CHAPTER III: RESULTS

Species Occurrence and Habitat Relationships

The geological, topographic, and climatic diversity of Nevada County contribute to its high plant and animal diversity. The county contains a complete east-west transect of the northern Sierra, from just above the Central Valley grasslands to the Great Basin vegetation on the Nevada border. The extent, elevation range, and numbers of Redlist and Yellowlist plants and animal species with documented occurrence in each of Nevada County's 27 large-patch ecosystems are summarized in Table 3-1. Discussions of plant and animal occurrence in large-patch ecosystems of the county are provided in the following sections.

Plant Diversity

Nevada County supports a rich flora, with 1,814 taxa of California's approximately 7,000 species, subspecies, and varieties documented within the county's boundaries (Appendix I, CalFlora 2002). This represents about 26% of the California flora growing on <0.6% of the state's total land area. A total of 115 plant families, representing 582 genera, are included in the flora of Nevada County. Of the 1,814 plant taxa found in Nevada County, about 19% are naturalized non-native species. Native taxa are those believed to have existed in California before initial visitation and colonization by Europeans (Hickman 1993). Ferns and fern-allies make up a little over 2% of the local flora; gymnosperms (conifers) total only 1% of the total number of taxa. Flowering plants make up over 96% of the taxa, which includes 22% monocots (i.e., grasses and lilies) and 74% dicots (other flowering plants). Fifty-six species of Redlist or Yellowlist plants have documented occurrences in Nevada County (Appendix II).

Nevada County spans a region from the eastern edge of the Sacramento Valley and lower Sierra foothills to the Sierra crest and east to the Nevada state line in a transitional zone between the Great Basin and Sierra Nevada floristic provinces (Hickman 1993). Nearly all Sierra Nevada ecosystems are found here, except Central Valley perennial grasslands, and true Alpine habitats (True 1973). Elevations range from approximately 250 feet elevation at Parks Bar on the Yuba River mainstem to the Subalpine ecosystems at 9,143 feet on the summit of Mt. Lola (**Table 3-1**).

Although Nevada County lacks a comprehensive floristic treatment, a checklist of vascular plants was issued in 1973 by the California Academy of Sciences (True 1973). The list was authored by a local botanist, the late Gordon True, who owned a small dairy ranch along McCourtney Road in the 1960's and early 1970's. His checklist was based on vouchered specimens collected by True and other notable botanists such as Peter Raven and John Thomas Howell. The majority of his specimens are housed at the California Academy of Sciences and the U.C. Berkeley and Jepson herbariums (CalFlora 2002). The other primary source for information on the Nevada County flora is the electronic database of the U.C. Berkeley Digital Library Project-CalFlora Database. The database includes Nevada County specimens collected as early as the mid- to late 1800's from explorers and plant collectors such as John Fremont and the Danish bookkeeper C.F. Sonne.

Unique Features of Nevada County Plant Populations

The California Environmental Quality Act, Appendix G, Initial Study Environment Checklist, requires that environmental analyses evaluate the impact of projects on locally significant plants. Both plants and plant communities can be considered significant if their local occurrence is on the outer limits of known distribution, a range extension, a rediscovery, or rare or uncommon in a local context. A number of Nevada County plant species and plant communities are significant for these reasons.

Nevada County is reported to be the southernmost extension of the global distribution of California pitcher plant, an unusual insectivorous plant (CalFlora 2002). The county is the northernmost limit of the Sierra Nevada distribution of whitebark pine, which makes its next appearance to the north on the highest peaks of the southern Cascade Range (Griffin and Critchfield 1976). Washoe pine is an uncommon species known from only a few occurrences in California between Modoc County and Mt. Rose, Nevada, including an unconfirmed report between Hobart Mills and Boca Reservoir (Griffin and Critchfield 1976).

Clark's ragwort and the Yellowlist long-petaled lewisia reach their northern limits in Nevada County. Another species, starved daisy, has a global distribution restricted to the higher elevations of Nevada and Placer counties (USDA Forest Service 2000, CalFlora 2002, CNDDB 2002). The Washington Ridge serpentines of Nevada County support the only Sierra Nevada occurrence of wedgeleaf violet, a species otherwise known only in northwestern California (True 1973). Some unusual and quite colorful plant associations are also found in the vernally wet habitats of some "lava caps" on the east and west slopes of the Sierra crest in the county. Nevada County

is also the apparent California epicenter of the genus *Carex* (sedges), with more than 60 documented species and subspecies (True 1973).

Other noteworthy disjunct occurrences are the small stands of knobcone pine in the Yuba River canyon and Red Dog areas; this species is common in the Cascade and Klamath ranges but quite uncommon in the Sierra Nevada (Griffin and Critchfield 1976). Although more common than other native cypresses, the global distribution of McNab cypress is limited to very widely scattered occurrences around the foothills surrounding the northern Sacramento Valley, primarily on serpentine or gabbrodiorite soils. A U.C. Davis researcher conducting a statewide study of serpentine diversity noted a particularly fine example of McNab cypress and leather oak chaparral on serpentine soils just south of the Sierra Nevada Memorial Hospital (Safford, pers. comm.). There are about 30 known occurrences of McNab cypress in the Sierra Nevada (CalFlora 2002). Many of the local occurrences of this species have been extirpated in Nevada County in the last few decades as the band of serpentine soils in or near the urban centers of Grass Valley and Nevada City have been converted to commercial, industrial, and residential development.

Disjunct populations and localized plant occurrences may not be rare from a statewide perspective, but many are at high risk of regional extinction (Shapiro 2000). Many are "relicts," populations left behind by climate change, persisting 10,000 to 20,000 years since the last Ice Age. Knobcone pines are a good example of this phenomenon. These disjunct occurrences are often genetically unique, due to long-term isolation from interbreeding with other populations. Rare, endemic, and disjunct taxa contribute to the diversity and uniqueness of a region's flora (Shevock 1996). As more populations are lost, those remaining are increasingly isolated from one another, making them more vulnerable to extinction (Shapiro 2000).

Poorly-Represented Species and Ecosystems

Certain species and habitats are conspicuously absent from Nevada County. For example, Chamise-Redshank chaparral forms a nearly continuous band along the Sierra foothills and other parts of the state (Mayer and Laudenslayer 1988), but skips Nevada County entirely, with the exception of a reported small stand in the South Yuba River canyon (Olmstead pers. comm.). No carbonate or highly alkaline soils are found here (USDA Forest Service 1994, Brittan 1993), soils that are associated with many rare and endemic taxa in other regions. Nor does the county host any vernal pools of large size or significance, with the exception of a few pools in northeastern Nevada County (USFS 2000, CDFG website). Relatively little Fresh Emergent

Wetland occurs in the foothill region of the county, and much of what does occur is dependent to some degree on intentional or unintentional releases or diversions of water by the Nevada Irrigation District (NID), including ditch leaks, manmade ponds, and irrigated pastures.

Redlist Plants

Only four plant species in Nevada County are "Redlisted" (i.e., listed as either Threatened or Endangered under the federal or state Endangered Species Acts [CNDDB 2002], Appendix II). Of these four listed species, the Tahoe yellow cress has probably been extirpated from the county. Tahoe yellow cress is documented by a single, historic collection in Truckee that is believed extirpated; little, if any, suitable habitat is still present for this species. The general vicinity of the collection area was searched in 1981, and no plants were observed (CNDDB 2002a). No surveys for this or any other Redlist or Yellowlist species were conducted for this study. The distribution and status of the remaining three Redlist species in Nevada County are discussed below.

Scadden Flat Checkerbloom

The entire global distribution of Scadden Flat checkerbloom is restricted to a few occurrences near Grass Valley. This species is not known to occur anywhere else in the world and is the one true endemic plant in Nevada County. This species is associated with the margins of Fresh Emergent Wetlands, and all populations are threatened to some degree by the invasive exotic Himalayan blackberry that consumes their habitats (CNDDB 2002a). Ponderosa pines are invading one of the marshes that contains this species. Site quality is reported to be good to poor among the three occurrences. CNDDB (2002b) indicates that one of the populations contains 2,000 plants, and a second contains only 10 plants; the size of the third population is not reported. Two of the occurrences are located within a highway right-of-way. Scadden Flat checkerbloom was first discovered by Gordon True and John Thomas Howell during True's inventory of the Nevada County flora in the late 1960's and early 1970's (True 1973). The species was described after publication of the local checklist, and the first population was documented in 1985 (CNDDB 2002a).

Stebbins' Morning-Glory and Pine Hill Flannelbush

Two other very rare Redlist species were previously only known from an area near Eldorado Hills and Cameron Park in El Dorado County until they were discovered southwest of Grass Valley. Both are endemic to chaparrals on Gabbrodiorite Soils, and they appear to decline in the absence of fire

(USFWS 1998). Consequently, both species appear to respond favorably to light and manmade disturbances. The Stebbins' morning-glory was stimulated to germinate by light disking behind a county-owned facility (Troutwine pers. comm.).

The Pine Hill flannelbush is a species in a genus known for interbreeding, and there is some question among expert botanists as to the exact taxonomic status of this species. The local occurrences of this species appear to be intermediate between the common species and the rare Pine Hill flannelbush, according to the author of the species description, the late Dr. Charles Lloyd (Lloyd 1992). CNDDB (2002a) states that the local occurrences are "most probably a morphologically distinct variant of Pine Hill flannelbush, or a hybrid of Pine Hill flannelbush and the common species." In a letter to a local botanist working for the County Agricultural Commissioner's office, that the local decumbent forms may be within the normal range of variation for the rare taxon, that they are not the common species, but may be intermediate between the two (Lloyd 1992). The local occurrences also tend to include individuals of both the common and decumbent forms.

Yellowlist Plants

The Yellowlist Cedar Crest popcornflower is another endemic plant to Nevada County. This species is known only from a 1937 collection near Cedar Ridge and another historic collection in extreme western Nevada County. It has not been collected since, but the taxon was recently moved from a CNPS List 1A (presumed extinct) to a CNPS List 3 (need more information) until taxonomic questions are resolved (CNPS 2001).

Three other very rare Yellowlist species, Torrey's buckwheat, starved daisy, and long-petaled lewisia, occur in rock or barren habitats near the Sierra crest and primarily on Forest Service lands (Appendix II). These species are not endemic to Nevada County, but two have a global distribution restricted to the Tahoe National Forest. Public ownership does not necessarily ensure protection. For example, several occurrences of a rare lewisia have been the target of plant poachers recently, with at least one population almost entirely destroyed. Several other species have been impacted by plant poachers, particularly insectivorous plants and members of the lily and orchid families (CNPS file data).

Recently, many non-vascular species, including bryophytes (mosses) and lichens, have been added to the CDFG and CNPS inventories of rare plants. Four of these species (all mosses) have documented occurrences in Nevada

County (CNDDB 2002a, CalFlora 2002). Three of these species, *Meesia triquetra, M. uliginosa, and Bruchia bolanderi* have known occurrences only in the higher elevations of the county. The fourth, a "copper moss", is known from an occurrence in rocky metamorphic areas of a stream canyon at the middle elevations. Specialists at the U.C. Berkeley Herbarium and with the California Lichen Society (CALS) noted a conspicuous absence of lichen specimens from Nevada County, and a comprehensive flora or checklist for either bryophytes or lichens is not available. The first comprehensive treatment of the mosses of California is still in draft format (Norris, unpublished). Consequently, information on rare lichens and mosses throughout the Sierra is fragmentary compared to most vascular plants (Shevock 1996).

Redlist and Yellowlist Plant and Ecosystem Relationships

A total of 27 large-patch ecosystem types were mapped for Nevada County (Table 2-1). Although the mapping of vegetation in Nevada County was based on the CWHR model, equivalents in Holland (1986) and Sawyer and Keeler-Wolf (1995) were noted when encountered in the field, and are provided as a cross-walk to CWHR and NCWHR in Table 2-2.

A total of 70 Holland (1986) vegetation communities, which are based in part on ecological characteristics and dominant species, were observed during the reconnaissance-level surveys. The Sawyer and Keeler-Wolf (1995) classification system is based entirely on the dominant species in the defining layer; 79 "series" based on this classification system were observed and noted during the surveys. It is expected that there are many more series and associations present that could only be detected with more comprehensive field surveys.

A matrix of the Redlist and Yellowlist plant richness for the 27 NCWHR large-patch ecosystems is provided in Appendix III. Summaries of these results show a few ecosystems that are considerably more likely to support Redlist/Yellowlist plant species than most others (**Figures 3-1 and 3-2**). Three habitats in particular fall into this category including: Montane Meadow, Barren Areas (rock outcrops), and Serpentine and Gabbrodiorite Soils. However, the Yellowlist plants are, in most cases, more likely to be associated with a specific small-patch ecosystem or have very specific microhabitat requirements. Thus, not all Montane Meadows have equal potential for occurrence of these species.

