Appendix 10B Wildlife Habitat Models and Methods

Appendix 10B Wildlife Habitat Models and Methods

10B.1 Introduction

This appendix provides the land cover type associations, model assumptions, and rationales used in the special-status species models. Using the assumptions and rationales from the model descriptions, a list of potentially suitable land cover types was created for each species, which was then modeled using GIS software to identify areas of potential habitat for most species in the study area (models were not created for a few species). Because the models are limited in part by the accuracy of aerial imagery interpretation and the inability to field verify the land cover mapping, they generally overestimate the amount of potential habitat in the study area for special-status wildlife species.

10B.2 Habitat Model Information for Vernal Pool Branchiopods–Conservancy Fairy Shrimp, Vernal Pool Fairy Shrimp, and Vernal Pool Tadpole Shrimp

The wetland ecosystem of the Central Valley supports valuable habitat for many vernal pool species, including Conservancy fairy shrimp (*Branchinecta conservatio*), vernal pool fairy shrimp (*Branchinecta lynchi*), and vernal pool tadpole shrimp (*Lepidurus packardi*) (i.e., vernal pool branchiopods). Vernal pools are a unique type of wetland ecosystem that temporarily fill with rainwater in the winter and spring and then dry out until the next rainy season (U.S. Fish and Wildlife Service 2005:I-1).

10B.2.1. Habitat Model Description

The parameters of modeled habitat for vernal pool branchiopods consist of seasonal wetland and ditch land cover types when the ditch is adjacent to or surrounded by annual grassland. The seasonal wetlands and ditches that provide potentially suitable habitat were identified through aerial imagery, and are mostly present north, south, and west of Funks Reservoir.

The assumption on which the habitat model parameters were based, and rationale for the assumption, are described below.

10B.2.1.1. Assumption

In the study area, suitable habitat for vernal pool branchiopods consists of seasonal wetland and ditch land cover types when the ditch is adjacent to or surrounded by annual grassland.

Rationale

Vernal pool branchiopods primarily occur in vernal pool, swale, or ephemeral freshwater habitats that are confined to a limited area by topographic constraints, soil types, and climatic conditions; additionally, the surrounding upland habitat is important for the ecological function of vernal pool habitat (U.S. Fish and Wildlife Service 2005:vii, I-8, I-10). Landscapes that support vernal pools are typically grasslands with areas of obstructed drainage that allows the formation of pooled rainwater; however, vernal pools can also be found in other land cover types such as oak woodland, desert, and chaparral (U.S. Fish and Wildlife Service 2005: I-13). Pools may be fed by or connected to swales that receive surface flow from the surrounding watershed or filled entirely by direct precipitation (U.S. Fish and Wildlife Service 2005:I-13; Hanes and Stromberg 1998:38, 44).

Conservancy fairy shrimp primarily occurs in large, turbid vernal pools (playa pools) that stay inundated for much longer than most vernal pools, often into summer (Eriksen and Belk 1999:88, U.S. Fish and Wildlife Service 2012:3). Vernal pool fairy shrimp commonly inhabits vernal pools or vernal pool-like habitats, typically in grassland landscapes. Vernal pool fairy shrimp is most frequently found in vernal pools or vernal swales in unplowed grasslands (Eng et al. 1990:257). Vernal pool tadpole shrimp occurs in a variety of seasonal habitats, including vernal pools and other seasonal pools, ponded clay flats, roadside ditches, and stock ponds (Helm 1998:132, Rogers 2001:1002).

The areas generally east of Funks Reservoir consist of cultivated lands and rural developments (e.g., the towns of Delevan and Maxwell). These areas are not considered suitable habitat for vernal pool branchiopods because when natural land is cultivated or developed, the physical characteristics required for vernal pool formation are altered. Alteration of vernal pools is generally irreversible (U.S. Fish and Wildlife Service 2005:I-18). Land use conversion often disrupts the physical and biological processes conducive to a functional vernal pool ecosystem because the associated ground-disturbing activities can alter the hydrology, soil formation, seed bank, and topography of the landscape (U.S. Fish and Wildlife Service 2005:I-16–I-18).

10B.2.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to ground truth the land cover mapping (e.g., determine if seasonal wetlands have sufficient depth and ponding duration to support one or more vernal pool branchiopod species). Vernal pool habitat must be inundated sufficiently by rainfall at the appropriate time of year to allow vernal pool branchiopods to reach maturity and reproduce; if the availability of aerial imagery is limited or the resolution is poor, it may not be possible to accurately determine the sufficiency of ponding. Additionally, very small seasonal wetlands that could provide suitable habitat may not be visible on aerial imagery. Other parameters that affect the habitat suitability for vernal pool branchiopods that are not measurable using aerial imagery review include water quality, ponding depth, and water temperature (U.S. Fish and Wildlife Service 2005:xiii, xiv). The amount of suitable habitat is overestimated in the model because it is assumed that all seasonal wetlands and ditches adjacent to or surrounded by annual grassland provide conditions necessary for habitat to be suitable for vernal pool branchiopods, which is unlikely to be the case.

10B.2.3. References

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10B.3 Habitat Model Information for Valley Elderberry Longhorn Beetle

Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) is completely dependent on its larval host plant, elderberry (*Sambucus sp.*) (Barr 1991:4, Collinge et al. 2001:104). Adult beetles have been described as feeding on the nectar, flowers, and leaves of elderberry plants. Eggs are laid on elderberry stems and leaves, and the larvae develop inside, feed upon, and pupate in the stems of elderberry shrubs (U.S. Fish and Wildlife Service 2019:1, 2).

10B.3.1. Habitat Model Description

The parameters of modeled habitat for the valley elderberry longhorn beetle consist of riparian land cover types (upland riparian,[1] scrub-shrub wetland, and forested wetland), as well as other land cover types that provide suitable habitat (blue oak woodland, oak savanna, annual grassland, and ruderal). The modeled habitat was also restricted to areas at elevations below 500 feet.

10B.3.1.1. Assumptions and Rationales

The assumptions upon which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption

Potentially suitable habitat for valley elderberry longhorn beetle consists of upland riparian, scrub-shrub wetland, forested wetland, blue oak woodland, oak savanna, annual grassland, and ruderal land cover types.

Rationale

Valley elderberry longhorn beetle occurs only in association with its host plant, elderberry, which is commonly found in riparian forests and adjacent grasslands in the Central Valley (Barr 1991:4–5). Elderberries are a component of riparian forests throughout the Central Valley. Although elderberries can grow outside riparian areas, shrubs supporting the greatest beetle densities are in areas where the shrubs are abundant and interspersed among trees in dense riparian forest. Associated dominant riparian species include Fremont’s cottonwood (*Populus fremontii*), box elder (*Acer negundo*), California sycamore (*Platanus racemosa*), black walnuts (*Juglans* spp.), white alder (*Alnus rhombifolia*), willows (*Salix* spp.), button willow (*Cephalanthus occidentalis*), Oregon ash (*Fraxinus latifolia*), wild grape (*Vitis californica*), California hibiscus (*Hibiscus californica*), and poison oak (*Toxicodendron diversilobum*) (Barr 1991:41; U.S. Fish and Wildlife Service 2017:6; Collinge et al. 2001:104). Occupancy of elderberry shrubs by valley elderberry longhorn beetle is generally low but tends to be highest in riparian communities (Barr 1991:49; Collinge et al. 2001:104, 107–109; Talley et al. 2007:25–27) and sites with high elderberry densities (Collinge et al. 2001:1). Elderberry shrubs also occur in non-riparian settings in valley oak and blue oak woodlands and annual grasslands (U.S. Fish

[1] The upland riparian land cover type consists of non-wetland riparian areas (i.e., located adjacent to streams but above the ordinary high-water mark) that include valley foothill riparian species, as well as blue oak (*Quercus douglasii*), foothill pine (*Pinus sabiniana*), ornamental trees, and other shrubs and trees that were not identifiable from aerial imagery interpretation.

and Wildlife Service 2017:6). However, valley elderberry longhorn beetle may not be able to colonize disconnected or fragmented habitat due to the species' limited dispersal abilities (Collinge et al. 2001:109; U.S. Fish and Wildlife Service 2017:7).

Assumption

Suitable habitat for valley elderberry longhorn beetle is restricted to areas below 500 feet in elevation.

Rationale

The presumed historical range of valley elderberry longhorn beetle consists of the Central Valley (the valley floor and lower foothills) from approximately Shasta County south to Madera County (U.S. Fish and Wildlife Service 2019:1; 79 Federal Register [FR] 55874). Most valley elderberry longhorn beetle observations have been at elevations below 500 feet (U.S. Fish and Wildlife Service 2017:4).

10B.3.2. Habitat Model Limitations

The model provides a conservative estimate of potentially suitable valley elderberry longhorn beetle habitat. The model is limited by the accuracy of aerial imagery interpretation and the lack of property access to field verify the land cover mapping (e.g., confirm presence of elderberry shrubs). All mapped habitats identified in the model are deemed to be equally suitable for the species and to contain elderberry shrubs. However, elderberries are not likely to be present throughout each land cover type. Additionally, studies have shown that valley elderberry longhorn beetle occurs in widely dispersed metapopulations (Collinge et al. 2001:109, 110; Talley et al. 2006:10) and is more rare and patchily distributed than are elderberry shrubs (Talley et al. 2006:27). Therefore, the amount of suitable habitat in the model is overestimated.

Other factors that affect habitat suitability cannot be determined through aerial imagery interpretation, such as the presence of Argentine ant (*Linepithema humile*) and European earwig (*Forficula auricularia*), which are nonnative insects that have been identified as potential threats to valley elderberry longhorn beetle (Talley et al. 2006:26; 77 FR 60259). Nonnative, invasive woody species in the understory of modeled potential habitat are not discernable on aerial imagery. These species may compete with or displace elderberry shrubs and include black locust (*Robinia pseudoacacia*), giant reed (*Arundo donax*), red sesbania (*Sesbania punicea*), Himalayan blackberry (*Rubus armeniacus*), tree-of-heaven (*Ailanthus altissima*), and Spanish broom (*Spartium junceum*) (Talley et al. 2006:45).

10B.3.3. References

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U.S. Fish and Wildlife Service. 2019. Revised Recovery Plan for Valley Elderberry Longhorn Beetle. U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California. iii + 18 pp. https://www.fws.gov/endangered/species/recovery-plans.html

10B.4 Habitat Model Information for Monarch Butterfly

The geographic range of monarch butterfly (*Danaus plexippus*) in California is throughout the state and includes spring and summer breeding areas and overwintering areas; the overwintering areas are almost entirely along the coast. Generally, the migratory and breeding habitat for this species consists of all areas with the required habitat, including milkweeds (*Asclepias spp.*), nectar sources, and roosting structures. Overwintering habitat consists of groves of trees that produce the necessary microclimate for survival. Most overwintering sites in California are within 1.5 miles of the Pacific Ocean or San Francisco Bay (Western Association of Wildlife Agencies 2019:8).

10B.4.1. Habitat Model Description

The parameters of modeled habitat for monarch butterfly (breeding, roosting, drinking, and/or migratory habitat) consist of annual grassland, blue oak woodland, chamise chaparral, ditch, ephemeral stream, foothill pine, forested wetland, freshwater marsh, hayfield (includes alfalfa), intermittent stream, managed wetland, mixed chaparral, oak savanna, ornamental woodland, perennial stream, pond, reservoir, ruderal, scrub-shrub wetland, seasonal wetland, and upland riparian[2] land cover types. These land cover types are considered breeding and/or migratory habitat because they potentially contain milkweed, roosting habitat, and nectar-producing plants. The project area is not within the known range of overwintering habitat for this species; therefore, there is no modeled overwintering habitat.

The assumption on which the habitat model parameters were based, and rationale for the assumption, are described below.

10B.4.1.1. Assumption

Potentially suitable monarch butterfly habitat consists of annual grassland, blue oak woodland, chamise chaparral, ditch, ephemeral stream, foothill pine, forested wetland, freshwater marsh, hayfield (includes alfalfa), intermittent stream, managed wetland, mixed chaparral, oak savanna, ornamental woodland, perennial stream, pond, reservoir, ruderal, scrub-shrub wetland, seasonal wetland, and upland riparian land cover types.

Rationale

Monarch butterfly requires milkweed for breeding, as it lays eggs on the milkweed plant, and milkweed is an obligate species for the monarch caterpillar (Western Association of Wildlife Agencies 2019:8, U.S. Fish and Wildlife Service 2020:8). There are multiple native and nonnative milkweed species in California that may grow in the natural and managed land cover types in the project area (Calflora 2021). Monarch butterfly requires nectar-producing plants for foraging and roosting sites (particularly during fall migration) (Western Association of Wildlife Agencies 2019:8; U.S. Fish and Wildlife Service 2020:9–10). Native and nonnative deciduous and evergreen trees, and narrow-leaved trees such as willows (*Salix* spp.), Russian olive

[2] The upland riparian land cover type consists of non-wetland riparian areas (i.e., located adjacent to streams but above the ordinary high-water mark) that include valley foothill riparian species, as well as blue oak (*Quercus douglasii*), foothill pine (*Pinus sabiniana*), ornamental trees, and other shrubs and trees that were not identifiable from aerial imagery interpretation.

(*Elaeagnus angustifolia*), locusts (*Robinia* spp.), pines (*Pinus* spp.), and eucalyptus (*Eucalyptus* spp.) are used as roosting sites (U.S. Fish and Wildlife Service 2019). The land cover types identified for the modeled habitat may contain nectar-producing plants and suitable roosting trees.

10B.4.2. Habitat Model Limitations

The model provides a conservative estimate of potentially suitable monarch butterfly habitat because all mapped habitats are deemed to be equally suitable. The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to field verify the land cover mapping (e.g., confirming areas mapped contain milkweeds, nectar-producing plants, or roosting sites). For example, the types of vegetation in potentially suitable habitat are not discernable from aerial imagery and may be a factor in forage site selection because nectar-producing plants are required. Not all areas mapped likely have milkweeds, nectar-producing plants, or suitable roosting trees; therefore, the amount of potentially suitable habitat identified in the model is likely overestimated.

