

RESOURCE NOTES

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Monitoring the Effectiveness of Bat Compatible Mine Gates'

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Background

Abandoned underground mine workings pose serious threats to human safety. In an effort to protect the public from the hazards of abandoned mines, public land managers have implemented large-scale closure efforts, often at significant expense. The most economically feasible mine closure methods include blasting, plugging, backfilling, and other permanent solutions. Recent studies have shown that numerous wildlife species, including bats, use these artificially created habitats. As much as 80 percent of the mines in the Western U.S. show some evidence of bat activity. Permanent abandoned mine closure methods have not only resulted in destruction of roosting habitat, but have also caused direct mortality of bats by entombing them within the sealed mine.

Many agencies have installed wildlife-passable gates at mine openings in an effort to mitigate the loss of animals and their habitat resulting from permanent closure. Gates allow animals to pass through openings too small for most humans, while maintaining air flow patterns crucial for internal habitat conditions. Unfortunately, many early gate designs impeded bats in flight, allowing predators to take them easily. In some areas, bats have abandoned historic roosting areas despite the addition of bat compatible gates.

Gates are effective in protecting the public from the dangers of

abandoned underground mine workings; however, few long-term monitoring studies have been conducted to determine if the gates impact bats or their behavior. Those studies done to date have typically neglected pre-closure bat population counts. Post-gating monitoring has been mainly limited to exit counts, where observers count bats as they leave the roost. Exit counts are time and labor intensive, often extremely variable, and may be biased by environmental factors and observer presence.

This resource note summarizes interim results of a study to evaluate the effectiveness of bat compatible gates at abandoned mines at Silver Reef, in southwestern Utah. Over 140 abandoned underground mines have been closed with bat compatible gates or grates at this site. Pre-closure surveys found extensive bat use in abandoned mines here, including maternity colonies of Townsend's big-eared bat (*Corynorhinus townsendii*) and fringed myotis (*Myotis thysanodes*). Study objectives include evaluating and ranking the effectiveness of infrared event counters, infrared video, and night vision equipment for counting bats as they pass through mine gates. The end result of the study will be an evaluation of bat roost monitoring techniques with development of protocols for effective methods. This study was a cooperative effort with the Utah Division of Oil, Gas, and Mining; Southern Utah University, and the St. George Field Office of the BLM. Funding was provided by grants from the National Fish and Wildlife Foundation and the Keck Foundation.

Methodology

Prior to closure, four internal bat surveys were conducted at Silver Reef, two each during the warm and cold seasons. These surveys were used as a baseline for determining

long-term changes in bat numbers at gated mines and were used to help select six gated and four un-gated sites for evaluation. Sites were selected based on availability of pre-closure count data, presence of colonies, and presence of two or fewer openings. All gates selected were constructed of 3.8 cm manganol steel bars, oriented horizontally, and spaced 11.4 - 14.6 cm apart. Vertical bars were welded into place approximately 61 cm on center.

From June 1997 through January 1998, exit counts using night vision goggles were used to count bats emerging from abandoned mines. Mist nets, harp traps, and acoustic surveys were used to identify bats to species. In January 1998, battery-powered active infrared event counters were secured inside the opening of each mine. Each event counter includes a floor-mounted transmitter which shines an infrared beam to a receiver mounted on the ceiling (back) of the mine. Each time the beam is broken the counter records the event and time.

Infrared video cameras were installed in up to four locations per site to verify the accuracy of events recorded by the counter and monitor bat behavior as they passed through the gate. Limitations of video systems included short tape and battery life, and low resolution. Battery life limitations were resolved by using infrared bullet and box cameras in place of standalone video camcorders. We were able to maximize tape and battery limitations and minimize the effect of observer presence on counts by using a video transmitter to send the signal to a monitor and recording unit at least 100 m away from the gated mine.

Interim Results and Discussion

Exit counts alone provided a biased sample of the number of bats using a



site. Observers had no means of verifying the accuracy of counts or determining which species were present. Observer notes were the only permanent record available for later review. Other sources of bias included observer limitations such as fatigue, inability to reliably count numbers in excess of 30 at once, or count swirling bats (exiting and then re-entering the roost). The presence of an observer sitting outside the mine may have been sufficient disturbance to cause bats to seek another exit or remain within the mine. Numerous observations were made of bats that clearly detected observers, even those that remained still and quiet throughout the count.

Active infrared event counters proved effective for counting bats entering and exiting mines. However, event counters underestimated the number of bats present when multiple bats broke the infrared beam at one time or when individuals avoided the beam entirely. Conversely, event counters overestimated the number of bats present when a single individual repeatedly triggered events by circling the infrared beam. Numerous observations were made of bats circling the overhead receivers.

Infrared video cameras provided the most information with the

highest degree of flexibility of the monitoring systems evaluated. Visual data stored on video tape serves as a permanent record which may be retrieved, analyzed, and edited at any time at a fraction of the cost of quality night vision equipment. However, reviewing video data can be very time-intensive without the use of costly electronic video editing tools.

Infrared time event recorders consistently provided higher counts than exit counts when conducted simultaneously. On at least two occasions, observers left the site after two hours when declining counts indicated that the emergence was complete. Within two hours following observer departure, the infrared event counter recorded close to 300 bats. While this appears to support the idea that observer presence can significantly bias exit counts, it should be noted that the event recorder was unmanned and therefore could not be verified. Bats could have moved into the area from another location to use the mine as a night roost, or individuals may have circled the infrared beam, triggering numerous events.

Having video images of each triggered event proved invaluable in verifying the accuracy of the data. In most cases, counts made from video

were identical to those of event counters. Where video counts were higher, we verified that one or more bats had missed the event counter's infrared beam. Where the event counter recorded more hits than the video, we were able to verify that bats were circling the event counter, triggering multiple hits. In one instance, the counter recorded over 1,000 events. Later review of the video showed that no bats had exited, but that a wood rat had rested on the floor mounted transmitter, triggering multiple hits.

Future efforts will focus on developing a qualified index for sampling with event counters alone, determining if bats habituate to event counters, reducing video review time by capturing short sequences triggered by video motion sensors, and determining the effect of observer presence on exit counts.

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