Nevada County offers a good representation of highly specialized wetlands known as "fens," bog-like peatlands that derive moisture and nutrients from

ground seeps or springs rather than precipitation as in a true bog. These small-patch ecosystems were mapped as portions of Montane Meadow ecosystems in the vegetation study. They potentially support the highest number of Yellowlist plants in Nevada County, a total of 15 species including two rare mosses known from only a few occurrences in the state. Eleven of the county's Yellowlist plants are associated with the rock outcrops, cliffs, or scree slopes, sparsely vegetated areas mapped as "Barren Areas" in this study. Barren Areas also include large, highly disturbed areas, such as hydraulic diggings. However, most of the Yellowlist plants in the county are associated with natural outcrops, cliffs, or scree slopes, generally at the higher elevations (i.e., above about 6,000 feet elevation).

Nevada County also contains approximately 4,550 acres of Serpentinite Soils, and about 9,900 acres of Gabbrodiorite Soils that exhibit some degree of plant endemism (**Table 3-3**). These small-patch ecosystems contain a disproportionately high number of rare and endemic species compared to other habitats (Kruckeberg 1984) and they contribute much to Nevada County's plant diversity. Nine species of Redlist/Yellowlist plants are associated with Serpentine or Gabbrodiorite Soils, such as the "Secca" soil series (USDA 1994 and 1995). These include two of the county's rarest species, the Stebbins' morning- glory and Pine Hill flannelbush. Seven of the eight Yellowlist plants associated with Fresh Emergent Wetlands in Nevada County are found in lower or upper montane areas (Zones 2 and 3), with the exception of one taxon that is restricted to the Grass Valley region.

Ponderosa Pine and Mixed-Conifer Forests also have potential to support Yellowlist plant species. Most of the seven Yellowlist plants associated with Ponderosa Pine Forests (Figure 3-2) occur in forest openings, such as small grassy clearings, open flats, rock outcrops, or old road cuts where there is ample light and/or reduced competition from other plants. Few species are associated with the deep shade in the interior of conifer forests. With the exception of one rare orchid, six of the seven Yellowlist taxa associated with Mixed-Conifer Forest also generally occur in canopy openings.

Large-patch ecosystems with little to no potential for Redlist or Yellowlist plants include all the man-made habitats such as Orchards, Vineyards, Croplands, and Urban areas (Figures 3-1 and 3-2). However, several small remnants of serpentine or gabbro soils in urbanized areas support populations of rare plants. Several natural ecosystems have little potential to support these species including Riverine, Lacustrine, Oak-Foothill Pine (except on serpentine or gabbrodiorite soils), Foothill Riparian, Eastside Riparian, Eastside Pine, and Subalpine Conifer (Appendix III).

Large-Patch Ecosystems and Land Ownership

The GIS-based maps and summaries of the distribution of NCWHR types were further defined by ownership, public or private lands in Nevada County (Table 3-1). This summary does not define levels of protection or consider the current ecological condition or the effects of specific land management practices on these ecosystems. Rather, it is included to provide a broad picture of the distribution and ownership patterns of these large-patch ecosystems. This summary indicates a concentration of private ownership in the foothills (i.e., elevation Zones 1 and 2) of Nevada County. About 10% of the Foothill Hardwood Woodlands in the county are in public ownership. A total of 10% of the Foothill Riparian Woodlands, 23% of the Foothill Chaparral, 4% of the Annual Grassland, and 9% of the Oak-Foothill Pine ecosystems in the county are in public ownership (Table 3-1).

In Nevada County, 28% of the Montane Hardwood Woodlands, including canyon live oak and black oak woodlands, is in public ownership. With the exception of Ponderosa Pine Forests (20% in public ownership), most of the county's conifer forest ecosystems are between about 45% and 65% in public ownership (Table 3-1).

While a relatively large number of the Zone 3 large-patch ecosystems are in public ownership as compared to Zones 1 and 2, Montane Meadows, a habitat rich in plant diversity, are 53% in public ownership. Among habitats east of the Sierra crest in Nevada County (Zone 4), Eastside Scrub ownership is 34% public, while Eastside Pine is 50% in public ownership (Table 3-1).

Serpentine and Gabbrodiorite soils (see "Small-Patch Ecosystems," below), biological islands of interesting and endemic plant and butterfly species, are also predominantly in private ownership. Approximately 13% of the county's Gabbrodiorite Soils are in public ownership, while Serpentine Soils are about 30% in public ownership (Table 3-3).

Non-Native, Invasive Plants

The flora of Nevada County includes approximately 350 non-native plant species that have naturalized or are found out of cultivation here (CalFlora 2002). Ornamental species growing exclusively in gardens or other landscaped settings are not included in this total. Non-native plants represent about 19% of the county's total flora (**Table 3-2**). Native taxa are those plant species believed to have existed in California before initial visitation and colonization by Europeans (Hickman 1993).

Invasive, exotic plants are defined as plants which are able to proliferate and aggressively alter or displace indigenous biological communities (Schwartz et al. 1996). The most aggressive exotic plants degrade natural areas because they can exclude native species, displace natural communities, promote faunal change, reduce biological diversity, disrupt ecosystem processes, alter fire fequencies, restrict economic return on crops, reduce recreational values, threaten endangered species, and fundamentally alter the unique character of California (CNPS 2001). An informal analysis by DFG found that 23% of California's 280 plant communities are heavily impacted by non-native plants, and another 28% are moderately affected (Keeler-Wolf 1993).

The rapid occupation of wildlands and ranching lands by pests such as yellow star-thistle, artichoke thistle, and whitetop have caused agriculturalists and habitat conservationists to work cooperatively around the state. In Nevada County, for example, a group of concerned individuals and agencies from conservation, timber, and agricultural communities gather each year in June to remove manually the federally-rated invasive musk thistle from a 600-acre infestation near Boca, east of Truckee.

In Nevada County, the areas most affected by invasive, non-native plants are the Foothill and Transitional Watersheds (Zones 1 and 2), and the Eastside Watersheds (Zone 4). Invasive and other non-native species are present in Westside Conifer Watersheds (Zone 3), but are generally restricted to disturbed areas along roads, recreational facilities, hydro facilities, areas logged or disturbed by off-road vehicles and equipment, or in riparian corridors affected by historical mining (GANDA 2000).

Foothill Watersheds (Zone 1)

In foothill zones throughout the state, non-native annual grasses and forbs, such as annual or Italian ryegrass, wild oats, brome grasses, vetches, and non-native thistles have greatly altered the character of the remaining grasslands, replacing native bunchgrasses and reducing the spring and summer wildflower displays (CNPS 1996). In Nevada County, the most widespread noxious weeds or invasive non-native plants include: yellow star-thistle, ripgut grass, medusa-head, Himalayan blackberry, and Italian thistle.

About 1/10th of California, including 10 million acres of rangelands, have been invaded by yellow star-thistle (Maddox and Mayfield 1985). The plant is toxic to horses, and stout spines render it inedible to sheep and cattle. Aside from its economic impacts, yellow star-thistle increases roadside fire hazards and reduces recreational values and biodiversity in affected areas.

Himalayan blackberry and scarlet wisteria (a horticultural escapee) have invaded some Foothill Riparian Woodlands of the county. These species can result in a single-species scrub over many miles of stream corridor. Large portions of Rock Creek are already dominated by scarlet wisteria (Table 3-2).

Transitional Watersheds (Zone 2)

In Transitional Watersheds of Nevada County, widespread invasive species include Scotch broom, yellow star-thistle, and Himalayan blackberry. Scotch broom infestations are particularly severe in the San Juan Ridge area, especially in areas disturbed by historic mining, brushing or logging, and catastrophic fires. Brooms and gorse, a related species with a single occurrence in the North San Juan area, have invaded many biological communities in the Coast Ranges and Sierra foothills. Brooms are highly flammable and especially common in urban/wildland interfaces. Seeds are viable for decades, and the ranges of these species continue to expand. Logged areas are frequently invaded by brooms, which prevent establishment of seedling trees (Schwartz et al. 1996).

Similar to Foothill Watersheds, Transitional Watersheds contain many miles of stream corridor that now consist of a monoculture of Himalayan blackberry, which reduces the structural diversity, plant and animal species diversity, and open water habitats. Other common, widespread invasive species include: black locust, wild fennel, and four species common in wetlands: Johnson grass, pennyroyal, harding grass, and velvetgrass. These watersheds also include several highly invasive species with the potential to spread explosively, but whose populations are currently small. These are typically the only species targeted for eradication by agencies. Examples of these "A-rated" noxious weeds include: plumeless thistle, with several occurrences on Banner Mountain, spotted knapweed on McCourtney Road and in Penn Valley, and skeleton weed with many occurrences from Higgins Corner to Rollins Reservoir, and Bridgeport to North Columbia (Table 3-2). One endangered plant species, Scadden Flat checkerbloom, a species with only three occurrences world-wide (including in the Grass Valley area), is threatened by Himalayan blackberry (CNDDB 2002a).

Westside Conifer Watersheds (Zone 3)

Compared to other parts of the county, Westside Conifer Watersheds have fewer and smaller infestations of noxious weeds or non-native species, due in part to their climate and to fewer vectors for infestations (Table 3-2). The I-80 corridor, however, is a primary vector for infestations of noxious weeds,

and it includes occurrences of many highly invasive "A-rated" noxious weeds (CalFlora 2002). Railroads are also important vectors, but the railroad corridor through these watersheds has not been surveyed as extensively as the I-80 corridor due to its relative inaccessibility. Spotted knapweed and diffuse knapweed, two highly invasive species, are known from several occurrences in the I-80 corridor from Yuba Gap to Soda Springs.

Yellow star-thistle has been reported to be reproducing above 7,000 feet near Donner Pass on OHV roads (VanZuuk pers. comm.) and up to 8,000 feet in other parts of the Sierra Nevada (USDA 2000). Other, more widespread, noxious weeds are found in these watersheds and eradication efforts are not endorsed by the state and federal agencies due to funding limitations. These species include Klamathweed, bull thistle, Scotch broom, and cheatgrass. Several other noxious weeds are routinely found along forest roads, log landings, recreational facilities, and hydro facilities both in the Tahoe National Forest and in other forests in the Sierra Nevada and southern Cascade Range (GANDA 2000 and 2002). The non-native Oxe-eye daisy is a common component of some Montane Meadow systems. Three horticultural escapees, English ivy, bouncing-bet, and periwinkle are frequent pests in Montane Riparian Woodlands, especially near roads and historical mining sites. A highly visible example of English ivy infestation occurs along the South Yuba River near Edwards Crossing.

Eastside Watersheds (Zone 4)

In Eastside Watersheds, particularly those east of Truckee, open, disturbed habitats along the I-80 corridor are particularly well-suited to infestation by invasive weeds. These areas contain the largest infestation of the federally-rated noxious weed, musk thistle, in California (Kerr pers. comm). Over 600 acres on Boca Hill east of Truckee have been invaded by musk thistle in the area burned during the Boca fire of the 1960s. It is believed that the musk thistle may have been introduced by firefighting equipment. Numerous satellite occurrences of musk thistle are also found in Truckee and Hirschdale. Other "A-rated" noxious weeds found east of Truckee include spotted knapweed, Dalmation toadflax (a horticultural escapee), and single occurrences of halogeton and Scotch thistle (Table 3-2).

The most widespread invasive exotic plant in Eastside Watersheds is the annual grass, cheatgrass. Cheatgrass and other annual grasses promote unnatural fuel conditions and fire cycles which have become self-sustaining. Such impacts reduce the ability of native plants to prosper, and they may cause the unnatural conversion of native vegetation types to non-native annual grassland. This conversion, which has also been induced by post-fire

seeding often can lead to increased erosion, because annual grasses and forbs lack the deep roots to prevent more long-term or serious erosion (California Department of Food and Agriculture 2002). Many other invasive non-native species are found in Eastside Watersheds including Russian knapweed, Dyer's woad, Russian thistle, and white-top (Table 3-2).

Vertebrate Diversity

Nevada County's elevational gradient and the large diversity of vegetation types provide habitats for 336 regularly occurring, native vertebrates, 45 introduced species, and 52 extremely rare species (i.e., recorded five or fewer times in the county). Nine other species may occur in the county, based on their known ranges and habitat requirements, but no definite records exist (Appendix IV).

Fishes are represented by seven families, with 20 native species and 33 non-native, introduced species (Appendix IV). Amphibians are represented by seven families, with nine native species, and one non-native, introduced species, the bullfrog. Two amphibians, the Redlist California red-legged frog and the Yellowlist Mt. Lyell salamander, may occur here based on their range and habitat requirements, but there are no documented records in the county (Appendix IV). Amphibians are most closely associated with aquatic ecosystems, but many species also use a variety of other terrestrial ecosystems for breeding, foraging, or escape cover (Appendix VI).

Reptiles are represented by eight families, with 21 native species and no introduced species. Three reptile species including the coachwhip, long-nosed snake, and night snake, have uncertain status in the county. None of these species has been documented by museum specimens or direct observations, but they may be present based on their distributions and habitat requirements (Appendix IV). Reptile species can be found in all of the aquatic and terrestrial large-patch ecosystems in the county (Appendix VI).

Birds are by far the most diverse vertebrate group, being represented by 55 families. These include 212 native species that regularly occur in the county (i.e., at least once per year), and by 43 other species that have extremely rare and/or irregular occurrences. The county bird list also includes five introduced species: ring-necked pheasant, wild turkey, rock dove (domestic pigeon), European starling, and house sparrow. One species, Allen's hummingbird, is suspected to occur in the county, but it has not been documented by specimens or by individuals identified in the hand. In the field this mostly coastal species (in California) is easily confused with the

rufous hummingbird, an abundant, local migrant. Thus, a total of 260 regular, extremely rare, and introduced bird species have been documented in Nevada County (Appendix IV, Williams 1997).

