

PREDATION ON *CORYNORHINUS TOWNSENDII* BY *RATTUS RATTUS*

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*Corynorhinus townsendii* (Townsend's big-eared bat) is a rare and declining species. Extensive surveys for the coastal subspecies, *C. townsendii*, in California indicate that only 50% of historic maternity colonies are occupied currently (Pierson and Rainey, 1996). Three of the largest maternity colonies occur in Marin County. Two of these have been monitored with evening exit counts on a regular basis since their discovery (1987 -- Randall House; 1990 -- Jerrys) through 1996. From 1987 through 1993, the Randall House colony slowly increased from 123 to 215 bats as the colony was afforded greater protection from disturbance once the bats were discovered. Since 1990, both colonies have been composed of ca. 200 adult bats in the spring, and ca. 300 adults and young through the summer and early fall.

Reproductive rates were estimated by comparing early season counts (May and June) with subsequent counts when the young were old enough to fly (July and August). The mean reproduction rate (percentage of females with young) has been  $37.5 \pm 6.4$  % (Randall House) and  $32.2 \pm 9.3$  % (Jerrys) except for 1993 at the Randall House colony. In 1993, there was no apparent reproductive success in that colony; counts of bats in May 1993 (215 bats) were essentially identical to counts when females and their young would normally have been flying in July

(211). That same year, the reproduction at the Jerrys colony was 24.1 %. This paper presents evidence that predation by *Rattus rattus* (black rat) was the primary cause of the poor reproductive success.

The Randall House colony is in a two-story house built in the 1880s, but which has been vacant for 20 years. The surrounding habitat is a mixture of Douglas-fir (*Pseudotsuga menziesii*) forest, grassland, bay (*Umbelluria californica*) woodlands, and a narrow riparian strip that borders the headwaters of Olema Creek. The valley is sparsely populated with only two houses located within 2.5 km of the roost. The nearest structures are a small ranch complex (two houses, a barn, and some adjacent sheds) 1.1 km to the south. Olema Creek is 100 m to the west of the house. The Randall House is partially surrounded by a thicket of blackberries, but the immediate area is grassland which is grazed down to less than a few cm for most of the year.

*Peromyscus maniculatus* (deer mice) were known to live in the house, but the presence of large rodent droppings and the sounds of scurrying animals in the attic in 1993 prompted me to investigate the possibility that rats had taken up residence in the house.

On 1 November 1993, four Eaton bait boxes (Eaton & Co., Inc., Twinsburg, Ohio) baited with raisins were placed

inside the Randall House. These boxes are roughly triangular (40 cm on a side) and consist of a passageway that leads to two small compartments in which rodent poison would normally be placed. Instead of poison, a 2 mm deep layer of fluorescent powder was spread throughout each box so that mammals which entered the box could be tracked (Lemen and Freeman, 1985).

The house was checked on 5 November with a portable ultraviolet light. All the raisin bait had been taken from each trap and powder had been tracked throughout much of the house. The dispersed powder was recognizable as having been spread by the body, tail, or feet of a rat-sized animal. All tracks were more than 3 cm in length, a size that could only have been left by two of the local rodents, *Neotoma fuscipes* (dusky-footed woodrat) or *R. rattus*.

Tail drags and tracks were found on the attic walls, vertical posts, and in the rafters, but their distribution in the rafters was not random. During most of the year, *Corynorhinus* tend to concentrate in one of three areas. A careful, systematic search of the rafters indicated that powder was present in only one area - one of the three sites traditionally used by *Corynorhinus*.

On 8 November, four Victor rat traps were set, two traps in the attic and one on each of the other two floors. The traps were checked on 9 and 19 November. On each occasion one adult female *R. rattus* was caught in the attic. Both rats had conspicuous fluorescent powder on their tail and feet. Measurements of the feet closely matched tracks on the floor and in the rafters. Continual trapping through March 1994 produced no additional rats and the attic has apparently remained

rat-free through 1999. No other large rodents were seen or trapped in the house. The only other rodent of appropriate size in the area is *N. fuscipes* which is not known to inhabit the upper stories of buildings (Ewer, 1971). *Neotoma* also builds conspicuous houses of sticks, and no such structures have been found.

