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25

Status of Terrestrial Vertebrates

ABSTRACT

The terrestrial vertebrate wildlife of the Sierra Nevada is represented by about 401 regularly occurring species, including three local extirpations in the 20th century. The mountain range includes about two-thirds of the bird and mammal species and about half the reptiles and amphibians in the State of California. This is principally because of its great extent, and because its foothill woodlands and chaparral, mid-elevation forests, and alpine vegetation reflect, in structure and function if not species, habitats found elsewhere in the State. About 17% of the Sierran vertebrate species are considered at risk by state or federal agencies; this figure is only slightly more than half the species at risk for the state as a whole. This relative security is a function of the smaller proportion of Sierran habitats that have been extensively modified. However, foothill species and those associated with riparian habitats have been substantially reduced. Continuing appropriation of native foothill communities, damage to riparian systems, and compromise of remaining late-successional forests appear to pose the greatest potential risks to Sierran wildlife. The California Wildlife Habitat Relationships System will become an increasingly critical tool in wildlife habitat management and policy decisions because it is an expert system that offers the potential for predicting the outcome on wildlife of proposed land-use changes. However, poor information on the past and present distribution, abundance, population trends, and micro-habitat requirements of most vertebrate species, and consequently the models derived from these data, presently weakens conservation efforts because agencies are likely unable to detect many real problems while overstating or seeking the wrong solutions to others.

INTRODUCTION

There are approximately 401 species of terrestrial vertebrates that use the Sierra Nevada now or in recent times according to the California Wildlife Habitat Relationships System (CWHR) (California Department of Fish and Game 1994) (appendix 25.1). Of these, thirteen are essentially restricted to the Sierra in California (one of these is an alien; i.e. not native to the Sierra Nevada); 278 (eight aliens) include the Sierra in their principal range; and another 110 (six aliens) use the Sierra as a minor portion of their range. Included in the 401 are 232 species of birds; 112 species of mammals; thirty-two species of reptiles; and twenty-five species of amphibians (appendix 25.1). By comparison, CWHR lists 643 vertebrates as regularly occurring in the State. The Sierra Nevada includes range for 68% of the birds, 62% of the mammals, 43% of the reptiles, and 54% of the amphibians in the State. There is proportionately less mesic amphibian habitat and warm-xeric reptile habitat in the Sierra Nevada than for the State as a whole (Mayer and Laudenslayer 1988). The distributions of species in the Sierra are, for the majority of non-avian species, based upon point samples taken over many years and for the most part constitute scientific best guesses. Among the species listed are those whose principal ranges are Great Basin, Central Valley, or Mojave Desert, but which appear to lap into the foothills of the Sierra Nevada on the east or west sides. Both the paucity of sample data and lack of a precise natural and generally agreed-upon boundary for the mountain range means that the figure of 401 species contains an uncertainty of about 10%.

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Back to CD-ROM Table of Contents

KEY QUESTIONS

This report addresses the following questions:

- What species of vertebrates amphibians, birds, mammals, and reptiles presently occur in the Sierra Nevada?
- What is the present status of Sierran vertebrates, and how has that status changed in recent times?
- What are the factors that influence the status and trend of terrestrial vertebrates in the Sierra Nevada?
- What is the present state of scientific knowledge of the status, distribution, trend, and habitat requirements of Sierran terrestrial vertebrates?
- What are the factors relevant to effective conservation and management of Sierran vertebrates in the future?

METHODS

This assessment is a summary synthesis of terrestrial vertebrate status and trends derived from scientific literature, agency reports, and several publicly-accessible databases, including the California Wildlife Habitat Relationships System (CWHR) and the California Natural Diversity Database. CWHR and its associated publications was used as the starting point to develop a list of Sierra Nevada vertebrate species, their status, and their habitat dependencies (appendix 25.1). Because amphibians are treated in detail in other Sierra Nevada Ecosystem Project assessments, they are included in this assessment only schematically, and to the extent that they provide insight into the overall condition of vertebrates in the Sierra Nevada.

For purposes of this report, the study area is the California portion of the Sierra Nevada sensu strictu, approximately bounded by the Central Valley to the west, Owens Valley and the Great Basin to the east, the Cascade Mountains to the north, and Lake Isabella and the Kern River to the south. Because sources of distribution information vary somewhat in their terminology and geographic precision, there is some imprecision in boundaries among different groups of animals.

SPECIES AT RISK

Species considered at risk in the Sierra, through listing as endangered or threatened by State or federal government, special concern by California, or sensitive by federal land managers (but not those locally at risk only elsewhere) include thirty-three birds, nineteen mammals, four reptiles, and thirteen amphibians: 17% of the Sierran terrestrial fauna. These figures are based upon listing either of the species as a whole, or listing of a Sierran subspecies. For the State as a whole, ~30% are so listed in the CWHR database (California Department of Fish and Game 1994), although this number is fluid. Thus based on this administrative criterion alone, Sierran terrestrial vertebrates proportionately are nearly twice as secure under present conditions as the full State fauna.

Three species well-distributed in the range at the time of European settlement are now extirpated from the Sierra Nevada entirely: Bell's vireo (Vireo bellii), California condor (Gymnogyps californianus), and grizzly bear (Ursus arctos), 0.7% of the Sierran vertebrate fauna. Evidence that the gray wolf (Canis lupus) regularly occupied the Sierra in recent centuries is unpersuasive (Schmidt 1991). For California as a whole, although no terrestrial species is extinct, seven (~1.4%) are extirpated from California (Steinhart 1990). Except for the North American Breeding Bird Survey (BBS), there has been no systematic and widespread monitoring to measure declines in population density or contraction of range. The California Department of Fish and Game has monitored some game species, particularly mule deer (Odocoileus hemionus) herds in the Sierra, but variability in methodologies has made inferences from these efforts uncertain at best. Thus the information leading to listing a species or population to be of special concern, or sensitive as the U.S. Forest Service and the Bureau of Land Management use these terms, usually means there are local indications of problems: Either population numbers appear to be low, or habitat believed to be required by the species in question is declining over a significant portion of the species range. While these are reasonable and pragmatic measures of risk, the lack of broad geographic data over a significant period of time for most species means that the term as used here assuredly misses some (perhaps many) species and probably incorrectly targets others.

There is not a close match between species officially judged at risk and those for which direct population data indicate serious and progressive declines as opposed to simple rarity. Great gray owl (Strix nebulosa) and limestone salamander (Hydromantes brunus), for example, are quite rare and local, but there is no compelling evidence of population declines. Contemporary loss of a significant portion of habitat is the most frequent cause for initially assigning a species to a risk category. However, once listed, studies to generate demographic data are often funded (California Department of Fish and Game 1991; Thelander 1994). In the case of breeding landbirds for which there are Breeding Bird Survey (BBS) data (Davidson and Manley 1993), DeSante (1995) identifies six species clearly and significantly declining: band-tailed pigeon (Columba fasciata), red-breasted sapsucker (Sphyrapicus ruber), American robin (Turdus migratorius), chipping sparrow (Spizella passerina), white-crowned sparrow (Zonotrichia

leucophrys), and olive-sided flycatcher (Contopus borealis) Of these six, only the last is a listed species, while the other five are notably widespread and common. There is evidence from BBS for the probable contemporary decline of another twelve species (DeSante 1995). Based on historical descriptions of their abundance, harlequin duck (Histrionicus histrionicus) and yellow-breasted chat (Icteria virens) are greatly reduced today, while Barrow's goldeneye (Bucephala islandica) no longer breeds in the Sierra Nevada, and willow flycatcher (Empidonax trailli) has nearly vanished there.

The California red-legged frog (Rana aurora draytonii) appears to have reached the point of virtual extinction in the Sierran western foothills on the margins of its range (Jennings and Hayes 1994). The Yosemite toad (Bufo canorus), foothill yellow-legged frog (Rana boylii), and mountain yellow-legged frog (Rana muscosa) all appear to be declining perilously in recent decades (Jennings and Hayes 1994; Fellers 1995) based on recent field re-examinations of historic museum collection sites. The California horned lizard (Phrynosoma coronatum frontale) has disappeared from most of its limited western foothill historic sites, while the western pond turtle (Clemmys marmorata), also a Sierran foothill fringe species, is still present at most sites but appears to be suffering perilous population declines because of poor survival of young (Jennings and Hayes 1994). In very recent years, the recovery of mountain sheep (Ovis canadensis) in the Sierra Nevada through reintroduction has suffered a severe reversal, and that species is in dangerous decline (Wehausen 1995).

PREHISTORIC AND RECENT FAUNA OF THE SIERRA NEVADA

During the Pleistocene, California's fauna included camels, horses, giant ground-sloths, mammoths, bison, and saber-toothed cats, all of which became extinct by the early Holocene, about 10,000 years ago. This megafauna largely occupied the valleys and coastal plains, but undoubtedly lapped into the foothills of the Sierra Nevada on both sides, although only a very few remains have been found there. Because the vegetation of the range, and the extent of its glaciation, varied considerably on a millennial scale (Anderson 1990), both now-extinct and presently extant vertebrates, particularly the large herbivores, may have occupied Sierran ranges in the past that are now unsuitable (Wagner 1989; Grayson 1993). Although the extinction of megafauna throughout North America is associated with the change in climate at the end of the Pleistocene, this is only several thousand years after the time when people crossed into North America from Asia. Human predation may well have played a role in this transformation of the faunal landscape. At the time of European settlement, large herds of tule elk (Cervus elaphus) and pronghorn (Antilocapra americana) were still present, especially in the interior valleys, while mule deer (Odocoileus hemionus) dominated the foothills and mountain sheep (Ovis canadensis) occupied the crest and eastern slopes. All four of these ungulates were hunted heavily by Spanish and Anglo settlers for their own needs and for city markets. This greatly reduced populations, while prime habitats were converted to use by domestic livestock. During the 19th and early 20th centuries, fur trapping for beaver (Castor canadensis), mink (Mustela vison), otter (Lutra canadensis), red fox (Vulpes vulpes), marten (Martes americana), and fisher (Martes pennanti), and trapping and shooting wolverines (Gulo gulo) as vermin, greatly reduced all of these species in the Sierra Nevada.

MODERN EXTIRPATIONS IN THE SIERRA NEVADA

Only three vertebrates are known to have been lost from the Sierran fauna in historic times.

Grizzly Extinction

The last California grizzly bear (Ursus arctos) identified with reasonable certainty was killed by cattleman Jesse B. Agnew near Horse Corral Meadow, Sequoia National Forest, in August, 1922; identification by lower canine tooth was made by C. Hart Merriam (Storer and Tevis 1955). A large bear that may well have been a grizzly was spotted by road crews in Sequoia National Park several times in the spring of 1924; in October of that year a Three Rivers cattleman named Alfred Hengst observed a bear in Cliff Creek (Sequoia N. P.) that "was the biggest bear I've ever seen, bigger than any cow, and looked as though sprinkled with snow. I had a close view of the beast which was undoubtedly a grizzly" (Fry 1924). That is the last likely sighting in California. Grizzly bears were well-distributed in California at the time of Spanish settlement, recorded everywhere but for the Great Basin, deserts, and eastern Modoc Plateau; they were concentrated in the open country of the valleys and coastal plains, especially in the riparian zones. In the Sierra they were reported most frequently in the foothill savannahs, woodlands and chaparral, but they appear to have been distributed throughout the range, selecting open country including montane meadows and the alpine zone during the snow-free months. Although largely herbivorous, grizzlies preyed upon cattle and other stock; Spanish and later Anglo settlers set out systematically to exterminate them, using large-bore rifles and steel-jawed traps as large as 5 feet in width. The closest surviving grizzly populations are in northeastern Washington and in the northern Rocky Mountains.

Least Bell's Vireo Extirpation

The least Bell's vireo (Vireo bellii pusillus) was historically distributed widely in riparian habitat of the San Joaquin Valley, southern Coast Range, and southwestern California, as well as the lower foothills of the Sierra Nevada. This bird still persists in small numbers in a few locations in southern California and the central coast, where it is listed as endangered by both state and federal governments. The decline of Bell's vireo parallels the spread of brown-headed cowbirds (Molothrus ater) in California, and in fact local control programs of this brood parasite have significantly increased nesting success (Goldwasser et al. 1980; Small 1994; S. A. Laymon personal communication). However, the destruction of willow-dominated riparian habitat has played a substantial role in the vireo's decline and has isolated remaining populations in small habitat islands.

California Condor Extinction in the Wild

The last wild California condor (Gymnogyps californianus) was captured in Kern County in 1987, one of 27 birds removed to captivity in the 1980s in an effort to save the species from extinction through captive breeding. The condor is a forager of open plains and savannahs, where it once apparently utilized the carcasses of Pleistocene megafauna, the surviving ungulates of the Holocene, and finally the cattle and sheep that replaced them. In the 20th century it ranged over the southern San Joaquin Valley, southern and central Coast Range, and as far south as the Transverse Range of Ventura and Los Angeles counties. However, condors selected cavities in cliffs, and even giant sequoias (Sequoiadendron giganteum), as nest sites, which brought them well into the western slope of the Sierra, as far north as Tuolumne County in recent times. In the 19th century, condors ranged from Canada to Baja California (Koford 1953). It is most likely that the decline of the vast herds of Pleistocene grazing animals upon which condors fed had made it a rare bird by the time of European exploration. In recent years the final decline of condors appears to have been accelerated by ingestion of lead shotgun pellets, collisions with power lines, eggshell thinning from DDT, and other largely-anthropogenic factors (Wilbur 1978). Experimental reintroductions from captive-bred zoo populations are now beginning, but it is uncertain whether the Sierra foothills and adjacent valley provide sufficient habitat quantity and quality, and whether known hazards can be mitigated sufficiently to reestablish a viable population of California condors.

