Golden Eagle (Aquila chrysaetos)

Legal Status

State: Fully Protected, Watch List
Federal: Protected under the Bald Eagle and Golden Eagle Protection Act and Migratory Bird Treaty Act, U.S. Fish and Wildlife Service Bird of Conservation Concern
Critical Habitat: N/A
Recovery Planning: N/A
Notes: Listing status not anticipated to change during permit period

Taxonomy

Of five or six golden eagle (Aquila chrysaetos) subspecies worldwide, only one occurs in North America: Aquila chrysaetos canadensis. No information is available on geographic or genetic variation within the North American subspecies (Kochert et al. 2002).

Distribution

General

The golden eagle is predominately a western North American species, ranging from northern Alaska though the western states and Great Plains to Mexico, with some breeding and wintering locations in eastern North America (Figure SP-B11). Within California, the golden eagle is a year-round resident generally inhabiting mountainous and hilly terrain throughout the open areas of the state. Descriptions of the species’ physical characteristics, behavior, and distribution are provided in a variety of field guides (e.g., Peterson 1990; Sibley 2000; National Geographic 2002).
Distribution and Occurrences within the Plan Area

Historical

The golden eagle is an uncommon permanent resident and migrant throughout the Plan Area, ranging from sea level up to 3,500 meters (11,480 feet) (Grinnell and Miller 1944). Habitat typically includes rolling foothills of oak and juniper woodlands, mountain areas, and desert. Breeding habitat is more prevalent in the southern portion of the Plan Area, including northern Imperial County, Riverside County, and southern San Bernardino County, as well as interspersed in northern San Bernardino and the more mountainous regions of southern Inyo County (University of Washington 2011). Historically rare or absent in the lower elevation desert regions of the Plan Area and the vicinity of the Salton Sea and the lower Colorado River (Kochert et al. 2002). There are 263 historical (i.e., prior to 1990) occurrences for golden eagle in the Plan Area and an additional 11 occurrences with an unknown observation date (CDFG 2012; Dudek 2011). There are golden eagle historical occurrences throughout the Plan Area, but with concentrations in the west Mojave, the region between Victorville and Barstow east of Interstate 15, the Mojave National Preserve, and the east portion of Joshua Tree National Park (Figure SP-B11).

Recent

There are 531 recent (i.e., since 1990) documented occurrences for golden eagle within the Plan Area (Figure SP-B11) (CDFG 2012; Dudek 2011). Golden eagles have occupied nearly every mountain range in the Plan Area; territory occupancy is variable from year to year, productivity is generally low, and most territories contain several alternate nests (La Pré 2011, pers. comm.). The Bureau of Land Management (BLM) identified “Key Raptor Areas” for golden eagles encompassing the Granite, El Paso, Newberry, and Red mountains (Raptor Research Foundation 1989), as well as important occupied habitat in the Clark Mountain Range and Calico Mountains. Golden eagles may be less abundant in southeastern Imperial County (La Pré 2011, pers. comm.) Many documented occurrences and nests exist to the southwest of the Plan Area in western Riverside and San Diego Counties (CDFG 2012).
Natural History

Habitat Requirements

Golden eagles use nearly all terrestrial habitats of the western states, occurring primarily in mountainous canyon land, rimrock terrain of open desert and grassland areas (Kochert et al. 2002) (Table 1). In central California, they prefer open grasslands and oak savanna, with lesser numbers in oak woodland and open shrublands (Hunt et al. 1998) but can also be found in desert grasslands and chaparral habitats (Millsap 1981). Secluded cliffs with overhanging ledges and large trees are used for nesting and cover. Preferred territory sites include those that have a favorable nest site, a dependable food supply, and broad expanses of open country for foraging (see Foraging Requirements). Hilly or mountainous country where takeoff and soaring are supported by updrafts is generally preferred to flat habitats (Johnsgard 1990). Deeply cut canyons rising to open mountain slopes and crags are ideal habitat (Kochert et al. 2002).