Mammals are the second most diverse vertebrate group, being represented by 23 families. These include: 74 native species; four extremely rare species (i.e., the Redlist Sierra Nevada red fox and California wolverine, and the Yellowlist Pacific fisher and the unlisted, but rare, western spotted skunk); and six non-native species (i.e., Virginia opossum, muskrat (probably introduced), black rat, Norway rat, house mouse, and wild pig (Appendix IV).

Redlist Animals

Only 15 animal species with known or potential occurrence in Nevada County are "Redlisted" (i.e., listed as either Threatened, Endangered, or Candidates under the federal or state Endangered Species Acts [CNDDB 2002b]) (**Figure 3-5**). These species include: valley elderberry longhorn beetle, Central Valley chinook salmon, Central Valley steelhead, Lahontan cutthroat trout, California red-legged frog, bald eagle, Swainson's hawk, American peregrine falcon, California black rail, sandhill crane, great gray owl, bank swallow, willow flycatcher, Sierra Nevada red fox, and California wolverine. None of these species is common or widespread, and several have not been documented in the county (Appendix V).

Two species, the valley elderberry longhorn beetle and California red-legged frog, were included on the list of potential Redlist species (Appendix V) because they are known to occur in adjacent counties (CNDDB 2002), and because potentially suitable habitat areas exist for them in Nevada County. However, neither of these species has been documented in the county either historically or recently (CNDDB 2002).

Three species, Swainson's hawk, great gray owl, and bank swallow have only been recorded on a few occasions, and none has nested in Nevada County. Large flocks of sandhill cranes frequently pass over the county during spring and fall migrations between their wintering grounds in the Central Valley and their Great Basin breeding grounds (Williams 1997, Sierra Foothill Audubon Society [unpublished notes]).

The status and distribution of Nevada County's nine other Redlist species are described below, and their potential occurrence in large-patch ecosystems of Nevada County is summarized in Figure 3-5.

Central Valley Chinook Salmon

Central Valley Chinook salmon are now found only in small populations in a 3 or 4-mile stretch of the Yuba River below Englebright Dam and in Dry Creek (CNDDB 2002a). Four discrete, seasonal runs of Chinook salmon were once abundant in the Sierra and supported commercial fisheries (Moyle, Yoshiama, and Knapp 1996). The only salmon runs remaining in Nevada County are the fall/late-fall and spring runs (Appendix V).

Central Valley Steelhead

Central Valley steelhead are now found only in small populations in a 3 or 4-mile stretch of the Yuba River below Englebright Dam and in Dry Creek (CNDDB 2002a). Unlike salmon, steelhead are not characterized by separate runs, but they usually appear in large foothill streams of the Sierra Nevada in winter and spring (Moyle, Yoshiama, and Knapp 1996).

Lahontan Cutthroat Trout

Primarily a stream-dwelling species throughout most of its range, a segment of the Lahontan cutthroat trout population in the Truckee River basin also occurs in large lakes. The larger lake-dwelling forms historically grew to 2 to 4 feet in length. Lahontan cutthroat trout were once abundant in the Truckee River basin, and they supported important commercial fisheries for several decades. Between 1873 and 1922, approximately 100,000 to 200,000 pounds of these trout were harvested annually from Pyramid Lake and the Truckee River (Townley 1980, Coffin and Cowan 1995). The Lake Tahoe Lahontan cutthroat trout disappeared in 1939, and by 1944 the original Pyramid Lake population was extinct due to the combined effects of overfishing, introductions of exotic species, and damage to spawning habitat caused by pollution, logging, barriers, and water diversions at Derby Dam (Coffin and Cowan 1995).

Currently, seven stream populations of the Riverine form of Lahontan cutthroat trout now occupy only 8 miles (2.2%) of the estimated 360 miles of historic stream habitat in the Truckee River basin. Independence Lake (partly in Sierra and Nevada counties) has the only self-sustaining lake-dwelling Lahontan cutthroat trout population. Spawning habitat includes the headwaters of Independence Creek in Nevada County. Another small, introduced population exists on the west slope in Nevada County in Macklin and East Fork Creeks (tributaries to the Middle Yuba River) that was probably derived from the now extinct Lake Tahoe population (Coffin and Cowan 1995).

Two populations of Lahontan cutthroat trout in Summit Lake (Nevada) and Independence Lake are genetically unique (Cowan 1988, Bartley and Gall 1993). These last wild, indigenous lake-dwelling populations may provide essential genetic brood stock for future reintroductions to other high elevation lakes within their former range (Coffin and Cowan 1995).

Bald Eagle

In Nevada County, bald eagles are uncommon nesters around large lakes and reservoirs with productive fisheries. Breeding pairs have been documented near Lake Spaulding, Milton Reservoir, and possibly Lake Van Norden on the west slope, and near Prosser Creek and Boca reservoirs in the eastern county (Appendix V). Non-breeding individuals may be observed foraging along the South Yuba River and at large reservoirs and lakes such as Bowman Reservoir, Lake Van Norden, Independence Lake, and Donner Lake (Sierra Foothills Audubon Society unpublished data, Tahoe National Forest unpublished data, Williams 1997).

American Peregrine Falcon

American peregrine falcons are uncommon, non-breeding visitors to Nevada County. Breeding pairs have not been observed in the county, but a nesting eyrie was discovered at an abandoned gravel quarry near the county line in Yuba County in 2002. Migrants might be seen from a variety of vantage points in the county including Bald Mountain, Banner Mountain, Spenceville Wildlife Management Area (WMA), and the South Yuba River (Sierra Foothills Audubon Society unpublished data, Tahoe National Forest unpublished data, Williams 1997).

California Black Rail

Permanent residents marshlands around the San Francisco Bay and along the Lower Colorado River (Grinnell and Miller 1944), previously unknown nesting populations of California black rails were recently discovered in the foothills of Butte, Yuba, and Nevada counties (Tecklin 1999). In Nevada County they occur in a few, isolated marshes along Garden Bar Road, McCourtney Road, and in and near the Spenceville WMA (CNDDB 2002a, Appendix V).

Willow Flycatcher

Nesting pairs of willow flycatchers were documented at Lake Van Norden in 1987 and along Sagehen Creek in 1984 (CNDDB 2002a). Suspected nesters have also been observed at Billy Mack Flat and along the Truckee River

below Hirschdale and at Boyington Mill, Independence Lake, Carpenter Valley, and near Donner Lake State Park (Tahoe National Forest unpublished data). The current status of these populations is unknown (CNDDB 2002a, Sierra Foothills Audubon Society unpublished data). Migrant willow flycatchers from northern breeding populations may be fairly common in riparian woodlands throughout the county (Williams 1997).

Sierra Nevada Red Fox

Sierra Nevada red fox are represented in Nevada County by a single sighting along Highway 89 in 1994 (CNDDB 2002a). The current status of this extremely rare carnivore in the county is unknown.

California Wolverine

California wolverines have been documented by experienced agency biologists in the following Nevada County locations: Lower Montez Lake, near Jackson Meadow, Red Mountain, Sagehen Creek basin, Perazzo Canyon, Euer Valley, Sunflower Hill, and Red Mountain (CNDDB 2002a, Tahoe National Forest unpublished data). The current status of this extremely rare carnivore in the county is unknown.

Yellowlist Animals

A total of 46 Yellowlist vertebrates and 11 invertebrates have known or potential occurrence in Nevada County (Appendix V). These include: two mollusks, five butterflies, four caddisflies, three fish, four amphibians, two reptiles, 23 birds, and 15 mammals (including 9 bats). While none of these species is protected under the state or federal endangered species acts, they are recognized as sensitive by state (e.g., DFG, CDF) and federal agencies (e.g., USFS, USFWS, BLM, NFMS).

Wildlife and Habitat Relationships

A matrix of the occurrence and breeding status of each of Nevada County's native fishes, amphibians, reptiles, birds, and mammals in the 27 NCWHR large-patch ecosystems is provided in Appendix VI. Two types, Foothill Riparian and Montane Riparian Woodlands, support the highest numbers of total species and breeding species (**Figures 3-3 and 3-4**). Large-patch ecosystems supporting the fewest total species and breeding species are active agricultural lands, including Vineyards, Orchards, and Croplands.

Some large-patch ecosystems are more likely to support Redlist and Yellowlist animals than others. The highest numbers of Redlist vertebrates

can be found in Fresh Emergent Wetlands, Montane Meadows, and Barren Areas (Figure 3-5). The highest numbers of Yellowlist vertebrates can be found in Foothill Hardwood, Montane Hardwood, and Eastside Riparian, Mixed-Conifer and Ponderosa Pine Forests, and Montane Riparian Woodlands (**Figure 3-6**).

Aquatic Ecosystems

Riverine

Structural and Ecological Characteristics

Moyle and Ellison (1991) developed a classification system for Sierra Nevada aquatic habitat types, including Riverine ecosystems. Those occurring in Nevada County include: permanent, intermittent, and ephemeral streams of the Sacramento-San Joaquin province and streams draining east of the crest in the Great Basin province (**Figure 3-7**). The Truckee River and all its tributaries occur in the Lahontan drainage of the Great Basin province, while the Yuba River (including the South Yuba and Middle Yuba rivers), Bear River, and all their tributaries are part of the Central Valley drainage of the Sacramento-San Joaquin River watershed.

Streams change greatly in character from their headwaters to their lower reaches. In mountainous areas, the headwaters (low-order streams) are typically turbulent, steep-gradient, clear and cold (Moyle 1993). They may be fishless, ephemeral drainages or permanent, fish-bearing streams. As these low order streams unite to form larger streams and rivers (high-order streams), the water loses much of its clarity, and the temperatures are warmer. As they leave the mountainous areas, the gradient is gentler, the velocities decrease, and the flow volumes increase. High-order streams contain more long pools, shallow gravelly riffles, and glides. Both low- and high-order streams in Nevada County experience low-flow periods during the summer and fall. Intermittent streams are synonymous with seasonal streams; ephemeral streams flow only during storm events.

In general, small, shallow streams tend to follow (but lag behind) air temperatures, warming and cooling with the seasons. Rivers and creeks with large areas exposed to direct sunlight are warmer than those shaded by trees, shrubs, and high steep banks (Mayer and Laudenslayer 1988). The constant swirling and churning of high velocity water over riffles and falls results in a higher oxygen content, while in sluggish or low-velocity streams or rivers, polluted waters, and deep holes, dissolved oxygen is lower. The nature of the substrate, composition of the water, climate, and gradient determine the rate at which a stream erodes its channel. The greater the

slope, the greater the capacity to transport abrasive materials through increased water velocity.

Descriptions of Riverine Ecosystems in Nevada County

The Riverine ecosystems described below were based on the classification system designed by Moyle and Ellison (1991) and used by DFG's Natural Diversity Data Base (CNDDB 2002a). Each type has distinct physical, chemical, and biological characteristics, and animal assemblages; the occurrence of endemic fishes and amphibians are key parts of these descriptions.

Examples of fish-bearing streams in "Central Valley Drainage" of Nevada County include:

"Resident rainbow trout stream," or low-order, cold, high-gradient streams dominated by rainbow trout and often riffle sculpin;

"Salmon-steelhead streams," third- to fifth-order streams between approximately 1,500 and 4,500 feet elevation with deep canyons containing deep, cold pools that can sustain spring chinook salmon through the summer, such as the Yuba River mainstem below Englebright Dam;

"Hardhead-squawfish stream," or low- to mid-elevation streams with deep bedrock pools, clear water and cool temperatures, and may include hardhead, Sacramento sucker, Sacramento squawfish, and several other species;

"California roach stream," small, clear, mid-elevation second-, third-, or fourth-order tributaries characterized by deep pools in canyons and are often intermittent in flows by late summer. California roach dominates, but juveniles of Sacramento squawfish and Sacramento sucker are often present; and,

"Squawfish-sucker stream," small low to mid-elevation streams with few deep pools that are dominated by Sacramento squawfish, Sacramento sucker, and often California roach.

Examples of permanent, fishless low-order tributaries that occur at mid-elevations of Nevada County include:

"Forest streams," second- or third-order streams in pine, fir, or hardwood forests that are too small or too high in gradient to support fish, such as many of the small perennial tributaries of the Yuba and Bear Rivers;

"Spring streams," springs with constant temperature and flows, fine substrates, clear water, that can unite to form a meadow stream. This type can support unusual and/or endemic invertebrates; and

"Meadow streams," first- or second-order meadow streams through high elevation meadows, generally with a sinuous braided channel, such as the Bear Valley meadow stream near White Rock Lake. Frogs may be abundant when these streams are not heavily grazed, and they may also contain introduced trout.

Examples of the variety of ephemeral Riverine ecosystems in Nevada County include:

"Conifer forest snowmelt streams," small intermittent, snow-melt streams in conifer forests that are also enhanced by seepage from wet meadows and fens;

"Foothill/valley ephemeral streams," low elevation streams in foothill oak woodlands or grasslands that flow primarily in response to winter and spring rainfall, although some may be semi-permanent in bedrock pools, such as upper Clear Creek or Grub Creek. These habitats have a distinctive succession of invertebrates and may be important for spawning of fishes from more permanent streams; and

"Foothill canyon ephemeral streams," high gradient seasonal tributaries (usually unnamed) that plunge down the sides of steep canyons of foothill streams.

