but remain relatively cool, may provide more appropriate temperatures. Temperatures in a room used to hibernate bats should remain at least in the low to mid 40°'s. Surprisingly, some species, such as big brown bats (*E. fuscus*), have been successfully hibernated for the winter without supplemental feedings at temperatures ranging from the lower 50°'s to the mid 60°'s. In some parts of the U.S. various species of bats have different temperature preferences in the wild. Variations may even exist within the same species from one geographical area to another. However, it is not recommended that either the upper or lower temperature ranges exceed these temperatures, as they have proven optimal for hibernating bats in captivity. Do not hibernate bats at freezing temperatures. Bats undergoing artificial hibernation must also be able to maintain sufficient body temperature with minimal outlay of energy.

Once an appropriate location has been chosen, set up an enclosure with a heating pad over a section of the top or on one side of the enclosure for warmth. In the wild, many bat species arouse from hibernation if temperatures drop below a certain level, and move to areas where conditions are more favorable. While a heating pad will allow a bat to move on or away from a warmer spot. Roosting pouches should be placed in numerous positions throughout the enclosure for crevice dwelling species. When possible, it is best to allow bats to hibernate in clusters of individuals as they normally do in the wild. For example, if a caretaker receives a small colony of big brown bats that were disturbed during hibernation, it would be best to hibernate them together as a group.

High humidity levels in a natural hibernaculum can result in the condensation of water droplets on bat's fur, thus making water available to the bat. In addition, relative humidity in many hibernacula approaches 90%. Bats in the wild sometimes arouse from hibernation to find water and replenish their fluids. In captivity, a small, shallow dish of water should be placed inside the enclosure and fresh water should be available to hibernating bats throughout the entire hibernation period.

We cannot perfectly duplicate natural hibernation. Because bats kept in artificial hibernation do not have access to their natural environment, the author recommends that bats be deliberately reawakened (see below) and provided with food and water periodically throughout the entire hibernation period.

Record the weight of the bat before initial hibernation and each time it is awakened and fed. The bat's initial weight should be in the upper end of the weight range for this species. The author recommends that a hibernating bat be reawakened, weighed, and fed after the first three days. If the bat appears healthy and has not experienced a significant weight loss (i.e., it is not at or below the lower end of the weight range for the species), continue to awaken and care for it once every one to six weeks thereafter throughout the normal period of hibernation (i.e., winter months).

To awaken a bat from hibernation, allow it to warm up to room temperature slowly. Do not force the animal into any kind of heated container. Instead, move the entire enclosure into a warmer room. Allow the animal to warm up slowly on its own. It will take different species of bats different periods of time to arouse, so allow the bat at least one to two hours to warm on its own before handling. Once it has warmed, weigh it, and then offer it water and food. Then return it to the enclosure (which should have remained at room temperature) for the night so it can complete the digestion process. If the bat appears well and has maintained a body weight at the upper end of the weight range for the species, it can be placed back into hibernation.

If the bat is kept out of hibernation for longer than 12 hours, it should be fed again as metabolic activity will have increased. The procedure of awakening and caring for a bat that is hibernating in captivity should be repeated once every one to six weeks throughout the hibernation period. Although many researchers have artificially hibernated bats for a matter of months without intermittent feeding, more frequent feedings allow caretakers to ensure the continued good health of each individual which will likely result in higher survival rates.

If intended for release, artificially hibernated bats should not be released until outdoor ambient temperatures have warmed sufficiently to allow an insect population. It is not necessary to hibernate bats kept in permanent captivity, even if they would normally do so in the wild. Hibernation is a method by which bats in the wild survive periods of sub-optimal temperatures and an insufficient food supply, a problem bats in captivity do not experience.

Again, artificial hibernation is a method by which a busy caretaker, who is already caring for several bats, or who receives dozens of bats disturbed during natural hibernation in the wild, can minimize his or her time. This allows a caretaker the opportunity to care for many more individuals than would be possible if each bat required daily care. In addition, artificial hibernation may also help to ensure normal timing of fertilization, implantation, or fetal development in females of reproductive age. Timing of births is important because rearing young needs to coincide with optimal temperatures and food availability in the wild. It is possible that artificial hibernation may help to ensure the survival of offspring of female bats released in the spring.