SPECIES RESTRICTED TO THE SIERRA NEVADA IN CALIFORNIA

Thirteen vertebrates are essentially restricted to the Sierra Nevada in California. Six of these are amphibians, including the Yosemite toad (Bufo canorus), three species of salamanders in the genus Hydromantes, and two in the genus Batrachoseps. All of these are fully confined to locales in the Sierra Nevada. Montane and Great Basin endemism in amphibians is likely related to population isolation and subsequent speciation that took place during the great Holocene climatic changes. The Yosemite toad is closely related to the widely-distributed western toad (Bufo boreas), while the Kern Canyon slender salamander (Batrachoseps simatus) and the relictual slender salamander (B. relictus) are among a generous handful of extremely localized slender salamander species occupying moist micro-sites within generally xeric habitats in California. Of the three web-toad salamanders of the genus Hydromantes that occur in California, all of them restricted to the Sierra Nevada, only the Mount Lyell salamander (Hydromantes platycephalus), found in the alpine and subalpine zones of the Yosemite to Kings Canyon Sierra, is relatively widely distributed. The limestone salamander of the Merced Canyon (H. brunus), and the as-yet unnamed Owens Valley web-toed salamander (Hydromantes sp.), found in some riparian areas on the lower eastern slope, are quite restricted (Jennings and Hayes 1994). Both slender and web-toed salamanders belong to the family Plethodontidae, which are lungless salamanders that do not require free water for reproduction.

There are four mammals restricted to the Sierra Nevada (Zeiner et al. 1990b), and a fifth, the heather vole (Phenacomys intermedius), which also has a very localized population on Mount Shasta, and is well-distributed in the Pacific Northwest (Ingles 1965). Two are chipmunks (Tamias), another highly speciose genus in the west. Sierran endemics include the alpine chipmunk (Tamias alpinus) and the long-eared chipmunk (T. quadrimaculatus). The Mount Lyell shrew (Sorex lyelli) has been found only a few times, in riparian areas near Mount Lyell in the Yosemite Region. The yellow-eared pocket mouse, (Perognathus xanthanotus) has been recorded only in the vicinity of Walker Pass, Kern County, at the junction of the Sierra Nevada and the Tehachapi ranges. It is closely-related to the more widely distributed great basin pocket mouse (P. parvus) and likely has similar chaparral and desert scrub habitat preferences (Zeiner at al. 1990b).

In California, pine grosbeaks (Pinicola enucleator) reside only in the upper montane and subalpine forests of the Sierra Nevada, where they are restricted to wet meadows and other riparian habitat. Beyond California, pine grosbeaks range widely through the moist forests of the Rocky Mountains, the Northwest, and the Northeast. White-tailed ptarmigan (Lagopus leucurus) have been introduced to the Sierra Nevada from the Rocky Mountains.

ALIEN SPECIES AND THEIR EFFECTS

Of the fifteen terrestrial vertebrate species now established in the Sierra but not native to the region, seven are birds, seven are mammals, and one is an amphibian. Several of these were intentionally introduced into the Sierra Nevada by the California Department of Fish and Game as game species. These include wild pig (Sus scrofa), chukar (Alectoris chukar), white-tailed ptarmigan (Lagopus leucurus), and wild turkey (Meleagris gallopavo). White-tailed ptarmigan is native to the Rocky Mountains and the Pacific Northwest, where it uses open, alpine habitats dominated by willow. It was introduced to the Mono Pass region of the Sierra in 1971–72 by the California Department of Fish and Game as a prospective game species, and this alien has since expanded its range from Sonora Pass in the north to northeastern Kings Canyon National Park (Small 1994; National Park Service files). Muskrat (Ondatra zibethicus) was introduced for commercial purposes, as was bullfrog (Rana catesbiana). Virginia opossum (Didelphis virginiana) spread into the Sierra from an introduction in San Jose, and possibly elsewhere in California, early in the century, while brown-headed cowbird (Molothrus ater) was first recorded breeding in California in 1870 and spread progressively throughout much of the State; it is described here as alien, although likely self-introduced, because its establishment and spread in California is closely connected to anthropogenic habitat disturbance. House sparrow (Passer domesticus), European starling (Sturna vulgaris), and rock dove (Columba livia) spread into California from intentional introductions in the eastern United States; in the Sierra Nevada they remain close to areas of human settlement and agriculture. House mouse (Mus musculus), brown rat (Rattus norvegicus), and black rat (Rattus rattus) are notorious pests in urban and some suburban areas including parts of the Sierra Nevada; they have been inadvertently introduced from Eurasia many times. Feral cats (Felis domesticus) prey on small vertebrates and compete with small native carnivores adjacent to settlements. Although truly feral dogs (Canis domesticus) are unusual, roaming packs of pet dogs have impacts on wildlife, especially ungulates, and domestic stock as well. Lastly, the domestic goat (Capra hircus) has escaped and established feral populations in a few locations in the central Sierran foothills, as have horses (Equus caballus) and cows (Bos taurus), the latter two usually only on a local and temporary basis in the Sierra, but nonetheless occasionally damaging wetlands and riparian habitats in particular.

Several of these species have had a significant impact on the ecology of the Sierra Nevada and its native species. The most serious effects have been produced by the brown-headed cowbird. The spread of this brood parasite in the Sierra Nevada (and the West in general) has mirrored farming, livestock grazing, clear-cut logging, and suburban development. (Gaines 1977; Rothstein et al. 1980; Verner and Ritter 1983; Airola 1986; Coker and Capen 1995). Preferred foraging habitats in the Sierra include heavily grazed meadows, recent clear-cuts, especially those that are grazed, open forest with short grass understory, pack stations and stables, picnic areas and campgrounds, lawns and golf courses, and residential areas with bird feeders. Closed-canopy and multi-layered forests, forests with shrub understory, tall-grass meadows, and clear-cuts after shrubs and trees are established do not provide cowbird foraging habitat (Laymon 1995). Brown-headed cowbirds were first reported in the Sierra foothills by Grinnell and Storer (1924) west of Yosemite in Snelling in 1915, and at Mono Lake in 1916. The species is now widespread throughout the lower and middle elevations. Cowbirds travel as far as 7 km from feeding areas to host nests (Rothstein et al. 1984; Airola 1986). The greater the area of disturbed landscape within 7 km, the greater the likelihood that a nest will be parasitized (Coker and Capen 1995). Cowbirds are implicated in or directly charged with the decline of a variety of songbirds in the Sierra Nevada, especially willow flycatcher, Bell's vireo, yellow warbler, chipping and song sparrow (DeSante, 1995).Most passerine birds are susceptible, but parasitism and its effects can be highly local (Laymon 1987). Parasitism rates in excess of 10% are cause for concern, and those in excess of 30% are a serious problem (Laymon 1995).

European starlings and house sparrows are largely restricted in the Sierra to the foothills in or adjacent to urban or agricultural lands. They compete aggressively for nest sites with a number of native birds, and starlings in particular may have a significant impact on the nesting success of cavity nesters: western bluebird, ash-throated flycatcher, woodpeckers, and swallows especially purple martin (Small 1994). Thus some settlement patterns lead to reductions or local disappearances of some native species, less through the loss of habitat than the introduction of alien competitors.

Bullfrogs, native to the eastern United States, are now widely distributed in ponds and slow-moving streams in California, including the foothills of the Sierra Nevada; they have been recorded at elevations as high as 2,500 m in Sequoia National Forest. Bullfrogs have almost completely replaced red-legged frogs and foothill yellow-legged frogs in many locations, and are undoubtedly a factor in the precipitous declines of the native Ranid frog species (Moyle 1973; Hayes and Jennings 1986). Bullfrogs also prey on young western pond turtles, where they may be a significant factor in the decline of this species, as well as ducklings and other aquatic and riparian vertebrates.

Wild pigs compete with mule deer, black bears, band-tailed pigeons, squirrels, and many other native species for mast, mushrooms, and other food items. They destroy herbaceous vegetation and root extensively, making them pests in agricultural as well as park lands. Pigs are increasing in numbers and range in California, including the Sierra Nevada foothills. They are the second most hunted big game species in the State (Barrett 1977; Wood and Barrett 1978).

Chukar, white-tailed ptarmigan, and turkey are all local and uncommon residents of the Sierra, where they appear to be providing hunting opportunities with little obvious ecological impact on native species.

SIERRAN MAMMALS

The 112 species of mammals that regularly use the Sierra Nevada, 62% of the State's mammals, are dominated in species richness by the smallest of them: shrews (7), bats (17), rabbits (7), and rodents (56) (appendix 25.1). Among the rich assemblage of rodents are seventeen squirrels and chipmunks as well as a variety of pocket gophers, pocket mice, kangaroo rats, white-footed mice, and voles, as well as larger rodents including mountain beaver, yellow-bellied marmot, [true] beaver, and porcupine. Most of these are nocturnal and seldom-observed except for the squirrels. Distribution records depend largely on museum specimens collected from a limited number of locales. Most mammalian data sets emphasize species of economic importance as game, pelts, or pests, and a small number of charismatic species that attract public attention, such as cougar, coyote, and mountain sheep.

Bats

Seventeen species of bats are believed to use the Sierra Nevada. Of these, seven have been nominated for listing under the Endangered Species Act. Three of those and one additional species have been listed as sensitive or special concern. Concerns began to be raised about many bat species when numbers using known historic roosts were noticeably smaller or had disappeared entirely. One obvious potential culprit in these declines has been pesticides, since bats are insectivorous and like birds have very high metabolisms. But habitat requirements of most bat species have been based on a very small number of sites. Recent work by Pierson (1995) and others in California suggests that the large, old trees and snags associated with late-successional forests may be quite important to long-eared myotis (Myotis evotis), long-legged myotis (M. volans), and fringed myotis (M. thysanodes) as healthy populations have been found only in late-successional forests. The large trees and snags of conifers possess cavities and crevices that provide thermal protection for these bats. The presence of spotted bat (Euderma maculatum), Brazilian free-tailed bat (Tadarida brasiliensis), and western mastif bat (Eumops perotis) is correlated with meadows, while many if not most Sierran bats forage over water, especially riparian corridors. As bats use lower elevations for part of the year, loss of high-quality riparian habitat there may be factor in the apparent decline of so many species. Relatively high densities of spotted bats and western mastif bats have been found only in the vicinity of the substantial cliffs afforded by large river drainages such as the Kings, Kaweah, Merced, and Tuolumne rivers (Pierson 1995)

Forest Carnivores

This group of species, typically referring to red fox (Vulpes vulpes), fisher (Martes pennanti), marten (Martes americana), and wolverine (Gulo gulo) has been the subject of considerable attention for the past several decades, particularly after publication of Status of Six Furbearer Populations in the Mountains of Northern California by Schempf and White (1977). Its title reflects a preoccupation with the former economic importance of these species, their present apparently-reduced numbers, and factors affecting recovery. In recent years, substantial efforts have been made to assess the status of fishers and martens in the Sierra Nevada as well as elsewhere in California (Zielinski et al. 1996a, 1996b) using systematic grids of baited track and camera stations. Although unable to assess trends from only a few years of data, the authors found martens to occupy much of their historic range in the Sierra Nevada. However, while they found significant fisher populations in the southern Sierra Nevada west-side mixed conifer zone, they were unable to detect fishers north of Yosemite National Park, despite reports of their presence there by Grinnell et al. (1937), and scattered reports from the 1960s collected by Schempf and White (1977). Because the northern Sierra Nevada habitat of fisher (i.e., late-successional forest) has been extensively modified by timber harvest and other resource-extractive activities, and heavy fisher trapping also took place there, more than one factor may be involved. The red fox subspecies (V. v. necator), found principally in the northern Sierra Nevada in California (as well as Cascades), has been seldom detected and almost unstudied. Much the same can be said of wolverine, although it is regularly but infrequently reported from one location or another throughout the Sierra Nevada from montane forests into the alpine zone. Schempf and White (1977) reported an increase in sightings in the 1970s in the southern Sierra.

Mountain Sheep

As in other places in the west, mountain (bighorn) sheep (Ovis canadensis) populations in the Sierra Nevada were decimated following the arrival of Europeans in the mid-19th century (Buechner 1960). Sheep populations in the Sierra were originally scattered along the crest and east slope from Sonora Pass south, and along the Great Western Divide of what is now Sequoia National Park; there was also a population in the Truckee River drainage (Jones 1950; Wehausen 1988). Likely causes for the precipitous population decline include market hunting, severe overgrazing by domestic stock, and probably most importantly the transmission of respiratory bacteria from domestic sheep to bighorn that were fatal to the latter (Wehausen 1980).