10B.4.3. References

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10B.5 Habitat Model Information for Crotch Bumble Bee and Western Bumble Bee

In California, Crotch bumble bee (*Bombus crotchii*) historically occurred on the Pacific Coast and in the western desert, Central Valley, and adjacent foothills (Williams et al. 2014:114–116, 132). Crotch bumble bee now appears to be absent from much of its historical range in the southern two-thirds of California, including the Central Valley (The Xerces Society for Invertebrate Conservation 2018:17, 32–35, 43; Hatfield et al. 2015a:19).

The known range of the western bumble bee (*Bombus occidentalis occidentalis*) extends throughout California, although populations from Central California to the southern British Columbia border have declined sharply since the late 1990s, particularly from lower elevation sites (Williams et al. 2014:116, Hatfield et al. 2015b:2). Western bumble bee populations are largely restricted to high elevation sites in the Sierra Nevada (The Xerces Society for Invertebrate Conservation 2018:6).

10B.5.1. Habitat Model Description

The parameters of the modeled habitat for Crotch bumble bee and western bumble bee consist of land cover types that could provide appropriate floral resources and nesting sites for these species and would therefore be considered potentially suitable habitat. These land cover types consist of annual grassland, chamise chaparral, mixed chaparral, oak savanna, seasonal wetland, and ruderal areas adjacent to the aforementioned land cover types.

The assumption on which the habitat model parameters were based, and rationale for the assumption, are described below.

10B.5.1.1. Assumption

Potentially suitable Crotch bumble bee and western bumble bee habitat consists of annual grassland, chamise chaparral, mixed chaparral, oak savanna, and seasonal wetland land cover types, as well as ruderal areas that are adjacent to these land cover types.

Rationale

In California, Crotch bumble bee inhabits open grasslands and scrub habitats (The Xerces Society for Invertebrate Conservation 2018:32). In an analysis conducted by Thorp et al. (1983:22), based on California records, Crotch bumble bee was found to be associated with the plants in Asclepiadaceae, Compositae (Asteraceae), Hydrophyllaceae, Labiatae (Laminaceae) and Leguminosae (Fabaceae). Crotch bumble bee is a generalist forager that feeds on a variety of widely distributed plant genera including *Antirrhinum*, *Asclepias*, *Phacelia*, *Chaenactis*, *Clarkia*, *Dendromecon*, *Eriogonum*, *Eschscholzia*, *Lupinus*, *Medicago*, and *Salvia* (Koch et al. 2012:82, Williams et al. 2014:132). These floral associations do not necessarily represent the species' foraging preference but are a representation of prevalence of these flower types in the landscape (The Xerces Society for Invertebrate Conservation 2018:32).

In California, western bumble bee inhabits grassy areas, urban parks and gardens, chaparral and scrub lands, and mountain meadows (Williams et al. 2014:116). Meadows and grasslands with abundant floral resources provide suitable habitat for this species (The Xerces Society for

Invertebrate Conservation 2018:33). An analysis by Thorp et al. (1983:31) reported that western bumble bee primarily associated with plants in the Compositae (Asteraceae), Leguminosae (Fabaceae), Rhamnaceae, and Rosaceae. A generalist forager, the plant genera most commonly associated with western bumble bee include *Asteraceae*, *Ceanothus*, *Centaurea*, *Chrysothamnus*, *Cirsium*, *Eriogonum*, *Geranium*, *Grindelia*, *Lupinus*, *Melilotus*, *Monardella*, *Rubus*, *Penstemon*, *Solidago*, and *Trifolium* (Williams et al. 2014:116, The Xerces Society for Invertebrate Conservation 2018:34). These floral associations do not necessarily represent the species' preference over other flowering plants but are a representation of the abundance of these flowers in the landscape (The Xerces Society for Invertebrate Conservation 2018:34).

10B.5.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to field verify the land cover mapping (e.g., confirm that areas mapped provide suitable nesting and foraging habitats). Bumble bees require the availability of nectar and pollen from floral resources throughout the duration of the colony period (spring, summer, and fall) (The Xerces Society for Invertebrate Conservation 2018:30); however, it is not possible to use aerial imagery to determine if sufficient flowering resources are present year-round within the modeled habitat. It is assumed that the land cover types in the model provide the floral resources to support bumble bee populations. Additionally, bumble bee populations can be negatively affected by pathogens and pesticides (The Xerces Society for Invertebrate Conservation 2018:30, 31); the presence of pathogens and use of pesticides are not discernible from aerial imagery review and are not considered in the model. Because bumble bees are sensitive to habitat fragmentation, isolated patches of habitat (e.g., habitat fragments that are too small or too distant from surrounding habitat to support diverse bumble bee communities) are not sufficient to fully support bumble bee populations (The Xerces Society for Invertebrate Conservation 2018:31; Hatfield and LeBuhn 2007:154–157). The model does not include a minimum land cover patch size to be included as suitable habitat. For these reasons, the model overestimates the amount of potentially suitable Crotch bumble bee and western bumble bee habitat in the study area.

10B.5.3. References

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10B.6 Habitat Model Information for Western Spadefoot

The range of western spadefoot (*Spea hammondii*) is the Central Valley and adjacent foothills and the Coast Ranges from south of Monterey County to western Baja California (Thomson et al. 2016:131). The species is almost completely terrestrial, entering water only to breed (Jennings and Hayes 1994:94).

10B.6.1. Habitat Model Description

Intermittent stream and seasonal wetland land cover types are defined as potential western spadefoot aquatic habitat in the model. Annual grassland, blue oak woodland, chamise chaparral, foothill pine, mixed chaparral, and oak savanna within 1,200 feet of modeled aquatic habitat are defined as potential upland habitat in the model.

10B.6.1.1. Assumptions and Rationales

The assumptions on which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption

Potentially suitable western spadefoot aquatic habitat consists of intermittent stream and seasonal wetland land cover types.

Rationale

Western spadefoot breeds in temporary rain pools, quiet streams (Stebbins 2003:203), and stock tanks (Morey 2005:515). Breeding habitats must retain water long enough for larvae to transform into toads (at least 30 days). Substantial larval mortality results from desiccation when pools last fewer than 30 days after eggs are laid (Morey 2005:515). Morey and Reznick (2004:172) reported that temporary pools used by western spadefoot remained filled for an average of 81 days.

Assumption

Potentially suitable western spadefoot upland habitat consists of annual grassland, blue oak woodland, chamise chaparral, foothill pine, mixed chaparral, and oak savanna within 1,200 feet of modeled aquatic habitat.

Rationale

Western spadefoot is a lowland toad that occupies seasonal pools, washes, river floodplains, alluvial fans, playas, and alkali flats in valley and foothill grasslands, oak woodland, pine-oak woodland, coastal sage scrub, and open chaparral (Stebbins 2003:203, Morey 2005:515). Adults move toward breeding sites in late winter to spring, in response to favorable temperatures and rainfall. Following breeding, adults return to upland habitats, where they spend most of the year aestivating (i.e., in a dormant state) in burrows. Western spadefoot likely requires loose, sandy or gravelly soil in which it can dig burrows (U.S. Fish and Wildlife Service 2005:II–08; Jennings and Hayes 1994:96). Metamorphosed juveniles may be found near breeding pools where they find refuge in mud cracks and under boards and other surface objects (Zeiner et al. 1988:1). Home range sizes and seasonal migration patterns of juveniles are unknown. Adults travel to and from breeding pools seasonally but little is known about the distance traveled between the pools and summer burrows. Similar to other spadefoot toads, western spadefoot does not burrow into the drying mud of the breeding pool and probably does not aestivate there (Morey 2005:516).

Semlitsch and Bodie (2003:1219, 1221) reviewed research on the use of terrestrial habitats of 19 frog species associated with wetlands and found that core terrestrial habitat use from the edge of aquatic sites ranged from 522 to 951 feet with the mean maximum terrestrial habitat use outward from the edge of aquatic habitat of 1,207 feet. Based on this information, and in the absence of data on upland habitat use by western spadefoot, a distance of 1,200 feet from potential aquatic habitat was used to define the extent of potential upland habitat in the model.

10B.6.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to field verify the land cover mapping (e.g., confirm areas mapped provide suitable aquatic and upland habitats).

Western spadefoot has been documented breeding in artificial water bodies such as stock tanks (Morey 2005:515) and a concrete-lined reservoir (Storer 1925:156). Stock tanks and the reservoir land cover type, however, are not included in the parameters for aquatic habitat because these habitats are atypical for western spadefoot breeding. Seasonal pools in which western spadefoot successfully reproduces lack fish, bullfrogs (*Lithobates catesbeianus*), and crayfish, which prey on western spadefoot (Jennings and Hayes 1994:96). The presence of aquatic predators in potential aquatic habitats is not detectible through aerial imagery interpretation. Likewise, the ponding duration and soil properties of upland habitat adjacent to aquatic habitat are not discernable through aerial imagery interpretation. Because characteristics such as ponding duration and presence of predators cannot be included in the model parameters, the model likely overestimates the amounts of potential aquatic and upland habitats present (as modeled upland habitat is based on modeled aquatic habitat).

10B.6.3. References

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10B.7 Habitat Model Information for California Red-legged Frog

California red-legged frog (*Rana draytonii*) inhabits marshes, streams, lakes, ponds, and other, usually permanent, sources of water that have dense riparian vegetation (Stebbins 2003:225). California red-legged frogs often disperse from breeding sites to various aquatic, riparian, and upland aestivation habitats during the summer but may also remain at breeding locations year-round (66 Federal Register [FR] 14628).).

10B.7.1. Habitat Model Description

Perennial stream, intermittent stream, freshwater marsh, reservoir, and pond are defined as suitable California red-legged frog aquatic habitat in the model. Annual grassland, blue oak woodland, ephemeral stream, foothill pine, forested wetland, oak savanna, ruderal, scrub-shrub wetland, seasonal wetland, and upland riparian[3] land cover types within 300 feet of modeled aquatic habitat are defined as upland habitat in the model. Modeled aquatic and upland habitats were restricted to areas surrounding and to the west of Funks Reservoir because California red-legged frog is considered extirpated from the floor of the Central Valley (U.S. Fish and Wildlife Service 2002:5). The portion of the project area generally east of Funks Reservoir is considered the valley floor. Dispersal habitat is defined as upland habitat land cover types (defined above) within 2 miles of aquatic habitat but is not included in the model.

10B.7.1.1. Assumptions and Rationales

The assumptions on which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption

Potentially suitable California red-legged frog aquatic habitat consists of freshwater marsh, perennial stream, intermittent stream, pond, and reservoir, with the exception of Funks Reservoir, which is not considered suitable habitat.

Rationale

California red-legged frog primarily breeds in ponds and less frequently in pools within streams (Thomson et al. 2016:103). Breeding adults are often associated with deep (greater than 2 feet) still or slow-moving water and dense, shrubby riparian or emergent vegetation (Hayes and Jennings 1988:146–147; U.S. Fish and Wildlife Service 2002:12). Ponds are suitable for all life stages (e.g., egg, tadpole, metamorph, adult) (U.S. Fish and Wildlife Service 2002:12). Larvae and metamorphs have been documented in streams, deep pools, backwaters within streams and creeks, ponds, marshes, sag ponds, dune ponds, and lagoons. California red-legged frog has also been documented in shallow sections of streams that lack riparian vegetation and in stock ponds (U.S. Fish and Wildlife Service 2002:12). An important feature for a breeding pond or slow-

[3] The upland riparian land cover type consists of non-wetland riparian areas (i.e., located adjacent to streams but above the ordinary high-water mark) that include valley foothill riparian species as well as blue oak (*Quercus douglasii*), foothill pine (*Pinus sabiniana*), ornamental trees, and other shrubs and trees that were not identifiable from aerial imagery.

flowing stream is vegetation or other material to which egg masses can be attached (75 FR 12817).

Assumption

Potentially suitable California red-legged frog upland habitat consists of annual grassland, blue oak woodland, ephemeral stream, foothill pine, forested wetland, oak savanna, ruderal, scrub-shrub wetland, seasonal wetland, and upland riparian land cover types within 300 feet of aquatic habitat.

Rationale

California red-legged frog requires upland habitat (e.g., grassland, riparian, woodland) for foraging, cover, and aestivation. Aestivation habitat consists of riparian vegetation and landscape features within 300 feet of riparian vegetation that provide cover and moisture during the dry season including boulders, rocks, organic debris (e.g., downed trees or logs), industrial debris, and agricultural features (e.g., drains, watering troughs, spring boxes, abandoned sheds, and haystacks) (61 FR 25814).

California red-legged frogs typically travel much shorter distances between aquatic and upland refugia and foraging habitats than when dispersing between breeding and nonbreeding aquatic habitats (Bulger et al. 2003:89, 91). Studies have shown that California red-legged frog remains close to aquatic habitat except when migrating. In one study, non-migrating California red-legged frogs in a mesic environment (Santa Cruz County) were almost always found within 16 feet of their resident pond or stream during dry intervals in the summer. In another study, conducted in a drier environment (eastern Contra Costa County) during fall, winter, and spring over 2 years, 57% of frogs with radio transmitters stayed at their breeding pools, whereas 43% moved into adjacent upland habitat or to other aquatic sites. Upland movement distances ranged from 3–233 feet and averaged 80 feet (Tatarian 2008:161). Other telemetry studies have shown that most of the monitored California red-legged frogs remained very close to their in-water capture sites (Bobzien and DiDonato 2007:27).

