

Chapter 5

Covered Terrestrial Species



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5 COVERED TERRESTRIAL SPECIES

5.1 Introduction

Chapter 5 includes species accounts for each terrestrial species covered by our HCP/NCCP. A species account is a brief description and history of the species from the scientific literature. Species accounts are the starting point for conservation planning—a process that must begin with awareness and understanding. The general topics developed for each species account in this chapter are geographic distribution, local distribution, life history, habitat requirements, ecological interactions, sensitivity to disturbance, and key uncertainties. Key uncertainties address gaps in MRC knowledge, such as the historical or current abundance of a species in the plan area, factors that might limit its recovery, impacts of land management upon species populations, and what exactly “species friendly” silviculture might be. MRC has italicized and flagged (▶) the key uncertainties that become hypotheses in the validation monitoring programs; Chapter 13, *Monitoring and Adaptive Management*, discusses these programs in detail.

5.1.1 🔥 Mendocino lighting complex (2008)

MRC has not fully assessed the impacts to the habitat and population of covered terrestrial species as a result of the lightning fires (see 1.18). Such assessment will require extensive monitoring of these species and their habitat. Under the individual species accounts, we have presented our preliminary determinations about the fire impacts.

5.2 Northern Spotted Owl

5.2.1 Geographic distribution

The spotted owl has 3 subspecies. A recent genetic study supports the delineation of these 3 subspecies through mitochondrial DNA (Barrowclough et al 2005). The authors of a recent status assessment of the northern spotted owl (Courtney et al 2004) also state that the northern spotted owl is a distinct subspecies. Two of the subspecies, the northern spotted owl (*Strix occidentalis caurina*) and the California spotted owl (*S. o. occidentalis*), occur in California and are thought to be closely related. The third subspecies, the Mexican spotted owl (*S. o. lucida*), is federally listed and found from southeastern Utah and central Colorado southward through the mountains of Mexico (Gutierrez et al. 1995).



Spotted Owl in the Albion (2011)

Of the 2 California subspecies, only the northern spotted owl is federally listed as threatened (USDI 1990). It breeds from southwestern British Columbia through western Washington and Oregon to Marin County, California (USFWS 1994b). A few confirmed sightings of spotted owls from the Santa Cruz Mountains were not identified to the level of subspecies (Small 1994). Northern spotted owls are considered to be an uncommon resident species in northwestern California (Harris 1993). The California spotted owl, a U.S. Forest Service sensitive species, is found mostly in the western portion of the Sierra Nevada range. It can also be found in mountainous regions of Monterey and Santa Barbara counties and a few localized sites in southern California (USDA Forest Service 1992).

5.2.2 Local distribution and regional status

5.2.2.1 Distribution inside and outside the plan area

Northern spotted owls are found across the assessment area. MRC surveyed approximately 250 individual territories on or adjacent to MRC land from 1988-2010. By the fall of 2010, 237 of these territories were still active¹. Of these 237 active territories, 224 were either (a) in the plan area or (b) outside the plan area but within 1000 ft of the plan area boundary.

5.2.2.2 Distribution in assessment area

MRC obtained information for northern spotted owl territories in both Mendocino County from the most recent CDFG database as of August 2010.² CDFG maintains this database and tracks all known northern spotted owl territories throughout the state of California. The database lists 534 territories in Mendocino County (up to MEN0614). Although MRC received the database in late 2010, most of the data is from 2009 and earlier. Of the 534 territories listed in Mendocino, 25 have been designated “abandoned” in consultation with USFWS and only 278 have been visited or surveyed since 2007. The plan area contains 142 of the 278 recently surveyed territories in Mendocino County or 51% of the total.



Owlets

5.2.2.3 Spotted owl density in northern California

Over the last 10-12 years, crude density³ (i.e., the number of owls per square kilometer) has been calculated for several forest lands in northwestern California; all fall within a close range. As of 2011, the density of northern spotted owls in the plan area is 0.209 owls/km². In Marin County the density is 0.3 owl pairs/km² (Fehring et al. 2004). Over a decade ago, a biological opinion for Pacific Lumber Company (PALCO) cited a density of 0.325 owls/km² (NMFS and USFWS 1999). In July 2008, the sister company of MRC, Humboldt Redwood Company (HRC), was formed from PALCO lands. HRC biologists report that, as of 2011, the owl density remains steady at .30 owls/km².⁴ Densities similar to that of the plan area were also found in (a) Willow Creek in Humboldt County—0.235 owls/km² (Franklin et al. 1990); (b) Simpson lands in northern California—0.209 owls/km² (Diller and Thome 1999); and (c) Redwood National Park—0.163 owls/km² (Tanner 1999).

5.2.3 Population trends

Research in California indicates that several study populations for the northern spotted owl may be stable or slightly declining (Franklin et al. 1996, Franklin et al. 2002). A minimum population estimate for northern spotted owls in California during the late 1980s and early 1990s was 1111 pairs (Gutiérrez et al. 1995). Although populations may be stable in northern California, northern spotted owl populations are declining across a large portion of their range due to destruction, fragmentation of old-growth habitat (Noon and McKelvey 1996), and, perhaps, barred owls (see section 5.2.6.3). A recent metapopulation study (Anthony et al 2004) indicated that, across the range of the northern spotted owl, lambda (or the population growth) was less than 1.0 for 12 of 13 demographic study areas. A lambda < 1.0 indicates a declining population. This is equivalent

¹ The term “active” refers to territories that had spotted owl occupancy at least once during the period from 1988-2007.

² Email to Robert Douglas (MRC) from Gordon Gould (CDFG) on 08/17/2006.

³ MRC defines crude density as the number of owls in each territory (pairs or resident singles) divided by the area of the plan area: 181 owls/863 km² = 0.209 owls/km².

⁴ 254 owls/846.6 km² = .30 owls/ km²

to a 4.1% decline in the northern spotted owl population per year. Fragmentation of old-growth habitat has isolated populations and reduced prey for spotted owls outside northern California as well (Thomas et al. 1990).

Extensive loss and degradation of habitat, primarily due to forestry practices, such as clearcutting and even-aged tree-management, generally have been regarded as a principal threat to spotted owls (Gutiérrez et al. 1995). Moreover, some timber managers consider selective harvest to be a largely unsuccessful management technique where spotted owls are concerned (Driscoll 2000). However, there is scant scientific literature addressing this issue (King et al. 1997). Therefore, only further research will determine the cumulative effects of various logging practices on spotted owls and their prey (Ward et al. 1998, Driscoll 2000).

5.2.4 Life history

5.2.4.1 Reproduction and growth

Northern spotted owls establish or re-establish pair bonds in early February and March as pairs begin to roost together (Forsman et al. 1984). Nest-site selection follows, usually in March and April. These owls typically have only 1 brood per season, and rarely re-nest if the first nest fails (Lewis and Wales 1993, as cited in Gutiérrez et al. 1985). A recent study in southern Oregon indicates that males with previous reproductive experience contributed more to the reproductive rate than inexperienced males (Dugger et al 2005). Northern spotted owls do not usually nest every year; one study found an average nesting rate of once every 2-3 years in northern California (Thome et al. 2000). For the most part, eggs are laid in April and clutch size varies from 1 to 4, although only 1 or 2 offspring usually survive. The female incubates the eggs for approximately 30 days (Forsman et al. 1984). The male generally feeds the female throughout the incubation and early brooding period. The female broods young for an additional 10 days after hatching; at that point, the owlets become active and the female begins to leave the young to forage for progressively longer periods (Forsman et al. 1984). Both the male and female continue to forage for the owlets and feed them directly until they leave the nest at approximately 35 days old, from mid-May through June. Both parents primarily roost near the young through August, although one parent may roost apart. The siblings often roost together but may move farther apart as they mature. Young become independent by late summer and dispersal typically begins in early September and continues through October (Gutiérrez et al. 1985). Females may breed as early as their second year (Gutiérrez 1985).

5.2.4.2 Movement and dispersal

Dispersal of the young facilitates colonization of unoccupied habitat, replacement of breeding pairs in an established territory, and increasing local genetic variation. Initial dispersal direction appears to be random (Miller 1989). Observed dispersal distances averaged 12 mi (19 km) for females and 4 mi (6 km) for males (Thomas et al. 1990); overall, the median distance was 27 mi (44 km). Gutiérrez et al. (1985) observed straight-line distance dispersal of 12–62 mi with a mean of 28.3 mi (45 km).

While juvenile dispersal is the norm, adult owls are known to disperse occasionally due to habitat disturbance, displacement by barred owls, death of a partner, or unknown reasons. One early researcher hypothesized that a reserve supply of birds might be necessary to replace territorial individuals who die (Nice 1941). The mechanisms involved in adult dispersal, however, are not as well understood as those associated with juvenile dispersal.

5.2.4.3 Turnover

Territory turnover occurs when a resident owl dies or shifts territories and another owl takes its place. Long-term pair bonds characterize spotted owl mating. Spotted owls are generally monogamous—they maintain the same home ranges and re-unite with their previous mates each year, if possible (Verner et al. 1991, as cited in Thome et al. 2000). Thome et al. (2000) rarely observed separations of spotted owl pairs, although occasionally an owl would re-pair with a new mate. Reproductive success was lower for owls occupying sites where turnover had previously occurred. This could reflect a new pair's inexperience at nesting, roosting, foraging, or paternal care.

5.2.4.4 Home range

Northern spotted owls have relatively large home ranges compared with other owls (Forsman et al. 1984). In one study in California (Thomas et al. 1990), home ranges of individual northern spotted owls varied in size between 1258 ac (503 ha) and 7823 ac (3129 ha). In Mendocino County, Pious and Ambrose (1994) studied 9 radio-tagged owls on Georgia-Pacific land and adjoining Louisiana-Pacific land, which is now MRC land. Both G-P and L-P were major landowners in Mendocino County. Home ranges in the Pious and Ambrose study varied from 806 to 4442 ac (326 to 1798 ha). A more recent study conducted by researchers in Mendocino County estimated the mean home-range size of northern spotted owls there as 1559 ac (using 95% minimum convex polygons) for 9 territories (Irwin et al. 2004).

There is significant overlap between home ranges of members of the same pair (Forsman et al. 1984, Solis and Gutiérrez 1990) and less overlap among adjacent pairs. Home range sizes vary geographically (Carey et al. 1992) and are often correlated with prey use. They are larger when flying squirrels are the primary prey and smaller when woodrats are the primary prey (Zabel et al. 1995, as cited in Gutiérrez et al. 1995). In Oregon, Forsman et al. (1984) found increasing home range size with a decreasing amount of old-growth forest.