Bighorn sheep were gone from the Yosemite region before the turn of the century (Grinnell and Storer 1924). By the 1970s, only two populations remained in the Sierra Nevada: in the vicinity of Mount Baxter (ca 220 individuals) and Mount Williamson (ca 30 individuals), west of Independence. The Mount Baxter herd was increasing during the 1970s (Wehausen 1980). From 1979 until 1988, the Mount Baxter population was used by the California Department of Fish and Game, in cooperation with the U.S. Forest Service and the National Park Service, to successfully reestablish herds near Wheeler Ridge, Mount Langley, and Lee Vining Canyon. Some cougars were removed from the Lee Vining Canyon area to reduce significant losses while that herd was getting established. By 1990, the three introduced herds were all increasing, and the overall Sierra bighorn population was at least 300 (Bleich et al. 1990).

Between 1977 and 1987, cougar (Felis concolor) depredation reports in Inyo and Mono counties, as well as for California as a whole, increased dramatically (Foley et al. 1995). During that period, fifty predation losses to the Mount Baxter herd were discovered on its escarpment-base winter range. Losses by cougar predation were detected in the other herds as well. During the extended drought of the late 1980s and early 1990s, the herds gradually abandoned their low elevation winter ranges for much higher elevation sites that, while inferior from the standpoint of forage and protection from cold, were relatively snow-free during the drought and afforded protection from predation. This profound behavior change is attributed by Wehausen (1995) to heavy cougar predation pressure on the traditional low-elevation ranges. Concurrent with this change in behavior has been a steady decline in population. The Mount Baxter population had 108 ewes in 1978; no more than twenty were counted in 1995. Twelve sheep died in a single avalanche on Wheeler Ridge in 1995; only ten ewes remain as its reproductive base. The Lee Vining Canyon population declined from approximately thirty-six ewes in 1993 to fourteen in 1995. Whether from accidents or an inferior energetic balance, the new situation is distinctly pessimistic, with the Sierra Nevada population probably well below the 250 recorded when reintroduction began in 1979.

There is no reason to assume cougar populations were smaller than at present prior to settlement, although they may well have fluctuated significantly over time. But whereas sheep were widespread in the Sierra at settlement, presently they only persist in scattered small pockets of high elevation habitat where snow depths are tolerable and cougars absent. One possible explanation is that in the past, sheep herds were sufficiently well-distributed and large that herds in decline on account of heavy predation or weather were supplemented by colonists from other thriving herds, thus providing a regional buffer for local perturbations as well as maintaining genetic diversity. The small and isolated populations now present can no longer provide either function.

Management of the Sierran bighorn is facilitated by the Sierra Interagency Bighorn Sheep Advisory Group, which includes technical representatives from participating agencies. This group is now considering a recommendation that a captive breeding program be established as insurance against complete collapse of the Sierran populations, and as a source for future reintroduction. However, domestic sheep and cattle allotments on the public lands of the eastern slope and Sierra crest, with their well known potential for disease introduction into bighorn, greatly restrict the number of potential sites available for reintroduction. So long as populations are relatively small and disconnected, some controls on predation, especially through cougar removals, may also be necessary.

SIERRAN BIRDS

The avifauna of the Sierra Nevada is still reasonably intact. Only Barrow's goldeneye (as a breeding species), Bell's vireo, and California condor have been wholly extirpated from the Sierra, but several species, including harlequin duck, great gray owl, and willow flycatcher, appear to be at great risk in the Sierra. The latter two are California endangered species, the only two species of Sierran landbirds (as defined here) that are currently officially listed, although bald eagle and peregrine falcon, which also breed in the Sierra, are on both state and federal threatened or endangered lists. Several additional Sierran landbirds are federal candidates for listing or California Species of Special Concern: Federal candidates include California spotted owl, olive-sided flycatcher, Bell's sage sparrow, as well as non-landbirds: harlequin duck, northern goshawk, and western sage grouse. Seven Sierran landbirds have been included on the California State Department of Fish and Game's list of "Species of Special Concern": Long-eared owl, black swift, Vaux's swift, purple martin, loggerhead shrike, yellow warbler, and yellow-breasted chat. Other Sierran "Species of Special Concern" include: osprey, sharp-shinned hawk, cooper's hawk, golden eagle, and prairie falcon. A new list of California Species of Special Concern is currently in draft stage. Thirteen additional Sierran landbirds are being considered for this new list.

Breeding Landbirds

(This section is extensively adapted from DeSante 1995.)

With the exception of game species, only breeding landbirds have been monitored both systematically and over the length of the range for multiple decades: The North American Breeding Bird Survey (BBS) routes began in 1966. However, only seventeen routes have been established in the entire Sierra Nevada physiographic region. As at least fourteen routes are necessary to establish trends with certainty by providing sufficient sample size, the majority of Sierran breeding landbirds are assigned to insufficient sample size; trend may be stable or unknown (Davidson and Manley 1993). In particular, routes

in the lower west-slope foothills have been inadequate to establish trends with confidence for the bulk of species breeding there.

Nonetheless, because of these systematic data, breeding landbirds provide the most useful group of vertebrates to examine as an indicator of Sierran vertebrate status and trend. DeSante (1995) has analyzed the literature of birds breeding in the Sierra Nevada, as well as BBS data for the period 1966–91, and the Monitoring Avian Productivity and Survivorship (MAPS) data for twelve stations operated in the Sierra during 1990–94. DeSante's report to the Sierra Nevada Ecosystem Project is summarized here.

Twenty-six years (1966–91) of BBS data indicate that only six breeding landbird species are definitely decreasing in the Sierra Nevada physiographic region (according to the classification system described above): band-tailed pigeon –5.5% per year, red-breasted sapsucker –7.5%, olive-sided flycatcher –3.2%, American robin –2.7%, chipping sparrow –5.0%, and white-crowned sparrow –9.7%. More species, however, likely would be found to be decreasing were it not for the paucity of BBS routes in the Sierra. In fact, twelve other species appear to be decreasing by amounts ranging from 1.2% to 8.5% per year: Mourning dove, belted kingfisher, western wood-pewee, Steller's jay, mountain chickadee, golden-crowned kinglet, Swainson's thrush, black-headed grosbeak, dark-eyed junco, brown-headed cowbird, house finch, and lesser goldfinch. These eighteen decreasing species have little apparent in common except that many of them are among the commonest, most widely distributed, and most characteristic landbird species in the Sierra. It's important to note that change detection in either direction is most likely to occur for species that occur on many transects.

Only four of these eighteen definite or likely-decreasing species are true neotropical migrants: olive-sided flycatcher, western wood-pewee, Swainson's thrush, and black-headed grosbeak. Marshall (1988) previously documented the disappearance of olive-sided flycatcher and Swainson's thrush from an area of the southern Sierra and suggested that it was caused by tropical deforestation on the species wintering grounds. Except for nighthawks and various swallows, olive-sided flycatcher, western wood-pewee, and Swainson's thrush are the three longest distance migrants among the Sierra's neotropical migrant landbirds, and relatively few or no individuals of these species winter in western Mexico where the majority of the Sierra's neotropical migrants are assumed to winter. An additional eleven species may be decreasing in the Sierra: flammulated owl, white-throated swift, northern rough-winged swallow, scrub jay, American crow, chestnut-backed chickadee, white-breasted nuthatch, blue-gray gnatcatcher, Townsend's solitaire, pine grosbeak, and evening grosbeak. Only six of twenty-nine definitely, likely, or possibly decreasing species are neotropical migrants. In contrast, fourteen of these twenty-nine decreasing species are short-distance migrants or short-distance/neotropical migrants, and nine are resident or resident/short-distance migrants. This suggests that local influences may be having a more significant negative effect than tropical deforestation on landbird populations.

Marshall (1988) also documented the disappearance of mountain quail, flammulated owl, northern pygmy-owl, spotted owl, and hairy woodpecker from his study area in the southern Sierra. The BBS data shows flammulated owl as possibly decreasing and northern pygmy-owl with a decreasing tendency, but shows hairy woodpecker as probably relatively stable (–0.8% per year). BBS data also show mountain quail as likely relatively stable (–0.6% per year). BBS data are insufficient to provide reliable trend information for spotted owl. Overall, the disappearances recorded by Marshall in the southern Sierra seem to be reflected in other parts of the Sierra as well. However, intensive work on the spotted owl, in the region (Sequoia and Kings Canyon National Parks) that abutted Marshall's (1988) study area, did detect the species there but was unable after four years of censuses to determine if the population was declining (Verner et al. 1992). Interestingly, calling for spotted owls by investigators also generated more locations for flammulated owl in the two national parks than had been recorded in all previous years (Sequoia and Kings Canyon National Parks files), suggesting that detection of this and species with similar habits may be quite poor.

On the other side of the ledger, four species were found to be definitely increasing in recent decades: White-headed woodpecker +3.4% per year, cliff swallow +26.3% per year, common raven +9.1%, and fox sparrow +3.2%. DeSante (1995) suspects that all of these increases result directly from human activities and adaptive responses on the part of the birds to these activities: Cliff swallow from increased nesting locations afforded by bridges and buildings, common ravens from increased human traffic on roads and a resulting increase in road kills that ravens have learned to utilize, fox sparrow from increased amounts of upland brushy habitat resulting from logging operations, and white-headed woodpecker from selective harvest practices (thinning) which white-heads favor. Eight other species are likely increasing by amounts ranging from +1.7% to +5.5% per year: Hammond's flycatcher, black phoebe, house wren, solitary and warbling vireos, and yellow, yellow-rumped, and MacGillivray's warblers. Six of these twelve definite or likely increasing species are true neotropical migrants: Hammond's flycatcher, cliff swallow, solitary and warbling vireos, and yellow and MacGillivray's warblers. Except for cliff swallow, which winters in South America, Sierran populations of these other five neotropical migrants probably winter primarily in western Mexico. An additional seven species are possibly increasing in the Sierra: tree swallow, hermit thrush, black-throated gray warbler, hermit warbler, western tanager, rufous-sided towhee, and Brewer's sparrow. Five of these (all but the towhee and sparrow) are true neotropical migrants that winter primarily in western Mexico. Thus, eleven of nineteen definitely, likely, or possibly increasing species are true neotropical migrants. These data, taken together with data on decreasing species presented

above, provide no indication that neotropical migrants as a group are decreasing in the Sierra at any greater rate than other species. More species seem to be decreasing in the Sierra (29) than increasing there (19), although the difference is doubtfully significant (DeSante 1995).

DeSante (1995) was able to identify four species as having relatively stable population trends in the Sierra: Northern flicker, pileated woodpecker, Bewick's wren, and Cassin's finch. Two of these (pileated woodpecker and Bewick's wren) are resident or resident/short-distance migrants. Ten other species were identified as having probably relatively stable population trends in the Sierra: Hairy woodpecker, red-breasted nuthatch, brown creeper, orange-crowned, Nashville, and Wilson's warblers, green-tailed towhee, Brewer's blackbird, purple finch, and pine siskin. Three of these (the woodpecker, nuthatch, and creeper) are also resident or resident/short-distance migrant species. Finally, eight additional species were identified as having possible relatively stable population trends in the Sierra: Common nighthawk, Anna's hummingbird, downy woodpecker, barn swallow, bushtit, wrentit, song sparrow, and northern oriole. Three of these are also resident or resident/short-distance migrant species. Thus, eight of the relatively stable species seem to be resident or resident/short-distance migrant species.

DeSante tested patterns regarding the number of species showing decreasing, increasing, or relatively stable population trends among the various migratory groups by means of a contingency table and Chi-square tests. The mean population trends for species with various migration strategies provide a further indication that neotropical migrants are not declining in the Sierra more than residents or short-distance migrants. The mean population trends for the twenty-one species of residents and resident/short-distance migrants having definite, likely, or possible population trends was –1.2% per year; for the twenty-six species of short-distance migrants and short-distance/neotropical migrants having definite, likely, or possible population trends it was –1.7% per year; and for the twenty-three species of neotropical migrants having definite, likely, or possible population trends, it was +1.9% per year (when cliff swallow with a +26.3% population trend was eliminated from the neotropical migrants, the mean population trend for the remaining twenty-two species was +0.8% per year). Limiting this analysis only to species showing definite or likely population trends, the results were: residents and resident/short-distance migrants +0.7%; short-distance migrants and short-distance/neotropical migrants –2.4%; and neotropical migrants +2.6% (when cliff swallow was eliminated this value became +0.6%).

Short-distance migrants, as a group, may be faring the worst among landbirds in the Sierra. DeSante's (1995) findings agree with Hutto (1988), who questioned the decline of neotropical migrants wintering in western Mexico, and with DeSante and George (1994) who found that neotropical migrants generally showed fewer and smaller decreasing trends than short-distance migrants over western United States as a whole. This should not be interpreted as indicating that problems do not exist among neotropical migrants nor that tropical deforestation is not a problem for Sierran landbirds, but merely that gross generalizations regarding massive declines in neotropical migratory landbirds in western North America in general, and the Sierra in particular, may be unfounded based upon available data.