Table 1. Habitat Associations for Golden Eagle

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Land Cover Use</th>
<th>Habitat Designation</th>
<th>Habitat Parameters</th>
<th>Supporting Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other (rock outcrops/barrens)</td>
<td>Nesting</td>
<td>Primary habitat</td>
<td>Rugged, open habitats with canyons and escarpments; secluded cliff faces with overhanging ledges</td>
<td>Direct observations and radio-telemetry studies</td>
</tr>
<tr>
<td>Upland tree-dominated Conifer</td>
<td>Nesting/roosting, cover</td>
<td>Primary habitat</td>
<td>Large trees, particularly oak trees near suitable ground squirrel and other prey habitat; trees large enough to support the large nest structure (up to 3 meters across and 1 meter deep)</td>
<td>Direct observations and radiotelemetry studies</td>
</tr>
</tbody>
</table>
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<th>Habitat Parameters</th>
<th>Supporting Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grasslands</td>
<td>Foraging</td>
<td>Secondary habitat</td>
<td>Relative open and expansive rolling foothills and mountain terrain, often with wide plateaus cut by streams or canyons on open mountain slopes</td>
<td>Direct observations and radiotelemetry studies, and aerial surveys</td>
</tr>
</tbody>
</table>

Source: Kochert et al. 2002
m – meter

Foraging Requirements

Golden eagles typically forage in open habitats including grasslands and shrublands. They feed mainly on leporids (hares and rabbits) and sciurids (ground squirrels, prairie dogs, marmots), but they also take birds, fish, and reptiles, mostly on or near the ground, and they frequently feed on carrion (Kochert et al. 2002). Their diet is most varied in nonbreeding season. Hunting typically involves soaring 30 to 90 meters (98–295 feet) above ground in search of prey, or making low, quartering flights, often 7–8 meters (23–26 feet) above ground. Golden eagles occasionally search from a perch and fly directly to prey (Polite and Pratt 1990) and they sometimes pirate food from other predators. Hunting in mated pairs is also documented (Kochert et al. 2002).

Reproduction

Golden eagles generally breed after attaining adult plumage, usually acquired in their fifth summer (Kochert et al. 2002). Mated pairs use the same nest each year, alternate nests in successive years, or nest only every other year (Terres 1991). Pairs rarely re-nest when the first clutch is destroyed (Watson 1997) and there are no records of pairs producing more than one brood per year. Golden eagles prefer to locate their nests on cliffs or trees near forest edges or in small stands near open fields (Bruce et al. 1982; Hunt et al. 1998). Breeding densities are
directly related to territorial spacing and foraging requirements for the species. Mating occurs from late January through August, with peak activity in March through July. Eggs are laid from early February to mid-May. Clutch size varies from one to four eggs, but two is the most common size (Brown 1976; Johnsgard 1990). Incubation lasts 43–45 days (Kochert et al. 2002), and the fledging period is 72–84 days (Johnsgard 1990). The young usually remain dependent on their parents for as long as eleven weeks after fledging. Long-term annual reproductive success ranges from 0.78 to 1.08 fledgling young per pair in the continental United States, varying with prey abundance and weather (Phillips et al. 1990; Thompson et al. 1982).

**Table 2. Key Seasonal Periods for Golden Eagle**

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breeding</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Migration</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
</tr>
</tbody>
</table>

**Notes:** Active year-round residents in Southern California.

**Sources:** Polite and Pratt 1990; Kochert et al. 2002

**Activity and Movement**

Golden eagles in the Plan Area are mostly resident, but may move downslope for winter or upslope after the breeding season (Polite and Pratt 1990). Dixon (1937) estimated an average home range size of about 93 kilometers$^2$ (36 miles$^2$) in Southern California, but home range can vary substantially with habitat conditions and prey availability. In the western U.S., on average, eagles forage over home ranges ranging from about 22 to 33 kilometers$^2$ (8.5 to 12.7 miles$^2$) during the breeding season (Kochert et al. 2002). Resident pairs maintain home ranges year-round with shifts in intensity of use from the breeding season to winter (Dunstan et al. 1978; Marzluff et al. 1997). Both residents and migratory individuals show fidelity to wintering areas (Kochert et al. 2002). Though limited dispersal data exist, three radio tagged resident breeders in California all moved to new territories within 8 kilometers after leaving their original ones (Kochert et al. 2002). Some migrants may temporarily move into areas used by resident birds during the winter.
Table 3. Spatial Behavior of the Golden Eagle