5.2.5 Habitat requirements

5.2.5.1 Forest types

In northern California, spotted owls are found in younger stands with less canopy cover compared with other regions (Pious 1994, Noon and McKelvey 1996, and Folliard et al. 2000). However, in general, spotted owls are found in older forests characterized by high canopy closure (>70%), multi-layered canopy structure, large-diameter trees, downed logs, and snags (Thomas et al. 1990, Buchanan 1991). The multi-layered canopy provides foraging, roosting, and nesting habitat, as well as various microclimates, which help spotted owls regulate their body temperature.

Northern spotted owls prefer forests with a high degree of complexity, probably because this forest type provides both older trees with cavities or snags for nesting and understory habitat for perching and foraging. In California, spotted owls prefer stands dominated by conifers with hardwood understories (Pious 1994). Spotted owls occur in stands with less brush (Gutiérrez et al. 1998) compared to surrounding areas unpopulated by owls. Gould (1977) noted that 98% of all spotted owl observations made in California were within 1970 ft (600 m) of water, although water has not been established as a key habitat variable for spotted owls.



Platform Branch in Conifer

Thome et al. (1999) compared random sites with spotted owl nest sites and found that nest sites had a lower proportion of younger forest stands. However, within those nest sites, reproductive success was greater in areas with a higher proportion of such stands. Moreover, lower proportions of the largest basal-area class also characterized sites with greater reproductive success. This is probably due to availability of prey, which appears to be negatively correlated with forest age in northern California. Mature stands allow maneuverability and provide optimum nesting habitat and protection from predation, whereas younger stands can provide additional complexity or increased prey base (Thome et al. 1999).

Overall, Thome et al. (1999) showed that northern spotted owls are associated with mature stands having some 21-40 year-old trees and stands with basal areas of 100-196 ft²/ac (23-45 m²/ha) and 200-301 ft²/ac (46-69 m²/ha). Residual trees in managed stands are beneficial for northern spotted owls and increase reproductive success. Large areas of young stands apparently can support reproductive success if a high residual tree component is retained. However, owls in the cited study may have occupied stands of younger and smaller trees in areas that had a higher abundance of prey, especially woodrats. The researchers emphasize that these results are only applicable to California north-coast forests managed with clearcut silvicultural practices (Thome et al. (1999).

5.2.5.2 Four habitat types

In order to better understand the needs of spotted owls, MRC parses habitat into nesting/roosting, foraging, dispersal, and non-suitable habitat. Though there are separate habitat types for both nesting/roosting and foraging, overlap often occurs. For instance, nesting/roosting habitat also can provide foraging habitat for owls, although foraging habitat generally does not provide nesting/roosting habitat. Furthermore, since distinguishing nesting and roosting habitat is difficult, we have combined these categories, though there may be some nesting/roosting stands that provide more structures and requirements for nesting than others. The needs for dispersal habitat are generally met by both nesting/roosting and foraging habitat. Non-suitable habitat is any habitat type that does not currently provide for either the nesting/roosting or foraging needs of spotted owls, i.e., open stands with low tree density. Additionally, we have described the prey habitat for the spotted owl in northern California as this does not always match its foraging habitat.

5.2.5.3 Nesting habitat

While nests are mainly in mature stands in other areas of the Pacific Northwest, observers have commonly spotted them in younger stands in northern California, where rapid growth allows for development of habitat before trees reach the old-growth stage. On MRC land, a study of nest sites in 2000 and 2001 indicated that nest trees were of greater dbh than trees selected randomly in random plots, and basal area around the nest tree was greater than basal area in random plots. Mean nest tree diameter on MRC land was 34.6 in. (89 cm) dbh, compared with 26.4 in. (66 cm) dbh in random plots. Nest tree plots were generally multi-layered (>2 vegetative layers) and mean canopy cover at nest sites was 89%.

Nests tend to be in tree or snag cavities, on platforms (in abandoned raptor or raven nests, squirrel nests, mistletoe brooms, or debris accumulations), or on broken-top snags. In more mature forests, spotted owls tend to use broken-top trees and cavities more frequently than platforms (LaHaye 1988, Buchanan 1991, Gutiérrez et al. 1995). Researchers located nests in northwestern California on the lower portions of slopes, probably because lower slopes and river terraces provide large trees (Sawyer et al. 1988, LaHaye and Gutiérrez 1999). Nesting habitat commonly consisted of Douglas-fir trees with an average age of 300 yrs, an average height of 92 ft (28 m), and a diameter in the range of 46.8-61.8 in. (119-157 cm) dbh (LaHaye and Gutiérrez 1999).

Forest cover was approximately 70% at the nest site (LaHaye and Gutiérrez 1999). In coastal Mendocino County, Pious (1995) noted that the majority of nests occurred in coastal redwood (73%), with fewer in Douglas fir (14%), and tanoak (8%).

5.2.5.4 Roosting habitat

The characteristics for roosting sites, especially during the summer, are dense canopy cover dominated by large-diameter trees, multiple canopy layer, and north-facing slopes (Barrows 1981, Gutiérrez et al. 1995). In the summer, spotted owls typically roost in cooler areas within well-shaded stands or near streams. Some have observed owls roosting low to the ground in understory trees that form an umbrella of leaves over the perch site during the summer months (Barrows and Barrows 1978). Winter roost sites are not necessarily identical to sites used during the summer months and can be in more open habitat (Barrows 1981). Multi-layered forests with sheltered roost sites appear to be essential to the owl's survival.

5.2.5.5 Foraging habitat



Dusky-footed Woodrat
Photo by Glenn Vargas

Foraging habitat varies more than roosting and nesting habitat (Thomas et al. 1990) but generally includes high canopy closure and complex structure (USFWS 1994c). Several studies have investigated foraging habitat requirements. Although spotted owls appear to avoid crossing clearcut areas and recently logged forests (Gutierrez et al. 1995), researchers have recorded foraging along forest edges (Ward 1990, as cited in Gutierrez et al. 1995; Zabel et al. 1995). However, Ward et al. (1998) reported that the optimal

ratio between young forest edge and remaining late-seral forest is indeterminate. Thomas et al. (1990) found that foraging owls consistently avoided young stands and pole stands. In contrast, Blakesley et al. (1992) found no tendency of owls to avoid young stands of approximately 11–21 in. (28–53 cm) dbh. In a study by Blakesley et al. (1992), owls used stands with diverse compositions and complex structures produced by natural processes.

Overall, old-growth forests are apparently the preferred foraging and roosting habitat for the spotted owl in its northern range. However, some open areas are also important foraging habitat in northern California, as the availability of prey is higher in disturbed areas (Folliard et al. 2000). Spotted owls are probably not able to maneuver well in the young stands with the highest prey abundance (Zabel et al. 1993, as cited in Thome et al. 1999); therefore, they are likely to forage in stands that are young enough to contain an abundance of prey, such as woodrats, but old enough to allow the owls to fly under the canopy (Thome et al. 1999).

5.2.5.6 Dispersal habitat

Requirements for dispersal habitat for the northern spotted owl are not well known. The 50-11-40 rule, suggested by Thomas et al. (1990), recommends that 50% of a landscape be in trees with an average dbh of 11 in. providing a minimum of 40% canopy cover for spotted owl dispersal.

5.2.5.7 Prey habitat

While mechanisms limiting and regulating northern spotted owl populations are unclear, prey abundance and availability are important factors in northern spotted owl survival (Gutierrez et al. 1995, Ward et al. 1998, Driscoll 2000). Spotted owls select for the largest, most available prey (Ward et al. 1998), such as dusky-footed woodrats in northern California. However, they are

somewhat opportunistic and will also prey on smaller mammals, such as deer mice, red-tree voles, and red-backed voles, among others (Gutierrez et al. 1995). In northern California, Ward (1990, as cited in Gutierrez et al. 1995) reported radio-marked male spotted owls foraging at sites with an abundance of woodrats, as well as deer mice.

Woodrats, the primary prey species in northern California (Gutierrez et al. 1985, Ward et al. 1998), prefer live oaks and other thick-leaved trees and shrubs with dense shrub cover (Kelly 1990). Hamm (1995) found them to be most abundant in seedling-shrub and sapling-pole seral stages. The second most important prey, northern flying squirrels, are found in coniferous and mixed forests, but may also occur in hardwoods with a high abundance of old and dead trees with numerous nesting cavities.



Flying Squirrel
Photo from Burke Museum

Although northern flying squirrels are more abundant in late-seral forests and, therefore, are more accessible to spotted owls, individuals have only about one-half of the biomass of woodrats (Ward et al. 1998). Thus, spotted owls with a high proportion of woodrats in their diets



Red-tailed Hawk
Photo by W.S. Clark

have smaller home ranges than those that eat mostly flying squirrels (Zabel et al. 1995). Franklin et al. (2000) stated that northern spotted owls in California prefer woodrats over any other prey item and select for foraging habitat of a mid-successional forest, where woodrats were both abundant and accessible (Franklin et al. 2000).

A prey-base study conducted in southwest Oregon found greater woodrat abundance in mixed-conifer forests than in Douglas-fir forests (Center et al. 1991). Woodrats were most abundant in young (<80 years) stands and in disturbed portions of old stands (>80 years) where dense re-vegetation occurred in mixed-conifer forests (Center et al. 1991). This same study also indicated a positive correlation between percentage of woodrat abundance and ground cover of fine and coarse litter. In coastal northwestern California, dusky-footed woodrat abundance typically peaks approximately 10–20 years after a clearcut (Driscoll 2000). In coastal redwood forests of northern California, Fitts and Northen (1991) reported the greatest woodrat abundance occurred in 7- and 11-year-old clearcuts.

In northwestern California, Sakai and Noon (1993) reported that radio-marked woodrats move between different habitat types, which suggested that sapling/brushy pole-timber stands adjacent to mature and old-growth Douglas-fir/tanoak forests may be sources for woodrats preyed upon by spotted owls. Sakai and Noon (1993) found woodrat densities were highest in (a) sapling/brushy pole-timber, 4.8-10.6 in. (12.1-27.0 cm) dbh and 15-40 yrs; (b) seedling/shrub, 0-4.7 in. (0-12 cm) dbh; and (c) large old-growth stands, 35.4 in. (>90.1 cm) dbh and >180 yrs. Woodrats did not occur in small saw-timber stands (41-80 yrs) and were rarely found in large saw-timber stands (81-180 yrs) (Sakai and Noon 1993). Moreover, the cited study suggested that implementing specific silvicultural practices that provide open areas for woodrats adjacent to suitable spotted

owl habitat may directly benefit spotted owl populations by providing an abundant and available prey source. Ward et al. (1998) reported that northern spotted owls may select conifer-hardwood edge sites as a possible compromise between finding abundant versus accessible dusky-footed woodrat populations.