U.S. Fish and Wildlife Service, in its critical habitat designation for California red-legged frog, defined the upland habitat primary constituent element as 200 feet from aquatic habitat, which provides foraging and dispersal habitat for California red-legged frog (71 FR 19249). Additionally, Bulger et al. (2003:87) found 90% of the non-migrating California red-legged frogs were within 200 feet of aquatic habitat throughout the year. However, a more conservative 300-foot buffer from aquatic habitat is used to define upland habitat in the model to include the limited number of California red-legged frogs that may occur more than 200 feet from aquatic habitat (Bulger et al. 2003:87–88).

Assumption

Potentially suitable dispersal habitat consists of all land cover types within 2 miles of modeled aquatic habitat.

Rationale

California red-legged frog travels through a variety of habitats to reach breeding and nonbreeding sites, upland refugia and foraging habitats, or new breeding locations (Bulger et al.

2003:90–91; Fellers and Kleeman 2007:275–276). Movement corridors may include annual grasslands, riparian corridors, woodlands, and sometimes active agricultural lands (Fellers and Kleeman 2007:277, 279–280, 282, 284). These movements are frequently made during wet weather and at night (U.S. Fish and Wildlife Service 2002:12–13.). Studies of California red-legged frogs living in coastal environments have shown that individuals can move approximately 1 mile over the course of a wet season (U.S. Fish and Wildlife Service 2002:12). Dispersal habitat may include nearly any areas within 0.9–1.7 miles of a breeding site that stays moist and cool through the summer (Fellers and Kleeman 2007:277, 279–280, 282, 284). Dispersal distances are dependent on habitat availability and environmental conditions (U.S. Fish and Wildlife Service 2002:13). California red-legged frog can be found within streams that are over 2 miles from the breeding site (U.S. Fish and Wildlife Service 2002:14).

Assumption

The portion of the study area on the Central Valley floor is not occupied by California red-legged frog.

Rationale

California red-legged frog was probably extirpated from the floor of the Central Valley before 1960 (U.S. Fish and Wildlife Service 2002:5). California red-legged frog may never have been widespread on the valley floor as specimen-based records are scarce north of the Kern River drainage and the last verifiable record of the species on the valley floor was in San Joaquin County from 1957 (U.S. Fish and Wildlife Service 2002:5). The valley floor constitutes a portion of the study area generally east of Funks Reservoir; thus, the modeled habitats for California red-legged frog are limited to suitable land cover types surrounding and to the west of Funks Reservoir.

10B.7.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the lack of property access to field verify the land cover mapping (e.g., confirm that aquatic habitats provide sufficient ponding duration, depth, and water quality). For example, it may not be possible to use aerial imagery to determine if emergent vegetation is present for egg mass attachment or if predators (e.g., bullfrogs [*Lithobates catesbeianus*], fish) are present in aquatic habitat; however, some stock ponds can support California red-legged frog despite a lack of emergent vegetation cover and the presence of nonnative predators (U.S. Fish and Wildlife Service 2002:12). Small mammal burrows and moist leaf litter are important for providing refuge sites for California red-legged frog in upland habitat (U.S. Fish and Wildlife Service 2002:14); the presence of these small features cannot be determined through review of aerial imagery.

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10B.8 Habitat Model Information for Western Pond Turtle

Western pond turtle (*Actinemys marmorata*) occurs in a wide range of permanent and nearly permanent aquatic habitats with ample basking sites (Thomson et al. 2016:299, Holland 1994:2-7). Upland habitat is also important to western pond turtle and is used for nesting, overwintering, and overland dispersal (Holland 1994:2-8, 2-9; Thomson et al. 2016:300).

10B.8.1. Habitat Model Description

Ditch, canal, perennial stream, intermittent stream, forested wetland, freshwater marsh, managed wetland, pond, reservoir, rice, scrub-shrub wetland, and seasonal wetland land cover types are defined as potential western pond turtle aquatic habitat in the model. Potentially suitable western pond turtle upland habitat consists of annual grassland, blue oak woodland, chamise chaparral, disturbed, foothill pine, mixed chaparral, oak savanna, ruderal, and upland riparian that is within 1,640 feet from aquatic habitat. Upland habitat may be used for nesting or overwintering. While western pond turtle may make substantial (up to 3.1 miles) overland movements, the frequency and extent of overland movement are poorly understood and somewhat variable (Holland 1994:2-9) and can be influenced by drought conditions (Purcell et al. 2017:15, 21) or other factors. As such, the model does not incorporate overland dispersal habitat.

10B.8.1.1. Assumptions and Rationales

The assumptions on which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption

Potentially suitable western pond turtle aquatic habitat consists of ditch, canal, perennial stream, intermittent stream, forested wetland, freshwater marsh, managed wetland, pond, reservoir, rice, seasonal wetland, and scrub-shrub wetland land cover types.

Rationale

Western pond turtle occupies rivers and streams, lakes, ponds, marshes, and irrigation ditches that typically have a rocky or muddy bottom (Stebbins 2003:250). Western pond turtle will also temporarily use semi-permanent or ephemeral water bodies, including stock ponds and seasonal wetlands (e.g., vernal pools) (Thomson et al. 2016:300, Bury and Germano 2008:4). Western pond turtle requires some slack or slow-water aquatic habitat and is uncommon in high gradient streams (Jennings and Hayes 1994:101). The species is generally found in quiet stream reaches that have abundant basking substrate (e.g., downed wood, large rocks) and little human disturbance (Thomson et al. 2016:300, Thomson et al. 2010:298). However, western pond turtles have also been documented in highly modified aquatic habitats with human disturbance and limited basking substrate (Thomson et al. 2016:300; Spinks et al. 2003:257; Germano and Bury 2001:26, 28). Western pond turtle will also use artificial substrate for basking (Alvarez 2006:2).

Assumption

Potentially suitable western pond turtle upland habitat consists of annual grassland, blue oak woodland, chamise chaparral, disturbed, foothill pine, mixed chaparral, oak savanna, ruderal, and upland riparian that is within 1,640 feet of modeled aquatic habitat. Upland habitat may be used for nesting and overwintering.

Rationale

Western pond turtle requires upland habitat that is suitable for nesting (Thomson et al. 2016:300). Suitable nesting sites must have loose enough soil to allow nest excavation (Thomson et al. 2016:300), proper thermal and hydric environments for egg incubation (Jennings and Hayes 1994:101), and low levels of disturbance (Thomson et al. 2016:300). How close the nest site is to aquatic habitat depends on the availability of suitable nesting habitat adjacent to the occupied aquatic habitat (Jennings and Hayes 1994:101). Females usually select nest sites within 328 feet of aquatic habitat, although nests have been found 1,640 feet from a water body (Thomson et al. 216:299). Lovich and Meyer (2002:540) reported nesting sites up to 1,919 feet from aquatic habitats and Holland (1994:2-10) reported nesting sites up to 1,312 feet from aquatic habitats. Nests may be much farther than typical nesting sites in flatter areas where appropriate soil moisture gradients and soil types extend further from the aquatic habitat (Jennings and Hayes 1994:101).

Western pond turtle may also leave aquatic habitat in late fall and move up to 1,640 feet (or possibly more) from water bodies for overwintering, seasonal terrestrial habitat use, and overland dispersal (Holland 1994:2-8). Studies suggest that distances travelled over land and habitats used during upland movement are highly variable among individuals, even those from the same population (Pilliod et al. 2013:207). When western pond turtles overwinter in upland habitat, they typically are found in shallow surface depressions within, and sometimes covered by, a thick layer of duff (leaf litter) or soil (Pilliod et al. 2013:208, Holland 1994:2-8). The frequency of use of upland overwintering sites seems to vary between habitat types, with all or most western pond turtles in northern California overwintering on land (Holland 1994:2-8).

10B.8.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to field verify the land cover mapping (e.g., confirm the mapped land cover types provide suitable aquatic and upland habitats). Aquatic habitat quality, attributes (e.g., presence of basking sites, refugia present), and the presence of nonnative species are not discernible from aerial imagery review; therefore, the model may overestimate the amount of potentially suitable aquatic habitat. Aquatic habitat quality varies with the availability of refugia (e.g., mud, rocks, logs, submerged vegetation, undercut areas along banks) and basking sites. Habitat use data indicate that western pond turtle may generally avoid areas, particularly in stream habitats, that lack significant refugia and individuals avoid areas of open water that lack nearby refugia and/or basking sites (Holland 1994:2-8). Likewise, hatchling turtles require shallow water habitat with relatively dense submerged or short emergent vegetation for foraging (Jennings and Hayes 1994:101). Aquatic habitat quality can change across different reaches of streams and waterways, thus there can be a high degree of variability in the suitability of water bodies. Introduced species such as bullfrogs (*Lithobates catesbeiana*), sunfish (*Lepomis* spp. and *Pomoxis* spp.), and red-eared slider (*Trachemys scripta elegans*) are known to adversely affect western pond turtle through predation, competition for prey, or spread of disease (Thomson et al. 2010:301; Holland 1994:2-12). Upland habitat characteristics that may limit the distribution of suitable western pond turtle nesting sites, such as localized soil conditions and frequency and degree of disturbance, may also not be discernible from aerial imagery review. For example, nests are typically excavated in dry soils with high clay or silt fraction and nest areas tend to be south or west-facing with slopes of 0–60° (Holland 1994:2-10). Therefore, the model may also overestimate the amount of potentially suitable upland habitat.

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10B.9 Habitat Model Information for Giant Gartersnake

Giant gartersnake (*Thamnophis gigas*) is endemic to the wetlands of the Sacramento and San Joaquin Valleys of California. Giant gartersnake inhabits marshes, ponds, sloughs, small lakes, low-gradient streams and other waterways, and agricultural wetlands, including irrigation and drainage canals, rice fields, and the adjacent uplands (U.S. Fish and Wildlife Service 2006:3).

10B.9.1. Habitat Model Description

Modeled aquatic and upland habitats for giant gartersnake in the study area are the GCID Main Canal and areas east; within 200 feet of the west bank of the GCID Main Canal north of Stone Corral Creek; and east and west of the GCID Main Canal south of Stone Corral Creek. The modeled aquatic habitat for giant gartersnake consists of canal, ditch, freshwater marsh, managed wetland, pond, and rice land cover types. Modeled upland habitat for giant gartersnake consists of annual grassland, disturbed, and ruderal land cover types immediately adjacent to and within 200 feet of the modeled aquatic habitat types.

10B.9.1.1. Assumptions and Rationales

The assumptions on which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption

Potentially suitable aquatic habitat for giant gartersnake consists of canal, ditch, freshwater marsh, managed wetland, pond, and rice land cover types east of the GCID Main Canal, and east and west of the GCID Main Canal south of Stone Corral Creek. Streams in the study area do not provide suitable habitat for giant gartersnake.

Rationale

Suitable giant gartersnake aquatic habitat consists of slow-moving or static water that is present from March through November with a mud substrate and the presence of prey (amphibians or fish) (U.S. Fish and Wildlife Service 2017:I-3). Emergent and bankside vegetation that provide cover from predators and for thermoregulation is also required. Other components of suitable aquatic habitat are basking sites with supportive vegetation (such as folded tule [*Schoenoplectus* spp.] clumps) adjacent to escape cover, upland refugia in locations that are not subject to recurrent flooding, and the absence of a continuous riparian canopy and large predatory fish, (U.S. Fish and Wildlife Service 2017:I-3).

The lands east of the GCID Main Canal support agricultural areas, including rice fields and agricultural ditches that are typically used by giant gartersnake. There are also managed wetlands east of the GCID Main Canal. North of Stone Corral Creek, ditches west of the GCID Main Canal are not directly connected to ditches east of the GCID Main Canal. Therefore, ditches north of Stone Corral Creek and west of the GCID Main Canal are not considered suitable giant gartersnake habitat. South of Stone Corral Creek there are rice fields east and west of the GCID Main Canal that may provide suitable habitat for giant gartersnake and there is a California Natural Diversity Database record for a giant gartersnake occurrence at South Corral Creek, which is adjacent to rice fields and the GCID Main Canal (California Department of Fish and Wildlife 2021).

The portions of Stone Corral, Funks, Logan, and Hunters Creeks within the Sites Reservoir footprint (west of the GCID Main Canal) are characterized by deeply incised channels that have high flows during winter storms, declining flows in spring and early summer, and intermittent flows in late summer (Brown 2000:24). Creek flows in the Antelope Valley vary widely when there is a lack of precipitation, which suggests that streams on the Antelope Valley floor are intermittent and only flow in the summers of high rainfall years. Grapevine Creek and Antelope Creek could flow year-round; however, these creeks have fair amounts of rocky substrates and limited bankside vegetation (rushes), except at their upper reaches (Brown 2000:36, 40, 43–44). Because the creeks in the study area do not hold water throughout the summer or do not provide suitable substrate and cover vegetation, they would not provide suitable habitat for giant gartersnake.

Assumption

Suitable giant gartersnake upland habitats consist of annual grassland, disturbed, and ruderal land cover types within 200 feet of suitable aquatic habitats (canal, ditch, freshwater marsh, managed wetland, pond, and rice).

Rationale

Upland habitat consists of land that is not typically inundated during the active season for giant gartersnake and is adjacent to aquatic habitat. Characteristics of suitable upland habitat are availability of bankside vegetation, such as cattails (*Typha* sp.) or tules; shelter that is more permanent in nature, such as bankside cracks and crevices; presence of holes or small mammal burrows; and the absence of overgrazing (U.S. Fish and Wildlife Service 2017:I-3). Riparian woodland is generally considered unsuitable habitat because of the lack of basking sites, presence of excessive shade, and lack of prey (U.S. Fish and Wildlife Service 1999:22). The species uses upland habitat for basking, to regulate body temperature, and for cover. Giant gartersnake uses mammal burrows to avoid predation, shed skin, and cool itself during hot days (U.S. Fish and Wildlife Service 2017:I-3). Giant gartersnake has been observed using burrows for refuge in the summer that are up to 164 feet from the marsh edge (U.S. Fish and Wildlife Service 2017:I-3) and U.S. Fish and Wildlife Service (1997:2) has defined upland habitat as adjacent uplands to a width of 200 feet from the edge of the bank. Small mammal burrows and other areas of cover above the flooding zone, such as riprap, are used for overwintering. Overwintering snakes have been documented in burrows as far as 656 to 820 feet from the edge of summer aquatic habitat (U.S. Fish and Wildlife Service 2017:I-3).

