Spotted bat, *Euderma maculatum*

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Description: *Euderma maculatum* can be distinguished from all other North American species by its unique coloration (three dorsal white spots on a background of black fur), and very large, pinkish-red ears (39-50 mm). The spots, ca. 15 mm in diameter, are located over each shoulder, and in the center of the rump. Additionally, there is a white patch at the base of each ear. It is one of the largest North American vespertilionids (forearm 48-54 mm, tail 45-50 mm, total length 107-125 mm (Watkins 1977, Woodsworth et al. 1981, Constantine 1987, Best 1988). Mean weight is 15.3 g (n=61)(Best 1988). Its wing and tail membranes, like the ears, are pinkish-red. Its ventral fur (like the dorsal spots) is white with a black base. Other North American species with very large ears (e.g., *Corynorhinus townsendii*, *Idionycteris phyllotis*, *Myotis evotis*, *Antrozous pallidus*) lack the black and white color pattern. The only other species with black fur, the silver-haired bat, *Lasionycteris noctivagans*, has short, rounded, dark ears, and its black fur, while often frosted in appearance, lacks distinct white spots.

Taxonomic Remarks: *E. maculatum* belongs to the Family Vespertilionidae. It was first described by Allen (1891) from a specimen collected in March 1890 in Ventura County in southern California. It was initially included in the genus *Histiotus* (now restricted to South American species) (Koopman 1993), and was subsequently recognized as a representative of a distinct genus, *Euderma* (Allen 1892). This genus has one species and no subspecies.

Handley (1959) viewed *Euderma* and *Plecotus* (including the taxon now recognized as *Idionycteris* [Williams et al. 1970]) as a phylogenetic unit, more closely related to one another than either is to any other genus within the Vespertilionidae. *Euderma* is placed in the tribe Plecotini (sensu Koopman and Jones 1970), which also includes *Idionycteris*, *Plecotus*, and *Barbastella*.

Relationships among plecotine genera have recently been re-examined by Frost and Timm (1992) and Tumlison and Douglas (1992). Using a similar set of morphological and karyological characters, these authors arrived at somewhat different conclusions. They concur in concluding that *Idionycteris* and *Euderma* are sister taxa, but Frost and Timm synonymize *Idionycteris* with *Euderma*, whereas as Tumlison and Douglas retain both genera. They offer differing views of the relationship between *Euderma* and the other genera. Tumlison and Douglas see *Idionycteris* and *Euderma* as the most derived taxa, and as a sister group to the Old World *Plecotus*. Frost and Timm, by contrast, treat *Euderma*, including *Idionycteris*, as the sister taxon to a clade comprised of *Barbastella*, *Corynorhinus* (= New World *Plecotus*) and *Plecotus* (= Old World species). A recent compilation of mammalian taxonomy (Koopman 1993) retains both *Idionycteris* and *Euderma*.

Distribution: This species is distributed throughout much of the western U.S. (Watkins 1977), with its range extending as far north as southern British Columbia (Woodsworth et al. 1981), and as far south as Durango, Mexico. The widely used distribution map from Hall (1981) does not reflect more recent range extensions. There are now records for western Colorado (Navo et al. 1992), Oregon (McMahon et al. 1981, Barss and Forbes 1984), and the Klamath Mountains of northwest California (Pierson et al. 1996, Pierson and Rainey in review). Within this overall range, the species' distribution appears to be patchy and geomorphically determined, limited to areas with appropriate roosting habitat.

The type specimen for this species is from Castaic Creek, Ventura County, California (Allen 1891). Prior to 1990, the majority of California records (mostly single, dead or moribund animals) came from low elevation, xeric settings (e.g., Red Rock Canyon State Park in Kern County, Mecca in

Riverside County, and several from the Owens Valley, Inyo County) (Grinnell 1910, Hall 1939, Constantine et al. 1979, Bleich and Pauli 1988). Additionally there were two records from Yosemite Valley (Ashcraft 1932, Parker 1952). The most northern record was from a single specimen picked up alive in Palo Cedro, Shasta County (Bleich and Pauli 1988).