Little is known about woodrat abundance patterns in coastal northwestern California (Hamm 1995), patch sizes required by woodrats to maintain self-sustaining populations (Sakai and Noon 1993), or the most effective silvicultural strategies to maintain woodrat habitat within regenerating clearcuts (Sakai and Noon 1993). Consequently, it is necessary to test hypotheses associated with timber management practices and determine the optimal spatial distribution of forest types and stages for spotted owls in a managed landscape (Sakai and Noon 1997, Ward et al. 1998). Specifically, MRC forests currently support a high density of tanoaks, woodrats, and spotted owls. Whether our restoration of conifer-dominated forest will result in a reduction of woodrats—the primary prey of spotted owls in northern California—is unclear.

5.2.6 Ecological interactions

5.2.6.1 Diet

Diet varies with season and includes a variety of mammals, birds, and insects. Overall, 92% of prey items are mammals (Forsman et al. 1984). Pious and Ambrose (1994) described the diet of northern spotted owls in coastal Mendocino County as consisting by biomass primarily of dusky-footed woodrats (74% in 1989, 82% in 1990) and brush rabbits (16% in 1989, 10% in 1990) with other species consisting of < 5% of the biomass.

5.2.6.2 Predators

Cooper's hawks, red-tailed hawks, northern goshawks, and great horned owls can prey on spotted owls. Great horned owls occur throughout the distribution of spotted owls and prey especially on juveniles, which are easily caught in open habitats such as woodlands, clearcuts, and grasslands. Forest fragmentation leads to increased numbers of great horned owls which may prey on juvenile spotted owls (Gutiérrez 1985). However, the authors of a recent status review of the northern spotted owl state that scientific findings no longer support the earlier perception that forest fragmentation increases the threat of predation (Courtney et al. 2004).

5.2.6.3 Interspecific competition with barred owl

Barred owls have expanded their distribution into the western United States and are now found throughout southwestern Canada, Washington, Oregon, and northern California. There were no observations of barred owls in California before the late 1970s and 1980s (Dark et al. 1998). Increased sightings of barred owls are probably due to (1) an actual increase in numbers through immigration and the subsequent successful establishment of breeding populations; and (2) a recent increase in surveying effort for spotted owls that has led to more observations of barred owls. Barred and spotted owls are ecologically similar. They forage in similar habitats and have overlapping diets, although barred owls appear to be more tolerant of disturbance and habitat fragmentation (Dark et al. 1998). Barred owls exhibit a behavioral dominance over spotted owls, which can lead to either displacement of spotted owls (Hamer 1988) or hybridization between the species (Hamer et al. 1994). Hybridization reduces reproductive success of existing spotted owl populations by, in essence, removing reproductive spotted owls from the breeding population. Additionally, the Endangered Species Act does not list hybrids (Dark et al. 1998). There is also some indication that barred owls may actually prey on spotted owls (Leskiw and Gutiérrez 1998).

A review of known hybrids in Oregon and Washington indicates that only 28 known territories in those states had examples of hybridization through 1999. This is a low number considering the

hundreds of known spotted owl territories in Oregon and Washington (Kelly and Forsman 2004). Moreover, modeling efforts indicate barred owls have the potential to invade the entire range of northern spotted owls, though researchers do not yet know the effect this may have (Peterson and Robins 2003). One study indicates that the occupancy of northern spotted owl territories decreased after barred owls were detected within 0.8 km of a spotted owl site center (Kelly et al 2003). Occupancy was only minimally reduced when barred owls were detected more than 0.8 km from a spotted owl site center (Kelly et al 2003). Another experimental study found that spotted owls responded less to spotted owl calls after exposure to barred owl calls; northern spotted owls responded less frequently in areas with a greater number of barred owls (Crozier et al 2006). Courtney et al. (2004) list competition from barred owls as a major threat but remain uncertain about its magnitude.



Barred Owls
Photo by Robert Suplee

The Northern Spotted Owl Recovery Plan was more confident of the threat of barred owls and the need to respond. “At this time,” the report states, “it appears long-term lethal control of significant numbers of barred owls should be assessed to recover the spotted owl” (USFWS 2008, p. 8). Gutierrez et al (2007) concluded that lethal control is the most effective method for controlling barred owls, but recommended that this method be initiated in designed experiments before using it as a management tool.

Barred owls compete with and on rare occasions prey on northern spotted owls; in the last 20 years or so, their range has expanded into northern California (Dark et al. 1998, Leskiw and Gutierrez 1998). Barred owls were first detected in Mendocino County in 1978.^{5/1} By the end of the 2008 breeding season, MRC biologists had detected barred owls within 1 km of 30 individual spotted owl territories. Since 2005, the number of barred owl territories detected within 1 km of spotted owl territories has increased steadily (1 in 2005, 4 in 2006, 6 in 2007, 9 in 2008, 4 in 2009, and 22 in 2010). While some territories had barred owl detections in some years and not others, 9 territories have had barred owl detections in at least 2 of the past 4 years. There are likely more undocumented occurrences of barred owls in Mendocino and Sonoma counties.

5.2.6.4 Disease

The first detection of West Nile Virus (WNV) in California was in 2002. WNV is an arbovirus spread mainly by infectious mosquitoes; birds are often the source of infection (Boyce et al. 2004). The extent to which WNV will be a major threat to spotted owl populations is unknown. Crows experimentally infected with WNV exhibited a 100% mortality rate (Komar et al. 2003). If forest corvids (ravens and jays) behave like crows, then spotted owls that live in close proximity to them on covered lands may contract the virus and face uncertain survival. Courtney et al (2004) rated the West Nile Virus as a threat to spotted owls although they were uncertain of its magnitude.

^{5/1-3} Email to Sarah Billig (MRC) from John Hunter (USFWS) on 11/14/2006.

5.2.7 Sensitivity to anthropogenic disturbances

5.2.7.1 Changes to forest stand structure

Timber harvesting and road building have direct effects on nesting, roosting, and foraging habitat by removing large trees and opening the canopy layer. Spotted owls are sensitive to habitat disturbance, due to their low tolerance for high temperatures and their association with late seral stages of forest and snags or cavity trees. In addition, forest fragmentation isolates populations, provides clearings where great horned owls may be more successful at preying on spotted owls (Forsman 1976), and provides habitat that competing barred owls may utilize better than spotted owls.

According to Wasser et al. (1997), timber harvesting and road building activities can also affect northern spotted owls by increasing physiological stress and contributing to decreased reproductive success. Male northern spotted owls exhibit a significant rise in fecal corticosterone levels when they occupy territories centered within 0.27 mi (0.41 km) of a major logging road or recent (within 10 yrs) timber activity (Wasser et al. 1997). No differences were recorded among females. Moreover, male corticosterone levels were higher in home ranges near clear-cut areas than in home ranges near selectively logged areas. There was a short-term elevation of stress hormones in female owls during the 1.5-month interval when their young began to fledge; this factor could prove important in developing guidelines for seasonal limitations on harvests in close proximity to nesting owls. “Management-related factors reflecting habitat condition and proximity to roads,” according to other researchers, “were not correlated with fecal corticosterone” (Tempel and Gutierrez 2004, p. 538).

5.2.7.2 Disturbance

Additional studies have examined the effect of disturbance on spotted owl behavior. Delaney et al. (1999) studied the effects of both chainsaw and helicopter noise on Mexican spotted owls (MSO). They found 345 ft (105 m) was the furthest distance at which MSOs flushed due to helicopter noise. Roads provide open space for predators, such as great horned owls, to prey on spotted owls. One reported case of a barred owl preying upon a spotted owl occurred on a trail (Leskiw and Gutiérrez 1998).

Noise is a source of disturbance and a potential threat to northern spotted owls, especially during the breeding season (USFWS 1997c), as it can cause the abandonment of nest and young. Noise includes road traffic, use of mechanized equipment, and recreational activities, such as boat use, off-road vehicle use, and hunting. Measurements in Redwood National Park and State Parks showed that chainsaw noise 100 ft (31 m) away from a nest was still 1.5–2 times louder than natural background noise (Redwood National and State Parks 1998).

5.2.8 Status assessment and strategies for recovery

5.2.8.1 Status assessment of northern spotted owl

The authors of the scientific evaluation of the status of the northern spotted owl (Courtney et al 2004) list 3 major threats to this subspecies:

1. Results of past and current timber harvests.
2. Loss of habitat to wildfire.
3. Barred owls.

In order to finalize the *Northern Spotted Owl Recovery Plan*, USFWS convened a panel of seven experts on June 1, 2006. The panel rated and identified the most pressing threats to the spotted owl (USFWS 2008, p. 7):

1. Past habitat loss.

2. Current habitat loss.
3. Competition from barred owls.

5.2.8.2 USFWS recovery plan for habitat retention

The *Northern Spotted Owl Recovery Plan (USFWS 2008)* designates Managed Owl Conservation Areas (MOCA) and Conservation Support Areas (CSA). These create a network of habitat and population density to support spotted owls. MOCAs are mapped areas that “contain or will develop suitable habitat considered essential for spotted owl recovery” (USFWS 2008, p. 13). The USFWS intent is that MOCAs will generally be static, though there may be minor adjustments to their boundaries consistent with the plan. There are two types of MOCAs.

- MOCA 1 is capable of supporting 20 or more breeding spotted owl pairs now or in the future.
- MOCA 2 is capable of supporting 1-9 pairs of breeding spotted owls.

CSAs are adjacent to or near MOCAs. They retain spotted owl habitat either through HCPs or through protected areas, such as state and federal parks.

5.2.8.3 USFWS recovery criteria

The *Northern Spotted Owl Recovery Plan* lists 3 criteria for recovery.

- **Criterion 1**
The population trend of spotted owls appears stable or increasing throughout 10 years of monitoring, as measured by a statistically reliable method, in each province including Western Washington Lowlands and the Willamette Valley, with a low probability that the population is actually declining.
- **Criterion 2**
The distribution of spotted owls, within each state, is such that at least 80% of Category 1 MOCAs contain 15 or more occupied spotted owl sites when surveyed over a 5-year period.
- **Criterion 3**
At least 30% of each province—Eastern Cascade Provinces in Washington and Oregon and California Cascades Province—contains high quality habitat; 75% of this habitat is within at least one home-range radius of an activity center of a territorial pair of spotted owls, as measured over a 5-year period.

5.2.9 Impacts of MLC (2008)

The lightning fires of 2008 burned through the core areas of 23 northern spotted owl territories. Of these territories, 14 had produced young in the past and 3 were high producers (i.e., they produced more than 0.8 fledglings per year averaged over a 10-year period). Just 3 of these 20 territories had nests in 2008, while 15 were occupied, 3 unoccupied, and 2 unknown.

5.2.10 Key uncertainties

MRC management has identified the following key uncertainties, with cross references to validation monitoring programs in parentheses:

- What is the degree to which barred owls will invade the plan area in Mendocino County?
- Are there conservation measures related to land management and disturbance that could favor spotted owls over barred owls?