The Truckee River watershed in the Great Basin (Lahontan drainage) province offers a different suite of species and habitats, including these stream habitats which also occur in Nevada County:

Conifer forest snowmelt streams, an ephemeral type;

Conifer forest stream, Meadow streams, and Spring streams (all permanent, fishless streams);

"Trout headwater streams," high elevation permanent streams with meadow systems, such as upper Independence Creek that originally contained native Lahontan or Paiute cutthroat trout but now usually contain non-native salmonids such as brown trout, brook trout, and introduced rainbow trout;

"Trout/sculpin streams," high-elevation, permanent streams of sufficient size and low enough gradient to support both Lahontan cutthroat trout and

Paiute sculpin, such as upper Sagehen Creek and upper Prosser Creek (CNDDB 2002a);

"Speckled dace streams," small meadow streams, usually spring-fed, that contain mainly speckled dace but occasionally Tahoe suckers and Lahontan cutthroat trout;

"Sucker/dace/redside streams," such as lower Sagehen Creek and lower Prosser Creek above the reservoir, cold-water streams containing the typical Lahontan drainage stream fish community; and

"Whitefish/cutthroat trout/sucker streams," mainstem rivers, such as the Truckee River and their larger tributaries (Moyle 1996) that contain the complete Lahontan fish fauna including mountain whitefish, Lahontan cutthroat trout (including large adults), and Tahoe sucker. Lahontan cutthroat trout are now replaced by non-native trout in most of these systems. Common introduced species include largemouth bass, smallmouth bass (and members of the family of Centrarchidae [sunfish, etc].), kokanee salmon, and lake trout.

Plant Diversity

Aquatic mosses and heavily branched filamentous algae are held to rocks by strong holdfasts and align with the current (Mayer and Laudenslayer 1988). Other algae grow in spheric or cushion-like colonies with smooth, gelatinous surfaces. Algae growth in streams is influenced by depth and current and often exhibit vertical zonation on rocks.

The terrestrial riparian vegetation that lines the banks of Riverine ecosystems is treated separately under "Montane Riparian," "Foothill Riparian," "Montane Meadow," and "Fresh Emergent Marsh." However, plant species characteristic of shallow water along slow-moving streams in the montane regions of Nevada County include: yellow pond lily, bog bean, beaked sedge, Bolander's quillwort, lesser duck weed, floating pondweed, mannagrass, water star-wort, aquatic buttercup, western waterweed, and a few aquatic mosses and lichens. Common terrestrial plants found on the banks and shading the channel of permanent montane streams include mountain alder, red osier dogwood, lady fern, torrent sedge, and Indian rhubarb.

Common aquatic and emergent plants of foothill regions of Nevada County include mosquito fern, gibbous duckweed, Canadian waterweed, common bulrush, broadleaf cattail, and water plantain. Mexican mosquito fern is a true aquatic and uncommon species that occurs in Nevada County. Common

woody streamside plants growing in the foothill regions of Nevada County near the shoreline include white alder, sandbar willow, arroyo willow, Gooding's willow, buttonwillow, scouring rush, horsetail, and ciliate willow herb.

Animal Diversity

Riverine ecosystems occupy a relatively small portion of the total landscape but are disproportionately important for the ecological processes of entire watersheds.

In a study of the Inyo National Forest, Riverine ecosystems and their associated vegetation constitute less than 0.4% of the land area but are essential for at least one phase of life for about 75% of the local wildlife species (Kondolf et al. 1987).

A high diversity of invertebrate and vertebrate animals rely on Riverine ecosystems in Nevada County. The aquatic invertebrate fauna are an essential basal element in the food chain, representing an extensive and diverse group of species, many of which are endemic to the Sierra (N.A. Erman pers. comm.). Invertebrates found in the county's rivers and creeks include: mayflies, alderflies, stoneflies, dragonflies, damselflies, water striders, and caddisflies. Five Yellowlist invertebrate species occur in Riverine ecosystems of Nevada County including four caddisflies found in Sagehen Creek Basin and the Great Basin rams-horn snail in the Truckee River (Appendix V).

In Nevada County, low-elevation Riverine Zone 1 ecosystems (i.e., "Foothill Watersheds;" and "Transition Watersheds") support about 74 vertebrate species including: 19 mammals, 35 birds, five reptiles, four amphibians, and 11 fish. Riverine Zone 2 ("Westside Conifer Watersheds") support about 73 vertebrate species including: 26 mammals, 33 birds, seven reptiles, five amphibians, and two fish. Riverine Zone 3 ("Eastside Watersheds") support about 63 vertebrate species including: 22 mammals, 24 birds, four reptiles, three amphibians, and 10 fish (Appendix VI).

Overall, Riverine ecosystems in Nevada County support a diverse fish fauna with 22 native species and 33 non-native species representing 11 families. Low-elevation rivers and large, perennial creeks (e.g., the Yuba River downstream from Englebright Dam and Dry Creek below Fairy Falls) support small runs of Central Valley steelhead and Central Valley Chinook salmon (see "Redlist Animals," above). Other native species include Sacramento roach, Sacramento sucker, riffle sculpin, Sacramento pike-minnow, and the Pacific lamprey. Mid-elevation rivers and creeks only support two native fish,

rainbow trout and the Yellowlist hardhead. East slope rivers and creeks have a high diversity of fishes that are native to the Truckee River system including the Redlist Lahontan cutthroat trout and the Yellowlist Lahontan Lake tui chub and Lahontan Creek tui chub (Appendix VI).

Fish-eating birds, such as ospreys (Yellowlist) and bald eagles (Redlist), forage for fish near the surface of pools and shallow waters along the Yuba and Bear rivers and at large east side reservoirs such as Prosser Creek and Boca. Belted kingfishers, double-crested cormorants, and common mergansers also forage for fish in streams and reservoirs. American dippers, the most characteristic of Riverine birds, forage for aquatic insects and, rarely, fish fry in the most turbulent mountain streams (Beedy and Granholm 1985, Gaines 1992).

Many amphibians and reptiles depend on Riverine ecosystems. Yellowlist foothill yellow-legged frog, mountain yellow-legged frog, and northwestern pond turtle have experienced declines in both population size and range. Predation from introduced fish and the bullfrog may be significant contributing factors (Zeiner et al. 1990). A variety of other reptiles including common garter snakes, western terrestrial garter snakes, Sierra garter snakes, and western rattlesnakes occur in Riverine ecosystems of Nevada County (Appendix VI).

Characteristic mammals in Riverine ecosystems include: northern river otter, American mink, muskrat, water shrew, American beaver, and the Yellowlist Sierra Nevada mountain beaver. Emerging aquatic insects are a major food source for three Yellowlist bats that forage over open waters: yuma myotis, long-eared myotis, and long-legged myotis (Appendix VI).

Distribution and Status

In California, Riverine ecosystems occur statewide, mostly between sea level and 8,000 feet (Mayer and Laudenslayer 1988). Riverine ecosystems extend for about 1,850 miles in the county and they span an elevation range from about 280 feet up to about 8,720 feet elevation. Rivers and creeks represent almost 2% of the county's total land area, and more than 60% of this acreage is on private land (Table 3-1).

Rivers and creeks are among the most altered large-patch ecosystems in the Sierra Nevada. Two major impacts are the 400-plus dams (25 feet or greater in height) and the significant amounts of hydraulic mining debris which passed through these systems historically. This included about 360,000 acre feet in the Yuba River drainage alone, constituting 40% of the total volume delivered to the Central Valley (Kattelmann 1996).

The loss and degradation of Riverine ecosystems are the principal reasons why so many aquatic species of invertebrates, fish, and amphibians in the Sierra Nevada are in decline (Moyle 1996). Factors contributing to this deterioration include: changes in the timing and amounts of stream flows (i.e., from regulated reservoirs and other diversions); changes in water quality; reduction in structural complexity (from loss of riparian trees, channelization, etc.); changes in stream channels; siltation; and invasions of non-native species (Meehan 1991).

Not all Riverine ecosystems in the Sierra have been affected equally. In general, high elevation aquatic ecosystems such as small, fishless, alpine streams and ponds have changed little from pristine conditions. Most of the threatened aquatic ecosystems are found in lowland areas (Moyle 1996).

Lacustrine

Structural and Ecological Characteristics

Lacustrine ecosystems are defined as inland, natural ponds and lakes, as well as manmade features, such as reservoirs, that are formed by dammed river channels. In this report, Lacustrine features as small as 1/10th of an acre or as large as hundreds of acres were mapped at all elevations of Nevada County.

Natural aquatic features less than 1/10th of an acre, such as small outcrop pools, mountain ponds, and vernal pools, are also found throughout the montane region of the county. However, most of these shallow features were not mapped as Lacustrine ecosystems due to limitations of scale in the aerial photography. Small and often intermittent wetland features are not deepwater or fish-bearing aquatic habitats, but some have a high probability of containing rare or endemic invertebrates (Erman 1996).

Snowmelt pools are clear, oligotrophic pools found in shallow depressions on granitic outcrops at high elevations where both freezing and drying are limiting factors. Vegetation is usually absent from these pools, but they fill seasonally with snowmelt or rain water and may support communities of seasonal organisms such as fairy shrimp and larvae of long-toed salamanders (Moyle 1996). In Nevada County they are most common in the region between Grouse Ridge and the Sierra crest and occur elsewhere in the state in similar settings.

Many seasonal, mountain ponds were observed in Nevada County between Grouse Ridge and the area north of Hirschdale, east of Truckee. These fishless, shallow ponds are generally found in meadows or cirques, and they are usually less than 1.5 meters in depth and less than one acre in area (Moyle 1996). These ponds usually dry by late summer and freeze solid or become deoxygenated in winter. Unlike the outcrop pools described above, these ponds often contain a flora of primarily perennial aquatic and emergent plant species.

The relatively calm waters of lakes and ponds contrast sharply with those of Riverine ecosystems. The oxygen content of lakes is relatively low compared to that of running water due to a combination of decomposition occurring at the bottom of lakes and to the small proportion of water in direct contact with air. The gradations of oxygen, light, and temperature in lakes, along with the currents and wave-action (seiches), greatly influence the vertical distribution of lake and reservoir organisms (Mayer and Laudenslayer 1988).

Most of the natural lakes in Nevada County occur in glaciated, mountainous areas. The action of the glaciers scoured basins out of bedrock and deposited ridges of glacial debris that dammed streams. Landslides and lava flows also can create water-filled depressions, and a few very small examples of these phenomena were observed on the east side of the county. In a geological time frame, they are temporary features of a landscape, eventually filling with sediments in a succession to marsh or wet meadows and, ultimately, to forest habitats. The sediments are a combination of silt brought in by inflowing streams or the erosion of side-slopes and by the organic debris produced by the action of organic organisms (Moyle 1993).

Natural lakes in Nevada County are generally small, shallow water bodies with a well-developed fringe of emergent marsh around the perimeter. The coldwater lakes of the highest elevations are clear and low in basic nutrients for plants (oligotrophic) due to bedrock bottoms and lack a distinct stratification of dissolved oxygen in summer or winter. Fish populations in these lakes are small, tend to be slow growing, and low in species diversity (typically one to five species) (Moyle 1993). The plants and animals found in the shallow water (littoral zone) around the edges of natural lakes may be distinct from the flora and fauna of deeper water (Mayer and Laudenslayer 1988). The open water (limnetic zone) extends from the deepest water to the depth of effective light penetration. The littoral zone is shallow enough to permit light penetration and occurs at the edges of lakes and throughout most natural and artificial ponds.

Many manmade reservoirs and agricultural or residential ponds exist below 5,000 feet in Nevada County. Most of the large reservoirs in Nevada County were created by private agencies for a combination of power generation and water storage and are also used for recreational purposes. They occur at elevations from about 250 feet to 7,930 feet elevation in the county (Table 3-1). Many of the "lakes" in the upper elevations of the county are actually small reservoirs that result from dammed mountain streams (e.g., Fordyce Lake and White Rock Lake). Reservoirs, such as Lake Van Norden or Meadow Lake, were also created by inundating wet meadows or by enlarging the storage capacity of existing natural lakes, such as Donner Lake and Independence Lake. Lake Van Norden was built on a wet meadow roughly 100 years ago, but the dam was breached in 1972, resulting in a shallow marsh and open water ecosystem that is extremely productive for waterfowl and other water birds (see "Fresh Emergent Wetlands," below).

Although many are named as lakes, it is important to recognize that reservoirs are different from natural lakes in their physical and biological characteristics. Most reservoirs fluctuate on an annual basis, gradually drawing down in summer to supply water for irrigation, power generation, or agriculture. However, even a fluctuation of as little as a few meters can prevent plants from establishing at the shoreline or aquatic plant beds from developing. Reservoirs are usually built in steep-sided canyons with no shallow water habitat. Both result in a lack of cover for young fishes in shallow water and a lack of diversity of habitat for adult fishes. The fish fauna at the dam end of a reservoir is often different from the fauna at the mouth of the river that supplies the reservoir (Moyle 1993). The dam end is usually deeper and stratifies in summer, with a warmer layer on top and a cooler or cold layer at the bottom. This characteristic is also true of deeper natural lakes.