More recent surveys (Pierson and Rainey in review) have detected the species (using its echolocation call which is audible to most humans) at several sites in the mountains of Shasta and Siskiyou counties and shown it is more widely distributed than previously realized in the Sierra Nevada. Most Sierran localities are mid-elevation (ca. 1,200-1,400 m), but one or more individuals have been predictably encountered at several high elevation sites (up to 2,880 m). P. Brown (pers. comm.) reports recent auditory detections at Mount Palomar in San Diego County; at Coso Peak, near China Lake, Inyo County; and north of Bishop, Inyo County. A roost in the Owen's Gorge, Mono County, was recently discovered (P. Brown pers. comm., E. Pierson and W. Rainey pers. obs.).

Life History: Little is known about the population biology of spotted bats, although available data suggest that females roost singly, and give birth to a single young (Findley and Jones 1965, Watkins 1977), with births occurring in June or early July. A female about to give birth was caught at Fort Pierce Wash in Utah on June 20 (Poché 1975). Woodsworth et al. (1981) collected a pregnant female on June 16, 1980 in British Columbia. A pregnant female, captured on June 11, 1969, in a mist net in Big Bend National Park in western Texas gave birth to a single young, which weighed 4 g (25% mother's weight)(Easterla 1971). Lactating females have been caught as early as June 12 in Texas (Easterla 1973) and as late as mid-August at 2,300 m in Utah (Easterla 1965), and on the Kaibab Plateau in Arizona (Berna 1990). Lactating females were caught in early September in Yosemite National Park (Pierson and Rainey 1996b, c).

E. maculatum appears to be a dietary specialist (Ross 1961, Easterla 1965, Easterla and Whitaker 1972), feeding primarily on moths (most likely noctuids) 5-12 mm in length. In two studies it was found to feed entirely on moths; in one study, the stomach contents of two individuals were 10-30 % by volume June beetles (Scarabaeidae)(Easterla and Whitaker 1972). Most observations suggest spotted bats forage alone (Wong and Fenton 1982, Wai-Ping and Fenton 1989), sometimes maintaining exclusive feeding areas (Leonard and Fenton 1983), and other times using a "trapline" strategy (Woodsworth et al. 1981). Individuals generally forage 5-15 m off the ground in large elliptical paths, with axes of 200-300 m (Wai-Ping and Fenton 1989, Navo et al. 1992). Unlike many species, spotted bats do not appear to night-roost, and are active all night, traveling one way distances from the roost site of 6-10 km each night (Wai-Ping and Fenton 1989).

Little is known of seasonal patterns for this species. It is not known whether the species migrates. Since other plecotine bats (i.e., *Corynorhinus*) are known to be relatively sedentary, however, long distance migration seems unlikely. On the east side of the Sierra, it has been detected frequently at Owens Lake in the spring and fall, but rarely in the summer (P. Brown pers. comm.). It has been found hibernating in the colder portions of its range (e.g., Hardy 1941), yet is present and periodically active throughout the winter in southwestern Utah (Ruffner et al. 1979, Poché 1981), and in the upper Sacramento River drainage of northern California (R. Miller pers. comm.). The presence of foraging animals in Yosemite Valley in both midsummer and in early November (E. Pierson and W. Rainey pers. obs.) suggests that Sierra Nevada populations do not migrate long distances.

Habitat: *E. maculatum* is found from 57 m below sea level (Grinnell 1910) to 3,230 m above sea level (Reynolds 1981), in habitats ranging from desert scrub to montane coniferous forest (Findley and Jones 1965, Best 1988). It has been collected most often in dry, rough desert terrain. Wherever

the species is found, there are substantial rock cliffs nearby (Parker 1952, Medeiros and Heckmann 1971, Easterla 1973, O'Farrell 1981, Berna 1990, Navo et al. 1992, Pierson and Rainey in review), suggesting that the distribution of spotted bats may be limited by the availability of suitable roosting habitat. Also, at all sites where resident populations have been identified, there is water in the area (O'Farrell 1981).