- ▶ Will removing barred owls from the plan area have a positive effect on spotted owls (M§13.9.1.4-7)?
- How does land management influence the interactions between barred owls and northern spotted owls?
- ▶ Are the population and number of spotted owl territories on covered lands increasing, stable, or decreasing (M§13.9.1.4-1)?
- ▶ Does MRC habitat typing for spotted owls accurately reflect actual habitat available on the landscape (M§13.9.1.4-2)?
- ▶ Can the pattern, arrangement, or acreage of nesting/roosting and foraging habitat affect spotted owl demographic rates (M§13.9.1.4-5)?
- ▶ Are spotted owl demographic parameters (e.g., productivity, survival, etc.) affected by the amount of protection they receive, i.e., do larger core areas provide for greater spotted owl productivity (M§13.9.1.4-3)?
- ▶ What is the effect of harvesting within 1000 ft of a spotted owl activity center with limited protection (M§13.9.1.4-4)?
- What are the redwood forest metrics for northern spotted owl nest-roost requirements; e.g., basal area, canopy closure, dbh distribution?
- What effect will more frequent harvest entries into MRC forests as a result of uneven-aged management have on northern spotted owls in the plan area?
- What effect will uneven-aged management have on the availability of spotted owl prey?
- What effect does herbicide applications have on woodrat populations?
- ▶ Is there a direct correlation between the density of hardwoods, especially tanoaks, within spotted owl territories and the demographic parameters of spotted owls (M§13.9.1.4-6)?
- What effect will West Nile Virus have for spotted owl survival in the plan area?

5.3 Marbled Murrelet

5.3.1 Geographic distribution

The marbled murrelet (*Brachyramphus marmoratus*) breeds from the Aleutian Archipelago and the eastern Bering Sea in Alaska to Monterey Bay in central California (USFWS 1997c, Ralph et al. 1995). Marbled murrelets winter throughout this breeding range and also occur in small numbers offshore from southern California (USFWS 1997c). Researchers completing genetics work on murrelet populations recently recommended five genetic management units: western Aleutian, central Aleutian Islands, mainland Alaska and British Columbia, northern California, and central California (Friesen et al 2005).

In California, suitable marbled murrelet forest habitat currently exists in 3 areas, 2 of which are separated by a large gap of approximately 298 mi (Cooperrider et al. 2000, p. 162):

- In the northern portion of Del Norte and Humboldt counties (mostly Redwood National Park).
- In the central portion of Humboldt County (mostly Humboldt Redwood Company and Humboldt Redwoods State Park).



Photo from USDA

- In San Mateo and Santa Cruz counties.

Miller et al. (1995) reported that nesting probably once occurred in a more or less continuous distribution along the California coast. Much of the area between Del Norte and Santa Cruz counties, including Mendocino County, probably supported significant numbers of murrelets prior to extensive timber harvesting. The distribution gap in Mendocino and Sonoma counties is part of Recovery Zone 5, according to the *Marbled Murrelet Recovery Plan* (USFWS 1997c). Little historical information regarding murrelet abundance is available for these areas. Based on their current range and scientific understanding of their habitat requirements, however, it seems likely that murrelets nested in substantial numbers along the Mendocino County coast prior to the removal of much of its old-growth forest (Carter and Erickson 1988).

In winter, marbled murrelets may be found as far south as San Diego County (Nelson and Singer 1994). In the southern portion of their range, marbled murrelets have been observed making winter flights into coastal forests. The reason is unknown but it may be to maintain nest sites, territories, and pair bonds, or to select nesting areas (Naslund 1993, Nelson 1997).

5.3.2 Local distribution

The potential distribution of murrelets on or in the vicinity of the plan area was determined by reviewing records from MRC, Georgia Pacific, CDFG, and USFWS on murrelet detections in Mendocino and Sonoma counties.⁶

There are few terrestrial breeding season (or “inland”) records for marbled murrelets in Mendocino County (Paton and Ralph 1990, Miller et al. 1995). Detections further than 5 miles inland appear to be uncommon in Mendocino and Sonoma counties. However, in 1997 and 2003 murrelets were detected as far as 9.75 miles inland indicating that potential habitat and murrelet use does occur up to 10 miles inland. There has been only 1 confirmation of marbled murrelets nesting in Mendocino County; eggshell fragments were found beneath a residual old-growth Douglas fir in 1993 near Alder Creek in what is now the plan area.

There are currently 6 known occupied murrelet sites in Recovery Zone 5. The area most consistently occupied in Recovery Zone 5 is Lower Alder Creek drainage. Lower Alder Creek is the only known occupied site in the plan area. MRC monitors activity levels on this drainage annually using radar surveys. There are 3 known occupied sites within this drainage: (1) the “occupied tree” approximately 2.8 miles inland; (2) the “eggshell fragment tree” approximately 3.1 miles inland; and (3) the West Brushy stand approximately 3.9 miles inland. We are also presuming murrelet occupancy at a fourth site with old-growth characteristics that is south of the main branch of Alder Creek but connected to the Alder Creek drainage by Tramway Gulch. All sites within Lower Alder Creek Drainage are within redwood/Douglas-fir stands; major components of these stands are large Douglas firs with platform branches required for potential murrelet nests. Additionally, 2 occupied sites are currently located on Hawthorne Timber lands: Horsetail and Gulch 16. The 2 sites are located at 6.4 and 9.8 miles inland, respectively.⁷ The Horsetail site is on a north-facing slope with multiple potential platforms and an abundance of moss on the branches. The Gulch 16 site has few potential platforms and widely spread platforms. Russian Gulch State Park, where a murrelet occupied site has been identified, has been a continuous source of detections. CDFG detected a murrelet on the Gualala River in the vicinity of

⁶ Esther Burkett and Staci Martinelli (CDFG), as well as John Hunter (USFWS), assisted MRC in this review process.

⁷ Email to Sarah Billig (MRC) from Scott Fullerton (The Campbell Group) on 2/23/2006.

Stewart's Point, as well as one near the convergence of the Wheatfield Fork of the Gualala River and Haupt Creek. Though CDFG has yet to identify an occupied stand for either of these detections, it is likely that the occupied stand is close by.

Murrelet detections at other sites, including Admiral Standley State Recreation Area and Angelo Preserve, indicate these sites were occupied at one point, but are likely unoccupied now. Both sites mentioned contain a significant component of mature and old growth Douglas fir and redwoods.

Murrelet detections outside of occupied sites have been rare throughout the assessment area. However, unoccupied habitat located near occupied habitat may be more important for the recovery of the species than suitable isolated habitat (USFWS 1995a, as cited in USFWS 1996b). Occupation of a stand will eventually enhance the value of younger stands as they mature because marbled murrelets are more likely to colonize new nesting sites if there are other murrelets nesting nearby (USFWS 1996b).

Few terrestrial observations of marbled murrelets in the vicinity of the HCP/NCCP assessment area have been reported. Detections were recorded at Russian Gulch State Park in 1976 and 1 km (0.6 mi) east of the town of Mendocino in 1988 (Paton and Ralph 1988). Additionally, an observer was "fairly sure" that murrelets were detected during a Russian Gulch/Van Damme transect survey conducted in 1988 (Paton and Ralph 1988). Later in the summer of 1998, 6 stations (4 in Jackson Demonstration State Forest near Russian Gulch State Park, 1 at Russian Gulch State Park, and 1 near the mouth of the Big River) were each surveyed once (CDFG 1998a). These surveys produced additional marbled murrelet detection at the Russian Gulch State Park station. CDFG has detection records on the Gualala River in the vicinity of Stewart's Point Road, including 20 detections on one occasion in 1999.

Efforts to survey for marbled murrelets within Jackson Demonstration State Forest (JDSF), which is contiguous with the plan area in coastal Mendocino County, have not resulted in any detection of marbled murrelets (Stillwater Sciences 1999, Table 2 and Map 12). JDSF researchers recommended further surveys in old-growth forest habitat, on other possible flight corridors, and in subsequent years because the presence of El Niño conditions may have precluded nesting of marbled murrelets during the survey period (Cota and Papke 1994).

Georgia-Pacific (G-P) lands in the Big River area were surveyed for marbled murrelets in 1994. Limited surveys conducted elsewhere on G-P lands indicated that murrelets traveled across G-P property in some areas to get to nesting sites. A pair of murrelets, for example, was observed flying across G-P land near the Wages Creek/Rider Gulch confluence, and other murrelets were detected in the Admiral Standley State Recreation Area on land directly adjacent to G-P. G-P did not think that suitable nesting habitat for the marbled murrelet was present on their land (G-P 1997). In 2003, observers heard and saw murrelets on 2 additional sites on Hawthorne Timber lands (previously G-P lands). In both these locations murrelets were displaying behavior indicative of occupancy. The 2 sites were located at 6.4 and 9.8 miles inland.⁸ However, absence of detections during terrestrial marbled murrelet surveys does not necessarily imply that murrelets are not present or nesting since marbled murrelets can be extremely difficult to detect (CDFG 1997b). Marbled murrelets fly very rapidly over or through the forest and are only briefly present over survey stations. Extraneous noise, visibility from survey stations, and skill of the observers can influence survey results (O'Donnell 1995). Researchers in Oregon have documented the

⁸ Email to Sarah Billig (MRC) from Scott Fullerton (The Campbell Group) on 2/23/2006.

presence of active murrelet nests after climbing trees in stands that did not yield detections through the use of the survey protocol (CDFG 1996c).

For a list of murrelet detections in Mendocino County refer to Table 10-20. This table records detections from 1976-2005 for Mendocino County as a whole and detections from 1998-2010 on what became MRC land. Appendix L, *Marbled Murrelet Data and Protocol*, records the murrelet surveys on MRC land going back to the previous LP ownership in 1994 and continuing with MRC efforts from 1998-2010.

5.3.2.1 Critical habitat in the plan area

USFWS has designated areas adjacent to the plan area as critical habitat for marbled murrelets (USFWS 1996b).⁹ These areas include Jackson Demonstration State Forest and Bureau of Land Management lands east and north of Rockport, Hendy Woods State Park, Montgomery Woods State Reserve, and Mailliard State Reserve. As of 2011, USFWS has not officially designated any part of the plan area as critical habitat. A 2007 proposal by USFWS for critical habitat, however, includes small portions of private timberlands as critical habitat including the occupied areas of Lower Alder Creek (MRC) and the Ten Mile Drainage (Campbell Timberlands).¹⁰

Critical habitat has been designated not only in zones where relatively large populations nest, but also in areas of current low use. The goal has been to fill in nesting distribution gaps, thereby buffering the species from future catastrophic events, such as oil spills and forest fires. In California, 71,040 ha (175,500 ac) of state lands were designated as critical habitat—of which adjacent JDSF land constitutes approximately 29%. Once critical habitat is designated, any federal agency wishing to take action on that land must first consult with the USFWS.