Plant Diversity

Phytoplankton are the tiny suspended plants, such as diatoms, desmids, and filamentous green algae, that dominate deepwater (>6 feet deep), aquatic habitats too deep for emergent plants. Because these tiny plants alone carry on photosynthesis in open water, they are the basis upon which the rest of limnetic life depends. The plants found in the littoral zone vary with elevation and water depth, with a distinct zonation apparent from the shoreline to the deeper water of the littoral zone. Plant species characteristic of the shoreline around lakes and ponds in the montane region of Nevada County include mannagrass, beaked sedge, bladder sedge, water sedge, least spikerush, and creeping spikerush.

In shallow water, common species include yellow water lily, bog bean, Bolander's quillwort, small duckweed, water star-wort, least spikerush, and aquatic buttercup. In the deeper portions of the littoral zone, pondweed and western waterweed are characteristic. Common terrestrial shrubs found on the shore in the transition to upland include mountain heather, western spiraea, Lemmon's willow, and Labrador tea.

Most reservoirs lack a well-developed fringe of wetland and riparian plants due to steep-sided slopes and fluctuations in water level. Where shallow areas occur, common aquatic and emergent plants of ponds and reservoirs in the foothill regions of Nevada County include mosquito fern, gibbous duckweed, Canadian waterweed, common bulrush, and broadleaf cattail. Common woody shoreline plants include the noxious weeds Himalayan blackberry and purple-top vervain and the native species, Fremont cottonwood, white alder, sandbar willow, arroyo willow, Gooding's willow, and buttonwillow.

Several Yellowlist plants are associated with shallow water habitats in Nevada County, including submerged bulrush, slender-leaved pondweed, white-stemmed pondweed, Robbins' pondweed, lesser bladderwort, and bog club-moss (CNDDB 2002a, CNPS 2000, USFS 2000, True 1973). Tahoe yellow cress is an extremely rare plant known globally from a few scattered occurrences on the sandy granitic beaches of Lake Tahoe, with an historic occurrence at Donner Lake not relocated and presumed extirpated (Appendix II).

Several noxious aquatic weeds could potentially occur in the ponds and reservoirs of the foothill region of the county, including several horticultural escapees, such as parrott's feather, hydrilla, and Eurasian milfoil (Table 3-2). Mexican mosquito fern is an uncommon species associated with lakes, ponds, and sluggish waters, with a few occurrences in the Dry Creek watershed (True 1973, GANDA unpublished data).

Animal Diversity

Lacustrine ecosystems are found in every geographical setting and elevation zone in Nevada County. Due to the importance of water to almost all wildlife, a variety of vertebrate species use these ecosystems in each of the county's elevation zones. West slope reservoirs (i.e., Foothill and Transitional Watersheds) support about 69 vertebrate species, while those in Westside Conifer Watersheds support about 57 species, and those in Eastside Watersheds support about 78 species (Figure 3-3).

In the higher elevations of Nevada County near the Sierra crest, Lacustrine ecosystems abound and are mostly encountered as naturally-occurring, very small lakes or ephemeral snowmelt ponds. In contrast, the vast majority of lakes and ponds below about 5,000 feet elevation in the county are manmade. Seasonally, reservoirs, irrigation and stock watering ponds, and other manmade water bodies provide important habitat for many species (especially for waterfowl, shorebirds, and other migratory water birds). They also help to ameliorate the loss of natural wetlands with open water.

Lacustrine ecosystems in Nevada County support at least 20 waterfowl species and many other waterbirds and are used as winter grounds or temporary stopover resting and foraging sites during migration. Waterfowl species include: ring-necked duck, lesser scaup, cinnamon and green-winged teal, hooded and common mergansers, ruddy duck, bufflehead, common goldeneye, and Yellowlist redhead. Waterbirds include great blue and green herons, pied-billed and western grebes, common loon, and Yellowlist American white pelican. Shorebirds (such as spotted, western, and least sandpipers, killdeer, and Wilson's phalarope) and swallows (northern rough-winged, tree, violet-green, and cliff swallows) are also common associates. Raptors are represented by Redlist bald eagle and peregrine falcon and Yellowlist osprey (Appendix VI).

Some bats have a strong preference for foraging over open water, and at least ten species are known to occur in Nevada County. These include 4 Yellowlist species: yuma myotis, long-legged, long-eared, and pale Townsend's big-eared bat (Appendix VI).

The east slope of Nevada County is fully contained within the Truckee River basin and Greater Lahontan basin, which support a unique and diverse assemblage of fish that are not found on the west slope. Numbers of Lacustrine fish species are much better represented in east slope lakes due, in part, to the diversity of the Lahontan drainage and the presence of high-elevation, deep-water, fish-bearing lakes, such as Donner, Independence (Nevada County), and nearby Lake Tahoe. Representative species include Tahoe sucker, mountain whitefish, Lahontan redside, and Lahontan speckled dace. The Lahontan Lake and Lahontan Creek tui chubs are Yellowlist species and they occur in Prosser Creek and Boca reservoirs. Formerly abundant throughout the Truckee River basin, the Redlist Lahontan cutthroat trout has been extirpated in many areas and now occurs in only small portion of its former range (see "Redlist Animals," above).

The vast network of canals and artificial water bodies throughout Nevada County are often the sites of exotic or nonnative species introductions and

concentrations, including many aquatic invertebrates (insects, snails, clams, crayfish, etc.), 32 non-native fish species (21 of which also inhabit streams), and the ubiquitous eastern U.S. bullfrog. During times of high rainfall or stream flow, exotic species can be flushed from ponds and reservoirs into stream and river systems where they compete with, or prey on, native species. Bullfrogs and several species of bass are known to prey on the eggs or tadpoles of the declining Yellowlist foothill yellow-legged frog as well as potentially extracting a significant toll on Yellowlist northwestern pond turtle hatchling or juvenile turtles (Moyle 1973, Holland 1991). Hatchlings of wood ducks, mallards, and even Canada geese often fall prey to largemouth bass.

Distribution and Status

Lacustrine ecosystems, including reservoirs, are found throughout California at virtually all elevations but are less abundant in arid regions. Natural lakes did not occur in the foothill region of the Sierra Nevada due in large part to the absence of glaciated landscapes; essentially all of the deepwater lakes and ponds in the foothills are manmade (Mayer and Laudenslayer 1988).

Most natural lakes and ponds in western Nevada County occur primarily between about 5,000 and 7,900 feet elevation from the Grouse Ridge area to the Sierra crest (**Figure 3-8a**). On the west slope, large, high-elevation reservoirs include Fordyce Lake, Lake Spaulding, and Bowman Lake. Large, low- and mid-elevation reservoirs on the west slope include: Scott's Flat Reservoir, Rollins Reservoir, Lake Wildwood, Lake of the Pines, and Camp Far West Reservoir, the latter only extending partly into the county.

Aside from Donner Lake, the county's largest natural lake, most lakes on the east slope of the county are artificial reservoirs (**Figure 3-8b**). Independence Lake, in both Nevada and Sierra counties, was a natural lake but its outflow and surface elevations are now regulated by a dam. Throughout Nevada County, Lacustrine ecosystems (both natural and artificial) occupy about 11,730 acres, and represent almost 2% of the county's area. Approximately 41% of the county's Lacustrine ecosystems are privately owned (Table 3-1).

Only about twenty natural lakes in the Sierra Nevada historically supported fish, and two of these (Donner Lake and Independence Lake) occur in Nevada County. Introduction of non-native fish species has been the single greatest factor associated with fish declines in the Sierra Nevada. The native Sacramento sucker and tui chubs do quite well in reservoirs, a habitat in which most other native fishes cannot survive. Today, 55% of native fish species and 86% of native amphibians are considered threatened, of special concern, or declining in the Sierra Nevada (Moyle et al. 1995).

In an assessment of the status of aquatic habitats in the Sierra Nevada prepared for the Sierra Nevada Ecosystem Project, Lacustrine habitats of special concern (i.e., declining in quality or abundance), that occur in Nevada County include subalpine lakes and ponds east of the Sierra crest (Moyle 1996). The rainbow trout, in particular, has been widely introduced on the eastside where it (and other introduced trout species) has largely replaced the native Lahontan cutthroat trout. All other Lacustrine ecosystems in Nevada County are either manmade or are natural features that are relatively secure. Nevertheless, most of these features are already greatly altered from their pristine state by the introduction of non-native species.

Most of the natural fishless lakes of the Sierra today contain one or more species of non-native salmonid fishes which have greatly altered the native biotic communities (Moyle, Yoshiyama, and Knapp 1996). Such introductions are also attributed to the decline of native amphibians that used the shallow waters of natural lakes, particularly the mountain yellow-legged frog which is now found at fewer than 15% of the high elevation sites where it was present in 1915. Some invertebrate species may have been eliminated altogether. Introductions of non-native fishes are done by both individuals and clubs as well as state and federal agencies. Most waters stocked with fish are not regularly evaluated for their fish populations, angler use, or trends in their native biota (Bahls 1992).

As a general rule, the more altered a lake or stream is by human disturbance, the more likely it will become dominated by non-native fish species (Baltz and Moyle 1993). The changes caused by reservoir dams and diversions have been identified as a major cause of the declines of seven of the twenty declining species in the Sierra Nevada and as a contributing factor in most of the rest (Moyle, Yoshiyama, and Knapp 1996). Reservoirs generally favor exotic species, which can then invade both upstream and downstream. Dams also contribute to declines by changing flow regimes and breeding substrates downstream, blocking movements and migrations, isolating populations, flooding natural habitats, and causing increased human use. Dams on major rivers have blocked access by spring-run chinook salmon to more than 95% of its spawning and holding areas, and have greatly reduced access to spawning grounds of other runs of salmon, steelhead, and Pacific lamprey (Moyle, Yoshiyama, and Knapp 1996).

The policy banning fish-stocking of hatchery trout in lakes in the National Parks has resulted in the partial reestablishment of the assemblages of native aquatic organisms to historically fishless lakes. Thus, it appears that it may not be too late to restore some high elevation Lacustrine ecosystems to

maintain aquatic species sensitive to fish predation. If current trends continue, however, further extirpations of native organisms are likely as the result of trout predation in combination with other factors (Moyle, Yoshiyama, and Knapp 1996).

Barren and Herbaceous Ecosystems

Barren Areas, Rocks, and Cliffs

Areas mapped as "Barren" include both natural features such as rock outcrops and cliffs as well as historically disturbed surface mines (**Figure 3-9**). In all cases, barren rock or soil dominates the ground layer, and tree and shrub cover is typically sparse or absent. Examples of Barren areas in Nevada County include glaciated granite domes and volcanic ridges near the Sierra crest, and the hydraulic diggings found at the middle elevations. Smaller rock outcrops may be frequent in some areas, but they were usually mapped with the vegetated, large-patch ecosystems that surround them. Natural rock outcrops, cliffs, and other barren features differ in many structural and ecological characteristics from hydraulic diggings, and are discussed in separate sections below.

Structural and Ecological Characteristics

In Nevada County, rock outcrops and cliffs are most common at elevations above 6,000 feet where massive, glaciated batholiths of granite or metamorphic rock dominate the landscape. Good examples are found near Bear Valley, Red Mountain, Bowman Lake, Grouse Ridge, and the Fordyce Creek watershed. Volcanic ridges, cliffs, and steep eroding talus and scree slopes (primarily andesitic mudflows) are also frequent in this region with the most prominent examples at Castle Peak, Andesite Ridge, and the volcanic ridge north of White Rock Creek. Sparsely vegetated cliffs of slates and schists are occasional in the mid- to low elevations of the major river drainages of the Middle and South Yuba river.

Mapping the exposed granitic bedrock of the region between Grouse Ridge and the Sierra crest also revealed small pockets of Montane Chaparral interspersed with stands of mid- to late-seral Red Fir or Mixed-Conifer Forest. These small stands may be dense or open, and the soils are poorly developed, with little or nonwoody debris or topsoil. Widely scattered, stunted individuals of Jeffrey pine or Sierra juniper are also common on rock outcrops. Native perennial herbs, bunchgrasses, and grass-like plants are concentrated along fractures, on ledges, and other areas where finer gravels, sand, fines, and moisture accumulate. Small snowmelt pools may be frequent on ledges and terraces. On the steep, eroded slopes of volcanic ridges, seeps and springs are sometimes common, particularly at the interface between the volcanic and the underlying material.

Plant Diversity

Within Rock Outcrops, pockets of Montane Chaparral may be common at the mid- to upper elevations. Shrubs may range from one to six feet in height, and dominant species usually include huckleberry oak, greenleaf manzanita, and pinemat manzanita. Small, scattered stands of conifer forest are dominated by red fir, white fir, Jeffrey pine, ponderosa pine, and incense cedar. Wind-swept and picturesque Sierra junipers are widely scattered, generally standing alone or in small clusters. Characteristic herbs and subshrubs (i.e., plants less than 18 inches high) on rock outcrops at these elevations include Parry's rush, mountain pride penstemon, needle phlox, Sierra sedum, Wright's buckwheat, Bridge's cliff-brake, California needlegrass, and squirreltail.