10B.9.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the lack of property access to field verify the land cover mapping (e.g., identify areas with suitable upland refugia). For example, basking sites adjacent to escape cover and an absence of large predatory fish are required for habitat to be suitable for giant gartersnake; these characteristics are not visible in aerial imagery. Additionally, refuge habitat such as bankside cracks and crevices, holes, and small mammal burrows are not visible on aerial imagery and are not considered in the model. Because all identified potentially suitable habitats do not have the characteristics required to provide suitable giant gartersnake aquatic and upland habitats, the model likely overestimates the amounts of suitable habitats present.

10B.9.3. References

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10B.10 Habitat Model Information for Northern Harrier

The geographic range of northern harrier (*Circus hudsonius*) in California extends from sea level near the coast to at least 9,000 feet in the Glass Mountain region of Mono County. The species' breeding range includes parts of northwestern and northeastern California, the Central Valley, Central Coast, and the Southern Coast, and its winter range extends into most of the rest of the state (Shuford and Gardali 2008:149–152; Cornell Lab of Ornithology 2019; Zeiner et al. 1990). Generally, the habitat for this species consists of open (treeless) habitats that provide adequate vegetative cover, an abundance of suitable prey, and scattered hunting and lookout perches such as shrubs or fence posts (Shuford and Gardali 2008:152).

10B.10.1. Habitat Model Description

The parameters of the modeled habitat for northern harrier consist of annual grassland, disturbed, ephemeral stream, freshwater marsh, hayfield (includes alfalfa), managed wetland, rice, row crops, ruderal, and seasonal wetland. These land cover types provide nesting and/or foraging habitat because they have suitable vegetative cover for nesting and/or potential habitat for prey species.

The assumption on which the habitat model parameters were based, and rationale for the assumption, are described below.

10B.10.1.1. Assumption

Potentially suitable northern harrier habitat consists of annual grassland, disturbed, ephemeral stream, freshwater marsh, hayfield (includes alfalfa), managed wetland, rice, row crops, ruderal, and seasonal wetland land cover types.

Rationale

Suitable habitat for northern harrier consists of open wetlands (e.g., marshy meadows, lightly grazed pastures, old fields, freshwater and brackish marshes, and tundra) and dry uplands (e.g., upland prairies, mesic grasslands, drained marshlands, croplands, and cold desert shrub-steppe). Populations breed predominantly in dry habitats in the U.S. and the densest populations are typically associated with large tracts of undisturbed habitats with thick ground vegetation (Smith et al. 2020). The Central Valley region supports the majority of breeding northern harriers. In the Central Valley, the species breeds mainly at private or public wetlands or other reserves, as well as in some types of agricultural fields and pasture lands. Northern harrier nests on the ground, mostly within patches of dense, often tall, vegetation in undisturbed areas (Shuford and Gardali 2008:151–152). Northern harrier feeds on a broad variety of small- to medium-sized vertebrates, primarily rodents and passerines, which can be in a variety of natural and managed areas. Wet habitats, including irrigated agriculture, tend to support large numbers of voles, which are key prey for northern harriers in California (Shuford and Gardali 2008:152).

10B.10.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to field verify the land cover mapping (e.g., confirm areas mapped provide suitable nesting habitat). For example, the type of vegetation in potentially suitable nesting habitat is not discernable from aerial imagery and may be a factor in nest site selection; this species prefers dense and often tall ground vegetation for nesting (Shuford and Gardali 2008:152, Cornell Lab of Ornithology 2019).

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10B.11 Habitat Model Information for Burrowing Owl

Burrowing owl (*Athene cunicularia*) is a year-round resident in the Central Valley, San Francisco Bay region, Carrizo Plain, and Imperial Valley. Burrowing owl occurs primarily in grassland habitats but may also be present in landscapes that are highly altered by human activity (Shuford and Gardali 2008:219, 221).

10B.11.1. Habitat Model Description

Annual grassland, hayfields (includes alfalfa), ruderal, disturbed, and developed land cover types are defined as potentially suitable burrowing owl habitat in the model.

The assumption on which the habitat model parameters were based, and rationale for the assumption, are described below.

10B.11.1.1. Assumption

Potentially suitable burrowing owl habitat consists of annual grassland, hayfields (includes alfalfa), ruderal, disturbed, and developed land cover types.

Rationale

Burrowing owl requires habitats that have open, well-drained terrain; short, sparse vegetation generally lacking trees; and underground burrows or burrow-like structures (Coulombe 1971:162; Plumpton and Lutz 1993:175; Klute et al. 2003:12; Shuford and Gardali 2008:221, 222). Burrowing owl typically occurs in dry, open, shortgrass, treeless plains and is often associated with burrowing mammals, primarily California ground squirrel (*Otospermophilus beecheyi*) (Klute et al. 2003:12, Poulin et al. 2020). The species occupies grasslands, deserts, scrublands, agricultural areas (including pastures, untilled margins of croplands, ruderal borders around agricultural fields), earthen levees and berms, and urban vacant lots, as well as margins of airports, golf courses, cemeteries, and roads (Coulombe 1971:162, 163; Shuford and Gardali 2008:222; Poulin et al. 2020). Burrowing owl may inhabit areas adjacent to unimproved and improved roads (Poulin et al. 2020, Brenckle 1936:167). Within the study area, these habitats are represented by the annual grassland, hayfields (includes alfalfa), ruderal, disturbed, and developed land cover types.

10B.11.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to field verify the land cover mapping (e.g., confirm areas mapped provide suitable habitat characteristics such as short grasses). The model does not consider the presence or absence of burrows or burrowing mammals. In California, burrowing owl depends on burrowing mammals to dig burrows for nesting and subterranean refuge; the presence of California ground squirrel is usually a key indicator of potential occurrence of burrowing owl (Shuford and Gardali 2008:221). Burrowing owl inhabits areas with a high density of small burrowing mammals (Poulin et al. 2020, Plumpton and Lutz 1993:177, 178). Burrow entrance size appears to be important for nest site selection, as well as the presence of high perches (Poulin et al. 2020). Presence of burrows, burrowing mammals, perching sites, and other microhabitat features that influence habitat suitability cannot be discerned from aerial imagery. Therefore, the model may overestimate the extent and distribution of potentially suitable habitat.

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10B.12 Habitat Model Information for Golden Eagle

Golden eagle (*Aquila chrysaetos*) is a year-round resident throughout much of California. The species does not breed in the center of the Central Valley but breeds in much of the rest of the state. Golden eagle generally inhabits rolling foothills, mountainous terrain, sage-juniper flats, and deserts throughout the state (Zeiner et al. 1990:142–143).

10B.12.1. Habitat Model Description

The parameters of the modeled nesting habitat for golden eagle consist of blue oak woodland, foothill pine, and oak savanna land cover types. Modeled foraging habitat consists of annual grassland, oak savanna, chamise chaparral, and mixed chaparral land cover types. The oak savanna land cover type is considered nesting and foraging habitat because it provides trees suitable for nesting and grassland for foraging.

10B.12.1.1. Assumptions and Rationales

The assumptions on which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption

Potentially suitable golden eagle nesting habitat consists of blue oak woodland, foothill pine, and oak savanna land cover types.

Rationale

Golden eagle inhabits nearly all terrestrial habitats of the western United States, except densely forested, densely populated, and agricultural areas (Katzner et al. 2020). Open areas that provide foraging habitat with ample prey, are near cliffs or trees that supply nesting sites, and have topography that creates updrafts essential for flight are preferred (Katzner et al. 2020). In the interior central Coast Ranges of California, golden eagle favors open and semi-open grasslands and oak savanna, with fewer individuals inhabiting oak woodland and open shrublands (Katzner et al. 2020, Hunt et al. 1999:4). Secluded, protected cliffs with overhanging ledges are usually preferred for nesting but large trees are also used for nesting and cover (Driscoll 2010:1, Hunt et al. 1999:4). Golden eagles have also been documented nesting in trees near forest edges and in small stands near open fields or clearcuts (Bruce et al. 1982:133). Trees used by golden eagles for nesting include several species of oak (*Quercus* spp.), foothill pine (*Pinus sabiniana*), coulter pine (*Pinus coulteri*), California bay (*Umbellularia californica*), eucalyptus (*Eucalyptus* spp.), Fremont's cottonwood (*Populus fremontii*), and California sycamore (*Platanus racemosa*) (Katzner et al. 2020, Hunt et al. 1999:4). Nests tend to be constructed in large, live trees, but eagles may continue to use a nest built in a tree that died after nest construction or they may occasionally build nests in dead trees (Katzner et al. 2020). Open grasslands are generally unsuitable for nesting due to lack of suitable nest structures; however, golden eagles have been documented nesting on electrical transmission towers traversing grasslands (Hunt et al. 1999:4).

Assumption

Potentially suitable golden eagle foraging habitat consists of annual grassland, oak savanna, chamise chaparral, and mixed chaparral land cover types.

Rationale

Grasslands, deserts, savannas, and early successional stages of forest and shrub habitats provide open foraging terrain for golden eagles (Zeiner et al. 1990:142). Golden eagle preys on a variety of animal species, with mammals making up 80–90% of its diet (Driscoll 2010:2). The diet of golden eagle consists mostly of rabbits, hares, and ground squirrels, but the species will also eat larger mammals (e.g., black-tailed deer [*Odocoileus* sp.], small livestock), gallinaceous birds, reptiles, and carrion (Katzner et al. 2020, Driscoll 2010:2, Zeiner et al. 1990:142, Hunt et al. 1999:4). Golden eagles are most likely to occur where there are dense populations of small mammal prey species (Katzner et al. 2020); small mammals are associated with annual grassland, chamise chaparral, mixed chaparral, and open woodland land cover types.

10B.12.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to field verify the land cover mapping (e.g., confirm that areas mapped provide suitable nesting and foraging habitats). Prey base abundance is not discernable from aerial imagery and it is a key element of suitable golden eagle habitat (Driscoll 2010:2). Golden eagle may nest on marginal substrate or tolerate higher levels of human activity in areas with abundant and available prey; similarly, a lack of available prey can adversely affect the species' reproductive success (Driscoll 2010:2). Golden eagle nests are frequently in areas that have a wide view of the surrounding landscape, provide updrafts and thermals for soaring and hunting, and are isolated from human disturbance and mammalian predators (Katzner et al. 2020; Driscoll 2010:1–3). Golden eagles at higher latitudes commonly have south-facing nest site locations, while golden eagles at lower latitudes tend to have north-facing nest site locations (Katzner et al. 2020). Tree height, exposure, distance to foraging habitat, presence of small mammals, and other conditions that influence nesting and foraging habitat suitability cannot be determined from aerial imagery review and the amount of suitable habitat is likely more limited than what is included in the model.

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10B.13 Habitat Model Information for Bald Eagle

Bald eagle (*Haliaeetus leucocephalus*) is a permanent resident and uncommon winter migrant in California (California Department of Fish and Game 1999). Bald eagle breeding habitat consists of forested areas next to large water bodies. Wintering bald eagles are associated with aquatic areas containing some open water for foraging (Buehler 2020).

10B.13.1. Habitat Model Description

The parameters of the modeled habitat for bald eagle consist of blue oak woodland, foothill pine, forested wetland, perennial stream, reservoir, and upland riparian[4] land cover types.

The assumption on which the habitat model parameters were based, and rationale for the assumption, are described below.

10B.13.1.1. Assumption

Potentially suitable bald eagle habitat (nesting, roosting, and foraging) consists of blue oak woodland, foothill pine, forested wetland, perennial stream, reservoir, and upland riparian land cover types.

Rationale

Bald eagle nesting, roosting, and foraging habitats are close to substantial bodies of water (e.g., rivers, lakes, and reservoirs) because fish constitute a large proportion of the species' diet. Bald eagle typically builds stick nests in large trees in mature and old-growth forests that are adjacent to large bodies of water or other suitable foraging habitat. Bald eagle will occasionally nest in riparian habitats, where nests are often in black cottonwoods (*Populus trichocarpa*) (Anthony et al. 1982:333). Forest tracts with bald eagle nests have relatively open canopies, some form of habitat discontinuity or edge, or high level of foliage-height diversity (i.e., the distribution of canopy cover among forest layers) (Buehler 2020). In California, ponderosa pine (*Pinus ponderosa*) and sugar pine (*Pinus lambertiana*) are the most frequently used tree species for nesting, and 87% of bald eagle nest sites are within 1 mile of water (Lehman 1979:13, Anthony et al. 1982:333). Where no large conifers are present, bald eagle will nest in deciduous trees such as oaks (*Quercus* spp.) and cottonwoods (*Populus* spp.) (Buehler 2020).

Bald eagle selects large, super-canopy roost trees that are open and accessible. Most roost trees in western North America are conifers, except in some riparian zones (Buehler 2020). Roost sites, like nest sites, are associated with aquatic foraging areas, but roost sites are farther from water than nest sites (Buehler 2020). Actual distances of nest and roost sites to water varies within and among bald eagle populations, and the distance to water is sometimes less critical for site selection than the quality of the foraging habitat present (Buehler 2020).

[4] The upland riparian land cover type consists of non-wetland riparian areas (i.e., located adjacent to streams but above the ordinary high-water mark) that include valley foothill riparian species, as well as blue oak (*Quercus douglasii*), foothill pine (*Pinus sabiniana*), ornamental trees, and other shrubs and trees that were not identifiable from aerial imagery interpretation.

