

# Lava Beds National Monument:

## A stronghold for Townsend's big-eared bats

By Kelly Fuhrmann

Lava Beds National Monument in northern California is geologically and ecologically remarkable because of its great variety of “textbook” volcanic formations. It is situated at the northeast flank of the Medicine Lake Volcano, at the junction of the Sierra-Klamath, Cascade, and Great Basin geological provinces. Its rugged, semi-arid, high-elevation volcanic terrain and associated ecosystems support more than 560 species of plants and animals, including 14 species of bats (see related article on page 52 about monitoring Mexican free-tailed bats). The numerous lava caves within the park provide habitat for bats, notably the Townsend's big-eared bat (*Corynorhinus townsendii townsendii*) (fig. 1), a federal and California State species of special concern.

The lava caves are characteristically lava tubes, formed as molten lava flows from a volcanic vent. Lava on the

edges of a flow cools and hardens, eventually creating an enclosed tube after the flow of lava from the vent subsides and the molten lava evacuates the inside of the tube onto the surrounding landscape. Sections of these tubes may collapse soon after cooling or while still flowing with lava, creating cave entrances (fig. 2). The cave environments are diverse in terms of internal climate, size, and size of

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**Figure 1. Lava Beds National Monument in northern California is a stronghold for Townsend's big-eared bat, a federal and California State species of special concern. In 1996, staff at the national monument began monitoring population dynamics of this special wildlife resource with the goal of ensuring its long-term survival.**

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Though this species has experienced a significant decline in numbers elsewhere in the western United States as a result of habitat destruction and roost disturbance (Pierson and Fellers 1998), Lava Beds National Monument is a stronghold for it. Some of the caves support maternal colonies in summer and others support hibernating populations in winter; additionally, adult males and yearling non-reproductive females form small, scattered bachelor groups in summer apart from the maternal colonies.

Despite their presence at Lava Beds, maternal and hibernating populations of this species are susceptible to disturbance by humans and may be vulnerable to slight changes in cave habitat environmental conditions such as humidity and temperature. These disturbances can result in the bats taking flight and abandoning young or changing roost locations. Hibernating bats are especially vulnerable to disturbance that can cause them to expend valuable energy in the form of stored fat needed to survive winter in the caves.



**Figure 2. Townsend's big-eared bats are thriving at Lava Beds National Monument in large part because of abundant, suitable habitat. Lava caves vary in terms of size and internal climate and support maternal colonies in summer and hibernating populations in winter.**

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## Long-term monitoring

Monument biologists began monitoring population trends of this special wildlife resource in 1996 to guide management actions for the protection of its habitat and to ensure a continued sanctuary for this species. For eight years we conducted summer field monitoring at three Townsend's big-eared bat maternal roost caves (fig. 3), the total number of maternal roost caves for this species in the monument. We determined the presence of the three maternal colonies by conducting cave entrance auditory and activity surveys using bat detectors, which identify high frequency bat echolocation calls. To gather data on the exit flight of the bats from the caves we followed monitoring protocols developed by the monument's Resource Management Division (Baldino 1996a and 1996b) in consultation with the Western Bat Working Group. This group of state and federal agencies, organizations, and individuals is interested in the conservation, research, and management of bats, including Townsend's big-eared bat, in the western United States and Canada. Night-vision equipment and hand-held counters enabled us to count bats as they exited maternal cave roost sites during the summer breeding period from April through September.

Maternal colonies consist of pregnant and nursing females and their pups and range in size from approximately 100 to more than 300 individuals. To determine reproductive success, we counted adult females during the early part of the breeding season, before the pups were born. We estimated reproductive success later in the season when the pups were able to fly and exit the caves to feed on night-flying insects. By comparing the early-season exit flight numbers with those late in the season we estimated annual reproductive success.

## Population trends

We conducted extensive cave reconnaissance surveys throughout the monument to locate all Townsend's big-eared bat maternal colonies and hibernation sites and identified three distinct maternal colonies. Over a period of 12 years (including observations made before intensive monitoring began in 1996), we noted a consistent pattern of use of specific caves by the maternal colonies. Identifying the three maternal colonies was important for sampling population trends because the counts can be repeated at these sites and compared from year to year.

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**Figure 3. A Townsend's big-eared bat maternal colony at a cave roost site at Lava Beds National Monument.**

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Monitoring of bat hibernation site populations can also provide a reliable population trend estimate over time. Male and female bats roost together at these sites, where mating takes place.

However, surveys of hibernation sites conducted in the interior of the caves can have greater potential for causing disturbance than those of maternal colonies and therefore are not conducted regularly.