Moreover, a few misclassifications of migratory behavior or population trend in the contingency table could alter the results so that they were not significant. Indeed, the data as presented have rather poor statistical power or robustness. There are other cautions: Much of this analysis is based on species that were recorded on less than fourteen routes in the Sierra. Such data are generally considered inadequate for detecting reliable regional trends. Thus the results presented here must be viewed as suggestive rather than conclusive. Second, the analysis presented here utilized twenty-six years of BBS data from 1966–91. Because trends for the more recent thirteen years were not separated from trends in the early thirteen years, the situation in the Sierra could have begun to deteriorate in recent years. However, DeSante and George (1994) found the reverse to be true. Populations of both short-distance and neotropical migrants tended to fare better during the more recent thirteen years than during the earlier thirteen years. Third, BBS results are based on roadside surveys and may not be valid for areas away from roads. A variety of habitat conditions may exist adjacent to the road that are unrepresentative of the area as a whole. And, because the locations of the transects were chosen in part for accessibility, landscape development or other modifications there may likewise be unrepresentative of the region.

Potential Risks Faced by Sierran Landbirds

Grazing

Grazing of Sierran habitats, particularly montane meadow and montane riparian habitats, may constitute a significant threat to Sierran landbirds. Grazing of montane meadows has been implicated as a major cause of the drastic decline of willow flycatchers in the Sierra; Gaines (1988) claims that willow flycatchers do not nest in willows whose lowermost foliage has been denuded by livestock. Grazing has also been implicated in the decline of great gray owls outside of Yosemite National Park; great gray owls do not forage in grazed meadows, perhaps because grazed meadows are attractive to great horned owls which exclude them (Gaines 1988), or because of changes in prey populations.

The major deleterious effects of grazing on montane meadows are decrease in the density and height of herbaceous growth in the meadow. Many of the landbird species utilizing these meadows depend upon insects that either live on the herbaceous growth or depend upon the primary productivity of the herbaceous growth for sustenance. (The dense concentrations of aphids on lupines and corn lilies in these meadows is one example.) A decrease in the quantity of this

herbaceous growth will result in a decrease in the food resources of landbirds that use the meadow. A decrease in the quantity of herbaceous vegetation may also lead to a concomitant proportional increase in the amount of shrubby woody vegetation. However, the increase in shrubby vegetation does not always translate into an increase in the quality of the willows that are usually present in montane meadows, as livestock often extensively browse and effectively defoliate the lowermost foliage of willows, thereby greatly reducing the usefulness of this resource to landbirds. Grazing also tends to destroy the banks of the streams flowing through the meadow which both widens and deepens the stream channels and thus increases the rate of channelization and lowers the water table (Ohmart 1994). All of these effects tend to cause a drying out of the meadow and to hasten its demise. Grazed riparian habitats, even without associated meadows, seem to be affected in a similar manner (Ohmart 1994). And finally, the grazing of montane meadows promotes contact between cowbirds (which are attracted to the grazing livestock) and a high density of nearby nests of many host species, including both those that nest in the meadow itself and those that nest, often in higher than average numbers, in the adjacent forest.

Montane meadows and montane riparian habitats are extremely important for Sierran birds. Not only is there a substantial subset of species that are dependent upon these habitats, the population densities of many forest-inhabiting species are often highest on the edges of montane meadows (DeSante 1995). Moreover, they are often used as important supplemental habitat for a variety of species, including the rapidly-declining red-breasted sapsucker, which depends upon willows in montane meadows for a steady supply of sap during the breeding season, and a number of finch species which require a daily water supply. Finally, montane meadows serve as a critical molting and pre-migratory staging area for the young and, to a lesser extent, the adults of many Sierran landbirds. Montane meadows in mid-summer may be the single most critical Sierran habitat requirement for many species that do not even utilize this habitat during the actual breeding season (DeSante 1995). Species such as orange-crowned and Nashville warblers fall into this category. The effects of grazing on other Sierra habitats are also likely deleterious to landbirds, but probably to a lesser extent than grazing in montane meadows. In all cases grazing tends to decrease the amount of herbaceous plant growth present in forest, woodland, and brushland habitats, thereby negatively affecting the food resources of many granivorous and some insectivorous species, and tends to increase the contact between cowbirds and their host species.

While the extent of cowbird parasitism in the Sierra may be increased by grazing, grazing itself may not be the basic cause for the increase in cowbirds in the Sierra. The fundamental cause for the increase in cowbirds in the Sierra may be related to agricultural practices and feedlots in the major valleys both east and west of the Sierra. The large populations of cowbirds that inhabit these valleys may serve as source populations for cowbirds that parasitize landbirds in the Sierra. Widespread, comprehensive cowbird control programs in the Sierra may be ineffective for reducing the overall problem; however, local cowbird control programs at certain critical meadows and riparian habitats may be necessary for protecting remnant populations of certain very rare species, such as willow flycatchers. The amount of grazing in the Sierra, at least at mid- and higher elevations, has been decreasing in recent years (Menke et al. 1996). Perhaps related to this, BBS indicates cowbird populations seem to be decreasing as well (DeSante 1995). However, at the present time grazing and its secondary effects may well be the single most significant negative factor in the maintenance of native Sierran landbird populations.

Logging

Forestry management practices, particularly logging and fire suppression, can have a profound effect on landbird populations in the Sierra and elsewhere (Hejl 1994). Extensive clearcutting is obviously detrimental to most forest-inhabiting species because it removes large areas of forest habitat. The even-aged forests that tend to result from planting after clearcuts often lack the tree species diversity and, apparently more importantly, structural diversity that seems to permit large and diverse bird populations to persist. Selective logging that preserves multi-aged stands and the structural diversity of the forest, may offer a better forest management prescription from an avifaunal standpoint than even-age forestry practices. Selective cutting, however, can also be detrimental if it removes or modifies important components or characteristics of the forest that are critical for certain species such as large snags and logs. Considerations of forest fragmentation are also important with regard to the management of Sierran forests. Fragmentation increases the ratio of forest edge to forest interior and has been implicated in the loss of bird species diversity in eastern forests, apparently primarily through increased rates of cowbird parasitism and nest predation (e.g., Coker and Capen 1995). It is possible that similar effects could be occurring in the Sierra, although perhaps to a lesser degree since Sierran forests naturally feature fine-scale fragmentation mosaics (Franklin and Fites-Kaufmann 1996).

A sufficient amount and distribution of old-growth and mature forests can serve as locations for source populations for species dependent upon such habitats. It also includes a sufficient quantity of the snags, logs, and other dead wood that are required by both primary and secondary cavity nesters, and used by such species as great gray owls (Hayward and Verner 1994) and spotted owls (Verner et al. 1992). These two critical aspects of forest management, providing a sufficient amount and distribution of late-successional forests, and providing a sufficient quantity and distribution of snags and other dead wood in forests of all ages with all degrees of canopy cover and tree densities, appear to be crucial for the continued existence of an intact and healthy Sierran forest avifauna. There are, of course, species including some possi-

bly declining that prefer open stands or forest openings as would have occurred in many places under aboriginal fire regimes; these conditions could be simulated with appropriate forestry practices.

Fire Suppression

Fire suppression in the Sierra Nevada has led to forest and chaparral stand conditions inimical to many Sierra landbirds because of loss of micro-habitat elements. These include dense ingrowth of shade-tolerant tree species in place of forest openings containing herbs and shrubs, and decadent stands of chaparral with low productivity instead of mosaics of various seral conditions. And, of course, the high fuels associated with suppression can lead to large, stand-destroying fires that eliminate large, old trees, snags, and logs.

Development of the Sierra and the Loss of Breeding Habitats

Development pressures throughout the Sierra, but especially in the foothills and lower elevations of the west slope, are becoming an increasingly important threat to the viability of Sierran landbird fauna, and to the ecological integrity of the Sierra as a whole. Two habitat types stand out as most endangered by this development, the arborescent riparian habitat along the west slope's rivers and streams, and oak woodland and forest. Chaparral, however, is also threatened by this development. The risks that these habitats face from development come from a number of sources. Dam building, water diversions, and agriculture have had massive negative effects on the riparian habitats and other wetlands of the west slope, especially in the lower foothills (Kattelmann 1996; Moyle and Randall 1996). Not only have forests of typical riparian species, such as willows, cottonwoods, and sycamores, been reduced to remnants, riparian valley oak communities have disappeared from all but a handful of locales. As most of the original riparian forest habitat in the Central Valley is gone, the remaining riparian habitat in the lower foothills becomes essential to a number of species with limited habitat and critically low population levels in the Sierra, such as black-chinned hummingbird, common yellowthroat, yellow-breasted chat, and blue grosbeak.

Low-density foothill and mid-elevation developments ("ranchettes"), can produce subtle but significant problems. Grazed paddocks and large expanses of mown grass provide centers for cowbird parasitism problems. Agricultural, residential, and commercial development of the Sierran foothills increases the number of starlings inhabiting those areas which negatively affects cavity nesters by usurpation of their nest holes (Small 1994). Pets, especially house cats, prey on many bird species, while they reduce the numbers of reptiles and small mammals that serve as prey for many birds. On the other hand, ponds, orchards, and some ornamental plantings may actually increase local native diversity, depending on size, management practices, and surrounding habitat (Mayer and Laudenslayer 1988).

Little information exists regarding the population trends of the landbirds of the Sierran oak woodland (interior live, blue, canyon, and black) and chaparral habitats, despite the fact that these habitats represent areas of high vertebrate species diversity, including landbirds, for California and the Sierra (Barrett 1980; Block and Morrison 1990; Garrison 1996). Many, perhaps most, Sierran species that specialize or reach high densities in oak woodland habitats seem to be decreasing in the Sierra (band-tailed pigeon, Lewis' and acorn woodpeckers, scrub jay, plain titmouse, blue-gray gnatcatcher, western bluebird, lesser and Lawrence's goldfinches). DeSante (1995) suspects that a number of rare or uncommon chaparral-inhabiting species (such as greater roadrunner and rufous-crowned, black-chinned, and sage sparrows) are likewise decreasing, although BBS data are too sparse for most of these species to provide population trends. Grassland species of the lower foothills (such as western kingbird, horned lark, and lark and grasshopper sparrows) might also be declining as a result of increased development of the foothills (DeSante 1995), but adequate transect data are lacking. It would appear that the foothill areas and lower west slopes of all the Sierra are the areas that are now in critical need of avian research and monitoring efforts.

Increased Recreational Use of the Sierra

Increased recreational use of the Sierra and the increased vehicular traffic associated with it may present a serious threat to certain species that specialize in, or are limited to, areas of high recreational use. Montane meadows and montane riparian areas, including those at high altitudes, stand out as being most vulnerable because of their great popularity with campers, hikers, and equestrians. On the other hand, national forest and national park rules governing these areas have become much more restrictive than in former years. Increased accessibility in the Sierra will bring more humans into contact with wildlife, especially in relatively remote areas, but should have little effect on most landbirds (except possibly game birds including band-tailed pigeons, mourning doves, quail, and grouse). Annual revisions of hunting regulations and bag limits to reflect trend data and new knowledge of species biology can significantly ameliorate any effects of taking.

Pesticide Use

Pesticide use could be having serious deleterious effects on Sierran bird populations, and may provide an explanation for otherwise unexplained declines where habitats appear to be intact, but there is little direct evidence of such effects. Pesticides can potentially affect landbird populations in two ways: (1) by directly reducing the prey base available to the birds; and (2) by chemical contamination of the birds via pesticide accumulation up the food chain. Recent work suggests that exposure by the developing zygote to even extremely dilute concentrations of some common pesticides the so-called estrogen mimics may ultimately reduce fertility. Two situa-

tions in which the direct depletion of the prey base could occur are: (1) heavy pesticide use on forest insect outbreaks such as those of bark beetles at mid- and higher elevations in the Sierra; and (2) heavy pesticide use in the Central Valley that could negatively affect those flying insects that are wind-drifted to higher elevations in the Sierra and that may provide a major food source for swifts, nighthawks, olive-sided flycatchers, and even, perhaps, gray-crowned rosy finches that feed extensively on wind-drifted insects precipitated on snow banks. Pesticide contamination of birds via accumulation up the food chain is likely to be most important for diurnal raptors and owls (and also, perhaps, kingfishers and other waterbirds) but could also possibly affect most insectivorous species to some degree. Heavy pesticide use on the tropical wintering grounds of Sierran species could also be exerting a negative effect through either or both of the above-mentioned mechanisms. Considerably more research on all aspects of pesticide accumulation and its effects are needed before this potential risk to Sierran birds can be dismissed.