<table>
<thead>
<tr>
<th>Type</th>
<th>Distance/Area</th>
<th>Location of Study</th>
<th>Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Territory</td>
<td>93 km$^2$</td>
<td>Southern California</td>
<td>Dixon 1937</td>
</tr>
<tr>
<td>Distance between active nest sites</td>
<td>&gt;0.8 km</td>
<td>Western United States</td>
<td>Palmer 1988</td>
</tr>
<tr>
<td>Dispersal from natal site</td>
<td>Ranged from 6.7 to 64.7 km</td>
<td>Idaho</td>
<td>Steenhof et al. 1984</td>
</tr>
</tbody>
</table>

$>$ – greater than km – kilometer

Ecological Relationships

Golden eagles are a top avian predator in the scrubland, grassland, and woodland ecosystems that make up much of the Plan Area. They may directly compete with ferruginous hawks (*Buteo regalis*) and other smaller hawks for small mammals, and with California condors (*Gymnogyps californianus*) and ravens (*Corvus corax*) for carrion. Territorial interactions with other golden eagles may result in some fatalities.

Population Status and Trends

**Global:** Secure (NatureServe 2011)

**State:** Vulnerable (NatureServe 2011)

**Within Plan Area:** Apparently stable (Remsen 1978)

The golden eagle is relatively common in some areas of its range. Local threats or declines do not pose a major conservation problem from a global perspective (NatureServe 2011). This species was once a common resident throughout the open areas of California. Numbers are now reduced near human population centers; nesting populations in San Diego County, decreased from an estimated 85 pairs in 1900 to 40 occupied territories in 1999 due to extensive residential development (Kochert et al. 2002).

Threats and Environmental Stressors

The decline of golden eagle is attributed primarily to habitat degradation and human-induced disturbances and fatalities, such as
disturbance of nest sites, and collisions with vehicles, utility towers, or structures (Kochert et al. 2002). Human activity near nests can cause nest failure, and golden eagles may be indirectly poisoned by consumed prey that has been poisoned by chemicals used to protect crops or kill rodents (Kochert et al. 2002). Additional threats to this species are poaching, electrocution from high tension wires, wind turbine strikes, and lead poisoning (Remsen 1978; Thelander 1974). In a study of the causes of fatalities in 61 golden eagles radio-tagged and recovered in the Diablo Range from January 1994 to December 1997, 37% were killed by wind turbine strikes, 16% by electrocution, and 5% by lead poisoning (Hunt et al. 1998). The pervasiveness of lead in the environment has contributed to eagle deaths through lead toxicosis, with evidence of elevated blood-lead levels (greater than 0.20 parts per million), likely from ingested hunter ammunition, in 36% of 162 eagles from Southern California from 1985 to 1986 (Harlow and Bloom 1989; Pattee et al. 1990). More than 270 eagles were electrocuted in North America between 1986 and 1996 (Harness and Wilson 2001); immature eagles are most susceptible to electrocution when landing on power poles (Kochert et al. 2002). Vehicle collisions have also been documented as a cause of mortality (Phillips 1986). Weather also may cause stress to golden eagles during sensitive periods. Studies have documented heat stress as a significant mortality factor for nestlings (Mosher and White 1976) and an inverse correlation exists between nesting success and the number of days with temperatures greater than 32°C (89.6°F) (Steenhof et al. 1997).

Conservation and Management Activities

There are no conservation actions in the Plan Area directed specifically at the golden eagle. However, land preservation in the Southern California desert and surrounding areas by agencies such as the National Park Service, Bureau of Land Management, Department of Defense, and California State Parks have indirectly benefited golden eagles by preserving open space. Management practices on these lands that enhance golden eagles’ prey base (e.g., rodents and rabbits), would likely confer additional benefits. Furthermore, the Bureau of Land Management identifies the golden eagles a sensitive species within the Plan Area (BLM 2007). Golden eagle management
and conservation generally includes habitat management, population enhancement, hazard management, controlling human activity in sensitive raptor areas, and education.

