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Notes

Habitat Use and Management Considerations for the Threatened Alameda Whipsnake (*Masticophis lateralis euryxanthus*) in Central California

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***Abstract.*—Uncommon or declining species are often relatively enigmatic, with large and numerous gaps in our understanding of the natural history of the species. The basking activity of the Alameda Whipsnake (*Masticophis lateralis euryxanthus*) is a gap in knowledge that may contribute to mismanagement of the species. We looked at 365 reported observations for this threatened subspecies and found 25% of the observations were reported in open habitat, such as trails, roads, parking areas, or other sites. This resulted in mortality to nearly 4% of all reported animals that were basking in open areas that allowed bicycle and motor vehicle traffic. Understanding the risk to anthropogenic modifications to habitat used by this subspecies may aid in recovery of the Alameda Whipsnake.**

Key Words.—basking; mortality; injury; mountain bikes; observations; roads; roadkill; trails

The California Whipsnake (*Masticophis lateralis*; formerly Striped Racer) is a near-endemic species that ranges through the mountains of California and south into Baja California, Mexico (Stebbins and McGinnis 2012). It is divided into two subspecies: the Alameda Whipsnake (*M. l. euryxanthus*), which occurs primarily in Alameda, Contra Costa, San Benito, San Joaquin, and Santa Clara counties in California, and the Chaparral Whipsnake (*M. l. lateralis*), which occurs in the remainder of the north and south Coast Range, the southern Cascade and Sierra Nevada ranges, and also Baja California (Ortenburger 1928; Richmond et al. 2011). Currently there is a paucity of published information on the natural history of the species, and little information related to the behavior of either subspecies. Efforts to understand and report information that can support management of this species, in particular Alameda Whipsnake, which is state and federally listed as threatened, are critical to maintaining, monitoring, and managing populations.

Published reports do provide insight into the characteristics and dimensions of the morphology, types of prey, associated habitats, thermal ecology, and reproductive ecology of the entire species. However, there is little information on habitat use, particularly how fragmentation of habitat could affect management of this subspecies. In particular, understanding how trails, roads, and developed areas impact the habitat of this snake could benefit its recovery.

To better understand habitat use, it is important to consider the thermal ecology of the snake. This aspect of the Alameda Whipsnake was carefully studied by Hammerson (1979), who found the subspecies to be highly thermophilic. This work suggested that basking, particularly morning basking, is critical to supporting the physiology of the snake in pursuing and capturing prey (typically lizards). Both subspecies of the California Whipsnake are known to bask in the tops of trees and have been reported there by several researchers (Grinnell and Grinnell 1907; Ortenburger 1923; Shafer and Hein 2005). More frequently, however, the Alameda Whipsnake, has been reported basking in open areas, presumably seeking exposure to direct solar radiation (Hammerson 1979; Sullivan 1981a). Sullivan (1981b) reported six Alameda Whipsnakes basking on a single road in Contra Costa and San Joaquin counties, California.

For our analysis, we reviewed 365 reported observations of the threatened subspecies, including our own observations, and attempted to understand aspects of its behavior that could potentially influence management considerations; particularly how often Alameda Whipsnakes were observed on roads or trails, or in developed areas. These 365 observations included all known California Natural Diversity Database (CNDDB) occurrences (California Natural Diversity Database. 2015. *Masticophis lateralis euryxanthus*. California Natural Diversity Database Version 5.1.1. Biogeographic Data Branch. Department of Fish and Wildlife. Available at: https://www.dfg.ca.gov/biogeodata/cnddb/mapsanddata.asp. [Accessed 9 October 2015]), specimens from the California Academy of Sciences (CAS; California Academy of Sciences. 2015. CAS Herpetology Collection Database. Available at: http://researcharchive.calacademy.org/research/herpetology/catalog/index.asp. [Accessed 4 October 2015]) and the Museum of Vertebrate Zoology

Figure 1. Basking Alameda Whipsnake (*Masticophis lateralis euryxanthus*) on an open trail, Contra Costa County, California. (Photographed by Kendall Oei).

(MVZ; Museum of Vertebrate Zoology. 2015. University of California, Berkeley. Available at: http://mvz.berkeley.edu. [Accessed 4 October 2015]), and individual Alameda Whipsnake sightings reported at parks, preserves, and open spaces within its range. We acknowledge the biases associated with using reported observations (which may include misidentification, missing data, examples that may not represent typical behavior, etc.), but feel that the information used herein can support certain conclusions. We excluded from analysis all reported observations associated with snake trapping events and attempted to determine what type of habitat was associated with the individual snakes, whenever possible. Notwithstanding the limited information provided by the remaining data, we were able to detect an important pattern of behavior. We were able to determine for 40% of these 365 observations whether or not the snake was using a road, trail, or developed area at the time of encounter.

Numerous reports (109, or 30%) of the 365 included information specifying whether the observation occurred within either natural (grassland, rock outcrops, oak woodland, chaparral) or developed areas (i.e., anthropogenic structures, such as driveways, parking areas, graded areas around campgrounds, etc.). Ninety observations (25%) indicated that the specimen was using an open area described as one of the following: hiking trail, fire access road, paved roadway, or developed area (i.e., public bathroom area or picnic area). Based on the thermal ecology of the snake (Hammerson 1979), it is quite possible that such open areas are favored by these snakes because they provide suitable basking habitat and exposure to direct solar radiation, or support surface basking when the substrate radiates heat. Three of the behaviors reported from roads and trails were perceived as sunning or basking (Fig. 1).

Ground-level basking, which is frequently how the species is observed, can facilitate predation and lead to direct or indirect mortality from this and other causes (Sullivan 1981b; Andrews et al. 2015). In the case of the Alameda Whipsnake, at least 13 of the 365 observations we analyzed included specimens that had apparently succumbed to anthropogenic-related mortality; four of these were described as roadkill, presumably killed by cars when the snake was on a roadway. At least one snake on a hiking trail was presumed killed by a mountain bike (MVZ 223176; Fig. 2). The direct causes of mortality for the remaining eight reported dead snakes were ambiguous (i.e., found on road dead). Although roadkill was the likely cause in all eight cases, it could not be determined with certainty.

Andrews and Gibbons (2005) reported that smaller species of snakes may avoid open spaces (including roadways) to reduce the risk of predation. This is less likely to be true of the larger of the two subspecies of California Whipsnakes. When Sullivan (1981) incorporated the tendency of snakes to bask on roads in formulating a methodology for detecting them, he included the whipsnake as an exemplar.

When formulating management decisions, it is important to acknowledge these findings. Specifically, management of the Alameda Whipsnake and its habitat requires careful consideration of habitat alterations and fragmentation. More specifically, habitats that are opened or bisected for placement of trails and roadways may increase the likelihood of ground basking by Alameda Whipsnakes. This may add to interactions between snakes and cars or bikes, and result in increased injury, mortality, and other types of disturbance (i.e., collection, predation, etc.). It is clear that this threatened subspecies can persist in areas bisected by roads and trails, but such infrastructure should be limited or its use restricted, whenever possible, to reduce likelihood of increased mortality of the species.

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Figure 2. Alameda Whipsnake (*Masticophis lateralis euryxanthus*) presumably killed on a trail when struck by a mountain bike, Alameda County, California. (Photograph courtesy of University of California, Berkeley, Museum of Vertebrate Zoology).

Zoology, Berkeley who assisted us in obtaining the photo of specimen #223176. We are also grateful to all those who report observation of sensitive species with such detail and clarity that data-mining becomes a reasonable methodology for data collection.

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