Habitat Destruction and Degradation of Wintering Grounds

Habitat loss on wintering grounds has been implicated as an important factor causing decreases of a number of forest-inhabiting neotropical landbirds of eastern North America (Robbins et al. 1989; Terborgh 1989), but the extent to which it is the major factor is unknown. Marshall (1988) suggested that tropical deforestation was also the major factor involved in the declines of olive-sided flycatchers and Swainson's thrushes in the southern Sierra. While this may be a correct assessment for these two rapidly disappearing species, it is doubtful that habitat loss and degradation on tropical wintering grounds can be implicated as the general overriding cause of population declines in Sierran landbirds since the Sierran BBS data do not indicate that neotropical migrants in the Sierra are faring worse that resident or short-distance migrants in the Sierra. Similarly, MAPS data from the Sierra provide no indication that Sierran neotropical migrants as a class have lower annual adult survival rates than Sierran resident or short-distance migrant species. Individual species, however, such as olive-sided flycatcher and Swainson's thrush and, perhaps western wood-pewee and black-headed grosbeak, may be adversely affected by this problem. Clearly, additional data on the relative productivity and survivorship of Sierran landbirds is needed. On the other hand, habitat loss or degradation of the temperate (southern U.S. or northern Mexico) wintering grounds of a number of relatively short-distance migrants may be a more serious problem. BBS data suggest that relatively more species of Sierran short-distance migrants may be declining than either resident or neotropical migrants. Moreover, a number of the declining short-distance migrants seem to be species that winter in grassland, brushland, or riparian habitat in the Southwest. Degradation or loss of these habitats caused by adverse agricultural and grazing practices, residential and commercial development, and pesticide use may be having a strong negative affect on the landbird avifauna of the Sierra. Obviously, more work is needed in this regard.

Large-Scale Climate Change

Landbird productivity data from constant-effort mist netting in a California coastal scrub habitat in a Mediterranean climate suggests that productivity is at a maximum under relatively average weather conditions and that productivity decreases both when weather conditions are drier or wetter than average (DeSante and Geupel 1987). If such a relationship exists in the montane environment of the Sierra, then the pattern of extreme weather conditions that has characterized Sierran weather during the past two decades may have depressed the productivity of landbirds. The mechanism for this effect could be concomitant changes in primary productivity in general, or changes in the production of critical food resources for the birds, including acorn, berry, and insect production. This could, perhaps, be the overriding reason why more species of Sierran landbirds seem to show population decreases than population increases. Consequently, a future period of more extreme weather than generally characterized the Sierra during the years from 1900–1980, when we as a society developed our notions of normal Sierran climate, may result in long-term lower productivity during a time when other risk factors are also increasing.

SIERRAN REPTILES

There are 32 species of reptiles occurring in the Sierra Nevada; all are native there. Four of these are considered presently at risk: western pond turtle (Clemmys marmorata), blunt-nosed leopard lizard (Gambelia silus), California horned lizard (Phryonosoma coronatum frontale), and California legless lizard (Anniella pulchra). All of these are species that are largely found elsewhere and only minimally lap into the western Sierran foothills, although western pond turtles and California legless lizards occasionally range above 1850 m in appropriate habitat. Jennings and Hayes (1994) found that western pond turtles continue to be extant in all but a few southernmost Sierran historical sites, although they have been eliminated from many southern San Joaquin Valley and south coastal sites. Population structure of this long-lived species indicates recruitment failure in many locales, likely stemming from some combination of aquatic nesting habitat damage and predation by alien bullfrogs and bass (Micropterus sp.). California legless lizards, which live underground in loose soil in mostly open country, may well have been inadvertently introduced into some of the higher Sierra Nevada sites through nursery operations, transported in the roots of shrubs and trees (Jennings and Hayes 1994).

Blunt-nosed leopard lizards once ranged fairly widely in

the southern San Joaquin Valley and adjacent low foothills, but have lost most habitat to urbanization and agriculture (California Department of Fish and Game 1991). The California horned lizard (P. c. frontale subspecies of the coast horned lizard) is largely a coastal and valley creature of central California which ranges into the western Sierran foothills in appropriate habitat. Although widely distributed, this horned lizard has disappeared from more than a third of its range, almost certainly as a result of habitat alteration by agriculture and development. Jennings and Hayes (1994) believe that reductions may be more severe than they appear because, like the western pond turtle, this species is long-lived and may persist for years when recruitment is no longer occurring. In the Sierra, principal threats appear to be urbanization (including domestic cats) with concomitant modification of the exposed substrate and open habitat preferred by horned lizards. Pesticides, especially those that mimic estrogen, may also be a factor for those species in or adjacent to croplands.

Of the remaining Sierran reptiles (appendix 25.1), most are valley and foothill animals that range into the warm, xeric portions of the western or eastern Sierra foothills, some of them only marginally. On the other hand, several are truly montane animals in whole or in part, regularly occurring at elevations above 2,000 m or more. These include the western rattlesnake (Crotalus viridis), rubber boa (Charina bottae), California mountain kingsnake (Lampropeltis zonata), western terrestrial garter snake (Thamnophis elegans), western fence lizard (Sceloporus occidentalis), sagebrush lizard (S. graciosus), and northern alligator lizard (Gerrhonotus coeruleus).

As with amphibians and the smaller mammals, status and trend have been crudely estimated by revisiting the sites where museum specimens often are very old and sometimes of uncertain provenance. This procedure, the only one available without more extensive contemporary recording of distributions, poses the risks both of failing to detect losses in locations where no collecting has been done, and of mistaking disappearance in a few revisited sites as representing widespread decline.

SIERRA NEVADA WILDLIFE HABITATS

The principal predictor of the presence of a particular vertebrate is appropriate habitat. Appropriate habitat for a wildlife species may vary by season or even activity. Wildlife habitats are largely equivalent to vegetation types or biological communities, but may also require the presence of abiotic elements such as cliffs, caves, lakes and streams, or sandy soils, and of biotic structural elements such as shrubs or trees at a particular seral stage, size, or density (e.g., large, decadent trees), snags, sufficient canopy cover, logs, litter, and duff important for some aspect of a vertebrate species life cycle. A system for classifying wildlife habitats in California, including the Sierra Nevada, has been developed by Mayer and Laudenslayer (1988), and others. Habitats in the Sierra Nevada can be thought of as features that, at their grossest level, run parallel to the axis of the Sierra at different elevations, either on the west slope or the east. Examples are blue oak woodland, mixed chaparral, mixed-conifer forest, alpine dwarf shrub, or piñon-juniper woodland. Within these macrohabitats, however, a particular species may be confined to specific locales, including meso- or micro-habitats such as riparian corridors, canyon cliffs, or wet meadows adjacent to late-successional forest. Many of these finer-scale habitat features tend to run perpendicular to the axis of the range, along river drainages.

Changes in Sierran Habitats

In general, most habitat types that occur in the Sierra are generously distributed there, and most of these types are also reasonably well approximated by similar types in the White Mountains, Coast Range, Cascades, or Klamath Mountains. This is the likely explanation for the relatively low level of vertebrate endemism in the Sierra, given its large land area.

On the other hand, habitat elements associated with river and stream systems are far scarcer, and these have suffered proportionately greater reduction through human modification or appropriation. These modifications include water diversions, drowning of bottom lands by reservoirs, long-term grazing in the riparian zones, timber harvest, and human settlement.

The factors that make riparian habitats key to so many Sierran species include not only the availability of water itself in a region with six-eight months of drought, but lower temperatures during summer, shade, higher productivity of riparian plants for food, hiding cover, increased availability of insect prey, special plant structures (e.g., willow thickets). East and west trending riparian corridors provide food and protection for animals that move locally or seasonally migrate to different elevations.

Similarly, oak savannahs and woodlands, and foothill chaparral on the western slopes have been extensively modified. The native herbaceous understory in these communities was virtually replaced by introduced Eurasian grasses and dicots in the mid-nineteenth century. Most of these areas with an extensive herb understory have been grazed heavily for many years, leading to progressive loss of shrub cover, or converted to agriculture; some former chaparral has been converted to grazing land and much of the remainder has become decadent or even succeeded to conifer forest owing to fire suppression (Cheatham and Haller 1975). On the other hand, local burning and firewood collection have reduced the availability of large, old trees, snags, and fallen logs in some woodlands. The foothill communities, especially along those streams where bank slopes are gentle, have also been extensively settled. Foothill savannah, woodland, chaparral, and

riparian habitats on the west slope of the Sierra offer mild winter conditions and comparatively higher productivity when the remainder of the range is cold and under snow, attracting migratory birds and wintering mammals that spend their summers at higher elevations. These habitats support species requiring open grassland, or grassland with scattered trees for nesting, perching, and feeding.

In the conifer forests, habitat has been less extensively and severely modified. Timber harvest combined with fire suppression, especially in west-side pine, east-side pine, Sierran mixed conifer, and red fir forests has modified the distribution of tree size and density, as well as large logs and snags. Late-successional conifer forests are important to species requiring moderated climates produced by the high, relatively closed canopy. Furthermore, multiple tree layers, large snags or logs provide sites for cover, nesting, feeding, and roosting. Clear-cut or burned areas produce montane chaparral or early-successional hardwood and conifer habitats that is converted quickly or quite slowly to conifer stands. Biological communities and structural elements that were present in aboriginal times have persisted, although some floristic components, size and spatial distribution of each habitat component may be different to varying degrees. (e.g., Minnich et al. 1995) Summer grazing in montane and subalpine meadows and grassy patches within forests appropriates highly-quality forage from wildlife to domestic stock, but the qualitative and quantitative effects on biodiversity of this nutrient removal with associated trampling in these locales are poorly known.

Habitat Dependency

In the Sierra, eighty-three terrestrial vertebrate species are considered dependent upon riparian (including wet meadow or lakeshore) habitat to sustain viable Sierran populations; 24% of these are at risk. Seventeen species are similarly dependent upon late-successional forests; 24% of these are at risk. There are eighty-six species that require west-slope foothill savannah, woodland, chaparral, or riparian habitats (some double-counted with riparian above) for Sierran population viability; 16% of these are listed as at risk (appendix 25.1) (California Department of Fish and Game 1994). This latter number is misleadingly low because many of these species are more widely distributed elsewhere, such as the Coast Range.

WILDLIFE MANAGEMENT

State of Knowledge of Sierran Wildlife

For only a few groups of vertebrates are there both longitudinal (over time) and geographic (over space) knowledge of status and trends in the Sierra Nevada: These include breeding land birds—there are seventeen long-term transects of the North American Breeding Bird Survey in the Sierra—and the most popular game species, such as mule deer and waterfowl. Birds, in general, are relatively easy to observe and popular with amateurs who keep records, such as the annual Christmas Bird Counts, so a fair amount of unsystematic data exist. For all other species, range maps have been developed by summing together dozens to hundreds of museum specimens for which good location data are presumed, and extrapolating on a map. These few vouchers have been collected over a span of as much as a century, and many or most locations are represented by specimens collected in the early or middle part of this century, the golden age of collecting for California.

The file drawers of national forest, national park, and Department of Fish and Game biologists, some county agencies, as well as many private land managers and landowners, often contain records of observation of rare or unusual wildlife, often with behavioral or habitat use attached. While of far less value than systematic scientific surveys, longitudinal studies, or investigations of species-habitat relations, they can be invaluable at improving the resolution of distribution information, and for making correlative inferences about habitat preferences and other ecological attributes of the species. At present there is no efficient way to locate these data. The California Natural Diversity Database, managed by the California Department of Fish and Game, keeps site records of agency-listed plant and animal species in the State. It has the potential to serve as a clearinghouse and manager of data on all species throughout California. However, to be effective at this function, a budget many times its present one would be required. This would be an invaluable service to land managers, landowners, and government agencies throughout California.

Trend, which is the change in abundance or distribution over time, is typically based on a handful of sites for which a handful of sampling time-points exist. From these it is a dubious business to infer status and trend of a species over its range in the Sierra Nevada. For the Breeding Bird Survey of seventeen routes in the entire Sierra Nevada, there are twenty-five years of data, although not all routes for all years. Similar data exist for waterfowl on refuges, and mule deer herds in some locations. A promising synthesis of the Breeding Bird Survey and the California Wildlife Habitat Relationships System (CWHR) has been produced by U.S. Forest Service, Pacific Southwest Region. Entitled Avesbase, (Davidson and Manley 1993), this computer database and analytical engine combines information about population trend and habitat distribution for neotropical migrant birds as an aid in assessing their risk in California.

California Wildlife Habitat Relationships System

The California Wildlife Habitat Relationships System (CWHR) was initiated in the early 1980s to provide a formalized and generally agreed-upon compendium of knowledge about the

distribution and habitat preferences of all the amphibians, reptiles, birds, and mammals in California as a means toward both improved wildlife management and improved land management practices. The immediate inspiration for CWHR came from the work of J. W. Thomas and his associates in a pioneering effort for the Blue Mountains of Oregon and Washington (Thomas 1979), but reflected an emerging national interest in such information (Nelson and Salwasser 1982). Although CWHR was intended by its developers to be a tool for professional wildlife biologists as the starting point in assessing the wildlife response to land management practices, in recent years the database has been used as an expert system both to calculate present wildlife species presence on land units, and response to habitat modifications.