In California, *E. maculatum* has been found in extremely arid areas, such as the Salton Sea (Grinnell 1910) and Red Rock Canyon (Hall 1939). There are past and current records from the Owens Valley (Bleich and Pauli 1988, P. Brown pers. comm., J. Szewczak pers. comm.) which is dominated by sagebrush (*Artemisia tridentata*), saltbush (*Atriplex* spp.), greasewood (*Sarcobatus vermiculatus*), and rabbitbrush (*Chrysothamnus nauseosus*). A number of authors report the species from areas dominated by Ponderosa pine (Handley 1959, Findley and Jones 1965, Watkins 1977, Woodsworth et al. 1981, Berna 1990, Navo et al. 1992, Pierson and Rainey in review), although there is no evidence the species roosts in trees, nor forages within forests. Typically the bats are detected in meadows or open areas surrounded by Ponderosa pine. They have also been observed in oak savannah (*Quercus* spp.) (Bleich and Pauli 1988), or mixed oak/conifer woodland (Pierson and Rainey in review). Pierson and Rainey (in review) have found spotted bats associated with cliffs and wet, montane meadows (from 1,200 to 2,900 m) in the Sierra Nevada.

Limited information is available on the specific roosting requirements of *E. maculatum*. Available data suggest, however, that the species roosts predominantly in small crevices in cliff faces (Easterla 1970, Easterla 1973, Poché 1975, Poché and Ruffner 1975) of varied lithology (including granite, basalt, limestone, sandstone, and other sedimentary rock). In the few cases in which it has been possible to locate released animals, they were in narrow cracks, one 3 cm wide (Poché and Ruffner 1975), another with an interior opening 10 cm wide, and the bat hanging by its feet 1.5 m from the base of the hole (Poché 1975). Radiotracking studies, conducted in the Okanagan Valley in British Columbia (Leonard and Fenton 1983, Taylor and Wai-Ping 1987), suggest that individual spotted bats roost singly in high cliffs, and are loyal to roosts.

Although spotted bats are not generally viewed as cave dwelling, there are several records of this species roosting in caves and mines. Hardy (1941) reports the finding of four spotted bats hibernating in February on the walls of a wet cave in Utah. There are additional records of a spotted bat found in a natural cave in Nevada in April (Soulages 1966), and in Wyoming (WDFG 1994). A spotted bat was also found in a mine in Sonora, Mexico (Vorhies 1935), and in a wet "cave dug into the side of a hill" in March, 1948 in San Bernardino County, California (Parker 1952).

Although spotted bats have been reported from in or around buildings, these have generally been considered aberrant records, and not indicative of normal behavior (O'Farrell 1981). For example, a spotted bat found at a fish hatchery in Fresno County, California proved to be rabid (Medeiros and Heckmann 1971). Others were found in odd circumstances (e.g., hanging from a second story window sill [August and Dingman 1973] or on the sides of buildings [Ashcraft 1932, Benson 1954, Easterla 1965]).

Status: Class II. Although recent investigations have identified several new localities for *E. maculatum* in California, and have expanded the known range (Pierson and Rainey submitted), the species was detected at only one out of nine historic localities surveyed (Pierson and Rainey 1996b, c). The only historic locality at which *E. maculatum* was found was Yosemite Valley. It was also not detected at 70 other localities, which offered apparently suitable roosting habitat. The conclusions drawn from this survey were that the species' distribution was very patchy, and, in the areas where it occurred, it was relatively rare. K. Miner (pers. comm.) reported detection in 1996

and 1997 of spotted bats at Red Rock Canyon, an historic locality. The recent reappearance of *E. maculatum* at this locality may be related to restoration of a flowing creek following tamarisk removal.

There are a number of potential threats to the roosting and foraging habitat of *E. maculatum* which are discussed in detail in Pierson and Rainey (1996b, c). The following is a summary.

Recreational Climbing. There has been an extraordinary increase in recreational rock climbing in the west in recent years, and improving technical aids have made previously unclimbable areas accessible. A recent informal survey by personnel at Yosemite National Park has documented 3,000 new climbing routes within the park, some employing unsanctioned alterations or attachments (Dept. of Resource Management, Yosemite National Park, pers. comm.). Popular sites, such as El Capitan in Yosemite Valley, experience climbing traffic jams, with multiple parties on a route at one time. Similarly, limited areas of columnar basalt cliffs along the western base of the Sierra Nevada have experienced increasingly heavy use since about 1990. Although no information is available regarding what proportion of the crevices used by climbers offers suitable roosting sites for *E. maculatum*, it is reasonable to presume that hands or temporary climbing aids inserted into a roost crevice would be cause for disturbance and possible abandonment of a site. Also, climbers actively alter cliff habitat, dislodging unstable rock and clearing ledges.