Bald eagle is an opportunistic forager that takes live prey and scavenges carrion. Bald eagles hunt for live fish in shallow water but more frequently scavenge dead or dying fish. Bald eagle also eats other aquatic and terrestrial animals including waterfowl, muskrats (*Ondatra zibethicus*), raccoons (*Procyon lotor*), and small mammals (Buehler 2020; Jackman et al. 1999:87, 90–92; California Department of Fish and Game 1999). In flooded fields, bald eagle occasionally feed on displaced voles or other small mammals (California Department of Fish and Game 1999). Favored foraging habitat usually includes water that is less than 1,600 feet from suitable perching trees, although bald eagles also forage in habitat that provides ample opportunities for scavenging carrion (Buehler 2020).

10B.13.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to field verify the land cover mapping (e.g., confirm that areas mapped provide suitable nesting and foraging habitats). For example, the abundance and diversity of the prey base and foliage-height diversity are important characteristics of suitable bald eagle nesting habitat (Buehler 2020) that are not discernable from aerial imagery. Additionally, the model does not consider proximity to human development and disturbance, which are factors in bald eagle habitat suitability. Studies show that bald eagle nests are farther from the shoreline in areas with considerable development or human activity than nest sites in less developed areas (Buehler 2020). The minimum distance from a nest site to human development in some populations is less than 328 feet; the average distance in most bald eagle populations is greater than 1,640 feet, which may reflect habitat selection away from development and human disturbance (Buehler 2020). Because bald eagles build large nests, nest trees must have accessible limbs capable of holding a heavy nest, be sufficiently tall (mean tree height of 131.1 feet), have substantial girth (i.e., 25 to 82 inches in diameter at 4.5 feet above the ground), and have intact, live overhead foliage (Lehman 1979:8–12). The required nest tree features are not visible on aerial imagery and the amount of suitable habitat is likely more limited than what is included in the model. Therefore, the model may overestimate the extent and distribution of potentially suitable bald eagle habitat.

10B.13.3. References

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10B.14 Habitat Model Information for Swainson's Hawk and White-tailed Kite

Throughout much of its range, Swainson's hawk (*Buteo swainsoni*) inhabits grasslands, prairies, shrub-steppes, and agricultural landscapes, including dry and irrigated row crops, alfalfa and hay fields, pastures, and rangelands. The species most often nests in trees in riparian woodlands and farm shelterbelts (Bechard et al. 2020:3).

White-tailed kite (*Elanus leucurus*) inhabits low elevation grasslands, agricultural, wetland, oak-woodland, and savanna habitats (Dunk 2020). Riparian areas adjacent to open areas are also used. White-tailed kites generally nest on habitat edges and with no apparent affinity to nest tree species, although tree structure is an important determination of use (Dunk 2020). Grasslands, low shrubs, open woodlands, and cultivated areas are favored for foraging (Dunk 2020).

10B.14.1. Habitat Model Description

The parameters of the modeled nesting habitat for Swainson's hawk and white-tailed kite consist of blue oak woodland, forested wetland, oak savanna, ornamental woodland, and upland riparian[5] land cover types. Isolated tree stands and solitary trees in agricultural fields or field borders or semi-developed areas were mapped as oak savanna or ornamental woodland and were included as potential nesting habitat, to the extent that they were mapped. Modeled foraging habitat consists of annual grassland, hay field (includes alfalfa), managed wetland, oak savanna, row crops, ruderal, and seasonal wetland. The oak savanna land cover type is considered nesting and foraging habitat because it provides trees suitable for nesting and grassland for foraging.

10B.14.1.1. Assumptions and Rationales

The assumptions on which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption

Potentially suitable Swainson's hawk and white-tailed kite nesting habitat consists of blue oak woodland, forested wetland, oak savanna, ornamental woodland, and upland riparian land cover types.

Rationale

In the Central Valley, Swainson's hawk frequently nest in large native trees such as valley oak (*Quercus lobata*), Fremont's cottonwood (*Populus fremontii*), walnut (*Juglans hindsii*), and willow (*Salix* sp.), and occasionally in nonnative trees such as eucalyptus (*Eucalyptus* sp.); however, any suitable tree may be used (Estep 1989:35; England et al. 1995:181–184; Bechard et al. 2020:4). Strips of remnant riparian forest along drainages contain most of the known nests in the Central Valley, which may be a function of nest tree availability (Estep 1984:3, 16; Schlorff

[5] The upland riparian land cover type consists of non-wetland riparian areas (i.e., located adjacent to streams but above the ordinary high-water mark) that include valley foothill riparian species, as well as blue oak (*Quercus douglasii*), foothill pine (*Pinus sabiniana*), ornamental trees, and other shrubs and trees that were not identifiable from aerial imagery interpretation.

and Bloom 1984:615–617; Bechard et al. 2020:3). Swainson's hawk nest sites have also been found on the peripheries of riparian and remnant oak woodlands, in urban/suburban areas with large trees adjacent to suitable foraging habitat (England et al. 1995:180–183; James 1992:773) and in roadside trees, trees along agricultural field borders, isolated trees, and small groves (California Department of Fish and Wildlife 2016:6; Anderson et al. 2007:3, 5; Woodbridge 1998:5).

White-tailed kite nests in trees or shrubs in open grassland, agricultural, wetland, oak woodland, and savanna habitats (Dunk 2020). White-tailed kites prefer areas of natural vegetation (Erichsen et al. 1996:165). Habitat elements that influence nest site selection and nesting distribution include habitat structure (usually trees with a dense canopy) and prey abundance and availability (primarily the association with California vole [*Microtus californicus*]), while the association with specific vegetation types (e.g., riparian, oak woodland, etc.) appears less important (Erichsen et al. 1996:165, 173; Dunk 2020). White-tailed kite nests have been documented in a variety of tree species, including oak (*Quercus* spp.), Fremont's cottonwood, willow, eucalyptus, box elder (*Acer negundo*), coast redwood (*Sequoia sempervirens*), ornamental trees including olive (*Olea* sp.) and pine (*Pinus* sp.) trees, and in shrubs less than 10 feet tall (e.g., *Atriplex and Baccharis*) (Dixon et al. 1957:159; Erichsen et al. 1996:172; Dunk 2020). Nest trees appear to be selected based on structure and security, and thus typically have a dense canopy or are within a dense group of trees or large stands (more than 250 acres), such as riparian forest or oak woodland. White-tailed kites also nest in single isolated trees and communally roost in small stands of trees (Dunk 2020).

Assumption

Potentially suitable Swainson's hawk and white-tailed kite foraging habitat consists of annual grassland, hay field, managed wetland, oak savanna, row crops, ruderal, and seasonal wetland.

Rationale

Swainson's hawks are essentially plains or open-country hunters, requiring large areas of open landscape for foraging. Historically, the species used the grasslands and relatively sparse shrublands of the Central Valley and other inland valleys, and valley oak savanna (California Department of Fish and Wildlife 2016:5). Swainson's hawk also forages in wetlands during the dry summer months when the vegetation in the wetlands is being mowed or disked (California Department of Fish and Wildlife 2016:5). When inundated (e.g., during wetter winter months), these wetlands are relatively unavailable for foraging (California Department of Fish and Wildlife 2016:7). With substantial conversion of natural foraging habitats to farming operations, Swainson's hawks have had to rely more heavily on agricultural lands for foraging. In the Central Valley, Swainson's hawks forage more often in mixed agricultural lands that provide low, open vegetation for hunting and relatively abundant rodent prey populations (California Department of Fish and Wildlife 2016:7). Important land cover types for foraging are alfalfa and other irrigated hay crops, grain and row crops, fallow fields, dryland pasture, grassy ruderal lots, and annual grasslands (Swolgaard et al. 2008:192, 194; California Department of Fish and Wildlife 2016:7).

White-tailed kite uses a variety of foraging land cover types, but those that support abundant rodent populations (e.g., California vole) are more suitable. The foraging success of white-tailed kite is directly proportional to the abundance and composition of prey species (Erichsen et al. 1996:173), with rodents being the main prey item (Dunk 2020; Mendelsohn and Jaksic 1989:8). Preferred foraging habitats are ungrazed grasslands, open woodlands, low shrubs, wetlands dominated by grasses, and fence rows and irrigation ditches with residual vegetation adjacent to grazed lands (Mendelsohn and Jaksic 1989:2, 8; Dunk 2020). Within cultivated areas, alfalfa and sugar beet fields are preferred, as well as rice stubble fields in the spring (Erichsen et al. 1994:46; Erichsen et al. 1996:170). Breeding male white-tailed kites, which feed the females during egg incubation, generally do not hunt more than 0.6 mile from nests and frequently use hunting areas immediately adjacent (less than 0.3 mile) to approximately 1 mile from the nest (Erichsen et al. 1996:168).

10B.14.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to field verify the land cover mapping (e.g., confirm that areas mapped provide suitable nesting and foraging habitats). For example, the field-level value of the agricultural crop types can change across the landscape as agricultural land use (e.g., land and farming patterns, agricultural practices, and harvesting regimes) and farming operations (e.g., weekly irrigation and monthly mowing during the growing season) are seasonally rotated, thus there is a high degree of variability in the suitability of these agricultural lands. In the Central Valley, specific crop structure and timing of agricultural practices are important in determining the foraging value of a field at any given time (California Department of Fish and Wildlife 2016:7); however, the model does not factor in changes in crop cultivation over time.

The heights of potentially suitable nest trees are also not discernable from aerial imagery and may be an important factor in nest site selection for Swainson's hawk; studies show the average height of nest trees range from 41.3 feet to 82 feet (California Department of Fish and Wildlife 2016:6). For white-tailed kite, tree structure appears to be an important factor in nest tree selection (Dunk 2020) but is also imperceptible on aerial imagery. To the extent possible, isolated trees and small tree stands adjacent to agricultural fields were mapped as ornamental woodland, and individual or small stands of oak trees were mapped as oak savanna; however, not all individual trees in developed areas were mapped, and the model may underestimate the extent and distribution of potentially suitable nesting habitat in ornamental woodland, oak savanna, developed land cover types. Overall, the model likely overestimates the amount of potentially suitable nesting habitat because not all trees within blue oak woodland, forested wetland, oak savanna, ornamental woodland, and upland riparian land cover types provide trees suitable for Swainson's hawk or white-tailed kite nesting.

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10B.15 Habitat Model Information for Western Yellow-billed Cuckoo

The breeding range of western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) in California is restricted to isolated locations along the South Fork Kern River, lower Colorado River, the Sacramento River, and some tributaries (Hughes 2020; Halterman et al. 2015:1). Western yellow billed cuckoo primarily breeds in large tracts of dense riparian woodlands along low-gradient streams (U.S. Fish and Wildlife Service 2019:5).

10B.15.1. Habitat Model Description

Forested wetland, scrub-shrub wetland, and upland riparian[6] land cover types are defined as potential western yellow-billed cuckoo habitat in the model. The modeled habitat for western yellow-billed cuckoo is based on information from Dettling et al. (2015). Dettling et al. (2015) evaluated the status of the western yellow-billed cuckoo along the mainstems of the Sacramento and Feather Rivers and quantified the amounts and distribution of potential habitat. To define potential western yellow-billed cuckoo habitat, Dettling et al. (2015:4) used the Central Valley Riparian Mapping Project vegetation layer to identify and map all riparian vegetation within 1.24 miles of the Sacramento and Feather Rivers. The vegetation classifications that Dettling et al. (2015:4) used to represent potential western yellow-billed cuckoo habitat were “Riparian Evergreen and Deciduous Woodland” and “Southwestern North American Riparian Wash/Scrub.”

Based on Dettling et al. (2015:4), potential western yellow-billed cuckoo habitat was defined in the model as riparian land cover types with a minimum patch size of 37 acres, a minimum patch width of 328 feet, and a maximum canopy gap width of 328 feet. The modeled habitat also includes riparian land cover types (i.e., forested wetland, scrub-shrub wetland, and, upland riparian) that may have changed since 2015 and any riparian land cover type that is a minimum of 37 acres that may have not been previously mapped based on a review of recent aerial imagery.

10B.15.1.1. Assumptions and Rationales

The assumptions on which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption

Dettling et al. (2015) is the best available information on the extent and distribution of potential western yellow-billed cuckoo habitat along the Sacramento River. However, as noted above, review of recent aerial imagery was used to identify additional potentially suitable western yellow-billed cuckoo in the model.

[6] The upland riparian land cover type consists of non-wetland riparian areas (i.e., located adjacent to streams but above the ordinary high-water mark) that include valley foothill riparian species, as well as blue oak (*Quercus douglasii*), foothill pine (*Pinus sabiniana*), ornamental trees, and other shrubs and trees that were not identifiable from aerial imagery interpretation.

Rationale

As discussed above, Dettling et al. (2015) evaluated and quantified the amounts and distribution of potential western yellow-billed cuckoo habitat along the Sacramento and Feather Rivers. In addition, Point Blue Conservation Science conducted extensive playback surveys for the western yellow-billed cuckoo along subsamples of the potential habitat identified along the Sacramento and Feather Rivers in 2012 and 2013 (Dettling et al. 2015:5–6). Dettling et al. (2015:7) identified 84 potential habitat patches along the Sacramento River, which had an average area of 239.7 acres (range of 37–1,371 acres). The total area of potential western yellow-billed cuckoo habitat along the Sacramento River was 21,000 acres (Dettling et al. 2015:1, 7). Dettling et al. (2015) is the most recent study that quantifies and maps potential western yellow-billed cuckoo habitat along the Sacramento River in the study area.

Assumption

Potentially suitable western yellow-billed cuckoo breeding and foraging habitat consists of forested wetland, scrub-shrub wetland, and upland riparian.