5.3.3 Population trends

Historical estimates indicate that 60,000 marbled murrelets once nested on the California coast (Larsen 1991, as cited in Cooperrider et al. 2000). The current California breeding population is estimated at approximately 2000 (Carter and Erickson 1992, Carter et al. 1992; both as cited in USFWS 1997c), with a state total of approximately 6500 breeding and non-breeding birds (Ralph and Miller 1995). While monitoring at sea shows murrelet populations may be stable, recruitment is low and demographic models indicate the population will decrease by 4-6% per year (Raphael 2006). This decrease is primarily due to loss of breeding habitat in old growth forests and poor reproductive success due to increased nest predation (McShane et al 2004). When the ratio of hatch-year to after-hatch-year was corrected using data from a recent study (Peery et al 2007), murrelet productivity proved poor in central California. Demographic models also suggest the population decline will continue for 50 years with the largest relative declines in California (McShane et al 2004). The production of only 1 egg per year, combined with a low recruitment rate complicates recovery efforts for this species. Most experts consider that at least 100 to 200 years will be necessary for marbled murrelet populations to recover to sustainable population levels because that is the time period necessary for second-growth forests to grow trees large enough to provide appropriate nesting habitat.

⁹ USFWS reopened the public comment period for its proposal to revise the critical habitat designation for the marbled murrelet. New comments were accepted until March 13, 2009. The pending decision of USFWS may necessitate changes to the final draft of the HCP/NCCP.

¹⁰ This proposal for critical habitat was retrieved at <http://www.fws.gov/pacific/marbledmurrelet/map13.html> on 9/19/2007

The murrelet recovery plan (USFWS 1997c) stated that it would take 100–200 years for forests to grow to a stage suitable for murrelet nesting if all harvesting was halted. It would then take an additional 64 years for murrelet populations to reach their original size (USFWS 1997c). The marbled murrelet recovery plan delineates 6 marbled murrelet conservation zones based on current population, habitat distribution, threats, and geopolitical boundaries (USFWS 1997c). The plan area is located in Recovery Zone 5, which extends from the southern boundary of Humboldt County, California, south to the mouth of San Francisco Bay. It includes offshore areas within 2 km (1.2 mi) of the shoreline, and extends inland for a distance of up to 40 km (25 mi) from the Pacific Ocean. The majority of marbled murrelet nesting habitat that remains in this area is located on private lands. The murrelet population occurring off shore of the Mendocino County coast is small; however, it, along with small populations occurring off the coasts of Sonoma and Marin counties, may be important for reconnecting murrelet populations in northern and central California. Very little suitable nesting habitat remains in these areas, and most of what does exist is on private lands. Stabilizing and enhancing this small but potentially critical population will require considerable cooperation between state, federal, and private landowners (USFWS 1997c).

5.3.3.1 Population sizes and densities in recovery zone 5

Because detecting murrelets in their forest breeding habitat is difficult, offshore surveys of foraging birds have generated the most reliable population density estimates available for the Mendocino County coast. Strong et al. (1997) used line-transect analyses based on data collected 500 m offshore to estimate densities between the Oregon border and Bodega Bay in 1994 and 1995. Between Cape Mendocino and Arena Cove, these estimates ranged from 0.66 to 2.70 birds/km² in 1994, with population estimates in that region of 133–385 birds. Variation in densities and population size is due to recruitment of hatch-year birds as summer progressed. In 1995, densities ranged from 0.70 to 5.95 birds/km²; population estimates were 133–966 murrelets.

In 2001, there were an estimated 117 murrelets in Recovery Zone 5; in 2002, approximately 250 murrelets; in 2003, approximately 48 murrelets; in 2004, approximately 84 murrelets; and in 2005, approximately 289 murrelets.¹¹ South of Arena Cove to Bodega Bay, data is available only for July of 1995. The estimated density of murrelets based on this data was 2.40 birds/km²; the population size was 286 (Miller et al 1995). These estimates can be compared with those detected near the Oregon border, which ranged from 29.9 to 36.3 birds/km² in 1994 and from 10.3 to 28.2 birds/km² in 1995. Estimated population sizes generated by these surveys ranged from 2835 to 3450 birds in 1994 and from 2135 to 3008 birds in 1995 (Miller et al 1995). The densities and population sizes of murrelets off the coasts of Mendocino and northern Sonoma counties thus appear to be very low. An important note is that this data does not necessarily provide specific information regarding breeding densities or population sizes. A relatively large proportion of some alcid populations do not breed for lack of nest sites or limitations of other resources (Strong et al. 1997). However, data generated by offshore transects can be used to estimate population productivity, as it provides information on juvenile to adult ratios.

5.3.4 Life history

5.3.4.1 Reproduction

Based on the rate of successful fledging of young from observed nests, marbled murrelet populations have had one of the lowest reproductive rates of any species in the seabird family Alcidae thus far studied (De Santo and Nelson 1995, USFWS 1997c). Although marbled

¹¹ Email to Sarah Billig (MRC) from John Hunter (USFWS) on 07/21/2006.

murrelets feed and roost on the water, they nest in stands of old-growth coniferous forest located within 81 km (50 mi) of the coast (Miller et al. 1995); some birds may nest much farther inland in British Columbia (Hull et al. 2001).

The breeding season for murrelets is from March 24th through September 15th. Nesting typically begins between early April and early July. Marbled murrelets are not as social as many other species in the family Alcidae, most of which nest in dense colonies. Although they will sometimes nest in the proximity of other pairs, marbled murrelets will also frequently nest alone. Small groups have often been observed flying over potential nesting sites. Marbled murrelets are extremely faithful to their nest sites; they may return to the same stand and even the same tree year after year (Miller et al. 1995).

Marbled murrelets do not build a traditional nest, but lay a single egg on a large branch or natural platform with large amounts of canopy cover at heights greater than 30 m. The egg is usually prevented from rolling off the branch by a small depression or cup made in moss or other natural debris on the limb (Miller et al. 1995). In Douglas-fir and redwood forests, eggs are frequently placed on duff platforms (Hamer and Everett 1996). Marbled murrelet nests are extremely difficult to locate.

5.3.4.2 Movement and dispersal

Marbled murrelets feed closer to shore than other alcids, usually within 3.2 km (2 mi) of the coast, and can also be found in bays, lagoons, and coves (USFWS 1996b, Nelson 1997). They often preferentially forage near kelp beds or at the mouths of streams. During the breeding season, marbled murrelets form congregations at dawn and dusk near the shore close to the breeding grounds (Nelson 1997). Hull et al. (2001) reported travel distances up to 102 km from inland nesting sites to offshore foraging areas.

The movements of marbled murrelets at sea during the non-breeding season are not well understood. In Washington and British Columbia, marbled murrelets were found to be year-round residents (Rodway et al. 1992, Speich and Wahl 1995; both as cited in Beauchamp et al. 1999); other surveys indicate partial shifts in seasonal distribution in Alaska, British Columbia, Oregon, and California (Campbell et al. 1990, Burger 1995, Courtney et al. 1996, Naslund 1993, Strong et al. 1995, Agler et al. 1998; all as cited in Beauchamp et al. 1999). Naslund (1993) reported that marbled murrelets in central California visited nesting areas throughout the non-breeding season (October–March), although in reduced numbers; some hypothesize the murrelets may be visiting previous nest sites, prospecting for new nest sites, or maintaining or forming pair bonds (USFWS 1997c). Based on the distribution of murrelets at sea following the breeding season, it appears that some California murrelets disperse south in some years although there is little movement of northern murrelet populations to the central coast of California (Sealy et al. 1991, as cited in Naslund 1993). Although the majority of murrelets appear to remain close to breeding locations throughout the year, Beauchamp et al. (1999) recaptured a banded bird approximately 220 km from the breeding site where it was originally banded; they then captured it again at the breeding location the following season, presenting the first evidence of long-distance migration between breeding and non-breeding areas for this species. Age differences may also play a role in seasonal migratory patterns (Kuletz and Kendall 1998, as cited in Beauchamp et al. 1999).

5.3.5 Habitat requirements

5.3.5.1 Breeding habitat

For nesting in California, marbled murrelets generally require old-growth coniferous forest located close to ocean waters, typically within 10 km (6.5 mi); abundant food resources should be near shore (Miller et al. 1995). The general characteristics of preferred nesting habitat in the Pacific Northwest include a dominance of old-growth trees in a multistoried stand with moderate to high canopy closure (Miller et al. 1995).

In California, stand dominance by redwood (> 50%, Miller et al. 1995, as cited in Cooperrider et al. 2000) in conjunction with dense canopy cover is important in predicting marbled murrelet occupancy (Nelson 1997). Only a few observations (and no nests) of marbled murrelets have been recorded in Douglas-fir dominated forests in California (Hunter et al. 1998). Recently, researchers in central California studied 17 nests and found that all of them were in old redwood forest (Baker et al 2006); 3 of these nests were in harvested stands. Redwood distribution in California is associated with the inland influence of marine air and summer fog (Hunter et al. 1998). Farther inland, where these influences are diminished, Douglas-fir and tanoak forests dominate. Although these stands may contain trees with large limbs and nesting platforms, summer temperatures are higher, resulting in a lack of moss on tree branches and hot, dry conditions that may be unsuitable for murrelet nesting (Hunter et al. 1998). Increasing the distance of murrelets to offshore feeding areas would likely increase energy demands on them during the breeding season (Hunter et al. 1998).

Miller and Ralph (1996) found dense crown cover of old-growth trees to be a dominant characteristic of occupied stands in northwestern California. The mean canopy cover over identified nests is 85% (USFWS 1995a). A typical old-growth forest used for nesting by marbled murrelets is characterized by large trees > 80 cm (32 in) dbh (Miller et al. 1995). In some areas in California, marbled murrelet activity has been documented in “residual” old-growth stands; however, these stands were directly adjacent to large old-growth stands and no nests were found (CDFG 1992a, as cited in USFWS 1995a). Mature second-growth forest stands are not believed to support nesting if they are isolated from old-growth forest stands (Larsen 1991, as cited in Miller et al. 1995). Baker et al (2006) concluded that murrelets primarily use old growth redwood stands for nesting but would use partially harvested stands if they retained some old growth characteristics.

According to Hamer and Nelson (1995), nesting habitat features are chosen in part to reduce predation. Nest sites are not located directly on the coast to avoid the heaviest concentrations of predators, such as gulls and corvids (ravens, crows, and jays). Elements that decrease predator detection of the nest include murrelet selection of dense old growth with multi-layered canopy cover and utilization of limbs with high overhead and horizontal cover located near tree trunks where the trunk itself contributes to the nest concealment. Other murrelet behavioral adaptations to reduce predation include shifting incubation duties and feeding chicks infrequently, thus minimizing the frequency of flights from the ocean to the nest (Nelson and Hamer 1995). Stands farthest from human activity also tend to have the least predation (Marzluff et al. 1997).