Dry, sparse volcanic ridges mostly occur in the subalpine zone above 8,500 feet in the county. There, trees and shrubs are relatively uncommon, but a diverse mix of herbs and subshrubs are scattered across the thin, gravelly soils. Characteristic species include woolly mule-ears, sulphur-flowered buckwheat, spur lupine, mountain mint, Bloomer's goldenbush, woolly butterweed, Davis' knotweed, mountain bunchgrass, and pussytoes.

On the much older formations of slates and schists in the major river drainages at lower to middle elevations, the seasonally moist rocks of the north-facing cliffs and small ephemeral seeps are often rich in lichens and mosses. Characteristic species in these areas include golden moss, crevice alum root, Pacific sedum, narrowleaf sword fern, nested polypody, hoary honeysuckle, and fringe cups. On the south-facing, rocky cliffs in the Yuba River drainages, the cantaloupe-colored flowers of sticky bush monkeyflower are a common sight. Other characteristic species here include woolly sunflower, canyon dudleya, Watson's spike-moss, one-sided bluegrass, and three week fescue.

Two Yellowlist subalpine plants, long-petaled lewisia and fell-fields claytonia, could occur on more or less Barren scree slopes on the highest peaks in the County. Yellowlist plants with known or potential occurrence in river canyons of Nevada County include: Cantelow's lewisia, Brandegee's clarkia, Stebbins' phacelia (Appendices II and III).

Animal Diversity

Cliffs and rocky outcrops, despite their steep gradients and lack of vegetation, are surprisingly rich in wildlife values. Approximately 81 vertebrate species are known to occur in these ecosystems (including hydraulic diggings) in Nevada County. These species include 32 mammals,

39 birds, and 10 reptiles. About 50 of these species use Barren Areas for breeding (Appendix VI).

A variety of birds and mammals find safety and breeding sites within rocky crevices. Common rock and cliff birds include canyon and rock wrens, nesting ravens, and an assortment of nesting raptors. High elevation, barren slopes provide full-time homes to few wildlife species, but they are well used by numerous species in transit. In late summer, horned larks, American pipits, western meadowlarks, mountain bluebirds, and other songbirds can be common while migrating. Yellow-bellied marmots and American pikas also find permanent homes in subalpine scree slopes. A variety of snakes and lizards favor rocky cliffs and outcrops, including western fence lizard, sagebrush lizard, and western rattlesnake. Most common amphibians in the county avoid barren habitats.

Yellowlist birds nesting on canyon walls and rock faces are golden eagle, prairie falcon (not yet recorded nesting in Nevada County), and black swift (probable nester along the Yuba River); while Redlist birds nesting on rock faces could include the American peregrine falcon (not yet recorded nesting in Nevada County). Yellowlist northern harriers, merlins, and prairie falcons and Redlist American peregrine falcons can be seen hunting along the open slopes (Appendices V and VI).

It is likely that a number of bat species use crevices in rock faces for roosting or maternity sites in Nevada County but little research has been conducted on these species. Yellowlist bats that use rock crevices include, but are not limited to, the following species: fringed myotis, pallid bat, spotted bat, and western greater mastiff bat (Zeiner et al. 1990). Resident mammals include one or two chipmunks; while Redlist California wolverine and Sierra Nevada red fox may be extremely rare visitors to Barren areas. Yellowlist Mt. Lyell salamander is associated with these habitats in other portions of the Sierra, but it has not been documented in Nevada County (Appendix V).

Distribution and Status

Approximately 24,870 acres of Barren Areas (including hydraulic diggings) exist in Nevada County, representing about 4% of the county's land area; about 35% of this land area is in private ownership (Table 3-1). By virtue of their steep rocky slopes and remote locations, cliff habitats are relatively protected from human disturbance in Nevada County and throughout the state. However, Barren Areas can be impacted indirectly through erosion of disturbed soils above, or by the introduction and spread of noxious weeds (Schwartz et al. 1996).

These ecosystems are distributed throughout the county (Figure 3-9). The best examples are found in the Castle Peak and Andesite Ridge areas and in the major river drainages of the Middle and South Yuba rivers. Good examples of volcanic cliffs are also found in the lower Truckee River drainage, east of Hirschdale, and on the ridge north of White Rock Creek. The subalpine slopes on the highest peaks in the County—Mt. Lola, Basin Peak, and Castle Peak—are among the ecosystems with the most limited distribution in the county. Most of these high elevation, Barren Areas are primarily in public ownership (**Figure 3-45**).

Hydraulic Diggings

Structural and Ecological Characteristics

These historical remnants of the Gold Rush era often contain cultural resources, unique wetland habitats, and rare plant and animal species. However, they may also contribute to the cumulative effects of erosion and point source pollution in a watershed (Moyle 1996). These eroded, open, sandy, or rocky areas are often sparsely vegetated with stunted trees and shrubs due to the nutrient-deficient soils. Water and time have produced some interesting marsh habitats and seasonal wetlands in the many shallow depressions of abandoned hydraulic mines. Many of these wetlands are rich in Yellowlist plant species and unusual plant associations that are found nowhere else in the county (Appendix II). Areas mapped as "Barren" also included more recently disturbed habitats such as gravel quarries and landfills.

Plant Diversity

The overall plant diversity in the upland portions of these landscapes is, not surprisingly, quite low. Ponderosa pines, Douglas firs, and incense cedars, usually of low stature and poor vigor, are the more commonly encountered tree species. Whiteleaf manzanita is the overwhelmingly dominant shrub species on the dry, gravelly slopes and flats.

The wetland ecosystems associated with hydraulic diggings are relatively diverse and support an unusually high number of rare plants. One Yellowlist species, bog club moss, is not known to occur elsewhere in the Sierra Nevada (CNDDB 2002a). Other Yellowlist plant taxa associated with the permanent and seasonal wetland ponds and marshes in hydraulic diggings include: red-anthered rush (known in California from a single occurrence in a diggings in southeastern Nevada County [CNDDB 2002a]), round-leaved sundew, and brown beaked-rush (Appendix II).

Lodgepole pines are sometimes found at particularly low elevations in diggings habitats where they often grow in association with eastern cranberry, a naturalized species that was introduced to the county during the Gold Rush era. Several unusual plant associations that normally occur at much higher elevations in fens and boggy meadows (e.g., swamps of Labrador tea and thickets of Sierra laurel and Douglas spiraea) are found in diggings.

Animal Diversity

Hydraulic diggings are used by a relatively high diversity of wildlife species, although in the case of some mammals it is not clear whether this represents preferred habitat or is merely a habitat with little human activity. Open country birds frequently stop over in hydraulic diggings during migration; these species include horned larks (otherwise very rare at mid-elevations in the Sierra Nevada), Townsend's solitaires, western meadowlarks, and mountain bluebirds. Coyotes, mountain lions, and black bears appear to be fairly common in large hydraulic diggings complexes as evidenced by their tracks found in the soft mud of such sites. A wide variety of common lizards and snakes are usually present in diggings ecosystems. However, a lack of soft soils, grasses, or trees seems to preclude many of the rodents and smaller mammals that are more common in adjacent vegetated sites.

Yellowlist amphibians that are known to occur in wetlands associated with hydraulic diggings areas include dense populations of foothill yellow-legged frogs along creeks. Large populations of the introduced and predatory bullfrog and predatory fish are also present in many of these areas, especially those with deep, standing water. In the absence of bullfrogs, these hydraulic ponds also might be suitable habitat for the Redlist California red-legged frog. This species was recently found in a mine tailings pond in Yuba County near New Bullard's Bar Reservoir. The Yellowlist reptile, northwestern pond turtle, occurs in standing waters in diggings habitat areas (Appendix VI).

Distribution and Status

These relics of the hydraulic mining age are concentrated in the middle elevations of Nevada County, and they are often near, or associated with small, historic town sites such as Red Dog or North Columbia (Figure 3-9). Some of the better examples of hydraulic mines can be found at Cherokee Diggings, Malakoff Diggins State Historical Park, Buckeye Diggings, and Columbia Diggings. While historical mining areas are protected through public ownership by BLM or California State Parks, others could be affected

by potential new mining projects, and many areas continue to be severely impacted by OHV use. Over 100 to 150 years of time has still not reclaimed many of the barren and eroding slopes and drainages, and these sites may continue to add unnaturally high levels of sediments and heavy metals such as mercury into adjacent wetlands, streams, and rivers (Moyle 1996).

Annual Grasslands and Irrigated Pastures

Structural and Ecological Characteristics

Prior to European settlement, native grasslands in Nevada County probably occurred largely as oak savanna, not as the treeless prairies (Valley Grassland) that once dominated the Central Valley (Mayer and Laudenslayer 1988).

Remnant patches of Valley Grassland may occur at the extreme western edge of Nevada County. The predominant Annual Grassland ecosystem, however, is an open grassland-oak savanna with widely scattered blue oaks, interior live oaks, and valley oaks. Elsewhere in Nevada County, Annual Grasslands occur in the understory of open Foothill Hardwood Woodlands, or as artificial openings in Oak-Foothill Pine Woodlands or Foothill Chaparral ecosystems. In many areas, woodland and chaparral have been cleared to create grazing land and are now Annual Grasslands. For this reason, the original boundaries of the grassland ecosystem have changed from that of the original prairie in the bottomlands of extreme western Nevada County (Ornduff 1974).

Annual Grasslands that are dominated by introduced species replace Valley Grasslands in the lower to middle elevations of the County (**Figure 3-10**). Annual Grasslands transition into Montane Meadows (dominated by native perennial grasses, forbs, and grass-like plants) above about 4,000 feet elevation, but there are a few occurrences of Montane Meadows on moister soils in valleys and on floodplains down to about 2,700 feet in Nevada County (Table 3-1). In this report, Irrigated Pastures were mapped as Annual Grasslands (Table 2-2).

Open grassland-oak savannas in Nevada County once may have been dominated by perennial bunchgrasses such as purple needlegrass, with other native annual and perennial forbs in the interspaces between bunchgrasses (Bartolome 1981). Today, these areas are now overwhelmingly dominated by introduced annual grasses, and native perennial bunchgrasses are now uncommon. However, most of the original bunchgrass species can be found sporadically throughout the low to middle elevations of the County, particularly on thin, rocky soils.

Domestic livestock grazing has shifted the species composition and extent of Annual Grasslands in the Sierra Nevada. Yearlong, heavy grazing favors introduced annual grasses at the expense of native perennial bunchgrasses (Heady 1977). It has been estimated that non-native species make up 70-80% of the biomass of California's pastures and Annual Grasslands (Ornduff 1974). The dominance of Annual Grasslands also has changed the fire and moisture regime in many areas, since annual grasses dry earlier and burn hotter than native perennial bunchgrasses. Large amounts of standing dead material can be found in late summer in years of abundant rainfall and under conditions of light to moderate grazing pressure (Mayer and Laudenslayer 1988). Little soil moisture is still available for native perennial species after seed set in Annual Grasslands (Heady 1977).

Plant Diversity

Mediterranean annual grasses are particularly successful in Annual Grasslands and irrigated pastures, as they are throughout the milder regions of California, and they dominate the grasslands in western Nevada County. Characteristic species include slender wild oat, ripgut brome, soft chess, medusa-head, and foxtail barley. Red-stemmed filaree is a dominant non-native forb that was introduced to California in the 16th century by Spanish missionaries. Other dominant species include the non-native forbs rose clover, bur clover, little hop clover, dovefoot geranium, black mustard, yellow star-thistle, Italian thistle, and storksbill (Table 3-2).

Despite their dominance by introduced species, dry Annual Grasslands are still home to many native species, particularly native bulbs and early or late season annual wildflowers such as California poppy, popcornflower, rancher's fire, common brodiaea, Ithuriel's spear, winecup clarkia, johnny-tucks, common madia, cream cups, and gold nuggets. Native species are nearly absent from irrigated pastures, since they are unable to compete with the vigorous pasture species and non-native wetland species such as Dallis grass, orchard grass, velvet grass, Bermuda grass, curly dock, lady's-thumb, barnyard grass, and white clover. Instead, native species are generally found only in wetland settings, consisting primarily of Baltic rush.

At middle elevations in partly shaded foothill woodlands, dominant species include the non-native hedgehog dogtail, hedge parsley, and the native blue wildrye. On poor, rocky soils, both native foothill bunchgrasses and forbs are more abundant than in the long-grazed open grasslands of the county's lowest elevations. Characteristic native grass species here include California melic, squirreltail, one-spike oatgrass, one-sided bluegrass, and blue wildrye, as well as non-native species such as soft chess, hedgehog dogtail, and ripgut brome.

Yellowlist plants potentially occurring in Annual Grasslands of Nevada County include Cedar Crest popcornflower, a species that has not been collected here since 1937 (Appendix II). Brandegee's clarkia and golden-anthered clarkia could occur on grassy slopes in the understory of oak woodlands or savanna (CNDDB 2002a).

Animal Diversity

Despite their dominance by introduced plants, and their relative lack of vertical structure, Annual Grasslands support a higher diversity of animals than many other large-patch ecosystems in Nevada County. Approximately 110 vertebrate species occur in Annual Grassland ecosystems including: 27 mammals, 65 birds, 16 reptiles, and two amphibians. However, most species in Annual Grasslands only forage or rest there, and only about 32 species breed in these habitats in Nevada County (Appendix VI).