From the start, CWHR was a cooperative effort that included biologists from government agencies, universities, and private industry. Principal cooperators were the U.S, Forest Service, California Department of Fish and Game, University of California, U.S. Bureau of Land Management, Southern California Edison, and the California Department of Forestry and Fire Protection. While the California Department of Fish and Game is the manager of the CWHR system including database, program, manuals, and user support, other agencies provided publication outlets for support documents, such as California Wildlife and Their Habitats: Western Sierra Nevada (Verner and Boss 1980). An informal technical support group, The California Interagency Wildlife Task Group, acts as steward of CWHR by maintaining quality control, assuring its continued development, and encouraging its use in resource management. Initially, existing publications and species experts were used to synthesize distribution and habitat preferences for each separate species, a significant step beyond Thomas (1979), which used wildlife guilds as units of analysis. Unifying the many existing California vegetation classification systems required a distinct, parallel effort to develop a wildlife habitat classification system (Mayer and Laudenslayer 1988) which brought wildlife and vegetation experts together to examine biological communities.

The objectives of the CWHR program are (Airola 1988):

- develop a system that can predict the potential of habitat to support wildlife species and to predict the effects of habitat changes on them
- provide easy access to a vast array of wildlife and habitat information through preparation of published volumes and a computerized database system
- encourage an ecosystem orientation that considers all wildlife species that may occur in an area
- foster consistency of analysis, so that impacts of different projects may be more readily compared, and understood by decision-makers and the public

The information in CWHR was ported to a computer database within a supporting menu-driven program (Timossi, Sweet, et al. 1994); while it was intended as an expert system, codifying the findings and opinions of species and habitat experts, it was designed for use by natural resource professionals who had been provided training in its use. The CWHR computer program and support documents (Mayer and Laudenslayer 1988; Timossi, Sweet, et al. 1994; Zeiner et al. 1988, 1990a, 1990b) are now widely in use in California.

In brief, the CWHR database has four levels of habitat suitability by a vertebrate species to each habitat/seral stage: optimum, suitable, marginal, or unsuitable. These levels are in turn differentiated into breeding, feeding, and resting values. Where special habitat elements are required by a species (e.g., large snag, mud flat, etc.), these are specified. The database provides species distribution information (contemporary and recent range) in a variety of ways, including biological province, county, national forest or BLM district, Fish and Game region, hydrologic region, and latitude/longitude.

In the most typical use of CWHR one develops a list of vertebrate species potentially present on a site, based upon additional information about the site such as location and habitat elements present (or absent), which further restricts the output list of candidate species present. CWHR was designed to minimize errors of omission—species present on a site but not listed by the program. Thus it tends to produce errors of commission—species listed but not present on a site. If one wishes to assess the change in wildlife species composition or habitat values produced by a land management action (e.g., timber harvest), field investigation is necessary to trim the initial list (Garrison 1994).

The CWHR is widely acknowledged by its developers, users, and critics to be highly imperfect. Present and potential distribution, the nature and distribution of habitats, and suitability of particular habitats to most terrestrial vertebrate species are poorly known. However, from the start CWHR was designed to evolve in response to new scientific knowledge and feedback from its users. Thus CWHR Version 5 is a substantial improvement over earlier versions.

Presently, developers are working to produce regional CWHRs for more precision, and an effort is underway to build geographic information system (GIS)-based habitat suitability models that account not only for the presence of appropriate habitat, but its extent and spatial arrangement as well (Timossi, Woodard, et al. 1994a, 1994b), and ultimately minimum viable population requirements. This has promise to provide more realistic population viability predictions, but is profoundly constrained at present both by lack of mechanistic habitat models for most vertebrates, and lack of detailed habitat information for all but a few locales.

Because CWHR uses relatively gross-scale habitat components (e.g., dominant vegetation and seral stage), it is least successful for small vertebrates, including many amphibians and reptiles, that key in to much finer-scale habitat requirements within broad types, such as particular kinds of prey,

cover types, or aquatic conditions. Efforts are now in their initial stages at the U.S. Forest Service, Pacific Southwest Forest Research Station at Arcata, to develop pattern recognition models for some of these species. Again, this admirable effort faces the dual difficulty of limited information on habitat requirements for many species, and even more limited availability of the mapped distribution of required habitat elements once determined.

Gap Analysis Program

A promising new scientific strategy for habitat conservation is the Gap Analysis Program (GAP) managed by the U.S. Department of the Interior, National Biological Service (Scott et al. 1993). Gap analysis uses geographic information systems (GIS) to overlay map of plant communities with those of land ownership and land use. This system facilitates the identification of biological communities, and thus the vertebrates that depend upon those habitats, that are vulnerable to conversion and degradation. The Sierra Nevada Ecosystem Project collaborated with GAP to complete a model for the Sierra Nevada (Davis and Stoms 1996). The power of GAP promises to be greatly enhanced by new models designed to use GAP and other GIS-based data as a starting point in identifying the most efficient sites for conservation strategies. One such strategy of note is the Biodiversity Management Area (BMA) strategy developed by Davis et al. (1996)

CONCLUSION

Compared to the more intensively-developed regions of California, the terrestrial vertebrate fauna of the Sierra Nevada is relatively intact. There have been few extinctions and most species appear to retain an approximation of their aboriginal geographic extent. The most important factor in population viability for nearly all species has been and continues to be habitat quantity and quality. Habitats that have suffered the greatest reductions in extent and integrity, and therefore the greatest losses of vertebrate biodiversity, appear to be the western-slope foothills, riparian habitats, and late-successional forests. The greatest threat to the preservation of viable populations of native wildlife in the Sierra may well be the poor quality of information about status, distribution, trend, and species biology especially species-habitat relationships. This uncertainty, unless corrected, will continue to lead to inefficient conservation strategies and unpredictable outcomes from land use changes, as well as public dissatisfaction with conservation policies and their outcomes. Once the quality of data is improved, however, models such as CWHR and GAP can be effectively applied to sound ecosystem management practices.

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APPENDIX 25.1

Sierra Nevada Vertebrate Species

WHR Code[a]	Common Name[b]	Scientific Name[c]	Sierra Nevada Use[d]	LSOG Habitat[e]	Western Foothills Habitat[f]	Riparian Habitat[g]	Risk[h]	Native[i]
A001	California tiger salamander	Ambystoma californiense	3	3	1	1	2	T
A003	Long toed salamander	Ambystoma macrodactylum	2	3	3	1	2	T
A006	Rough-skinned newt	Taricha granulosa	3	2	2	1	3	T
A007	California newt	Taricha torosa (sierrae)	2	2	1	1	3	T
A012	Ensatina	Ensatina eschscholtzi	2	2	3	3	3	T
A014	California slender salamander	Batrachoseps attenuatus	2	2	2	3	3	T
A015	Black-bellied slender salamander	Batrachoseps nigriventris	2	2	2	3	3	T
A016	Pacific slender salamander	Batrachoseps pacificus	2	3	2	3	3	T
A017	Kern canyon slender salamander	Batrachoseps simatus	1	3	1	3	2	T
A017	Relictual slender salamander	Batrachoseps relictus	1	3	2	2	2	T
A020	Black salamander	Aneides flavipunctatus	3	2	1	2	3	T
A022	Arboreal salamander	Aneides lugubris	2	2	2	2	3	T
A023	Mount lyell salamander	Hydromantes platycephalus	1	3	3	3	2	T
A023	Owens valley web-toed salamander	Hydromantes sp.	1	3	3	1	2	T
A025	Limestone salamander	Hydromantes brunus	1	3	3	3	2	T
A028	Western spadefoot	Scaphiopus hammondi	3	3	1	1	2	T
A029	Great basin spadefoot	Scaphiopus intermontanus	3	3	3	1	3	T
A032	Western toad	Bufo boreas	2	3	2	2	3	T
A033	Yosemite toad	Bufo canorus	1	3	3	1	2	T
A039	Pacific treefrog	Pseudacris regilla	2	3	2	3	3	T
A040	Red-legged frog	Rana aurora draytonii	2	3	1	1	2	T
A043	Foothill yellow-legged frog	Rana boylei	2	3	1	1	2	T
A044	Mountain yellow-legged frog	Rana muscosa	2	3	3	1	2	T
A045	Northern leopard frog	Rana pipiens	3	3	3	1	2	T
A046	Bullfrog	Rana catesbeiana	3	3	2	1	3	F
B003	Common loon	Gavia immer	3	3	2	3	2	T
B006	Pied-billed grebe	Podilymbus podiceps	3	3	2	2	3	T
B007	Horned grebe	Podiceps auritus	3	3	3	3	3	T
B009	Eared grebe	Podiceps nigricollis	2	3	2	3	3	T
B010	Western grebe	Aechmophorus occidentalis	3	3	2	3	3	T
B010	Clark's grebe	Aechmophorus clarkii	3	3	2	2	3	T
B042	American white pelican	Pelecanus erythrorhynchos	3	3	3	3	2	T

continued

[a]CWHR code is the California Wildlife Habitat Relationships System code.
[b]Common name is the CWHR appellation.
[c]Scientific name is the CWHR appelation
[d]Sierra Nevada use:
1 indicates that all of species range in California is in Sierra Nevada.
2 indicates that principal range includes Sierra Nevada.
3 indicates that Sierra Nevada is peripheral range only.
[e]LSOG (late succesional and old-growth) habitat:
1 indicates that population viability in Sierra requires LSOG habitats.
2 indicates that species uses LSOG but is not dependent upon it.
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B049	American bittern	Botaurus lentiginosus	3	3	2	1	3	T
B051	Great blue heron	Ardea herodias	2	3	2	1	3	T
B053	Snowy egret	Egretta thula	3	3	2	1	3	T
B058	Green-backed heron	Butorides striatus	3	3	1	1	3	T
B059	Black-crowned night heron	Nycticorax nycticorax	3	3	1	1	3	T
B062	White-faced ibis	Plegadis chihi	3	3	3	1	2	T
B067	Tundra swan	Cygnus columbianus	3	3	2	1	3	T
B075	Canada goose	Branta canadensis	3	3	2	1	3	T
B076	Wood duck	Aix sponsa	3	3	2	1	3	T
B077	Green-winged teal	Anas crecca	3	3	1	1	3	T
B079	Mallard	Anas platyrhynchos	2	3	2	1	3	T
B083	Cinnamon teal	Anas cyanoptera	3	3	1	2	3	T
B084	Northern shoveler	Anas clypeata	3	3	1	1	3	T
B085	Gadwall	Anas strepera	3	3	3	2	3	T
B087	American wigeon	Anas americana	3	3	1	1	3	T
B089	Canvasback	Aythya valisineria	3	3	1	3	3	T
B090	Redhead	Aythya americana	3	3	3	3	3	T
B091	Ring-necked duck	Aythya collaris	2	3	2	2	3	T
B094	Lesser scaup	Aythya affinis	2	3	1	3	3	T
B096	Harlequin duck	Histrionicus histrionicus	3	3	3	1	2	T
B101	Common goldeneye	Bucephala clangula	2	3	3	2	3	T
B102	Barrow's goldeneye	Bucephala islandica	3	3	3	1	2	T
B103	Bufflehead	Bucephala albeola	3	3	2	2	3	T
B105	Common merganser	Mergus merganser	2	3	2	1	3	T
B107	Ruddy duck	Oxyura jamaicensis	3	3	2	1	3	T
B108	Turkey vulture	Cathartes aura	2	3	1	3	3	T
B109	California condor	Gymnogyps californianus	2	3	2	3	1	T
B110	Osprey	Pandion haliaetus	2	3	2	1	2	T
B111	White-tailed kite	Elanus caeruleus	3	3	1	3	3	T
B113	Bald eagle	Haliaeetus leucocephalus	3	3	2	1	2	T
B114	Northern harrier	Circus cyaneus	3	3	2	2	2	T
B115	Sharp-shinned hawk	Accipiter striatus	2	2	2	2	2	T
B116	Cooper's hawk	Accipiter cooperii	2	3	2	2	2	T
B117	Northern goshawk	Accipiter gentilis	2	1	3	2	2	T
B119	Red-shouldered hawk	Buteo lineatus	2	3	1	1	3	T
B123	Red-tailed hawk	Buteo jamaicensis	2	3	2	3	3	T
B124	Ferruginous hawk	Buteo regalis	3	3	3	3	2	T
B125	Rough-legged hawk	Buteo lagopus	3	3	3	3	3	T
B126	Golden eagle	Aquila chrysaetos	2	3	2	3	2	T
B127	American kestrel	Falco sparverius	2	3	1	3	3	T
B128	Merlin	Falco columbarius	3	3	2	2	2	T
B129	Peregrine falcon	Falco peregrinus	2	3	2	3	2	T
B131	Prairie falcon	Falco mexicanus	2	3	2	3	2	T
B132	Chukar	Alectoris chukar	3	3		3	3	F
B134	Blue grouse	Dendragapus obscurus	2	2	3	3	3	T
B135	White-tailed ptarmigan	Lagopus leucurus	1	3	3	3	3	F
B137	Sage grouse	Centrocercus urophasianus	3	3	3	3	2	T
B138	Turkey	Meleagris gallopavo	2	3	2	2	3	F
B140	California quail	Callipepla californica	2	3	2	3	3	T
B141	Mountain quail	Oreortyx pictus	2	3	2	3	3	T
B145	Virginia rail	Rallus limicola	2	3	2	1	3	T
B146	Sora	Porzana carolina	3	3	2	1	3	T
B148	Common moorhen	Gallinula chloropus	3	3	1	1	3	T
B149	American coot	Fulica americana	3	3	2	1	3	T
B158	Killdeer	Charadrius vociferus	3	3	2	2	3	T
B164	American avocet	Recurvirostra americana	3	3	3	1	3	T
B168	Willet	Catoptrophorus semi-palmatus	3	3	3	1	3	T
B170	Spotted sandpiper	Actitis macularia	2	3	2	1	3	T