The USFWS released a *Draft Eagle Conservation Guidance* document in January 2011 (USFWS 2011). This document provides guidance for preparation of Eagle Conservation Plans (ECPs) related to wind energy facilities. It would be a voluntary program for project proponents, but they would have to coordinate with the USFWS if a different approach was taken to ensure that alternative approaches would provide comparable data (USFWS 2011). The evaluation of a proposed wind energy project would be conducted in five stages:

1. **Stage 1:** Identify potential wind facility locations with manageable risk to eagles at the landscape level;

2. **Stage 2:** Obtain site-specific data to predict eagle fatality rates and disturbance take at wind facility sites that pass Stage 1 assessment.

3. **Conduct turbine-based risk assessment and estimate the fatality rate of eagles for the facility evaluated in Stage 2, excluding possible advanced conservation practices (ACPs).**

4. **Identify and evaluate ACPs that might avoid or minimize fatalities identified in Stage 3. When required to do so, identify compensatory mitigation necessary to reduce any remaining fatality effect to a no-net-loss standard.**

5. **Document annual eagle fatality rate and disturbance effects. Identify additional ACPs to reduce observed level of mortality, and determine if initial ACPs are working and should be continued. When appropriate, monitor effectiveness of compensatory mitigation.**

   (USFWS 2011, p. 6).

At the end of each of the first four stages, the project proponent would determine which of the following categories the project, as planned, would fall into: (1) high risk to eagles, little opportunity to minimize effects; (2) high to moderate risk to eagles, but with an opportunity to
minimize effects; (3) minimal risk to eagles; or (4) uncertain. The USFWS recommends that projects that fall into category 1 be moved, significantly redesigned, abandoned because they likely would not meet the regulatory requirement for an ECP and permit issuance. Projects that fall into categories 2, 3, and 4 would be candidates for an ECP and permit (USFWS 2011).

The Draft Eagle Conservation Guidance is currently under review and has not been formally adopted by the USFWS.

**Data Characterization**

Several regional surveys in the portions of the Plan Area for golden eagle have been conducted by the Wildlife Research Institute, Inc. (WRI), including an area of approximately 4,142 kilometers$^2$ (1,600 miles$^2$) in the eastern Mojave Desert in San Bernardino and Riverside counties (WRI 2010), in the western Mojave Desert (WRI 2002), on BLM Open Areas in the Johnson and Stoddard valleys (WRI 2003, 2009a), and in Anza Borrego State Park (WRI 2009b). These studies have collected data for golden eagle nests and alternative nests, nest condition and whether it was active or not, nest elevation, GPS coordinates, nest substrate (cliff, transmission tower, etc.), age class, and behavior (e.g., WRI 2010). In addition, annual nesting surveys in San Diego County have been conducted since 1988, including the desert regions of eastern San Diego County (Unitt 2004). In other areas of California, extensive long-term studies have been conducted in the central coast ranges of California on the distribution, demographics, and general biology of golden eagles as part of investigations on the impact of wind turbine operation on this species (Hunt et al. 1998). These studies provide detailed information on the distribution and habitat-use patterns of resident and nonresident golden eagles, population structure, reproductive rates, survival rates, and population equilibrium dynamics in the central coast ranges of California. Some additional literature, some of which pertains to Southern California, is available for the golden eagle because it is a highly visible, fully protected bird of prey and top avian predator within its range. Most of the literature pertains to general natural history, behavior, distribution, and population changes in the past 30 to 40 years. Some information is available on demographics and
population trends. Limited species-specific management information is available.

Management and Monitoring Considerations

Management of healthy eagle populations includes maintaining prey habitat in foraging areas, by maintaining native shrub communities (Marzluff et al. 1997; Kochert et al. 1999), protecting foraging habitat within 3 kilometers (1.9 miles) of nests from human disturbance and fire, and restoring shrubs in burned areas (Kochert et al. 1999). Fires have caused large-scale losses of shrubs and degraded prey (e.g., rabbits) habitat in areas used by eagles throughout California. Thus, recovery of these areas as foraging habitat is important.