Collected from 1996 to 2003, the monitoring data suggest that the populations of Townsend's big-eared bats at Lava Beds National Monument are relatively stable, with small annual fluctuations. As shown in figure 4 (page 50), error bars overlap, indicating no significant difference between years. Totals for annual population of the maternal colonies are documented from exit counts and shown in figure 5 (page 50).

Though comprehensive monitoring of this species ended with the 2003 field season, maternity counts continue on a limited basis at the monument today. In 2004, the population estimate at one maternity roost site did not differ significantly from those made 1996–2003.

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## Cave roost preferences

Townsend's big-eared bats are known for roost fidelity, and at Lava Beds the maternal colonies and hibernating bats returned to



the same caves on an annual basis. Though cave environmental conditions are important factors that can affect reproductive success, this regular pattern of returning to the same roost site suggests conditions are favorable for the maternal and hibernating bats. Pregnant and nursing female big-eared bats roost very close to each other, apparently maintaining a microclimate within these colonies with the heat radiated from their bodies. This microclimate is critical for keeping the pups warm until they are sufficiently developed to fly and forage for insects on their own. Monitoring indicated that average to high humidity (approximately 50%–100%) and moderate temperatures (approximately 50°F–75°F or 10°C–24°C) generally prevailed in maternal roost caves, while high humidity (approximately 80%–100%) and low temperatures (approximately 30°F–38°F or -2°C–3°C) were common conditions in caves used by hibernating bats at Lava Beds.

An example of environmental conditions preferred by one maternal colony at Lava Beds is shown in figure 6. The maternal colony at this site formed in late April and left the cave in late May. It moved to two other caves before returning to the first cave in mid-August, remaining until mid-September. Because young may be born from late May through July (Nowak 1994), the pattern of changing roost sites during the breeding season may be a result of fluctuating cave environmental conditions and environmental requirements of the maternal colony. The bats may prefer higher humidity and lower temperature at the beginning of the breeding season, whereas lower humidity and higher temperature may accommodate them better late in the season. Furthermore, past experience with environmental conditions in a variety of cave roost sites in the monument may play a role in their movements among those sites. We observed this pattern of maternal colonies of Townsend's big-eared bats changing roost sites throughout the breeding season in all of the colonies.

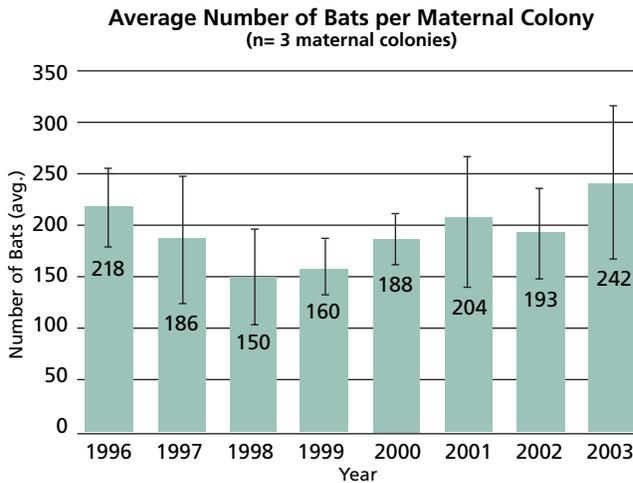


Figure 4. Population averages of three maternal colonies of Townsend's big-eared bats at Lava Beds National Monument. Error bars represent  $\pm 1$  standard deviation.