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B185	Least sandpiper	Calidris minutilla	2	3	2	1	3	T
B199	Common snipe	Gallinago gallinago	2	3	2	1	3	T
B200	Wilson's phalarope	Phalaropus tricolor	3	3	2	3	3	T
B214	Ring-billed gull	Larus delawarensis	3	3	2	3	3	T
B215	California gull	Larus californicus	3	3	2	3	2	T
B216	Herring gull	Larus argentatus	3	3		2	3	T
B227	Caspian tern	Sterna caspia	3	3	3	2	3	T
B233	Forster's tern	Sterna forsteri	3	3	3	1	3	T
B235	Black tern	Chlidonias niger	3	3	3	1	3	T
B250	Rock dove	Columba livia	2	3	2	3	3	F
B251	Band-tailed pigeon	Columba fasciata	2	2	2	3	3	T
B255	Mourning dove	Zenaida macroura	2	3	1	3	3	T
B260	Greater roadrunner	Geococcyx californianus	3	3	1	3	3	T
B262	Common barn owl	Tyto alba	2	3	1	3	3	T
B263	Flammulated owl	Otus flammeolus	2	2	3	3	3	T
B264	Western screech owl	Otus kennicottii	2	3	2	2	3	T
B265	Great horned owl	Bubo virginianus	2	3	2	3	3	T
B267	Northern pygmy owl	Glaucidium gnoma	2	2	2	2	3	T
B269	Burrowing owl	Athene cunicularia	3	3	1	3	2	T
B270	Spotted owl	Strix occidentalis	2	1	2	2	2	T
B271	Great gray owl	Strix nebulosa	2	1	3	2	2	T
B272	Long-eared owl	Asio otus	2	2	1	2	2	T
B273	Short-eared owl	Asio flammeus	2	3	1	3	2	T
B274	Northern saw-whet owl	Aegolius acadicus	2	2	2	3	3	T
B276	Common nighthawk	Chordeiles minor	2	3	2	2	3	T
B277	Common poorwill	Phalaenoptilus nuttallii	2	3	2	3	3	T
B279	Black swift	Cypseloides niger	2	3	2	3	2	T
B281	Vaux's swift	Chaetura vauxi	2	1	2	3	3	T
B282	White-throated swift	Aeronautes saxatalis	2	3	2	3	3	T
B286	Black-chinned hummingbird	Archilochus alexandri	2	3	1	3	3	T
B287	Anna's hummingbird	Calypte anna	2	3	2	3	3	T
B289	Calliope hummingbird	Stellula calliope	2	3	2	2	3	T
B290	Broad-tailed hummingbird	Selasphorus platycercus	3	3	3	2	3	T
B291	Rufous hummingbird	Selasphorus rufus	3	3	2	2	3	T
B292	Allen's hummingbird	Selasphorus sasin	3	3	2	3	3	T
B293	Belted kingfisher	Ceryle alcyon	2	3	2	1	3	T
B294	Lewis' woodpecker	Melanerpes lewis	2	3	2	3	3	T
B296	Acorn woodpecker	Melanerpes formicivorus	2	3	1	3	3	T
B298	Red-naped sapsucker	Sphyrapicus nuchalis	3	2	3	1	3	T
B299	Red-breasted sapsucker	Sphyrapicus ruber	2	2	2	2	3	T
B300	Williamson's sapsucker	Sphyrapicus thyroideus	2	2	3	3	3	T
B302	Nuttall's woodpecker	Picoides nuttallii	2	3	1	2	3	T
B303	Downy woodpecker	Picoides pubescens	2	3	2	1	3	T
B304	Hairy woodpecker	Picoides villosus	2	2	2	2	3	T
B305	White-headed woodpecker	Picoides albolarvatus	2	1	3	3	3	T
B306	Black-backed woodpecker	Picoides arcticus	2	2	3	3	3	T
B307	Northern flicker	Colaptes auratus	2	3	2	3	3	T
B308	Pileated woodpecker	Dryocopus pileatus	2	1	3	3	3	T
B309	Olive-sided flycatcher	Contopus borealis	2	2	2	3	2	T
B311	Western wood-pewee	Contopus sordioulus	2	3	2	2	3	T
B315	Willow flycatcher	Empidonax traillii	2	2	2	1	2	T
B317	Hammonds' flycatcher	Empidonax hammondii	2	2	2	3	3	T
B318	Dusky flycatcher	Empidonax oberholseri	2	3	2	3	3	T
B319	Gray flycatcher	Empidonax wrightii	3	3	3	3	3	T
B320	Cordilleran flycatcher	Empidonax difficilis	3	3	2	3	3	T
B320	Pacific-slope flycatcher	Empidonax occidentalis	2	3	2	2	3	T
B321	Black phoebe	Sayornis nigricans	2	3	2	1	3	T
B323	Say's phoebe	Sayornis saya	3	3	2	3	3	T

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B326	Ash-throated flycatcher	Myiarchus cinerascens	2	3	2	3	3	T
B333	Western kingbird	Tyrannus verticalis	2	3	2	3	3	T
B337	Horned lark	Eremophila alpestris	2	3	2	3	3	T
B338	Purple martin	Progne subis	2	3	2	3	2	T
B339	Tree swallow	Tachycineta bicolor	2	2	2	1	3	T
B340	Violet-green swallow	Tachycineta thalassina	2	3	2	3	3	T
B341	Northern rough-winged swallow	Stelgidopteryx serripennis	2	3	2	2	3	T
B343	Cliff swallow	Hirundo pyrrhonota	2	3	2	2	3	T
B344	Barn swallow	Hirundo rustica	2	3	2	2	3	T
B346	Steller's jay	Cyanocitta stelleri	2	2	3	3	3	T
B348	Scrub jay	Aphelocoma coerulescens	2	3	1	3	3	T
B349	Pinyon jay	Gymnorhinus cyanocephalus	3	3	2	3	3	T
B350	Clark's nutcracker	Nucifraga columbiana	2	3	3	3	3	T
B351	Black-billed magpie	Pica pica	3	3	3	1	3	T
B352	Yellow-billed magpie	Pica nuttalli	3	3	1	2	3	T
B353	American crow	Corvus brachyrhvnchos	3	3	2	3	3	T
B354	Common raven	Corvus corax	2	3	2	3	3	T
B356	Mountain chickadee	Parus gambeli	2	3	3	3	3	T
B357	Chestnut-backed chickadee	Parus rufescens	2	2	3	3	3	T
B358	Plain titmouse	Parus inornatus	2	3	1	3	3	T
B360	Bushtit	Psaltriparus minimus	2	3	1	3	3	T
B361	Red-breasted nuthatch	Sitta canadensis	2	1	3	3	3	T
B362	White-breasted nuthatch	Sitta carolinensis	2	2	2	3	3	T
B363	Pygmy nuthatch	Sitta pygmaea	2	1	3	3	3	T
B364	Brown creeper	Certhia americana	2	1	3	2	3	T
B366	Rock wren	Salpinctes obsoletus	2	3	1	3	3	T
B367	Canyon wren	Catherpes mexicanus	2	3	2	2	3	T
B368	Bewick's wren	Thryomanes bewickii	2	3	1	3	3	T
B369	House wren	Troglodytes aedon	2	3	2	2	3	T
B370	Winter wren	Troglodytes troglodytes	2	1	3	1	3	T
B372	Marsh wren	Cistothorus palustris	2	3	1	1	3	T
B373	American dipper	Cinclus mexicanus	2	3	2	1	3	T
B375	Golden-crowned kinglet	Regulus satrapa	2	2	3	2	3	T
B376	Ruby-crowned kinglet	Regulus calendula	2	3	2	3	3	T
B377	Blue-gray gnatcatcher	Polioptila caerulea	2	3	1	3	3	T
B380	Western bluebird	Sialia mexicana	2	3	2	3	3	T
B381	Mountain bluebird	Sialia currucoides	2	3	3	3	3	T
B382	Townsend's solitaire	Myadestes townsendi	2	3	2	3	3	T
B385	Swainson's thrush	Catharus ustulatus	2	3	2	2	3	T
B386	Hermit thrush	Catharus guttatus	2	2	2	2	3	T
B389	American robin	Turdus migratorius	2	3	2	2	3	T
B390	Varied thrush	Ixoreus naevius	2	2	2	3	3	T
B391	Wrentit	Chamaea fasciata	2	3	1	3	3	T
B393	Northern mockingbird	Mimus polyglottos	3	3	1	2	3	T
B394	Sage thrasher	Oreoscoptes montanus	3	3	3	3	3	T
B398	California thrasher	Toxostoma redivivum	2	3	1	2	2	T
B404	American pipit	Anthus rubescens	2	3	2	3	3	T
B407	Cedar waxwing	Bombycilla cedrorum	2	3	2	3	3	T
B408	Phainopepla	Phainopepla nitens	2	3	1	3	3	T
B409	Northern shrike	Lanius excubitor	3	3	3	3	3	T
B410	Loggerhead shrike	Lanius ludovicianus	2	3	1	3	3	T
B411	European starling	Sturnus vulgaris	2	3	1	3	3	F
B413	Bell's vireo	Vireo bellii	2	3	1	1	1	T
B415	Solitary vireo	Vireo solitarius	2	3	2	3	3	T
B417	Hutton's vireo	Vireo huttoni	2	3	1	3	3	T
B418	Warbling vireo	Vireo gilvus	2	3	2	2	3	T
B425	Orange-crowned warbler	Vermivora celata	2	3	2	2	3	T

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B426	Nashville warbler	Vermivora ruficapilla	2	3	2	3	3	T
B427	Virginia's warbler	Vermivora virginiae	2	3	3	3	3	T
B430	Yellow warbler	Dendroica petechia	2	2	2	2	2	T
B435	Yellow-rumped warbler	Dendroica coronata	2	3	2	3	3	T
B436	Black-throated gray warbler	Dendroica nigrescens	2	3	2	3	3	T
B438	Hermit warbler	Dendroica occidentalis	2	1	2	3	3	T
B460	Macgillivray's warbler	Oporornis tolmiei	2	3	2	1	3	T
B461	Common yellowthroat	Geothlypis trichas	2	3	2	1	2	T
B463	Wilson's warbler	Wilsonia pusilla	2	3	2	1	3	T
B467	Yellow-breasted chat	Icteria virens	2	3	1	1	2	T
B471	Western tanager	Piranga ludoviciana	2	3	2	3	3	T
B475	Black-headed grosbeak	Pheucticus melanocephalus	2	3	2	3	3	T
B476	Blue grosbeak	Guiraca caerulea	3	3	1	1	3	T
B477	Lazuli bunting	Passerina amoena	2	3	2	2	3	T
B482	Green-tailed towhee	Pipilo chlorurus	2	3	3	3	3	T
B483	Rufous-sided towhee	Pipilo erythrophthalmus	2	3	2	3	3	T
B484	California towhee	Pipilo crissalis	2	3	1	3	3	T
B487	Rufous-crowned sparrow	Aimophila ruficeps	2	3	1	3	3	T
B489	Chipping sparrow	Spizella passerina	2	3	2	3	3	T
B491	Brewer's sparrow	Spizella breweri	2	3	3	3	3	T
B493	Black-chinned sparrow	Spizella atrogularis	2	3	3	3	3	T
B494	Vesper sparrow	Pooecetes gramineus	3	3	1	3	3	T
B495	Lark sparrow	Chondestes grammacus	2	3	1	3	3	T
B496	Black-throated sparrow	Amphispiza bilineata	3	3	1	3	3	T
B497	Sage sparrow	Amphispiza belli	2	3	1	3	3	T
B499	Savannah sparrow	Passerculus sandwichensis	3	3	1	2	3	T
B501	Grasshopper sparrow	Ammooramus savannarum	2	3	1	3	3	T
B504	Fox sparrow	Passerella iliaca	2	3	2	3	3	T
B505	Song sparrow	Melospiza melodia	2	3	2	1	3	T
B506	Lincoln's sparrow	Melospiza lincolnii	2	3	2	1	3	T
B509	Golden-crowned sparrow	Zonotrichia atricapilla	2	3	2	2	3	T
B510	White-crowned sparrow	Zonotrichia leucophrys	2	3	2	1	3	T
B512	Dark-eyed junco	Junco hyemalis	2	3	2	3	3	T
B519	Red-winged blackbird	Agelaius phoeniceus	2	3	2	1	3	T
B520	Tricolored blackbird	Agelaius tricolor	3	3	1	1	2	T
B521	Western meadowlark	Sturnella neglecta	2	3	1	3	3	T
B522	Yellow-headed blackbird	Xanthocephalus xanthocephalus	3	3	1	1	3	T
B524	Brewer's blackbird	Euphagus cyanocephalus	2	3	2	3	3	T
B528	Brown-headed cowbird	Molothrus ater	2	3	2	2	3	T
B532	Northern oriole	Icterus galbula	2	3	1	2	3	T
B534	Rosy finch	Leucosticte arctoa	2	3	3	3	3	T
B535	Pine grosbeak	Pinicola enucleator	1	3	3	1	3	T
B536	Purple finch	Carpodacus purpureus	2	1	2	2	3	T
B537	Cassin's finch	Carpodacus cassinii	2	1	3	2	3	T
B538	House finch	Carpodacus mexicanus	2	3	1	3	3	T
B539	Red crossbill	Loxia curvirostra	2	3	3	3	3	T
B542	Pine siskin	Carduelis pinus	2	3	2	3	3	T
B543	Lesser goldfinch	Carduelis psaltria	2	3	2	1	3	T
B544	Lawrence's goldfinch	Carduelis lawrencei	3	3	2	2	3	T
B545	American goldfinch	Carduelis tristis	2	3	1	2	3	T
B546	Evening grosbeak	Coccothraustes vespertinus	2	1	2	3	3	T
B547	House sparrow	Passer domesticus	2	3	2	3	3	F
M001	Virginia opossum	Didelphis virginiana	2	3	1	2	3	F
M002	Mt. Lyell shrew	Sorex lyelli	1	3	3	1	2	T
M003	Vagrant shrew	Sorex vagrans	2	2	3	1	3	T
M004	Dusky shrew	Sorex monticolus	2	2	3	1	3	T
M006	Ornate shrew	Sorex ornatus	2	2	1	1	3	T
M008	Inyo shrew	Sorex tenellus	2	3	3	2	3	T