Water reservoirs. The same canyons which offer suitable cliff habitat for *E. maculatum* also provide basins for storage reservoirs, and other water projects. Almost every river which drains the west side of the Sierra Nevada range in California has one or more such reservoirs. It is almost certain that roosting habitat has been lost for these species as a result of these projects. For example, *E. maculatum* is known to occur in the Hetch Hetchy area of Yosemite National Park (Pierson and Rainey 1993). The meadows, riparian woodland, and lower cliff faces of the valley are now submerged. Although *E. maculatum* still occurs there, it is likely that both its roosting and foraging habitat were reduced by this project. The population which once likely foraged in the valley directly below the cliffs, now must travel several miles downstream to find a suitable foraging area (Pierson and Rainey in review).

Highway Projects. River drainages, because they frequently offer the easiest routes through mountain ranges, are also favored corridors for highway construction. Such construction commonly entails blasting of cliff faces, either for initial highway construction or later improvements (i.e., widening and straightening). Since bats are frequently overlooked in the environmental assessment process, cliff roosting species, such as *E. maculatum*, are at risk of both direct impacts from blasting, and long-term loss of roosting habitat from cliff modifications. In some settings, it is possible that soil removal and blasting may expose rock and create habitat, but this is not generally the case since fractured, potentially unstable rock is often removed.

Grazing/Meadow Management. Whereas a number of bat species appear to forage predominantly over water, or along vegetation boundaries (e.g., riparian zones, forest edges), *E. maculatum* frequently forages in open areas, particularly over meadows. To the extent that intensive grazing and trampling of meadows by livestock alters the insect productivity (particularly for lepidopterans), it may impact the foraging habitat of *E. maculatum*, and could adversely affect local populations.

Pesticide Spraying and Environmental Contaminants. Pesticides have been shown to have detrimental effects on bat populations (Clark et al. 1978, Clark 1981, Clark et al. 1983). Persistent chlorinated hydrocarbons are now banned. While the shorter half-life organophosphates, now in wide use, are known to have negative impacts on raptors (Wilson et al. 1991), their effect on bats has

not been investigated. Short-term neurotoxic insecticides could be lethal or impair maneuverability, leading to reduced foraging efficiency and increased vulnerability to predators. Lepidopteran-specific agents like *Bacillus thuringensis* result in significant, if short-term, reduction in the prey base for lepidopteran specialists like *E. maculatum* (Sample et al. 1993).

Recreational Caving. Although *E. maculatum* is not generally considered a cave roosting species, it has been found in caves on several occasions. Though dates are not always available for these records, there is the suggestion that this species is more likely to use caves for hibernation. Disturbance of cave-dwelling bats at roosting sites has been a major cause for population declines for a number of species in the eastern United States, and could potentially have similar impacts on *E. maculatum.*

Closure of Abandoned Mines. Aggressive mine closure programs for hazard abatement have been underway for ten or more years in a number of western states. Until very recently, most closures were undertaken without any prior biological assessment. To the extent that *E. maculatum* may use abandoned mines, they would be at risk from these practices.

Mining and Quarry Operations. Mining and quarry operations which impact cliff habitat could potentially remove roosting habitat. Additionally, the noise generated by active mining and quarry operations could disturb roosting bats, although quarries may in some circumstances create cliff habitat.