Annual Grasslands provide abundant food and cover for high numbers of rodents and other small mammals. As a result, several raptors thrive in Annual Grasslands including red-tailed hawk, red-shouldered hawk, and American kestrel (Mayer and Laudenslayer 1988). Other characteristic wildlife in Annual Grasslands of the county include racer, California whipsnake, gopher snake, western kingbird, western bluebird, western meadowlark, California ground squirrel, Botta's pocket gopher, and black-tailed jackrabbit (Appendix VI).

Annual Grasslands in Nevada County offer valuable foraging and suitable nesting habitat for several Yellowlist birds including: white-tailed kite, northern harrier, and loggerhead shrike (Appendices V and VI). Exotic and invasive animal species that are characteristic of Annual Grasslands in the county include: bullfrog, wild turkey, European starling, house sparrow, house mouse, black rat, and wild pig. These ecosystems also are attractive foraging areas for the parasitic brown-headed cowbird (see "Montane Meadows," below).

Distribution and Status

While the original native grassland prairies have been greatly reduced throughout their range, non-native Annual Grasslands remain common both locally and throughout most of lowland California. They are most extensive in the Central Valley but also occur in low valleys or gentle slopes of the Sierra Nevada, Coast Ranges, Transverse Ranges and Peninsular Ranges (Mayer and Laudenslayer 1988). In Nevada County, non-native Annual Grasslands and grassland-savanna are most common between approximately 270 and 1,500 feet elevation. However, they also occur as

artificial openings in foothill woodlands up to approximately 4,360 feet. More than 31,900 acres of Annual Grasslands and Irrigated Pastures exist in Nevada County, representing about 5% of the county's land area; about 96% of these lands are in private ownership (Table 3-1).

Remnant examples of native Valley Grasslands, which are often found around the edges of wetlands or moist bottomlands, are patchy and generally have poorly defined boundaries. Most of the known occurrences in Nevada County are generally less than 1 acre in size. Large stands of native deer grass are generally found in association with seeps or wetlands on poor soils. Native foothill grasslands of upland perennial bunchgrasses are also better represented on poor soils than on deeper agricultural soils. Native grasslands continue to disappear in California with agricultural, residential, and industrial development. They must be managed with moderate grazing to prevent their conversion to Annual Grasslands. In the absence of grazing, or as a result of disking or very heavy grazing, weedy, non-native annual grasses may out-compete the desired species (Freckman et al. 1979).

Montane Meadows

Structural and Ecological Characteristics

Montane Meadows can occur within virtually all of the large-patch ecosystems in montane regions of the Sierra Nevada. Montane Meadows, including subalpine meadows above about 8,500 feet, are usually characterized by both wet and dry types. The lower portions of most Montane Meadow systems are often wetland areas where water is at or near the surface during a portion of the growing season. Areas mapped as Montane Meadow include both large meadow systems, such as Carpenter Valley and Bear Valley, and other, small, unnamed pocket and stringer meadows. Montane Meadows do not include the non-native Annual Grasslands that are common in the foothill regions of the County below about 2,500 feet elevation (Mayer and Laudenslayer 1988, Sawyer and Keeler-Wolf 1995).

In the Sierra Nevada, Montane Meadows often occur as successional stages that grow after historic lakebeds fill with soil and before they are colonized by forested ecosystems. Hydrology is the most important factor controlling the stability and species composition of Montane Meadows, and meadows tend to be found on somewhat water-logged soils compared to the surrounding forest soils. Meadow soils are typically alluvial and fine-textured, and they can occur in a variety of settings, including basins, valleys, flats, gentle slopes, and filled-in lake basins. While Montane

Meadows are often associated with perennial streams, seeps, and springs, they also occur in transitional areas between conifer forest or Montane Chaparral on drier, coarser soils. Although meadows are generally believed to succeed bog communities, followed by succession to forest communities, some meadows in the Sierra Nevada are at least 1,200 years old (Wood 1979).

Montane Meadows have been described as the most botanically diverse of the plant community types in the Sierra Nevada, and they generally support far more plant species than surrounding upland forests and chaparral (Ratliff 1982). Dense growth of sedges and rushes, native perennial grasses and wildflowers characterize these herb-dominated ecosystems; shrub and tree layers generally are sparse except around the margins where they often border conifer forest. Clumps of willow shrubs are a prominent feature of some meadow streams and very wet meadows, and they are one of the factors that make such sites so attractive to nesting birds and other wildlife. Several different vegetation layers may be present in such Montane Meadows, represented by low mosses and herbs an inch or so high, tall grasses and forbs up to 3 feet tall, and sometimes willow shrubs up to about 6 feet tall.

Plant Diversity

Plant species composition of Montane Meadows generally varies along a moisture gradient (Holland 1996, Sawyer and Keeler-Wolf 1995). Low portions of meadows such as swales and along meadow streams are often dominated by a dense growth of sedges. Low areas generally have a lower floristic diveristy than higher, seasonally-moist areas which are often very diverse in forbs, grasses, and grass-like plants. Dominant species in the wettest portions include bladder sedge, beaked sedge, small-fruited bulrush, and tall manna grass. Characteristic species in the moist to wet portions of meadows in Nevada County include: tufted hairgrass, western aster, alpine aster, rough bentgrass, Kentucky bluegrass (an introduced species), meadow barley, clustered field sedge, Nebraska sedge, Jones' sedge, Baltic rush, Nevada rush, pull-up muhly, Jeffrey's shooting star, Bigelow's sneezeweed, California corn lily, cow parsnip, Parish's yampah, tinker's penny, five-finger cinquefoil, and many more.

Important components of willow scrub portions of Montane Meadows include Lemmon's willow, Geyer's willow, Jepson's willow, gray-leaved Sierra willow, and bilberry. Giant red paintbrush (a partial root parasite) and white-stemmed gooseberry are frequent at the base of willows. Several culturally significant plant species may also be found in these meadows. For example,

sedges were used in basketry, and yampahs and camas lily roots were an important food source for Native Americans. In the drier ecotone areas between moist meadows and the surrounding forest or chaparral, vegetation is sparser and several upland species may co-occur with wet meadow species. In the drier meadow edges, bracken fern, yarrow, horkelias, blue wildrye, one-sided bluegrass, and mountain or Douglas' spiraea may be common.

Yellowlist plants that are associated with wet portions of Montane Meadows in Nevada County include Davy's sedge and thread-leaved beakseed. Rare "Meesia" mosses and sundews also occur in wet meadows and near fens, seeps, and springs. Plumas ivesia is a Yellowlist species found in the seasonally wet portions of meadows east of the Sierra crest, and hidden-petal campion is associated with dry meadow or forest edges in Red Fir and Subalpine Conifer Forests (Appendices II and III). Cheat grass, Klamathweed, and bull thistle are noxious weeds often associated with heavily-grazed Montane Meadows or near roads and recreational facilities (Table 3-2).

Animal Diversity

Montane Meadow ecosystems have high wildlife values due to their abundance of grass, sedge, and wildflower seeds that provide seasonally-abundant food (Mayer and Laudenslayer 1988). Meadows also offer shelter (under the turf) for small mammals and open escape routes for birds. Only in water-saturated areas do the numbers of species decline as many species of small mammals and reptiles are intolerant of standing waters or saturated soils (Zeiner et al. 1990). Approximately 139 vertebrate species occur in Montane Meadows of Nevada County including: 53 mammals, 66 birds, 15 reptiles, and five amphibians. This forest type provides breeding habitat for about 61 of these species (Appendix VI).

Drier meadows can be densely populated with pocket gophers, voles, shrews, and a variety of mice along with attendant predators such as snakes, owls, hawks, weasels, and foxes. Insect production in Montane Meadows is usually higher than in surrounding forests or chaparral. During the summer nesting season and late summer migration, montane willow thickets are among the most important feeding sites in the higher mountains for warblers, white-crowned and Lincoln's sparrows, and many other birds. Large concentrations of songbirds in Montane Meadows may also draw avian predators such as Cooper's hawks, sharp-shinned hawks, and red-tailed hawks (Appendix VI).

The Redlist great gray owl (recorded a few times in Nevada County at lower elevations during winter) and Sierra Nevada red fox, and the Yellowlist Sierra Nevada showshoe hare and American badger all use drier Montane Meadow systems for feeding (Zeiner et al. 1990). Ungrazed, or lightly grazed wet meadows at higher elevations are frequently rich with willow groves that are well-used by small birds, including nesting Redlist little willow flycatcher. In addition to other birds of prey, concentrations of songbirds in Montane Meadows may also draw the Yellowlist northern goshawk and merlin (Appendix VI).

Non-native animals that may use Montane Meadows (especially those below about 3,500 feet) include wild turkey, European starling, wild pig, black rat, and house mouse. Livestock operations attract brown-headed cowbirds, a native North American species that expanded its range into California in the early 1900s. Cowbirds parasitize the nests of other native songbirds and reduce their reproductive success (Grinnell and Miller 1944, Verner and Ritter 1983, Beedy and Granholm 1985, Gaines 1992). In Montane Meadows of the Sierra Nevada, brown-headed cowbirds are most abundant in areas where livestock grazing occurs within about 4 miles of their riparian breeding areas (Rothstein et al. 1984).

Distribution and Status

The distribution of Montane Meadows in California is scattered within lower and upper coniferous forest types in the North Coast Ranges, Klamath Range, Cascade Range, Sierra Nevada, and Peninsular and Transverse Ranges (Mayer and Laudenslayer 1988). According to a GAP-analysis, approximately 14% of wet and dry Montane Meadow habitat in the Sierra Nevada is in private ownership and the remainder is in public ownership (Davis and Stoms 1996).

Approximately 3,710 acres of Montane Meadows exist in Nevada County, representing < 1% of the county's total land area; approximately 47% of this acreage is on private lands (Table 3-1). In Nevada County, most Montane Meadows are most common between about 4,000 and 8,850 feet elevation on the west slope and east of the Sierra crest. Many large Montane Meadows can be found west of the crest (e.g., Bear Valley and Loney Meadows and English Meadow at the headwaters of the Middle Yuba River). A few, isolated Montane Meadows are found as low as 2,700 feet near Grass Valley; however, non-native species are a large component in these low-elevation remnants of Montane Meadow (e.g., near the North Star Mine and Empire Mine). The largest examples in Nevada County include Euer and Carpenter valleys and the remnant portions of meadows on the east shore of Lake Van Norden (**Figure 3-11**).

Recreational development and livestock grazing disproportionately impact these biologically important and often small and fragile habitats. Weedy, non-native plants are not yet a major component of most Montane Meadows. However, livestock grazing and vehicle traffic can introduce noxious weeds and non-native species to Montane Meadows (Schwartz et al. 1996). Channel erosion and downcutting of meadow streams resulting from overgrazing may result in a succession to drier habitat; and overgrazed meadows have more forbs and fewer grasses and grass-like plants (Mayer and Laudenslayer 1988).

Fresh Emergent Wetlands

Structural and Ecological Characteristics

Fresh Emergent Wetlands are distinguished from deep water aquatic habitats and wet meadows or grassland habitats by the presence of tall, erect, grass-like plants that are rooted in soils that are permanently or seasonally flooded or inundated. These ecosystems can occur in basins or depressions at all elevations, aspects, and exposures, but they are most common on level to gently-rolling topography (Mayer and Laudenslayer 1988).

In the foothill region of Nevada County, Fresh Emergent Wetlands are often associated with small manmade ponds and natural drainages that are enhanced by intentional or unintentional releases of NID water. Fresh Emergent Wetlands also can occur as fringes around reservoirs where the slopes are gentle enough to create a rim of shallow water provided that water levels do not fluctuate widely. On slow-moving meadow streams, Fresh Emergent Wetlands can occur as a narrow band over long distances. Non-maintained roadside ditches are another likely setting for these habitats.

The hydric soils supporting Fresh Emergent Wetlands are typically clayey, silty, or peaty, and often have a sulphur-like odor due to the anaerobic conditions that exist under still water (USACE 1987). Cattail and bulrush marshes often have this characteristic. Like Montane Meadows, these marshes are transitory, eventually succeeding to upland habitats through gradual filling. The speed at which this occurs varies depending on the rate of sedimentation, frequency of flooding, and rate of soil development, but this process usually occurs over geologic time since marshes often appear relatively stable for many decades (Mayer and Laudenslayer 1988).

Plant Diversity

Plant species composition of Fresh Emergent Wetlands varies somewhat between foothill and montane regions and within a single marsh depending on the basin contours that reflect the depth and duration of flooding (Mayer and Laudenslayer 1988). For example, deeper portions of a marsh are generally dominated by taller species, primarily cattails and bulrushes. Near the upper edge of the marsh zone, grasses and grass-like plants 1 to 3 feet tall and occasional tree or shrub species are more common.

In the foothill zone of Nevada County, characteristic species include broadleaf cattail, common bulrush, creeping spikerush, Pacific rush, Baltic rush, mannagrass, floating water-primrose, water-plantain, and swamp smartweed. Gooding's willow and buttonwillow are woody species that tolerate flooding and are occasionally found around freshwater marshes.