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M010	Water shrew	Sorex palustris	2	2	3	1	3	T
M012	Trowbridge's shrew	Sorex trowbridgii	2	2	3	3	3	T
M018	Broad-footed mole	Scapanus latimanus	2	3	2	2	3	T
M021	Little brown myotis	Myotis lucifugus	2	2	3	2	3	T
M023	Yuma myotis	Myotis yumanensis	2	2	2	2	2	T
M025	Long-eared myotis	Myotis evotis	2	3	3	2	2	T
M026	Fringed myotis	Myotis thysanodes	2	3	3	2	2	T
M027	Long-legged myotis	Myotis volans	2	2	2	3	2	T
M028	California myotis	Myotis californicus	2	3	2	3	3	T
M029	Western small-footed myotis	Myotis ciliolabrum	2	3	2	2	2	T
M030	Silver-haired bat	Lasionycteris noctivagans	2	2	2	2	3	T
M031	Western pipistrelle	Pipistrellus hesperus	2	3	1	2	3	T
M032	Big brown bat	Eptesicus fuscus	2	3	2	2	3	T
M033	Western red bat	Lasiurus blossevillii	2	3	1	2	3	T
M034	Hoary bat	Lasiurus cinereus	2	2	2	3	3	T
M036	Spotted bat	Euderma maculatum	2	3	2	2	2	T
M037	Townsend's big-eared bat	Plecotus townsendii	2	3	2	2	2	T
M038	Pallid bat	Antrozous pallidus	2	3	1	3	2	T
M039	Brazilian free-tailed bat	Tadarida brasiliensis	2	3	1	3	3	T
M042	Western mastiff bat	Eumops perotis	2	3	2	3	2	T
M043	Pika	Ochotona princeps	2	3	3	3	3	T
M045	Brush rabbit	Sylvilagus bachmani	2	3	1	3	3	T
M046	Nuttall's cottontail	Sylvilagus nuttallii	2	3	3	3	3	T
M047	Desert cottontail	Sylvilagus audubonii	3	3	1	3	3	T
M049	Snowshoe hare	Lepus americanus	2	3	3	3	2	T
M050	White-tailed hare	Lepus townsendii	2	3	3	3	2	T
M051	Black-tailed hare	Lepus californicus	2	3	2	3	3	T
M052	Mountain beaver	Aplodontia rufa	2	2	3	1	3	T
M053	Alpine chipmunk	Tamias alpinus	1	3	3	3	3	T
M054	Least chipmunk	Tamias minimus	2	3	3	3	3	T
M055	Yellow-pine chipmunk	Tamias amoenus	2	3	3	3	3	T
M057	Allen's chipmunk	Tamias senex	2	3	3	3	3	T
M060	Merriam's chipmunk	Tamias merriami	2	3	2	3	3	T
M062	Long-eared chipmunk	Tamias quadrimaculatus	1	3	3	3	3	T
M063	Lodgepole chipmunk	Tamias speciosus	2	3	3	3	3	T
M064	Panamint chipmunk	Tamias panamintinus	2	3	3	3	2	T
M065	Uinta chipmunk	Tamias umbrinus	2	3	3	3	3	T
M066	Yellow-bellied marmot	Marmota flaviventris	2	3	3	2	3	T
M067	White-tailed antelope squirrel	Ammospermophilus leucurus	3	3	3	3	3	T
M070	Belding's ground squirrel	Spermophilus beldingi	2	3	3	2	3	T
M072	California ground squirrel	Spermophilus beecheyi	2	3	2	3	3	T
M075	Golden-mantled ground squirrel	Spermophilus lateralis	2	3	3	3	3	T
M077	Western gray squirrel	Sciurus griseus	2	2	2	3	3	T
M079	Douglas' squirrel	Tamiasciurus douglasii	2	2	3	3	3	T
M080	Northern flying squirrel	Glaucomys sabrinus	2	1	3	3	3	T
M081	Botta's pocket gopher	Thomomys bottae	2	3	2	3	3	T
M083	Northern pocket gopher	Thomomys talpoides	2	3	3	2	3	T
M085	Mountain pocket gopher	Thomomys monticola	2	3	3	2	3	T
M086	Little pocket mouse	Perognathus longimembris	3	3	1	3	3	T
M088	Great basin pocket mouse	Perognathus parvus	3	3	3	3	3	T
M090	Yellow-eared pocket mouse	Perognathus xanthanotus	1	3	2	3	3	T
M091	Long-tailed pocket mouse	Chaetodipus formosus	3	3	3	3	3	T
M095	California pocket mouse	Chaetodipus californicus	2	3	1	3	3	T
M097	Dark kangaroo mouse	Microdipodops megacephalus	3	3	3	3	3	T
M104	Heermann's kangaroo rat	Dipodomys heermanni	2	3	1	3	3	T

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M105	California kangaroo rat	Dipodomys californicus	2	3	1	3	3	T
M107	Panamint kangaroo rat	Dipodomys panamintinus	3	3	3	3	3	T
M109	Desert kangaroo rat	Dipodomys deserti	3	3	3	3	3	T
M110	Merriam's kangaroo rat	Dipodomys merriami	3	3	3	3	3	T
M112	Beaver	Castor canadensis	2	3	2	1	3	T
M113	Western harvest mouse	Reithrodontomys megalotis	2	3	2	2	3	T
M116	California mouse	Peromyscus californicus	2	3	2	3	3	T
M117	Deer mouse	Peromyscus maniculatus	2	3	2	2	3	T
M118	Canyon mouse	Peromyscus crinitus	3	3	3	3	3	T
M119	Brush mouse	Peromyscus boylii	2	3	2	3	3	T
M120	Pinyon mouse	Peromyscus truei	2	3	1	3	3	T
M121	Northern grasshopper mouse	Onychomys leucogaster	3	3	3	2	3	T
M122	Southern grasshopper mouse	Onychomys torridus	3	3	2	3	2	T
M126	Desert woodrat	Neotoma lepida	3	3	2	3	3	T
M127	Dusky-footed woodrat	Neotoma fuscipes	2	2	2	2	3	T
M128	Bushy-tailed woodrat	Neotoma cinerea	2	3	3	2	3	T
M129	Western red-backed vole	Clethrionomys californicus	3	1	3	2	3	T
M130	Heather vole	Phenacomys intermedius	1	3	3	2	3	T
M133	Montane vole	Microtus montanus	2	3	3	1	3	T
M134	California vole	Microtus californicus	2	3	2	2	3	T
M136	Long-tailed vole	Microtus longicaudus	2	3	3	2	3	T
M138	Sagebrush vole	Lemmiscus curtatus	3	3	3	3	3	T
M139	Muskrat	Ondatra zibethicus	3	3	1	1	3	F
M140	Black rat	Rattus rattus	2	3	2	3	3	F
M141	Norway rat	Rattus norvegicus	3	3	2	3	3	F
M142	House mouse	Mus musculus	2	3	2	3	3	F
M143	Western jumping mouse	Zapus princeps	2	2	3	2	3	T
M145	Porcupine	Erethizon dorsatum	2	2	2	2	3	T
M146	Coyote	Canis latrans	2	3	2	3	3	T
M147	Sierra nevada red fox	Vulpes vulpes	2	2	3	3	2	T
M149	Gray fox	Urocyon cinereoargenteus	2	3	2	2	3	T
M151	Black bear	Ursus americanus	2	2	2	2	3	T
M151	Grizzly bear	Ursus arctos	2	3	2	3	1	T
M152	Ringtail	Bassariscus astutus	2	3	2	2	3	T
M153	Raccoon	Procyon lotor	2	3	2	1	3	T
M154	Marten	Martes americana	2	2	3	3	2	T
M155	Fisher	Martes pennanti	2	1	3	3	2	T
M156	Ermine	Mustela erminea	2	2	3	3	3	T
M157	Long-tailed weasel	Mustela frenata	2	3	2	3	3	T
M158	Mink	Mustela vison	2	3	2	1	3	T
M159	Wolverine	Gulo gulo	2	2	3	3	2	T
M160	Badger	Taxidea taxus	2	3	2	3	2	T
M161	Western spotted skunk	Spilogale gracilis	2	3	2	3	3	T
M162	Striped skunk	Mephitis mephitis	2	3	2	3	3	T
M163	River otter	Lutra canadensis	2	3	2	1	3	T
M165	Mountain lion	Felis concolor	2	3	2	3	3	T
M166	Bobcat	Felis rufus	2	3	2	3	3	T
M176	Wild pig	Sus scrofa	3	3	2	2	3	F
M181	Mule deer	Odocoileus hemionus	2	3	2	2	3	T
M183	Mountain sheep	Ovis canadensis	2	3	3	3	2	T
M186	Feral goat	Capra hircus	3	3	2	3	3	F
R004	Western pond turtle	Clemmys marmorata	3	3	1	1	2	T
R019	Blunt-nosed leopard lizard	Gambelia silus	3	3	2	3	2	T
R022	Western fence lizard	Sceloporus occidentalis	2	3	2	3	3	T
R023	Sagebrush lizard	Sceloporus graciosus	2	3	3	3	3	T
R024	Side-blotched lizard	Uta stansburiana	3	3	2	3	3	T
R029	California horned lizard	Phrynosoma coronatum frontale	3	3	2	3	2	T

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R030	Desert horned lizard	Phrynosoma platyrhinos	3	3	3	3	3	T
R036	Western skink	Eumeces skiltonianus	2	3	2	3	3	T
R037	Gilbert's skink	Eumeces gilberti	2	3	1	3	3	T
R039	Western whiptail	Cnemidophorus tigris	2	3	2	3	3	T
R040	Southern alligator lizard	Gerrhonotus multicarinatus	2	3	2	3	3	T
R042	Northern alligator lizard	Gerrhonotus coeruleus	2	3	3	3	3	T
R043	California legless lizard	Anniella pulchra	3	3	1	3	2	T
R046	Rubber boa	Charina bottae	3	2	3	2	3	T
R048	Ringneck snake	Diadophis punctatus	3	3	1	3	3	T
R049	Sharp-tailed snake	Contia tenuis	2	3	2	2	3	T
R051	Racer	Coluber constrictor	2	3	2	3	3	T
R052	Coachwhip	Masticophis flagellum	3	3	1	3	3	T
R053	California whipsnake	Masticophis lateralis	3	3	1	3	3	T
R054	Striped whipsnake	Masticophis taeniatus	3	3	3	3	3	T
R057	Gopher snake	Pituophis melanoleucus	2	3	1	3	3	T
R058	Common kingsnake	Lampropeltis getulus	2	3	1	2	3	T
R059	California mountain kingsnake	Lampropeltis zonata	2	2	3	2	3	T
R060	Long-nosed snake	Rhinocheilus lecontei	3	3	1	3	3	T
R061	Common garter snake	Thamnophis sirtalis	2	3	1	1	3	T
R062	Western terrestrial garter snake	Thamnophis elegans	2	3	3	1	3	T
R063	Western aquatic garter snake	Thamnophis couchi	2	2	2	1	3	T
R069	Southwestern black-headed snake	Tantilla hobartsmithi	3	3	1	3	3	T
R071	Night snake	Hypsiglena torquata	2	3	1	3	3	T
R074	Speckled rattlesnake	Crotalus mitchelli	3	3	3	3	3	T
R075	Sidewinder	Crotalus cerastes	3	3	3	3	3	T
R076	Western rattlesnake	Crotalus viridis	2	2	2	2	3	T

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