Rationale

Breeding western yellow-billed cuckoos are riparian obligates and nest almost exclusively in riparian woodland with native broadleaf trees and shrubs (Halterman et al. 2015:3). Suitable habitat has a tree or large-shrub component with a variable overstory canopy and an understory component (U.S. Fish and Wildlife Service 2019:5, 6). The overstory of the riparian habitat typically includes cottonwood (*Populus* sp.) and willow (*Salix* sp.) trees (U.S. Fish and Wildlife Service 2019:6). Nest sites are often in dense foliage, and nests are primarily in willow, Fremont's cottonwood (*Populus fremontii*), and mesquite (*Prosopis* sp.). Along the Sacramento River, nests have rarely been found in prune (*Prunus* sp.), English walnut (*Juglans regia*), and almond (*Prunus dulcis*) orchards (Laymon 1998:4). Cottonwoods are used extensively for foraging and are an important component of foraging habitat (78 Federal Register [FR] 61634).

Assumption

Potentially suitable western yellow-billed cuckoo habitat consists of forested wetland, scrub-shrub wetland, and upland riparian that are a minimum of 37 acres in size and have a minimum patch width of 328 feet and a maximum canopy gap width of 328 feet.

Rationale

The minimum acreage threshold is based on the western yellow-billed cuckoos' requirement of large blocks of riparian habitat for breeding (78 FR 61633) and published research that previously modeled cuckoo habitat.

Gaines (1974:204, 208–209) determined the parameters of western yellow-billed cuckoo habitat along the Sacramento River through surveys, which consisted of a minimum patch size of 25 acres, minimum patch width of 330 feet, minimum patch length of 990 feet, occurrence within 330 feet of surface water, and vegetation dominated by cottonwood willow forest and thickets. Riparian Habitat Joint Venture (2004:57) found western yellow-billed cuckoo occupancy typically required large patch sizes (50–100 acres with a minimum width of 328 feet). Girvetz and Greco (2009:5, 7, 9, 11) used a minimum patch size of 12.36 acres, a minimum patch width of 328 feet, and a maximum canopy gap width of 328 feet to define western yellow-billed cuckoo habitat and found that the patch size of cottonwood forest was the most important habitat variable to predict presence of western yellow-billed cuckoo on the Sacramento River. Dettling et al. (2015:9) used a minimum patch size of 37 acres to reflect information on the home range size of western yellow-billed cuckoo.

10B.15.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the lack of property access to field verify the land cover mapping (e.g., identify areas with suitable nesting substrate). For example, it is not possible to use aerial imagery to determine if dense scrubby vegetation is present below overstory vegetation, the canopy and understory height, or the dominant plant species in the canopy and understory. The composition of the woody (i.e., trees and shrubs) vegetation at a site has been shown to affect western yellow-billed cuckoo occupancy rates and is influenced by the percentages of native and nonnative plant cover (Halterman et al. 2015:5). Suitable nesting habitat is structurally complex with overstory of trees and tall shrubs, sub-canopy layers, and an understory of various tree and shrub species (U.S. Fish and Wildlife Service 2019:6; Halterman et al. 2015:5), which cannot be ascertained through aerial imagery review. Due to the limitations of aerial imagery interpretation, the vegetative composition of the riparian land cover types cannot be determined. Additionally, other potentially important aspects of western yellow-billed cuckoo habitat including food availability (Dettling et al. 2014:19), presence of predators, stream hydrology, and environmental factors (e.g., site temperature, amount of shade, and humidity) (Halterman et al. 2015:5, 78 FR 61648) cannot be incorporated into the model.

10B.15.3. References

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10B.16 Habitat Model Information for Bank Swallow

The geographic range for bank swallow (*Riparia riparia*) in California includes breeding in portions of the northern and central regions of the state where appropriate habitat exists. There are scattered colonies throughout northern California, but an estimated 70 to 90% of the breeding population is along the Sacramento River and its tributaries. This species overwinters in Central and South America (Bank Swallow Technical Advisory Committee 2013:9–10) and breeds in California between approximately March and September (California Department of Fish and Game 1999). Habitat for bank swallow typically consists of riparian, lake, and coastal areas with vertical banks, bluffs, and cliffs composed of fine-textured or sandy soils (California Department of Fish and Game 1999).

10B.16.1. Habitat Model Description

Potentially suitable bank swallow nesting habitat consists of portions of the Sacramento River with eroded, vertical banks. A model for bank swallow nesting habitat was not created because all potentially suitable nesting habitat is in the operations study area (defined in Chapter 10) along the Sacramento River. Modeled foraging habitat consists of annual grassland, blue oak woodland, barren, chamise chaparral, ephemeral stream, forested wetland, foothill pine, freshwater marsh, intermittent stream, mixed chaparral, oak savanna, perennial stream, pond, reservoir, scrub-shrub wetland, seasonal wetland, upland riparian[7], canal, disturbed, ditch, hayfield, managed wetland, orchard, ornamental woodland, reservoir, rice, row crops, ruderal, and vineyard land cover types.

10B.16.1.1. Assumptions and Rationales

The assumptions on which the habitat description and habitat model parameters were based, and rationale for each assumption, are described below.

Assumption

Potentially suitable bank swallow nesting habitat consists of portions of the Sacramento River with eroded, vertical banks.

Rationale

Bank swallows typically establish colonies along eroded, vertical banks in river systems with friable alluvial soils. Nesting colonies are infrequently found in artificial sites, including sand quarries and road cuts (Bank Swallow Technical Advisory Committee 2013:12–13). Nesting sites are almost always near water (California Department of Fish and Game 1999). In addition, riparian overbank vegetation appears to be an important habitat feature for bank swallow nesting, foraging, or both on the Sacramento River; a 10-year survey indicated that colonies were more strongly associated with native herbaceous/scrub and riparian forest habitat types than with orchards (Garcia 2009:53, 55; Bank Swallow Technical Advisory Committee 2013:13). Nesting

[7] The upland riparian land cover type consists of non-wetland riparian areas (i.e., located adjacent to streams but above the ordinary high-water mark) that include valley foothill riparian species, as well as blue oak (*Quercus douglasii*), foothill pine (*Pinus sabiniana*), ornamental trees, and other shrubs and trees that were not identifiable from aerial imagery interpretation.

site selection is also based on attributes such as soil moisture, soil texture, orientation of the bank face, verticality of the bank face, and proximity to foraging areas (California Department of Fish and Game 1995:11).

Assumption

Potentially suitable bank swallow foraging habitat consists of annual grassland, blue oak woodland, barren, chamise chaparral, ephemeral stream, forested wetland, foothill pine, freshwater marsh, intermittent stream, mixed chaparral, oak savanna, perennial stream, pond, reservoir, scrub-shrub wetland, seasonal wetland, upland riparian,[8] canal, disturbed, ditch, hayfield, managed wetland, orchard, ornamental woodland, reservoir, rice, row crops, ruderal, and vineyard.

Rationale

Foraging habitat for bank swallow includes wetlands, open water, grasslands, riparian woodland, orchards, agricultural fields, shrub lands, and upland woodlands (Bank Swallow Technical Advisory Committee 2013:14, California Department of Fish and Game 1999). Bank swallows typically forage in flight on a wide variety of aerial and terrestrial soft-bodied insects including flies, bees, and beetles (Bank Swallow Technical Advisory Committee 2013:14, California Department of Fish and Game 1999), which may be found in the modeled land cover types.

10B.16.2. Habitat Model Limitations

The amount of foraging habitat that would be used by bank swallow is likely overestimated in the model. While bank swallows may forage up to 6 miles from nest sites, this species typically forages within approximately 650 feet of nest sites (Garrison 1998:4).

10B.16.3. References

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[8] The upland riparian land cover type consists of non-wetland riparian areas (i.e., located adjacent to streams but above the ordinary high-water mark) that include valley foothill riparian species, as well as blue oak (*Quercus douglasii*), foothill pine (*Pinus sabiniana*), ornamental trees, and other shrubs and trees that were not identifiable from aerial imagery interpretation.

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10B.17 Habitat Model Information for Yellow-breasted Chat and Yellow Warbler

Yellow-breasted chat (*Icteria virens*) is an uncommon summer resident and migrant in coastal California and the foothills of the Sierra Nevada and is found up to an elevation of 4,800 feet in valley foothill riparian habitats (California Department of Fish and Game 2005a).

Yellow warbler (*Setophaga petechia*) is primarily a migrant and summer resident in California (Shuford and Gardali 2008:333). The breeding range of yellow warbler in California consists of the Coast Range in Del Norte County, east to the Modoc Plateau, south along the Coast Range to Santa Barbara and Ventura Counties and along the western slope of the Sierra Nevada south to Kern County. The breeding range also includes the eastern side of California from the Lake Tahoe area south through Inyo County, several southern California mountain ranges, and most of San Diego County (California Department of Fish and Game 2005b).

10B.17.1. Habitat Model Description

The parameters of the modeled yellow-breasted chat and yellow warbler habitat consist of forested wetland, scrub-shrub wetland, and upland riparian[9] land cover types.

The assumption on which the habitat model parameters were based, and rationale for the assumption, are described below.

10B.17.1.1. Assumption

Potentially suitable yellow-breasted chat and yellow warbler habitat consists of forested wetland, scrub-shrub wetland, and upland riparian land cover types.

Rationale

Yellow-breasted chat is found in low, dense vegetation without a closed tree canopy, including shrubby habitat along streams and swamps, pond margins, forest edges, regenerating burned-over forests, logged areas, fencerows, and upland thickets of recently abandoned farmland (Eckerle and Thompson 2020:2). The species is occasionally found in areas of open grass if dense shrubs are nearby (Johnston and Odum 1956:54). In northern and central California, yellow-breasted chats use riparian woodland or riparian shrub thickets with dense vegetation typically composed of Himalayan blackberry (*Rubus armeniacus*), wild grape (*Vitis* spp.), and willows (*Salix* spp.) (Shuford and Gardali 2008:355, Grinnell and Miller 1944:416). Tall willows, cottonwoods (*Populus* spp.), and sycamores (*Platanus* spp.) are often used for singing perches (Grinnell and Miller 1944:416). Nests are built in dense shrubs along streams and rivers (California Department of Fish and Game 2005a).

[9] The upland riparian land cover type consists of non-wetland riparian areas (i.e., located adjacent to streams but above the ordinary high-water mark) that include valley foothill riparian species, as well as blue oak (*Quercus douglasii*), foothill pine (*Pinus sabiniana*), ornamental trees, and other shrubs and trees that were not identifiable from aerial imagery interpretation.

Yellow-breasted chat is known to forage in the foliage of low, dense shrubs; thickets; and short trees (Eckerle and Thompson 2020:14, California Department of Fish and Game 2005a). The species may also forage on the ground (Eckerle and Thompson 2020:8). Adults feed on insects, spiders, and wild fruit; soft-bodied insects are fed to nestlings (Shuford and Gardali 2008:355). Melhop and Lynch (1986:225) observed that yellow-breasted chat forages in areas of early stages of succession, as opposed to young and mature forests. Kroodsma (1982:84,85) reported that yellow-breasted chats prefer patches of dense blackberry vines (*Rubus* spp.) and avoid areas with high percentage of grass cover.

Yellow warbler generally inhabits riparian vegetation near water along streams and wet meadows. The species is often found in willows and cottonwoods, and also occupies various other riparian shrubs and trees. As a migrant, yellow warbler is found in scrub-shrub and semi-open, second-growth forest habitats that are often associated with wetlands (Lowther et al. 2020). This species is known to forage for insects over trees and shrubs (California Department of Fish and Game 2005b) and has been observed within herbaceous vegetation in wetland areas (Mayta pers. comm.). The diet of yellow warbler in California consists mostly of insects, including ants, bees, wasps, caterpillars, beetles, true bugs, and flies; spiders; and a small amount of plant matter (California Department of Fish and Game 2005b, Shuford and Gardali 2008:336).

10B.17.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to field verify the land cover mapping (e.g., confirm areas mapped provide suitable nesting and foraging habitats). For example, while aerial interpretation can be used to generally determine the overstory canopy of riparian habitat, it is not possible to characterize the understory vegetation of riparian habitat, which is important in nest site selection and overall site occupancy by yellow-breasted chat. Nesting yellow-breasted chats occupy early successional riparian habitats with well-developed shrub layers, and vegetation structure appears to be an important factor in nest site selection (Shuford and Gardali 2008:355). Additionally, yellow-breasted chat population density is higher in vegetation stands that have open canopies and dense understories. Yellow-breasted chat population density was positively correlated with shrub density to a height of 14.8 feet, above which population density declined (Crawford et al. 1981:685, 690). Thus, without being able to assess the vegetation structure of the understory, the model likely overestimates the amount of potentially suitable yellow-breasted chat habitat.

Similarly, the type of vegetation in potentially suitable yellow warbler nesting habitat is not discernable from aerial imagery and may be a factor in nest site selection; presence of willows and Oregon ash (*Fraxinus latifolia*) are thought to be important predictors of yellow warbler abundance (Shuford and Gardali 2008:335). Therefore, without being able to assess the vegetation structure of the understory, the model may overestimate the amount of potentially suitable yellow warbler habitat.

10B.17.3. References

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10B.17.4. Personal Communications

Mayta, Sheri. Senior Biologist. GPA Consulting, Ventura, California. March 5, 2021 — Telephone call with Marieka Schrader, Senior Biologist, ICF, Sacramento, California.

10B.18 Habitat Model Information for Tricolored Blackbird

Tricolored blackbird (*Agelaius tricolor*) is a highly colonial species that is largely endemic to California. Colonies require access to water and suitable nesting substrates (including flooded, thorny, or spiny vegetation) surrounded by foraging habitat (e.g., semi-natural grasslands agricultural croplands, alkali scrub habitats) with significant populations of insect prey within a few miles of colonies (Beedy et al. 2020:1; Hamilton 2004:3).

10B.18.1. Habitat Model Description

Freshwater marsh and managed wetland land cover types are defined as potential tricolored blackbird nesting habitat in the model. Annual grassland, seasonal wetland, row crops, and rice are defined as potential foraging habitat in the model. Additionally, ruderal land cover that is adjacent to another defined foraging habitat land cover type is also included as foraging habitat; ruderal land cover that is not adjacent to foraging habitat is not considered to be potential foraging habitat. Only foraging habitat land cover types within 3 miles of potential nesting habitat are included in the model.