*Rattus rattus* typically live in the tops of buildings (Burt and Grossenheider, 1976), but is also frequently found along stream courses away from buildings (Ewer, 1971). The Randall House roost is only 100 m from Olema Creek and 1.1 km from the nearest buildings. The rats probably traveled between ranch complexes using the riparian zone as a corridor.

Rats are omnivorous, feeding on a wide variety of animal and plant matter (Howard and Marsh, 1981). Even so, available food for rats at the Randall House seems quite sparse for most of the year. The most conspicuous potential food sources are bats and the berry vines adjacent to the house. Bats would be a potential food source nearly year round. Non-volant, young bats born in early June would be easy prey for a rat. In the cooler winter months, adults enter torpor and hence would become more susceptible to rat predation.

Reproductive failure of the *Corynorhinus* maternity colony at the Randall House seems largely attributable to the presence of rats. There were no unusual climatic events, that might have reduced food supply, and the other colony, which was monitored that year, had normal reproductive success. The reproductive output from this colony in 1992 was approximately 110 young in comparison with no growth in 1993 and 57 in 1994.

Rats have seldom been implicated in predation on bats (Gillette and Kimbrough, 1970). Rysgaard (1942) listed house rats as presumed predators of *Eptesicus fuscus* (big brown bat), but the evidence was mostly speculative. *Rattus rattus* fed on *Mystacina robusta* (= *M. turberculata*), on the Big South Cape and Solomon Islands off the coast of New Zealand. It took only about 12 months before a *R. rattus* irruption caused the extinction of the last known population of this species (Daniel and Williams, 1984). *Rattus norvegicus* is the only mammal known to prey on *Myotis vivesi* (insular bat; Villa, 1982).

With the loss of many natural habitats, bats are increasingly relying on man-made structures as roost sites. For *C. townsendii*, natural habitats such as caves have often been disturbed by humans, and large basal tree hollows in old growth forests have been greatly reduced from timber harvest. Many abandoned buildings provide easy access for bats with limited human disturbance. In the southern and coastal parts of the United States, these are the same places where *R. rattus* and *R. norvegicus* are often found. This study provides evidence that *R. rattus* may have a significant impact on a relatively large population of a bat species of management concern.

Additional experiments utilizing techniques such as fluorescent powder may demonstrate that predation by rats is more common than formerly believed. If so, old buildings may actually serve as population sinks for bats, offsetting some of their conservation value. Fortunately, rat control has been the subject of extensive investigation (Moors et al., 1992) and application of appropriate

control measures might help to improve survival of affected bat populations.

*Resumen--Corynorhinus townsendii* (el murciélago de orejas grandes de Townsend) es una especie rara y en peligro de extinción, sobre todo en la región costera del estado de California. En 1993, hubo un fracaso reproductivo en un refugio de reproducción bien estudiado. Este estudio ofrece evidencia de que *Rattus rattus* (la rata negra) fue la causa del fracaso observado. Para estimar el índice de reproducción de la especie se compararon las cantidades de la primera parte de la temporada con las cantidades subsecuentes, cuando los murciélagos jóvenes estaban lo suficientemente marduros como para volar. En 1993, no había ningún éxito reproductivo aparente; el número de adultos en mayo (215 murciélagos) era idéntico al número en julio (211 murciélagos), cuando las hembras y sus crías normalmente ya volaban. Dos hembras adultas de *Rattus rattus* se atraparon en el refugio. Los científicos usaron una caja de cebo con polvo fluorescente para obtener evidencia de que las ratas subían las paredes donde se encontraron los murciélagos. Los datos indican que *Rattus rattus* tiene un efecto significativo en la población relativamente numerosa de *Corynorhinus*. El futuro de esta especie nos preocupa.

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