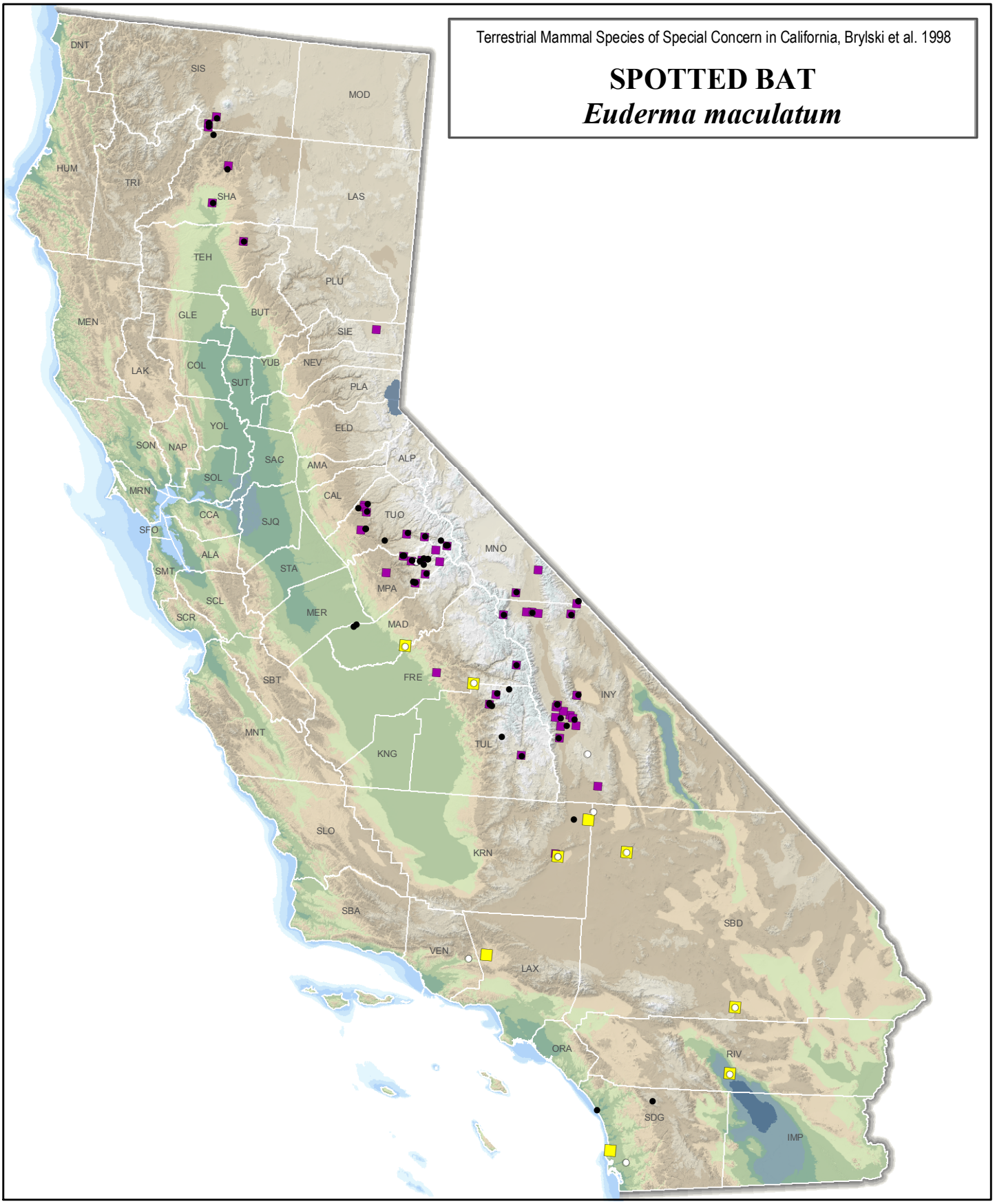
Management Recommendations: The combination of small population size and patchy distribution place individual populations of *E. maculatum* at risk of local extirpation from anthropogenic and stochastic causes. Wherever populations are identified, special measures should be taken to protect them.

Recent surveys, which expanded the known range of *E. maculatum*, suggest that additional surveys should be conducted, particularly in the Coast Ranges, at higher altitudes in the Sierra Nevada, and on the east side of the Sierra Nevada.

More information is needed on the spatial and temporal distribution of populations. It is not known how loyal individuals are to particular roost sites, and thus whether single roost sites, or roosting areas need to be monitored and protected. Studies need to be conducted to assess the impact of certain human activities, particularly recreational climbing, in the vicinity of roost sites.

Terrestrial Mammal Species of Special Concern in California, Brylski et al. 1998

SPOTTED BAT
Euderma maculatum



RESOURCES AGENCY CALIFORNIA DEPARTMENT FISH & GAME

Locations verified by authors
(captures, observations, museum records)

- • Post - 1978
- ○ 1978 and before
- ■ CNDDB 1979 - 1998
- □ CNDDB 1978 and before

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