10B.18.1.1. Assumptions and Rationales

The assumptions on which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption

Potentially suitable tricolored blackbird nesting habitats consist of freshwater marsh and managed wetland land cover types.

Rationale

Historically (in the 1930s), the majority of tricolored blackbird breeding colonies in the Sacramento Valley were in freshwater marshes dominated by nesting substrate (e.g., cattail [*Typha* sp.], bulrush [*Schoenoplectus* sp.]) that was flooded (Neff 1937:78, Beedy et al. 2020:1). By the 1970s, approximately half of the colonies reported in the Sacramento and San Joaquin Valleys were in wetland vegetation (DeHaven et al. 1975:171, 172). Although the primary nesting substrates used by tricolored blackbird have different distributions across the breeding range in California (Cook and Toft 2005:80), wetlands with cattail and bulrush substrates are used throughout the breeding range (Graves et al. 2013:2850, 2852) and nesting continues to occur in wetlands (Beedy et al. 2020:1).

Assumption

Potentially suitable tricolored blackbird foraging habitats consist of annual grassland, seasonal wetland, row crops, and rice. Ruderal land cover that is adjacent to other potential foraging habitat land cover types is also included as foraging habitat in the model. Ruderal land cover that is not adjacent to other defined foraging land cover is not considered suitable foraging habitat.

Rationale

Tricolored blackbird forages in a wide variety of habitats that may provide sources of seeds and invertebrates (Beedy et al. 2020:1). Historically, native foraging habitats that supported abundant insect prey items and vegetative diet items (e.g., seeds) were grasslands, shrublands, wetlands, riparian, scrub, and other forested habitats (U.S. Fish and Wildlife Service 2019:13). With the loss of the majority of wetlands and perennial grassland, the tricolored blackbird has shifted to utilizing agricultural-associated habitats and other nonnative vegetation to replace or supplement their foraging needs (U.S. Fish and Wildlife Service 2019:14–16). Primary foraging habitats for breeding tricolored blackbirds now consist of grasslands, low-density shrublands (e.g., alkali scrub), pastures, dry seasonal pools, and certain agricultural crops such as alfalfa and rice (California Department of Fish and Wildlife 2018:28).

For a breeding colony to be successful, adults require abundant insect prey items for egg production and to feed nestlings (California Department of Fish and Wildlife 2018:28–30). Within the study area, the availability of insect prey in isolated patches of ruderal vegetation is likely low; ruderal vegetation that is not adjacent to other foraging land cover types would not likely contain enough prey to support breeding colonies. Vineyards, orchards, cultivated row crops (e.g., sugar beets, corn, peas, beets, and onions), and conventional rice paddies provide limited or no suitable foraging habitat for tricolored blackbird but organic and unsprayed (by insecticides) rice paddies may provide abundant insect populations that breeding colonies need (Beedy et al. 2020:1).

Assumption

Potentially suitable foraging habitat is limited to annual grassland, seasonal wetland, row crops, and rice (and ruderal land cover adjacent to these land cover types) within 3 miles of nesting habitat.

Rationale

Tricolored blackbird forages almost exclusively away from the nesting territory, and breeding colonies require suitable foraging habitat with abundant insect prey within a few miles of the colony site (California Department of Fish and Wildlife 2018:28). Most tricolored blackbirds forage within 3.1 miles of the colony but can range up to 8 miles from the colony (Beedy et al. 2020:6, California Department of Fish and Wildlife 2018:2, Beedy and Hamilton 1997:5). The proximity to highly abundant insect food supplies is an important factor in the selection of breeding sites by tricolored blackbird (Orians 1961:290, 292; California Department of Fish and Wildlife 2018:28). Data are not available to define the minimum extent of foraging habitat; however, studies show that breeding colonies with less than 200–300 acres of foraging habitat do not persist and several thousand acres are necessary to maintain large colonies (Hamilton 2004:10, California Department of Fish and Wildlife 2018:28).

10B.18.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to field verify the land cover mapping (e.g., confirm areas mapped provide suitable nesting and foraging habitats). The model may underestimate the amount of nesting habitat because suitable nesting habitat may be present at some of the ponds in the study area, but ponds were not included in the model. It is likely that overall, the amount suitable nesting habitat is overstimated because not all of the modeled freshwater marsh and managed wetland is of sufficient size and structure to support tricolored blackbird nesting.

Tricolored blackbird has been documented nesting in thorny or spiny vegetation such as Himalayan blackberry (*Rubus armeniacus*), willow (*Salix* sp.), wild rose (*Rosa* sp.), milk thistle (*Silybum marianum*), nettle (*Urtica* sp.), and bull thistle (*Cirsium vulgare*) (DeHaven et al. 1975:171, 172; Beedy and Hamilton 1997:4; Graves et al. 2013:2852; Beedy et al. 2020:1; California Department of Fish and Wildlife 2018:24). Tricolored blackbird has also been found to nest in agricultural grain fields such as triticale, and weedy mustard fields (*Brassica* sp.) (Graves et al. 2013:2857, 2858; Beedy et al. 2020:3; California Department of Fish and Wildlife 2018:24). These vegetation types, however, are not included in the parameters for nesting habitat because they are not discernable through aerial imagery interpretation. Additionally, grain field nesting sites are mainly in areas south of the study area (e.g., southern San Joaquin Valley), nettle sites mostly occur in the southern San Joaquin Valley and the surrounding foothill grasslands, and thistle sites are primarily in the southern Sierra Nevada foothills (California Department of Fish and Wildlife 2018:24, 25). Most colonies still occur in cattails and bulrushes in existing wetland habitats and irrigation drainages, but nesting in these native substrates, especially outside of the Sacramento Valley, occurs at a lesser degree than historically (Meese 2017:11).

The composition of crop types across the landscape is important in determining the foraging value of an agricultural field at any given time because it affects the availability of prey items (California Department of Fish and Wildlife 2018:28); cropping patterns can change across the landscape, thus there is a high degree of variability in the suitability of these agricultural lands. The model also does not consider the use of pesticides in the agricultural landscape, which can result in direct mortality or can reduce reproductive success by eliminating suitable foraging vegetation and insects (U.S. Fish and Wildlife 2019:ii, iii, 45). For example, the likelihood of breeding colony presence is influenced by the proportion of grassland and alfalfa cover in the landscape; colonies were more likely to occur in a landscape when there was 30% to 80% grassland cover and 15% alfalfa cover (California Department of Fish and Wildlife 2018:28). The model, however, does not factor in the specific crop that is grown in agricultural lands and may overestimate the amount of suitable foraging habitat.

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10B.19 Habitat Model Information for Pallid Bat and Long-Eared Myotis

The geographic range for pallid bat (*Antrozous pallidus*) extends throughout California (Zeiner et al. 1990:70). Generally, the habitat for this species consists of deserts, grasslands, shrublands, woodlands, and forests (Zeiner et al. 1990:70) from sea level to 6,000 feet, although it has been observed at higher elevations (Baker et al. 2008, Western Bat Working Group 2017).

The geographic range for long-eared myotis (*Myotis evotis*) extends throughout most of California, but excludes the Central Valley and hot deserts (Zeiner et al. 1990). Long-eared myotis habitat consists of all woodland, forest, and brush habitats, but the species seems to prefer coniferous woodlands and forests (Zeiner et al. 1990).

10B.19.1. Habitat Model Description

The parameters of the modeled roosting and foraging habitat for pallid bat and long-eared myotis consist of blue oak woodland, canal, chamise chaparral, developed, ditch, foothill pine, forested wetland, mixed chaparral, oak savanna, orchard, ornamental woodland, and upland riparian[10] land cover types. These land cover types are considered roosting and foraging habitats because both species may roost in human-made structures, roost on bridges or flow control system components of canals and ditches, and forage in smaller openings in forested areas or between individual trees. Modeled foraging habitat consists of natural land cover types (annual grassland, barren, ephemeral stream, freshwater marsh, intermittent stream, perennial stream, pond, scrub-shrub wetland, seasonal wetland, and pond) and managed land cover types (disturbed, hayfield [includes alfalfa], managed wetland, reservoir, rice, row crops, ruderal, and vineyard).

10B.19.1.1. Assumptions and Rationales

The assumptions on which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption

Potentially suitable pallid bat and long-eared myotis roosting habitat consists of blue oak woodland, canal, chamise chaparral, developed, ditch, foothill pine, forested wetland, mixed chaparral, oak savanna, orchard, ornamental woodland, and upland riparian land cover types.

Rationale

Pallid bat roosts in crevices in rocky outcrops and cliffs, caves, mines, trees, and various human-made structures (Western Bat Working Group 2017). Although pallid bat is thought to prefer rocky outcrops, cliffs, and crevices with access to open habitats for foraging (Zeiner et al. 1990:70), a study by Baker et al. (2008:272–273) suggests that, even in areas with abundant rock features, this species may choose trees as roosts. Trees, rocky outcrops, cliffs, and human-made

[10] The upland riparian land cover type consists of non-wetland riparian areas (i.e., located adjacent to streams but above the ordinary high-water mark) that include valley foothill riparian species, as well as blue oak (*Quercus douglasii*), foothill pine (*Pinus sabiniana*), ornamental trees, and other shrubs and trees that were not identifiable from aerial imagery interpretation.

structures are or may be present within the blue oak woodland, canal, chamise chaparral, developed, ditch, foothill pine, forested wetland, mixed chaparral, oak savanna, orchard, ornamental woodland, and upland riparian land cover types.

Long-eared myotis roosts under exfoliating tree bark, on the ground, and in hollow trees, tree snags, buildings, bridges, caves, mines, cliff crevices, sinkholes, and rocky outcrops (Zeiner et al. 1990, Western Bat Working Group 2017). Trees, rocky outcrops, buildings, cliff crevices, and other potential roost structures are or may be present within the blue oak woodland, canal, chamise chaparral, developed, ditch, foothill pine, forested wetland, mixed chaparral, oak savanna, orchard, ornamental woodland, and upland riparian land cover types.

Assumption

Potentially suitable pallid bat and long-eared myotis foraging habitat consists of natural land cover types (annual grassland, barren, blue oak woodland, chamise chaparral, ephemeral stream, foothill pine, forested wetland, freshwater marsh, intermittent stream, mixed chaparral, oak savanna, perennial stream, pond, scrub-shrub wetland, seasonal wetland, and upland riparian) and managed land cover types (canal, developed, disturbed, ditch, hayfield, managed wetland, orchard, ornamental woodland, reservoir, rice, row crops, ruderal, and vineyard).

Rationale

Pallid bat is known to forage over a variety of landscapes, including open shrub-steppe grasslands, oak savanna grasslands, open ponderosa pine forests, talus slopes, gravel roads, lava flows, orchards, and vineyards (Western Bat Working Group 2017); however a study by Baker et al. (2008:273), suggests that even in areas with abundant rock features, this species may forage in closed-canopy forest. Pallid bat catches a variety of prey, including arthropods on plant surfaces and insects in midair (Western Bat Working Group 2017) that may be found in the natural and managed land cover types in the model.

Long-eared myotis forages among trees, over water, and over shrubs, and catches insects in flight, from foliage, or from the ground (Zeiner et al. 1990). This species eats moths and small beetles, as well as flies, lacewings, wasps, and true bugs (Zeiner et al. 1990, Western Bat Working Group 2017) that may be found in the natural and managed land cover types in the model.

10B.19.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to field verify the land cover mapping (e.g., confirm areas mapped provide suitable roosting habitats). For example, the type of habitat in potentially suitable roost trees and roost structures is not discernable from aerial imagery and may be a factor in roost site selection for these species; both pallid bat and long-eared myotis are known to roost in various crevices and small cavities in trees and built structures. Some land cover types that were included in the model (e.g., canal, ditch) may contain structures that provide suitable roosting habitat; however, the roosting habitat encompasses a small percentage of the overall land cover. As such, the extent of potentially suitable roosting habitat is overestimated for these land cover types.

To the extent possible, individual or small stands of oak trees were mapped as oak savanna and isolated trees and small tree stands adjacent to agricultural fields were mapped as ornamental woodland; however, not all individual trees in developed areas were mapped, and the model may underestimate the extent and distribution of potentially suitable tree roosting habitat in oak savanna, ornamental woodland, and developed land cover types. Overall, the model likely overestimates the amount of potentially suitable roosting habitat because not all trees and potential roosting structures within blue oak woodland, canal, chamise chaparral, ditch, foothill pine, forested wetland, mixed chaparral, orchard, and upland riparian land cover types provide crevices or other structural componenets and appropriate environmental conditions necessary for suitable bat roosting sites.

10B.19.3. References

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10B.20 Habitat Model Information for Townsend's Big-eared Bat and Silver-haired Bat

The geographic range of Townsend's big eared bat (*Corynorhinus townsendii*) extends throughout California, except for the highest elevations in the Sierra Nevada range (California Department of Fish and Wildlife 2016:14; Szewczak et al. 2018:7, 15). Generally, the habitat for this species includes inland deserts; cool, moist coastal redwood forests; oak woodlands of the Coast Range and Sierra Nevada foothills; and lower to mid-elevation mixed coniferous-deciduous forests (California Department of Fish and Wildlife 2016:22).

The geographic range of silver-haired bat (*Lasionycteris noctivagans*) extends through portions of California, primarily from the Oregon border south along the coast to San Francisco Bay, and along the Sierra Nevada and Great Basin region to Inyo County. The species has also been recorded in Monterey, Sacramento, Stanislaus, Ventura, and Yolo Counties and may be found throughout the state during migration. Habitat for silver-haired bat consists of coastal and montane coniferous forests, valley foothill woodlands, pinyon-juniper woodlands, and valley foothill and montane riparian habitats (California Department of Fish and Game 2005).