The first recorded sighting of a murrelet tree nest was 1974 (Binford et al. 1975). By 2000, a total of more than 170 nests had been located, only 18 of which were in California (Cooperrider et al. 2000). Detailed measurements were taken on 47 of these nest trees across the Pacific Northwest (California, Oregon, Washington, and British Columbia), including 10 nest trees in California (Hamer and Nelson 1995). Most of the nest trees were in old-growth stands, and the nests were placed on mossy limbs. In the Pacific Northwest, the diameter of the trees averaged

83 in (211 cm), while in California the diameter averaged 108 in (278 cm) (Hamer and Nelson 1995). Researchers in central California found the mean dbh of nest trees was 83.8 in (209.5 cm) (Baker et al 2006). The smallest trees used for nesting had an average dbh of 34 in (88 cm) in the Pacific Northwest and 54 in (139 cm) in California. Nests were placed on large branches; the average branch diameter at the nest was 13 in (34 cm) (Pacific Northwest and California). Across the Pacific Northwest breeding range, the most common tree species used by marbled murrelets was Douglas fir but murrelets also nested in Sitka spruce, western hemlock, coast redwood, and western red cedar. In California, the murrelets used redwoods (5 nests), Douglas fir (4 nests), and western hemlock (1 nest). The research of Baker et al (2006) in central California located 15 nests—12 in Douglas fir and 3 in broken-top redwoods. The specific trees selected for nesting generally had wide branches or natural deformities to provide suitable support for the egg and incubating adult.

The smallest branch diameter observed for a murrelet nest in California was 6 in. while the smallest branch diameter for a nest in the Pacific Northwest was 4 in. These branches are from mistletoe brooms, decay, or tree damage (Hamer and Nelson 1995). They are typically found in 50-91% of the crown height and are generally not found on lower portions of the tree, though in Oregon nests have been found at 26% the crown height. Though generally there is a large amount of canopy cover over the nest (mean in California = 87%) the range of canopy over the nest for known nests in California is 5-100%.

Most research indicates that large, contiguous blocks of older-aged forests provide higher quality nesting habitat than small, fragmented stands. Hamer and Nelson (1995) noted that, in the Pacific Northwest, murrelet nest trees were in stands that ranged from 3 to 1100 ha (7 to 2718 ac), with a mean ranging from 31 ha (77 ac) in Alaska to 354 ha (875 ac) in Washington. In California, stands containing nest trees ranged in size from 100-1100 ha with a mean of 352 ha (range 247-2718 ac, mean 870 ac). Marbled murrelets appear to be fairly intolerant of ecological habitat alterations; the edge effects associated with habitat fragmentation probably explain murrelets preference for large tracts of contiguous forest and their nesting success there.

Topography also appears to be important for nest site selection. In northern California, detection levels for marbled murrelets were 3 times higher in major drainages than on major ridges (Miller and Ralph 1996). Both lower Alder Creek and Russian Gulch, areas in which murrelet occupied behavior has been observed, exhibit steep topography. Trees are generally larger and limb breakage from wind is likely reduced in large drainages. Lower elevations, i.e., < 100 m (330 ft), have more occupied stations than higher elevations, i.e., > 200 m (660 ft).

5.3.5.2 Foraging habitat

In California, marbled murrelets forage in coastal waters at the edge of the open ocean (Hunt 1995) at surface and mid-water depths typically less than 50–100 m (164-328 ft) (USFWS 1997c). These areas typically lack obvious features that result in concentrations of prey, with the exception of the occasional river delta or headland area (Hunt 1995).

5.3.6 Ecological interactions

5.3.6.1 Diet

Marbled murrelets feed primarily on invertebrates and fish (Miller et al. 1995). Little data on food preferences is available for the California coast, but sand lance may be a primary component of the diet. Other fish taken include Pacific herring, northern anchovy, osmerids, and sea perch. At the southern end of the marbled murrelet range, sardines and rockfish may be the most important prey items. Invertebrate prey is most important in the winter and spring, and includes euphausiids, mysids, and amphipods (USFWS 1996b). Recently, researchers discovered that pre-

breeding murrelets in central California are preying on marine life lower on the food chain than they did historically, resulting in a lower energy return per catch (Becker and Bessinger 2006).

5.3.6.2 Predators

Observers have noted high rates of predation at the relatively few marbled murrelet nests monitored to date. Common ravens and Steller's jays are frequent nest predators, but other potential predators include great horned owls, American crows, and sharp-shinned hawks. Human disturbance often results in higher corvid populations, thereby potentially reducing murrelet reproductive success.

5.3.6.3 Competition

Unlike marbled murrelets found along the coast from Washington to Alaska that have been observed foraging in mixed species flocks, murrelets in the southern portion of their range tend to forage in pairs or small monospecific flocks of up to 25 individuals (Ainley et al. 1995; Strachan et al. 1995; all as cited in Hunt 1995). The lack of participation in mixed foraging flocks may be tied to avoidance of competition with larger, more aggressive seabirds, particularly gulls (Chilton and Sealy 1987, as cited in Hunt 1995). However, differences in ocean conditions or distribution and behavior of fish aggregations may also contribute to the lack of mixed species foraging among marbled murrelets in the southern portion of their range (Hunt 1995).

5.3.7 Sensitivity to anthropogenic disturbances

Threats to marbled murrelet populations are numerous. The principle threat to these birds is the loss and fragmentation of nesting habitat due to timber harvesting (Miller et al. 1995). Other factors include

- Increases in predation.
- Oil spills.
- Gill netting.¹²
- Fluctuations in food supply due to El Niño.
- Changes in stream sediment that could affect prey base.
- Windthrow.
- Wildfires.
- Over-fishing of prey base.
- Additional human disturbances.

5.3.7.1 Loss and fragmentation of nesting habitat

Because this species relies on old-growth coniferous forest located close to marine waters for nesting habitat, timber harvesting presents a significant threat. Fragmented forests often have extensive tracts with reduced canopy closure, which allows predators to more easily access both eggs and adult birds. Forest fragmentation also leads to a general increase in reproductive habitat for avian predators, such as ravens and crows; this results in greater predator densities (Miller et al. 1995). Many nests found to date have been located at stand edges; these nests have been subjected to high levels of predation and affected by human disturbance. Successful nests tend to be farther from forest edges (mean = 155.4 m versus 27.4 m, USFWS 1995b). Fragmentation of forest habitat (resulting in smaller stand size and edge effects) are important factors that appear to reduce nest success (Nelson and Hamer 1995b, as cited in Cooperrider et al. 2000). A study by Peery et al (2004) found that food availability in some years and nest predation in other years limited murrelets in central California; nest availability was not a limitation.

¹² Eliminated in California and reduced in Washington (McShane et al 2004)

Populations of corvids and other predators are expanding due to development, forest fragmentation, and opening of the forest canopy; this ultimately increases corvid nesting and foraging habitat (Ehrlich et al. 1988, Shuford 1993). Compared with other alcids that typically do not nest in forest habitats, marbled murrelets are believed to be more vulnerable to nest predation (USFWS 1997c). The increased role of predation in the decline of this species is probably strongly linked with anthropogenic influences, particularly forest fragmentation and associated edge effects. Human recreational activities may also result in increased densities of avian predators, including crows, ravens, and Steller's jays.

Raphael (2006) reports that since the inception of the Northwest Forest Management Plan, there has been a loss of 2% of higher suitability breeding habitat on federal forest lands; a 12% decrease in the same habitat has occurred on private timberlands (due to timber harvest). There is evidence that at-sea estimates of population size are positively correlated with amounts of nesting habitat nearby, though at-sea conditions continue to have a meaningful impact on murrelet populations (Raphael 2006).

5.3.7.2 Oil spills

Oil spills pose a significant threat to marbled murrelets. Because marbled murrelets forage primarily in waters near shore, they have one of the highest index values for oil spill vulnerability among seabirds (King and Sanger 1979, as cited in Miller et al. 1995). Oil spills not only cause direct mortality to murrelets, but also reduce the species' prey base.

Large numbers of marbled murrelets were killed in the 1989 Exxon Valdez spill in Alaska. After the Apex Houston oil spill in central California in 1986, at least eleven dead marbled murrelets were recovered (Miller et al. 1995) and mortality levels were likely much higher. Mortality due to oil spills may be part of a cumulative effect along with other anthropogenic factors to reduce the likelihood of population recovery in affected areas.

5.3.7.3 Commercial fishing

Gill-nets often entangle murrelets underwater. In British Columbia and Alaska, hundreds to thousands of marbled murrelets are killed annually in gill-nets. Gill-net fishing is prohibited in northern California from Point Reyes north, resulting in a concomitant reduction in seabird mortality.

5.3.7.4 Changes in prey availability

Marbled murrelets often forage at the mouths of streams where they meet marine waters, and thus may be indirectly affected by forest management activities that increase fine sediment loading to streams. It has been noted that "these habitats and associated prey organisms have been degraded from increased sediment loads due to timber harvesting operations and other land management practices that reduce natural vegetation and increase runoff and erosion" (Miller et al. 1995, p. 6). Natural climatic cycles such as El Niño affect many seabird populations by changing ocean conditions, thereby decreasing primary productivity. The effects of El Niño may be somewhat reduced because marbled murrelets consume a very diverse group of prey species (Miller et al. 1995).

5.3.7.5 Management efforts

Little is known regarding the historical distribution and population sizes of marbled murrelets in Mendocino County. Because of the difficulty of identifying the areas where murrelets nest, there are uncertainties in how best to manage habitat to protect the species on private property. Information that would lead to the development of appropriate strategies for enhancing previously disturbed and fragmented habitat so that it becomes suitable for nesting murrelets is largely

lacking. Wildlife managers are uncertain whether to protect stands where murrelets have been known to nest previously (and where other murrelets may perhaps be attracted by their presence) or to protect a larger number of smaller patches of habitat surrounding suitable nest trees. Tolerance to various management-related disturbances during the nesting season is unknown.

Experts in murrelet biology agree that the recovery of the murrelet population in Mendocino and Sonoma counties is critical to the recovery of the species as a whole since there is a distribution gap in populations (USFWS 1997c). The extremely small population size of murrelets that currently exists in coastal Mendocino and Sonoma counties makes the probability of recovery tenuous at best. However, many steps can be taken to increase the chance that these populations may return to sustainable sizes. Section 5.3.7.6 outlines short-term and long-term strategies developed by USFWS (1995a). Although the strategies address murrelet population recovery throughout California, Oregon, and Washington, they can also provide guidance for developing appropriate measures on private lands. During a recent status review of the marbled murrelet, panelists concluded that the long-term survival of the species in Washington, Oregon, and California was uncertain (McShane et al 2004).

5.3.7.6 Short-term actions to stabilize marbled murrelet populations

The purpose of these short-term strategies, developed by USFWS (1995a), is to stabilize current murrelet populations and prevent further declines. Following are forest management strategies relevant to murrelets:

- Maintain and protect occupied nesting habitat and minimize loss of unoccupied but suitable nesting habitat.