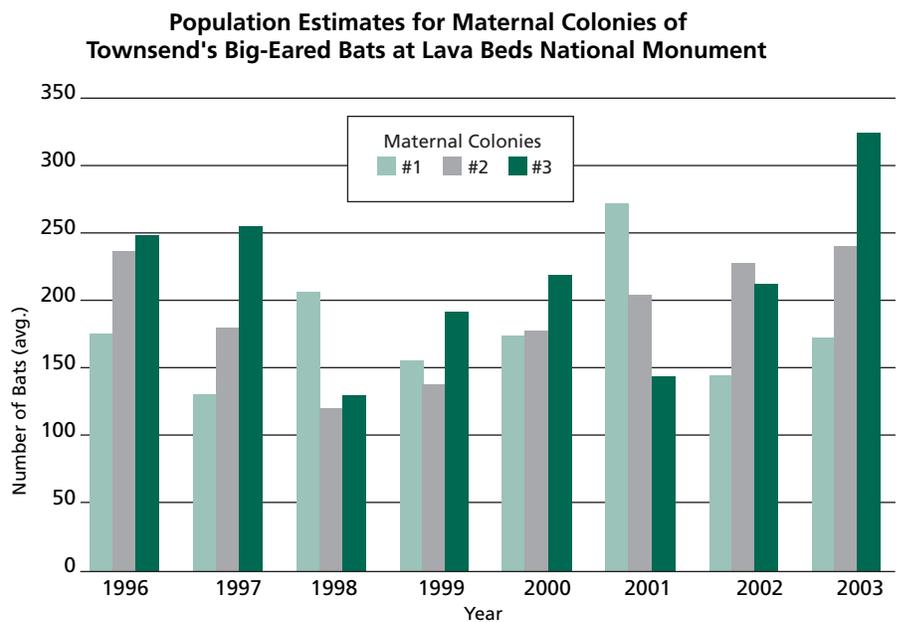


Figure 5. Population estimates for maternal colonies of Townsend's big-eared bats at Lava Beds National Monument.

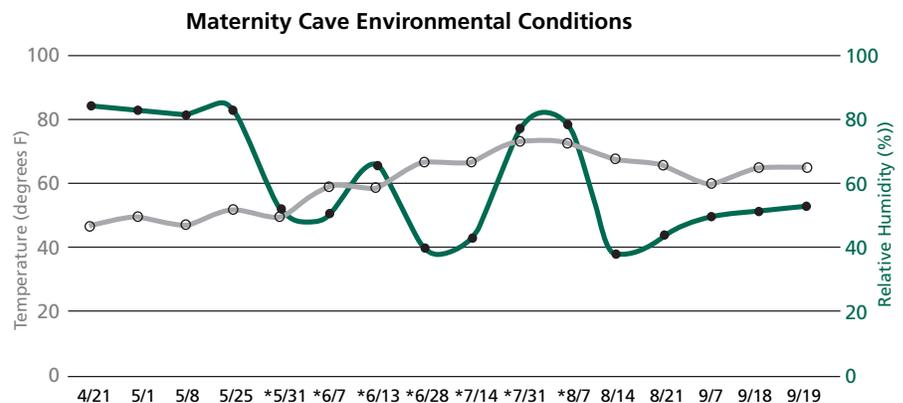


Figure 6. The graph shows cave temperature and relative humidity conditions for one of the maternal colonies being monitored. The dates represent a confirmed occupation of three caves by one maternal colony. The dates with asterisks represent conditions in other maternal caves where the colony moved.

## Habitat protection measures

Information from monitoring has influenced management actions at Lava Beds to increase protection of this sensitive species. For example, caving is an activity enjoyed by many visitors to the monument. Cavers can unwittingly disturb cave roosting maternal and hibernating bats. As already discussed, roost disturbance has been linked to declines in Townsend's big-eared bats elsewhere in the western United States. To ensure an undisturbed habitat, which is critical to this species' survival, specially designed gates have been installed at some cave entrances to keep people out but to allow bats to enter and exit naturally. Monument personnel also post closure signs at entrances to maternal caves in the spring and hibernation site caves in the fall. These signs inform visitors of the protected status of the respective caves and the devastating effects of disturbing Townsend's big-eared bat roosts. In addition, staff seasonally patrol maternal and hibernation site cave entrances to check for indications of disturbance and to educate visitors about the sensitive maternal bat colonies.

Public outreach and education are a part of visitor contact programs at the monument's visitor center, on interpretive cave tours (fig. 7), during field interactions between visitors and resource protection rangers, and as a part of summer campfire talks. Monument staff has also developed and presented education programs for local environmental conferences, meetings, and schools to promote public awareness of the benefits of bats, their biology, and conservation, and the ongoing bat research at Lava Beds.

In summer 2004 the monument launched a project that offers further protection for maternal bat colonies through the use of radio technology. Sensors were placed at several cave entrances that have been closed to protect Townsend's big-eared bat maternal roosts. When triggered by human foot traffic near these cave entrances the sensors transmit signals to the two-way radios of law enforcement rangers, indicating trespass at a specific cave. Resource protection rangers then respond to the cave entrance to prevent disturbance of the maternal colonies. In 2004, they made more than 40 sensor-related contacts with visitors to the monument.

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Protection measures employing modern technology and staff vigilance are helping to ensure that the Townsend's big-eared bat population at Lava Beds National Monument is not disturbed and that the monument will remain a refuge for this species of special concern.

Eight years of monitoring the maternal population dynamics of this sensitive species has identified this population as a stable one. In addition, cave roost environmental monitoring has given us insight into the preferred cave roost conditions of Townsend's big-eared bats. Outreach efforts support management of this species and will provide

future benefits for conservation of all bat species beyond the boundaries of Lava Beds National Monument.



**Figure 7. Guided cave tour at Lava Beds National Monument.**  
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