10B.20.1. Habitat Model Description

The parameters of the modeled roosting and foraging habitat for Townsend's big-eared bat and silver-haired bat consist of blue oak woodland, canal, chamise chaparral, developed, ditch, foothill pine, forested wetland, mixed chaparral, oak savanna, orchard, ornamental woodland, and upland riparian[11] land cover types. These land cover types are considered roosting and foraging habitats because these species may roost in or forage over built structures, as well as roost and forage in forested areas. Modeled foraging habitat consists of natural land cover types (annual grassland, barren, ephemeral stream, freshwater marsh, intermittent stream, perennial stream, pond, scrub-shrub wetland, and seasonal wetland) and managed land cover types (disturbed, hayfield [includes alfalfa], managed wetland, reservoir, rice, row crops, ruderal, and vineyard).

10B.20.1.1. Assumptions and Rationales

The assumptions on which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption

Potentially suitable Townsend's big-eared bat and silver-haired bat roosting habitat consists of blue oak woodland, canal, chamise chaparral, developed, ditch, foothill pine, forested wetland, mixed chaparral, oak savanna, orchard, ornamental woodland, and upland riparian land cover types.

[11] The upland riparian land cover type consists of non-wetland riparian areas (i.e., located adjacent to streams but above the ordinary high-water mark) that include valley foothill riparian species, as well as blue oak (*Quercus douglasii*), foothill pine (*Pinus sabiniana*), ornamental trees, and other shrubs and trees that were not identifiable from aerial imagery interpretation.

Rationale

Townend's big-eared bat roosts primarily in abandoned mines and natural caves, but also roosts in human-made structures and hollow trees (Pierson and Rainey 1998:3; California Department of Fish and Wildlife 2016:22–23; Szewczak et al. 2018:12). Human-made structures, hollow trees, and possibly natural caves are or may be present within the blue oak woodland, canal, chamise chaparral, developed, ditch, foothill pine, forested wetland, mixed chaparral, oak savanna, orchard, ornamental woodland, and upland riparian land cover types.

Silver-haired bat roosts in hollow trees, snags, rock crevices, caves, and under bark (California Department of Fish and Game 2005; Western Bat Working Group 2017) and occasionally under wood piles, in leaf litter, under foundations, and in buildings and mines (Western Bat Working Group 2017). Trees, snags, leaf litter, buildings, and possibly caves are or may be present within the blue oak woodland, canal, chamise chaparral, developed, ditch, foothill pine, forested wetland, mixed chaparral, oak savanna, orchard, ornamental woodland, and upland riparian land cover types.

Assumption

Potentially suitable Townsend's big-eared bat and silver-haired bat foraging habitat consists of natural land cover types (annual grassland, barren, blue oak woodland, chamise chaparral, ephemeral stream, foothill pine, forested wetland, freshwater marsh, intermittent stream, mixed chaparral, oak savanna, perennial stream, pond, scrub-shrub wetland, seasonal wetland, and upland riparian) and managed land cover types (canal, developed, disturbed, ditch, hayfield, managed wetland, orchard, ornamental woodland, reservoir, rice, row crops, ruderal, and vineyard).

Rationale

Townsend's big-eared bat typically forages in forested habitat, in oak canopies, and along heavily vegetated stream corridors and habitat edges (California Department of Fish and Game 2000; California Department of Fish and Wildlife 2016:23–24;) but may also forage in open areas. This species is thought to eat primarily medium-sized moths, supplemented with occasional captures of other insects, including flies, beetles, and aquatic insects (California Department of Fish and Game 2000, California Department of Fish and Wildlife 2016:18), which may be found in the natural and managed land cover types in the model.

Silver-haired bat forages in riparian zones along waterways and over meadows, ponds, and open brushy areas (California Department of Fish and Game 2005, Western Bat Working Group 2017). This species feeds mainly on moths and other soft-bodied insects, but also eats beetles and hard-shelled insects (California Department of Fish and Game 2005). These insects may be found in the natural and managed land cover types in the model.

10B.20.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to field verify the land cover mapping (e.g., confirm areas mapped provide suitable roosting habitat). For example, the type of habitat in potentially suitable roost trees and roost structures is not discernable from aerial imagery and may be a factor in roost site selection for these species; both Townsend's big-eared bat and silver-haired bat roost in trees and a variety of structures.

Some land cover types were included in the model (e.g., canal, ditch) may contain suitable structures that provide suitable roosting habitat; however, the roosting habitat encompasses a small percentage of the overall land cover. As such, the extent of potentially suitable roosting habitat is overestimated for these land cover types. To the extent possible, individual or small stands of oak trees were mapped as oak savanna and isolated trees and small tree stands adjacent to agricultural fields were mapped as ornamental woodland; however, not all individual trees in developed areas were mapped, and the model may underestimate the extent and distribution of potentially suitable roosting habitat in oak savanna, ornamental woodland, and developed land cover types. Overall, the model likely overestimates the amount of potentially suitable roosting habitat because not all of the modeled blue oak woodland, canal, chamise chaparral, ditch, foothill pine, forested wetland, mixed chaparral, orchard, and upland riparian land cover types have hollow trees or cave like structures, crevices or other structural components and appropriate environmental conditions necessary for suitable bat roosting sites.

10B.20.3. References

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10B.21 Habitat Model Information for Western Red Bat and Hoary Bat

The geographic ranges for western red bat (*Lasiurus blossevillii*) and hoary bat (*Lasiurus cinereus*) extend through most of California (Zeiner et al. 1990:60). Woodlands and forests provide suitable habitat for both species (Zeiner et al. 1990:60).

10B.21.1. Habitat Model Description

The model defines potentially suitable roosting and foraging habitats for western red bat and hoary bat as blue oak woodland, chamise chaparral, foothill pine, forested wetland, mixed chaparral, oak savanna, orchard, ornamental woodland, and upland riparian[12] land cover types. These land cover types are considered both roosting and foraging habitat because they contain potential roosting habitat and these species may forage in smaller openings in forested areas or between individual trees. Modeled foraging habitat consists of natural land cover types (annual grassland, barren, ephemeral stream, freshwater marsh, intermittent stream, perennial stream, pond, scrub-shrub wetland, and seasonal wetland) and managed land cover types (canal, developed, disturbed, ditch, hayfield [includes alfalfa], managed wetland, reservoir, rice, row crops, ruderal, and vineyard).

10B.21.1.1. Assumptions and Rationales

The assumptions on which the habitat model parameters were based, and rationale for each assumption, are described below.

Assumption

Potentially suitable western red bat and hoary bat roosting habitat consists of blue oak woodland, chamise chaparral, foothill pine, forested wetland, mixed chaparral, oak savanna, orchard, ornamental woodland, and upland riparian land cover types.

Rationale

Western red bat is commonly associated with forests and woodlands and appears to prefer open habitats or habitat mosaics with access to trees for roosting. Western red bat typically roosts in tree foliage and prefers roost sites that are protected from above and open below (Zeiner et al. 1990:60). A study from New Mexico also suggests that this species may choose roost sites based on higher foliage density (Andersen and Geluso 2018:177–179). Western red bat appears to be associated with intact riparian habitat (particularly willows [*Salix* spp.], cottonwoods [*Populus* spp.], and sycamores [*Platanus* spp.]) (Pierson et al. 2006:14, Western Bat Working Group 2017); however, this species has been observed in a variety of trees, including orchard trees (Pierson et al. 2006:15).

[12] The upland riparian land cover type consists of non-wetland riparian areas (i.e., located adjacent to streams but above the ordinary high-water mark) that include valley foothill riparian species, as well as blue oak (*Quercus douglasii*), foothill pine (*Pinus sabiniana*), ornamental trees, and other shrubs and trees that were not identifiable from aerial imagery interpretation.

Hoary bat roosts primarily in the foliage of medium to large trees (Zeiner et al. 1990, Western Bat Working Group 2017), and while this species is typically associated with natural woodland and forest land cover types, it has also been observed in suburban trees (Quirk pers. comm.). Hoary bat is also thought to prefer roost locations that are protected above and open below (Zeiner et al. 1990; Salganek 2019:6–7). The species typically roosts in foliage of medium to large deciduous or coniferous trees (Zeiner et al. 1990, Western Bat Working Group 2017) and is thought to prefer roosting at the ends of branches (Western Bat Working Group 2017). In addition, other species of foliage-roosting bats (e.g., western red bat) are known to use orchard trees (Pierson et al. 2006:15, Western Bat Working Group 2017); therefore, there is potential for hoary bat to use similar types of trees.

Assumption

Potentially suitable western red bat and hoary bat foraging habitat consists of natural land cover types (annual grassland, barren, blue oak woodland, chamise chaparral, ephemeral stream, foothill pine, forested wetland, freshwater marsh, intermittent stream, mixed chaparral, oak savanna, perennial stream, pond, scrub-shrub wetland, seasonal wetland, and upland riparian) and managed land cover types (canal, developed, disturbed, ditch, hayfield [includes alfalfa], managed wetland, orchard, ornamental woodland, reservoir, rice, row crops, ruderal, and vineyard).

Rationale

Western red bat forages over a wide variety of habitats, including riparian habitats (Pierson et al. 2006:14), grasslands, shrublands, open woodlands and forests, and croplands (Zeiner et al. 1990:60). This species eats a variety of insects (Zeiner et al. 1990:60, Western Bat Working Group 2017) that may be found in the natural and managed land cover types in the model.

Hoary bat forages primarily in open areas or along habitat edges (Zeiner et al. 1990, Western Bat Working Group 2017), but this species may forage in smaller openings between trees in woodland areas. Therefore, forested and woodland land cover types are included as foraging habitat in the model. This species is thought to prefer moths but eats a variety of insects (Zeiner et al. 1990, Western Bat Working Group 2017) that may be found in the natural and managed land cover types in the model.

10B.21.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to field verify the land cover mapping (e.g., confirm areas mapped provide suitable roosting habitat). For example, the type of foliage in potentially suitable roost trees is not discernable from aerial imagery and may be a factor in western red bat roost site selection. Additionally, the height and density of foliage in potentially suitable roost trees are not discernable from aerial imagery and may affect hoary bat roost site selection. Hoary bat has also been known to roost in suburban trees (Quirk pers. comm.). To the extent possible, individual or small stands of oak trees (*Quercus* spp.) were mapped as oak savanna and isolated trees and small tree stands adjacent to agricultural fields were mapped as ornamental woodland; however, not all individual trees in developed areas were mapped, and the model may underestimate the extent and distribution of potentially suitable roosting habitat in oak savanna and ornamental woodland land cover types. Overall, the model likely overestimates the amount of potentially suitable roosting habitat because not all of the modeled blue oak woodland, chamise chaparral, foothill pine, forested wetland, mixed chaparral, oak savanna, orchard, ornamental woodland, and upland riparian land cover types have structural components and appropriate environmental conditions necessary for tree roosting bats.

10B.21.3. References

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10B.21.4. Personal Communications

Quirk, Corky. Executive Director. NorCal Bats. January 21, 2021 — Email to Marieka Schrader, Senior Biologist, ICF, Sacramento, California.

10B.22 Habitat Model Information for American Badger

The geographic range of American badger (*Taxidea taxus*) extends throughout California (Zeiner et al. 1990). This species is semi-fossorial and excavates burrows in friable soil for cover and reproduction (Zeiner et al. 1990, Quinn 2008:34).

10B.22.1. Habitat Model Description

The parameters of the modeled American badger habitat consist of annual grassland, blue oak woodland, chamise chaparral, ephemeral stream, foothill pine, mixed chaparral, and oak savanna land cover types. These areas are considered potentially suitable habitat because they may contain suitable vegetation, friable soils, and a prey source. Disturbed and ruderal habitats that abut potentially suitable land cover types are also included in the model.

The assumption on which the habitat model parameters were based, and the rationale for the assumption, are described below.

10B.22.1.1. Assumption

Potentially suitable American badger habitat consists of annual grassland, blue oak woodland, chamise chaparral, ephemeral stream, foothill pine, mixed chaparral, and oak savanna land cover types, as well as disturbed and ruderal land cover types that abut potentially suitable habitat.

Rationale

American badger occurs in a variety of open, arid habitats but most commonly is associated with grasslands, savannas, and mountain meadows. The species requires relatively open, uncultivated ground (Williams 1986:66–67). While American badger prefers grassland and scrub habitats, it has also been found in hardwood and conifer woodlands, in conifer forests, and on the boundaries of its preferred habitat types (Quinn 2008:31, 131–132). American badgers do not survive in cultivated areas, and agricultural practices and urban development have caused mortalities that have resulted in the limited presence of the species in these areas (Williams 1986:66, Lay 2008:4).

American badger requires friable soils in which it can dig burrows for cover and bear young (Zeiner et al. 1990). Within its home range, American badger avoids flat terrain for denning, possibly because of poor drainage or the additional energy required to dig a den in flat ground as opposed to into a hillside (Quinn 2008:132). The distribution of this species is correlated with population and distribution of fossorial rodents, which are American badger's preferred prey (Lay 2008:4). American badger is a carnivore that eats mostly small mammals (Quinn 2008:10) but will also prey on birds, reptiles, insects, invertebrates, and plants (Quinn 2008:10, Zeiner et al. 1990). The land cover types identified in the model are consistent with the habitats that American badger has been reportedly associated with or that provide potential prey and foraging opportunities.

10B.22.2. Habitat Model Limitations

The model is limited primarily by the accuracy of aerial imagery interpretation and the inability to field verify the land cover mapping (e.g., confirm areas mapped provide suitable habitat). For example, in areas of suitable vegetative cover, the soil textures are not discernable from largescale mapping and American badgers require friable soils (Zeiner et al. 1990). Because all land cover types may not contain friable soils, the model may overestimate the amount of suitable habitat. Although American badger is likely uncommon in agricultural and developed areas, it may inhabit the edges of intact or otherwise suitable habitats (Quinn 2008:34); therefore, the model may also overestimate the amounts of disturbed and ruderal habitats that are suitable.

10B.22.3. References

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