Particular emphasis should be placed on maintaining potential and suitable habitat in large contiguous blocks. This will provide more nesting and hiding opportunities, provide multiple nesting options for pairs, facilitate social interactions, and provide greater interior forest habitat, minimizing edge effects. Larger stands may even lead to a core of birds that ultimately breed as sub-adults or are available to replace breeding birds lost through natural or anthropogenic causes.

- Maintain and enhance buffer habitat surrounding potential nesting stands.

Maintaining buffers will help to mediate edge effects of all types. To have the greatest benefit, buffer zones, of whatever stand age present, should be a minimum of 100–200 m (328-656 ft).

- Maintain current north/south and east/west distribution of nesting habitat throughout the historical geographical range of the species.

Maintaining a contiguous habitat distribution is critical for preventing large gaps in distribution that might result from fire or other catastrophic events. In addition, researchers do not know how nesting success varies with distance from coast. Therefore, some assume that inland nesting sites are as important to recruitment as those closer to shore.

- Increase recruitment by minimizing disturbances at nests.

Low juvenile to adult ratios have been documented throughout the range of the marbled murrelet. Current evidence suggests that this is due to high rates of predation on eggs and nestlings. Breeding adult alcids are generally sensitive to nest site disturbances during the incubation period and the first few days of chick rearing. Human activities near nesting areas that result in increased numbers of avian predators could exacerbate this problem; flushing adults off of nests leads to increased exposure to predation or to accidental losses of eggs and chicks due to falling off or being knocked off nest platforms. Adjusting human activity in nesting areas to minimize impacts on courtship, mating, and nesting could minimize impacts of disturbances. While human activities attract higher than average numbers of predators to nesting areas, forest fragmentation per se is the more important consideration.

5.3.7.7 Long-term actions to facilitate continued recovery of the species

Long-term strategies recognize the complexity of ecosystems; creating mature forest habitat and improving marine habitat requires long time-frames. The following are long-term strategies:

- Increase the amount and quality of suitable nesting habitat.

This goal, important in all conservation zones, is especially crucial in Mendocino and Sonoma counties. Because so little nesting habitat remains in this area, long-term strategies to restore habitat should be a major priority. A panel of experts (Carey et al 2003) concluded that efforts can and should be made to develop young stands (40-80 yrs old) into potential murrelet habitat. The panel recommended that targeted stands be initially thinned from below (in a uniform fashion); the goal of a second entry would be to develop large branches on potential murrelet trees.

- Decrease forest fragmentation by increasing the size of suitable stands to provide a larger area of interior forest conditions.

The majority of suitable nesting habitat for murrelets, particularly in Mendocino County, exists as isolated stands subject to edge effects and associated problems described above. A research priority should be to develop judicious ways to use silvicultural techniques, such as thinning in young unoccupied stands to hasten development of large trees with appropriate structural characteristics (e.g., large protected branches suitable for nesting) and to decrease vulnerability of habitat fragments to wind, fire, and predators.

- Protect existing younger forest stands with good potential to buffer and enlarge existing stands, reduce fragmentation, and provide replacement habitat for suitable nesting habitat lost to disturbance.

Stands that are currently greater than 80 years old are the most immediate source of new habitat and are the only replacement for existing habitat that may be lost to disturbance over the next century. These stands should not be subjected to any silvicultural treatment that diminishes their capacity to provide quality nesting habitat in the future. Within secured areas, these “recruitment” stands should not be harvested or thinned.

- Use silvicultural techniques to increase speed of development of new habitat.

Several such techniques may be appropriate to increase the area of suitable nesting stands and the rate at which they develop. For example, thinning accelerates tree growth and can be used as a tool to produce large trees more quickly than under normal stand development. Producing trees that have the large moss or mistletoe covered branches required for murrelet nesting can be achieved by growing at least some trees on long rotations, such as “green-tree retention,” which designates approximately 20 to 40 trees per hectare to be retained at harvest, with a new crop of younger trees established beneath the older tree canopy.

- Improve and develop north/south distribution of nesting habitat.

Current gaps in the distribution of nesting habitat include most of the Mendocino Zone. Such gaps represent partial barriers to gene flow between breeding populations; providing suitable habitat within these areas will help to buffer existing populations against poor breeding success and catastrophic losses.

- Improve and develop east/west distribution of nesting habitat.

Many areas within the range of marbled murrelets, including most of California, no longer have large amounts of suitable nesting habitat close to the coast, forcing murrelets to fly considerable distances inland to nest. A better understanding of the inland boundary of suitable nesting habitat will aid in the development of suitable nesting habitat.

5.3.8 Key uncertainties

Stabilizing current population levels of marbled murrelets and developing an effective recovery program for the species will require a much more complete understanding of the basic biology, ecology, and behavior of these birds than is currently available. At the same time, the recovery of this species is largely dependent on the protection and management of the marine and terrestrial habitats upon which it depends.

MRC management has identified the following key uncertainties, with cross references to validation monitoring programs in parentheses:¹³

- ▶ *Will specific silvicultural prescriptions generate suitable marbled murrelet habitat quicker than not managing a stand silviculturally (M§13.9.2.2-2)?*
- How can MRC ensure that the lower Alder Creek population of murrelets is not jeopardized?
- ▶ *Does the current boundary of the Lower Alder Creek Management Area (LACMA) cover all areas of murrelet habitat in the Lower Alder Creek drainage (M§13.9.2.2-1)?*
- Will West Nile virus have a positive or negative effect on murrelet populations, i.e., will it reduce the number of murrelet predators or the number of murrelets?
- ▶ *Will marbled murrelets re-colonize other areas of the plan area (M§13.9.2.2-3)?*

¹³ This list from USFWS (1995a) summarizes key research issues that must be addressed before recovery efforts can be fully realized.

5.4 Point Arena Mountain Beaver

5.4.1 Geographic distribution

Mountain beavers (*Aplodontia rufa*) are generally distributed from California to Washington, with some populations extending into British Columbia (Canada). The distribution of mountain beaver sites is often patchy; sites tend to be localized and uncommon in areas inland from the coast. There are 7 mountain beaver subspecies, 4 of which are endemic to California. Two of these—the Point Reyes mountain beaver (*Aplodonta rufa phaea*) and the Point Arena mountain beaver



**Mountain Beaver
Sierran Sub-species
Photo by Dr. Lloyd Ingles
Photo Details from Dale Steele,
CDFG**

(*Aplodontia rufa nigra*)—occur only in small areas, even though additional suitable habitat may be available. Sites of Point Arena mountain beavers occur as far north as Bridgeport Landing and just south of Point Arena. There are presently 262 known sites of Point Arena mountain beavers.¹⁴

Most of the available information is on subspecies other than the Point Arena mountain beaver, although all mountain beaver subspecies likely have similar life histories. Unless otherwise noted, the information in this species account pertains to the Point Arena mountain beaver.

5.4.2 Local distribution

Data on distribution of sites in the plan area are sparse, but Point Arena mountain beavers have been observed in Mallo Pass Creek, Mills Creek, Alder Creek, Owl Creek, and the Garcia River watersheds (USFWS 1998a, MRC unpublished data 2007). There are currently 14 known Point Arena mountain beaver sites¹⁵ on covered lands in 13 burrow systems; 10 of those burrow systems have been mapped for a total of 1.87 ac ranging in size from 0.06 to 0.57 ac in size (MRC unpublished data 2007).

5.4.3 Population trends

The Point Arena mountain beaver apparently occupies only a portion of its historical range (Steele 1989). The subspecies currently exists in small disjunctive sites separated by unsuitable habitat (Steele 1989). Habitat loss resulting from livestock grazing and urbanization is the most likely cause of this decline (Steele 1989). Although land use, such as forest logging, may have created suitable habitat, other land use, such as livestock grazing, has reduced coastal scrub habitat used by mountain beavers (Steele 1986), offsetting any gains from forest conversions. Furthermore, urban development and associated activities, such as trash dumping, increased predation by pets, construction of roads, and off-trail hiking, have adverse effects on Point Arena mountain beaver sites (USFWS 1998a). Due to urban development along the California coast, the potential for population declines from habitat loss is great (Steele 1989, USFWS 1998a).

5.4.4 Life history

Mountain beavers live in extensive underground burrow systems with multiple entrances (Camp 1918). Most nests are built 0.9 m (3 ft) or more below the surface in a dome-shaped chamber that is packed with vegetation. From the nest chamber, a series of tunnels radiate outward to other

¹⁴ Email from John Hunter (USFWS) to Craig Hansen (ICF J & S) on 01/08/09.

¹⁵ Two sites which we originally identified as separate burrow systems were actually within 50 ft of each other and part of the same burrow system. We still considered them separate sites.



**Baby Mountain Beaver,
Northern Sub-species,
Washington**

Photo Details from Dale Steele, CDFG

chambers used for caching food and depositing feces (Sleeper 1997). Along with nest chambers, 4 other chambers occur in mountain beaver burrows including food storage, refuge, fecal deposit, and a chamber for depositing rocks and clumps of hard clay (“earthballs”) encountered during digging activities (Voth 1968). Female and male nests differ in the types of nest materials used in construction of burrows and it has been shown that female nests contain fewer parasites. Only 1 animal occupies the burrow; the exception is during the breeding season or while females are rearing young (USFWS 1998a). The burrow system provides optimal microclimates for mountain beavers as they are cool and moist in the summer and warm and protected in the winter.

Mountain beavers are active year-round and do not hibernate (Scheffer 1929), but activity generally decreases during the winter (Voth 1968). They are primarily nocturnal but are occasionally active during the day as well (Maser et al. 1981). Ingles (1959) observed that mountain beavers are active for about 8 out of 24 hours each day.

5.4.4.1 Reproduction

Data collected from Point Reyes mountain beavers indicates breeding occurs from mid-December to early March, with a peak in activity in February (Pfeiffer 1958). Mountain beavers have a relatively low reproductive rate (Pfeiffer 1958). Females begin breeding at about 2 years of age and breeding females ovulate at the same time. Gestation is believed to last approximately 28 to 30 days and litters average 2 to 3 young (range = 1–5). Although specific data on reproduction is not available for the Point Arena mountain beaver subspecies, their life history is assumed to be similar to other populations of mountain beavers.

5.4.4.2 Growth and development

Young are born from February to June, although birth rates peak between March and May (Polite 1999). Young are born blind and naked but growth is rapid and newborns are completely covered with hair within 2 weeks (Lovejoy and Black 1974). Lactation lasts about 2 months. Juveniles acquire the coarse adult pelage within a year. Although juveniles have a sex ratio of 1:1, trapping of adult animals showed a ratio biased towards males. While this may be the result of either a demographic shift or trapping bias, Lovejoy and Black (1974) posit that this is indeed an indication of shifting sex ratios rather than a sampling artifact. They did not, however, offer an explanation as to why this might occur.