As discussed above under Threats and Environmental Stressors, human activities near nests can cause nest failure and nest abandonment. Planned activities in the Plan Area should consider what management actions and monitoring considerations are required to avoid and minimize human impacts to nest sites, including seasonal restrictions on certain activities near active nests and protective buffer zones (both spatial and visual) around active nest sites. Monitoring of nest sites in areas where human activities are occurring would help distinguish between relatively benign activities that are tolerated by golden eagles and activities that disturb birds.

Another important consideration for management and monitoring of golden eagle populations is ensuring that eagles have access to safe food sources. Agricultural activities, for example, may affect golden eagles through contamination of prey by chemicals used to protect crops, including phorate, carbofuran, strychnine, and anticoagulant rodenticides (Kochert et al. 2002).

Other human-caused sources of mortality for golden eagles that may warrant monitoring and management and/or design specifications to minimize threats include wind turbine and vehicle collisions (Hunt et al. 1998; Phillips 1986) and electrocutions from power lines (Harness and Wilson 2001). Utility companies such as Southern California Edison incorporate anti-perching and anti-collision guidelines in design of transmission line facilities consistent with the Avian Power Line Interaction Committee (APLIC 2006).
As discussed above, the USFWS recently released the Draft Eagle Conservation Guidance for public review (USFWS 2011). The Stage 5 objective is annual monitoring of eagle mortality and disturbance effects, the effectiveness of compensatory mitigation, and identification of additional advanced conservation practices (ACPs) to reduce mortality and other adverse effects (USFWS 2011).

Development of a population monitoring strategy should be a priority, especially in the western United States where population declines are suspected (Kochert et al. 2002)

**Predicted Species Distribution in Plan Area**

Two separate models for breeding and foraging were developed for golden eagle. There are 506,622 acres of modeled suitable breeding habitat for golden eagle in the Plan Area. Modeled suitable breeding habitat occurs throughout the Plan Area from 200 to 9,000 feet in elevation. Modeled suitable breeding habitat includes steep slopes as well as forest and woodland communities. There are 21,373,122 acres of modeled suitable foraging habitat for golden eagle in the Plan Area. Modeled suitable foraging habitat occurs throughout the Plan Area below 11,500 feet in elevation. Modeled habitat includes agriculture and a wide variety of natural communities. Appendix C includes specific model parameters and figures showing the modeled suitable habitat in the Plan Area.

Appendix C provides a summary of the methodology used to model DRECP Covered Species with Maxent. For the golden eagle, 377 occurrence points were used to train the Maxent model and 125 occurrence points were used to test the model’s performance. Overall, the Maxent model has very good statistical support. The very large number and widespread distribution of occurrence samples across the species range result in strong predictive ability throughout most of the Plan Area. Based on a natural break in the distribution of the probability of occurrence that Maxent estimates, all 100-meter grid cells with greater than 0.288 probability of occurrence were defined as golden eagle habitat.

The Maxent model predicts 6,305,679 acres of golden eagle habitat, compared with 506,622 acres predicted by the expert model. The
Maxent model predicts golden eagle habitat throughout the northwestern and southwestern West Mojave, south and east of Victorville, and all along the Owens Valley, as well as smaller areas along the Colorado River by Needles, near the Salton Sea, and north of Bishop, all near occurrence data, but not encompassing all the occurrence points. The expert foraging model is much more widely distributed across the entire Plan Area, but the expert breeding habitat model is more narrowly distributed and frequently overlaps with the Maxent model.

Model Summary

*Primary Habitat—Nesting Habitat*

[Describe primary habitat.]

*Secondary Habitat—Foraging*

[Describe secondary habitat.]

Model Results

[Summarize model results.]

Literature Cited


Golden Eagle (Aquila chysaetos)


BIRDS

Golden Eagle (Aquila chysaetos)


WRI. 2009a. Western Mojave 2008 Raptor Survey; BLM Johnson Valley and Stoddard Valley Open Areas and Environs. Prepared for USDI BLM, Moreno Valley, California. 30 June.

Golden Eagle Occurrences in the Plan Area (N=794)

Note: Occurrence point size graphically represents the precision level code for the data point but is not scaled geographically.