The mountain beaver breeding season is December 1st through June 30th. This time period encompasses the physiological changes associated with the initiation of breeding through the end of lactation (Hubbard 1922, Scheffer 1929, Pfeiffer 1958, Lovejoy and Black 1974).

5.4.4.3 Movements and dispersal

Mountain beavers move around burrow systems throughout the year, though their movements appear to be restricted outside of the dispersal season. Results of radio-telemetry studies on mountain beavers in Washington by Martin (1971) showed that 9 of 11 animals remained near their initial site of capture. Ninety percent of Martin’s study animals remained within 80 ft (24 m) of their nest chambers though they have been recorded up to 350 ft (107 m) away from nest chambers (Martin 1971).



**Surveying Mountain Beaver Habitat
Owl Creek**



**Burrows of
Point Arena Mountain Beaver
Photo by Dennis Deck**

The extent that juvenile mountain beavers will disperse outside the burrow system is unknown. One study indicates mountain beavers could disperse up to 1850 ft (564 m) from their nest sites (Martin 1971) while another (Hacker and Coblenz 1993) suggests they could disperse up to 1476 ft (450 m). Such dispersal is believed to take place through excavation of the existing burrow system (USFWS 1998a), but above-ground dispersal has also been observed (Martin 1971). Dispersing juveniles may make several attempts to establish a nest before finding a suitable location where they generally remain for a long period of time (Martin 1971). Unoccupied nests may be taken over quickly by other mountain beavers (Martin 1971), indicating that available nest sites are limited. The juvenile dispersal season is likely complete by early fall (USFWS 1998a). The time period in which mountain beaver are thought to disperse is April 15th through September 30th (Pfeiffer 1958, Martin 1971).

5.4.5 Habitat requirements

Mountain beavers are a highly endemic species found in the Pacific Northwest. In general, they are associated with wooded coastal environments typically characterized by

- Cool moist environment.
- Dense stands of perennial vegetation.
- High percentage of small woody material.
- Well drained soft soil.
- North-facing slopes and gullies.

Hacker and Coblenz (1993) also found that, in re-colonizing clearcuts in Oregon, mountain beavers selected areas with greater quantities of large and small downed wood. Point Arena mountain beavers live in a relatively mild climate due to the proximity of their habitat to the ocean (USFWS 1998a). They appear to have a very limited ability to thermoregulate (USFWS 1998a). Their specialized physiology restricts them to cool, moist habitats (Sleeper 1997). Because their kidneys do not concentrate urine, mountain beavers require a large daily intake of water, which may be obtained by drinking or ingestion of adequate succulent vegetation (Zeiner et al. 1990a). In the northern portions of their range, surface water may be diverted down burrows; mountain beavers do not avoid partially flooded tunnels (Scheffer 1929).

5.4.5.1 Vegetation

Point Arena mountain beavers occur in a variety of habitat types, including coastal scrub, coastal prairie, riparian areas, freshwater seeps, and brushy areas (Fitts 2002, unpublished report). Mountain beavers are associated with dense, perennial vegetation where food is abundant year

round and water is easily available (Scheffer 1929). Their sites are usually found in coastal areas, such as

- Northern coastal scrub.
- Coastal bluff scrub.
- Northern riparian scrub.
- North coast riparian.
- Coastal prairie.
- Northern dune scrub.

In the forest, sites of Point Arena mountain beavers are generally in riparian areas, as well as areas where there are freshwater seeps and brush.

Burrow sites of Point Arena mountain beavers are also found in conifer stands though this is a rare occurrence. One Point Arena mountain beaver site has been recently discovered on the south side of the Garcia River about 15 m (50 ft) from the river, between a riparian zone dominated by red alder and California laurel and a hillslope dominated by redwood and grand fir (USFWS 1998a). The area inhabited is covered by dense, high vegetation—3-4 ft (1.0-1.2 m)—dominated by cow parsnip, stinging nettle, horsetail, and California blackberry.

Based on known habitat use, potential habitat is any area with herbaceous or brushy vegetation (excluding grasses) on the ground. The likelihood of encountering Point Arena mountain beavers in areas solely comprised of redwoods and Douglas fir, however, is very low. Due to the clumpy distribution and generally small size of potential habitat in the plan area, MRC has not been able to map all potential habitat using aerial photographs or our structure classes. Table 10-8 lists the MRC structure classes.

5.4.5.2 Soils

Mountain beaver burrows are associated with deep and friable soils (Polite 1999). Although the burrows are generally found in moderately firm soil, mountain beavers also excavate in other soil types, such as sticky clay (Hubbard 1922) and sandy soils stabilized by plants, including ice plants and European beach grass (Fitts 1996).

5.4.6 Ecological interactions

5.4.6.1 Diet



Mountain Beaver Haystack
Photo by Dale Steele

Mountain beavers are voracious eaters (Ingles 1959) that eat a wide variety of food items (Camp 1918, Scheffer 1929). Ingles (1959) estimated that individuals spend approximately 73% of their time foraging and eating. Mountain beavers gather food and bring it back to the burrows where they consume it in the feeding chamber adjacent to the nest. Overall, mountain beavers store about 2.5 times more food than they actually consume (Voth 1968). Voth (1968) noted that 85% of the diet of non-breeding males and females consisted of ferns, while 34% of the diets of reproductive females consisted of coniferous plant material. Mountain beavers forage on the ground and to a height of 15 ft

(4.6-m) in trees. Their diet includes plants that are unpalatable or toxic to other mammals, including foxglove and larkspur; this diet choice allows them to exploit a large, uncontested food niche. Mountain beavers have been observed cutting bundles of plants and laying them out to wilt (“haystacking”). Scheffer (1929) suggested that this provided dried vegetation for nesting

and food storage; however, other explanations include the possibility that dried plants aid in regulating the moisture content of stored foods by mixing wilted with fresh vegetation (Voth 1968).

5.4.6.2 Predators

Bobcats, long-tailed weasels, fishers, coyotes, great horned owls, striped skunks, golden eagles, and minks, as well as domestic and feral dogs and cats may prey on mountain beavers (Ingles 1965, Knick 1984, USFWS 1998a).

5.4.6.3 Interspecific interactions and competition

Mountain beaver burrow systems support a large community of vertebrates and invertebrates, including salamanders, moles, shrews, woodrats, mink, hares, brush rabbits, gophers, mice, and ground squirrels (Scheffer 1945, Pfeiffer 1953, Voth 1968, Maser et al. 1981). Whether their presence in the burrows is due to commensalism, predation, or is simply accidental is unknown. The invertebrate community found within the burrows is also unique. The world's largest flea, *Hystricopsylla schefferi*, which is 0.35 in (9 mm) in length, is associated with mountain beaver burrows (Scheffer 1929). An invertebrate community that aids in fecal decomposition is found within the fecal pellet chambers (Voth 1968). Mountain beavers are hosts to species-specific mites, ticks, and tapeworms (Canaris and Bowers 1992). Parasites specific to the Point Arena mountain beaver have not been investigated (USFWS 1998a).

5.4.7 Sensitivity to anthropogenic disturbances

Little is known about the sensitivity of mountain beavers to disturbance (USFWS 1998a). Because of their clumped and fragmented distribution, the subspecies is very vulnerable to localized natural or anthropogenic catastrophic disturbances, such as storms, fire, flooding, landslides, disease, or prolonged drought (USFWS 1998a).

5.4.7.1 Livestock grazing

Cattle and sheep grazing have resulted in the loss and degradation of coastal scrub habitat used by mountain beavers (Steele 1989). Cattle may also adversely impact mountain beaver habitat by trampling burrows and crushing runways, as has been observed at Alder Creek (Steele 1989). Livestock grazing could be an important factor limiting the expansion of existing sites of Point Arena mountain beaver (USFWS 1998a).

5.4.7.2 Urban development

Urban development and associated activities have been an important factor resulting in the loss and degradation of coastal scrub habitat within the range of the Point Arena mountain beaver. Predation by feral and non-feral dogs and cats likely increases near areas of human habitation and may be affecting some sites (USFWS 1998a). Rodent and pest control by residents of urban development could result in negative effects to the Point Arena mountain beaver. The construction of private and county roads and the existence of State Highway 1 within the distribution of the Point Arena mountain beaver likely results in barriers that prevent or impede dispersal between sites or into potentially suitable, unoccupied habitat (Steele 1989), as well as direct mortality (USFWS 1998a). Housing developments planned for the Irish Gulch area of Mendocino County may result in additional indirect and direct effects on Point Arena mountain beavers (USFWS 1998a).

Fiber optics projects have tunneled beneath Point Arena mountain beaver sites and created noise, vibration, and physical impacts to habitat (USFWS 1998a). Wildlife managers do not know how these activities have affected overall health of the subspecies.

Gopher control programs have resulted in Point Arena mountain beaver mortality because of a mistaken belief that they were gophers (USFWS 1998a). Trapping and poison baiting of rodents is common along the Mendocino County coast (Steele 1986). Use of other chemicals, such as pesticides and herbicides, may also result in mortality (USFWS 1998a).

5.4.7.3 Recreational activities

Crushing of vegetation and burrows by campers and hikers may adversely affect sites of Point Arena mountain beavers (USFWS 1998a). Closure of sensitive areas to recreation has resulted in an increase in activity by mountain beavers (USFWS 1998a).

5.4.7.4 Forest management

Mountain beavers may adapt relatively well to habitat changes resulting from logging because of their subterranean habits and preference for dense vegetation that may be present following logging or wildfire (Sleeper 1997). Animals may remain in their burrows despite the clearing of vegetation and burning. Evidence indicates that mountain beavers may use openings in conifer stands and readily colonize areas where conifers have been removed (Scheffer 1929, Hooven 1973, Neal and Borrecco 1981). When there has been logging in an area, mountain beavers appear to select sites where coarse woody debris remains (Hacker and Coblentz 1993). Other subspecies of mountain beaver are considered pests that merit control actions in recent timber harvest areas since they consume newly planted seedlings.

5.4.8 Impacts of MLC (2008)

The lightning fires of 2008 were only in a small portion of the mountain beaver assessment area in Mallo Pass Creek. The fires did not burn through any known burrow systems of the mountain beaver. In fact, they were at least 670 meters from any such burrow.

5.4.9 Key uncertainties

MRC management has identified the following key uncertainties, with cross references to validation monitoring programs in parentheses:

- What are the numbers and distribution of Point Arena mountain beavers occurring in the plan area?
- What are the effects of covered activities on connectivity, dispersal, habitat quality, and use?
- What buffering (if any) is needed to protect Point Arena mountain beaver sites from disturbance?
- ▶ *Can MRC timber harvests and management create new habitat for Point Arena mountain beavers and allow for expansion of burrow systems into new areas (M§13.9.3.2-2)?*
- ▶ *Does our current habitat definition correctly describe potential habitat for Point Arena mountain beaver (M§13.9.3.2-1)?*