In montane marshes, beaked sedge and bladder sedge are commonly encountered species, and broadleaf and narrowleaf cattail also occur. Other frequently encountered montane marsh species in Nevada County include creeping spikerush, least spikerush, long-leaved pondweed, floating pondweed, Howell's and Bolander's quillworts, Canadian waterweed, Siberian milfoil, emersed bur-reed, Congdon's bulrush, and aquatic buttercup. Several special status plants are associated with these habitats in Nevada County, including northern bugleweed, marsh skullcap, white-stemmed pondweed, Robbins' pondweed, and an insectivorous plant, lesser bladderwort.

Yellowlist plant species that are associated with Fresh Emergent Wetlands in, or near, Nevada County include Scadden Flat checkerbloom, a species known globally from only a few populations near Grass Valley. Other Yellowlist plants that occur in foothill marshes include red-anthered rush and Mexican mosquito fern (Appendices II and III).

Himalayan blackberry and purple-top vervain are invasive, non-native plants often occurring in or adjacent to freshwater marshes. Other noxious weeds known from within, or near, Nevada County include hydrilla, purple loosestrife, Eurasian milfoil, and parrott's feather. Giant reed is another highly invasive weed known from lower foothill and valley elevations. Their aquatic setting and their ability to reproduce asexually by stolons or turions make many of the aquatic/emergent weeds particularly difficult to control or eradicate. Several species are common aquarium species or horticultural escapees (Table 3-2).

Animal Diversity

Compared to most terrestrial, large-patch ecosystems in Nevada County, Fresh Emergent Wetlands support a relatively low number of vertebrate species. This is because most reptile and small mammal species (e.g., most rodents) avoid flooded areas and permanently saturated soils. In contrast, many species and high numbers of water birds are drawn to marshes, mudflats, and other wetland habitats (Zeiner et al. 1990). Approximately 73 vertebrate species occur in Fresh Emergent Wetlands of Nevada County including 14 mammals, 52 birds, three reptiles, and four amphibians. Fresh Emergent Wetlands provide breeding habitat for about 31 of these species (Appendix VI).

Characteristic water birds that nest in Nevada County marshes and other wetlands include Canada goose, mallard, cinnamon teal, Virginia rail, sora, American coot, common moorhen, killdeer, and common snipe. These species are joined by a host of migratory waterfowl in fall, and many may remain in the county through the winter and spring. Typical migratory and wintering waterfowl in the county include gadwall, American wigeon, northern pintail, green-winged teal, ring-necked duck, bufflehead, common goldeneye, and ruddy duck (Appendix VI).

The most frequent mammals in marshes of the county include a variety of foraging bats, vagrant, dusky, and ornate shrews, shrew-moles, American beavers, and muskrats. Amphibians in these habitats include: long-toed salamanders, California newts, western toads, and Pacific treefrogs. Northwestern pond turtles, common garter snakes, and Sierra garter snakes are the only reptiles that regularly occur in marshes of Nevada County (Appendix VI).

The Redlist California black rail is a resident marsh bird that is known to occur in Fresh Emergent Wetlands in Nevada County. Other Redlist birds that may forage rarely in these ecosystems include bald eagle and American peregrine falcon. American white pelicans and redheads are Yellowlist water birds that may visit local marshes and wetlands in winter or during migration. The Yellowlist northern harrier may nest and forage in Fresh Emergent Wetlands, and white-tailed kites sometimes forage on their margins (Appendices V and VI).

At least three species of Yellowlist bats may forage over Fresh Emergent Wetlands including: yuma myotis, long-eared myotis, and long-legged myotis. These habitats in the county support no regularly - occurring Yellowlist reptiles or amphibians except for the Northwestern pond turtle (Appendices V and VI).

Bullfrogs are abundant, non-native amphibians that are common in shallow ponds and other permanent wetlands of the county. This invasive species, along with introduced bass and signal crayfish, can displace or directly prey on many native, aquatic species (Zeiner et al. 1990, Jennings and Hayes 1994).

Distribution and Status

In California, Fresh Emergent Wetlands are found throughout the state at all elevations, but they are most common below 7,500 feet. The state's largest acreages of these wetlands occur in the Sacramento Valley, San Joaquin Valley, Klamath Basin, Sacramento-San Joaquin delta region, and Imperial Valley-Salton Sea (Mayer and Laudenslayer 1988, Holland 1986).

In Nevada County, Fresh Emergent Wetlands span a large elevational gradient from about 380 feet up to about 7,970 feet elevation (Table 3-1). However, they are generally found around the margins of natural lakes at higher elevations (i.e., above about 4,000 feet), such as the many small lakes in the Grouse Ridge area. Approximately 4,552 acres of Fresh Emergent Wetlands exist in the county, representing <1% of the county's total land area; about 68% of this acreage is on private land (Table 3-1). Most individual occurrences of marshland in the county are < 2 acre in extent. However, one of the county's largest foothill wetlands is the expansive cattail marsh just west of Grass Valley near Scadden Flat (Figures 3-12a and b). Large, high elevation marshes occur at a quarry pond just south of Truckee at about 5,800 feet elevation, and Lake Van Norden at about 7,000 feet. Lake Van Norden is at the headwaters of the South Yuba River, and it provides valuable habitat for migratory and nesting waterfowl and other water birds. Other large examples of marsh habitats are found in the diggings ponds throughout the middle elevations of the county (**Figure 3-12a**).

Small pockets of Fresh Emergent Wetland are widely scattered in all elevations of Nevada County but are never common. Small marshes can be found along low gradient reaches of rivers and streams in backwater areas or ponded overflow channels. In the foothill zone of Nevada County a disproportionately high number of the marsh habitats are induced or created by irrigation runoff and are potentially threatened by canal encasement. These ecosystems also are vulnerable to conversion for agricultural, residential, or urban uses.

Fresh Emergent Wetland ecosystems are recognized throughout California as important natural communities because of their limited extent compared to

historical distributions, their importance to dependent plant and wildlife species, and threats facing remaining wetland areas. This status is supported by the DFG policy promoting "no net loss" of wetland habitats, which includes Fresh Emergent Wetlands (California Fish and Game Commission 1987). Portions of these ecosystems may also qualify as jurisdictional wetlands under Section 404 of the federal Clean Water Act (USACE 1987). Section 404 is enforced by the U.S. Army Corps of Engineers in consultation with USFWS and/or NMFS concerning possible take of federally-listed plants and animals that may result from the fill of jurisdictional wetlands or Waters of the United States.

Whether naturally occurring or manmade, Fresh Emergent Wetlands usually offer valuable wildlife habitat except in areas with a high degree of disturbance from humans. Residential and urban development near marshes in foothill areas may reduce their integrity through the introduction of predators (including feral cats and dogs) and non-native aquatic species. In montane regions of the county, most Fresh Emergent Wetlands are relatively stable, although erosion of surrounding slopes due to timber harvesting or road construction could potentially hasten their conversion to upland habitats. Rapid expansion of the Truckee area and surrounding communities also could threaten these ecosystems east of the Sierra crest. The acreage of Fresh Emergent Wetlands in California has decreased dramatically since the turn of the century due to drainage and conversion to other uses, primarily agriculture (Mayer and Laudenslayer 1988).

Shrub Ecosystems

Foothill Chaparral

Structural and Ecological Characteristics

Foothill Chaparral ecosystems in Nevada County are characterized by having a high topographic and geologic diversity. In this report, Foothill Chaparral is defined as being dominated by whiteleaf manzanita and buckbrush-dominant chaparrals, while the higher elevation Montane Chaparral is characterized by a dominance of greenleaf manzanita, Indian manzanita, deerbrush, and mountain whitethorn. In the county, Foothill Chaparral ecosystems include successional habitats in oak woodlands or lower elevation Ponderosa Pine

Forest as well as persistent chaparrals on poor soils, such as lava caps, and Serpentine and Gabbrodiorite Soils. Many Foothill Chaparral shrub species provide and conserve mutualistic soil fungi that promote conifer seedling establishment (Horton et al. 1999).

Foothill Chaparral often occurs in settings that are too hot, dry, rocky and steep to support tree-dominated habitats (Holland 1986). It generally occurs on south-facing slopes, transitioning to woodlands of interior live oak or Ponderosa Pine Forests on north-facing slopes. Foothill Chaparral ecosystems occur on a wide variety of rock types including: granite, recent volcanic rocks with little soil development, serpentinite, gabbrodiorite, slates, and metamorphosed volcanic rock; they do not occur on alluvial soils. Parent material often influences species composition, particularly on serpentine and gabbro soils which exhibit a high degree of rare and endemic species (see "Small-Patch Ecosystems, Serpentine and Gabbrodiorite Soils," below).

Foothill Chaparral may be sparse on serpentine or lava caps, with a total cover ranging from 30% to 60% (Mayer and Laudenslayer 1988). On other soils it generally forms impenetrable thickets 6 to 24 feet high (Holland 1986). In Nevada County, however, a range of roughly 6 to 12 feet is more characteristic. Earlier successional chaparrals, or chaparrals on serpentine soils may be much lower, generally ranging from 3 to 6 feet high. Chaparral shrubs have thick, stiff, leathery evergreen leaves, called "sclerophylls," an adaptation to heat and drought. In this fire-maintained community, many species have adapted by stump-sprouting or by seed germination that responds favorably to fire (Holland 1986).

In an early successional stage, the herb layer of Foothill Chaparral may be dense until crowded out by the developing shrub species. In older stands that have not burned in several decades, the understory is often composed of thick leaf litter and short-lived species such as yerba santa and ceanothus. Widely-scattered emergent pines or oaks are common, but generally represent less than 10% of the overall cover. Foothill Chaparral ecosystems may persist for many years as successional stages to Foothill Hardwood Woodlands, until the slow-growing oaks begin to shade or compete with the shrub species; this process may take at least 50 years in blue oak woodlands (Mayer and Laudenslayer 1988).

Plant Diversity

Whiteleaf manzanita, buckbrush, and shrubby interior live oaks are the dominant species in Foothill Chaparral ecosystems of Nevada County. Sites

that have experienced considerable soil disturbance or those that occur as a successional stage to Ponderosa Pine Forest may contain only a few shrub species, usually whiteleaf manzanita. However, under most other circumstances, particularly on poor or rocky soils, Foothill Chaparral ecosystems in Nevada County may be quite diverse with native shrubs, forbs, and native bunchgrasses, including hoary coffeeberry, redberry, western redbud, birchleaf mountain mahogany, Lemmon's ceanothus, Klamath plum, yerba santa, Fremont silk-tassel, western service berry, deerbrush, Brewer's white oak, chaparral honeysuckle, chaparral clematis, pitcher sage, and poison oak.

On serpentine soils, chaparral pea, leather oak, and McNab cypress are common, but California flannelbush and bush poppy are quite rare in Nevada County. Chamise, a species characteristic of chaparrals throughout the state including the foothills of both northern and southern Sierra Nevada (Mayer and Laudenslayer 1988), is strangely absent from Nevada County except for a small stand in the South Yuba River canyon (Olmstead pers. comm.). Within Foothill Chaparral ecosystems, openings such as rock outcrops or road cuts support common plants in the herb layer including creeping sage, climbing bedstraw, American vetch, Sierra milkwort, Watson's wild cucumber, common brodiaea, coyote mint, California helianthella, spiked rosinweed, bladder parsnip, purple sanicle, and several native bunchgrasses such as California melic, squirreltail, and one-sided bluegrass.

Foothill Chaparral ecosystems support many endemic Redlist and Yellowlist plants (Figures 3-1 and 3-2; Appendix II). Serpentine and gabbrodiorite soils may support the Redlist Stebbins' morning-glory and Pine Hill flannelbush (or a possible intermediate or variant of Pine Hill flannelbush and California flannelbush). Yellowlist species Bacigalupi's yampah, Follett's monardella, Sanborn's onion, and Congdon's onion are also found in serpentine and gabbrodiorite chaparrals in Nevada County. Other Yellowlist plants found in Foothill Chaparral in Nevada County include Humboldt lily, Brandegee's clarkia, and Sylvan microseris.

Relatively few non-native, invasive plant species occur in Foothill Chaparral ecosystems, but abundant and widespread species such as yellow star-thistle may occur in disturbed areas (Table 3-2).

Animal Diversity

A large number of animal species frequent Foothill Chaparral ecosystems because they provide abundant food supplies, shelter, and nesting sites and some species can be found in their highest abundance there. Approximately

109 vertebrate species occur in these ecosystems including: 29 mammals, 62 birds, 15 reptiles, and three amphibians. Foothill Chaparral ecosystems provide breeding habitat for about 48 of these species (Appendix VI).

Dusky-footed woodrats and deer mice are both very common in Foothill Chaparral providing abundant food for snakes and carnivores. In addition to these rodents, a number of other mammals occupy these dense thickets where they avoid disturbance from humans. Mountain lions, black bears, coyotes, gray foxes, and ringtails are among the larger mammals that roam these habitats. Other common mammals include western gray squirrels, California ground squirrels, and brush rabbits. Gopher snakes, California whipsnakes, western rattlesnakes, and California kingsnakes are readily found in Foothill Chaparral ecosystems, along with smaller snakes such as racers, ringneck snakes, and sharp-tailed snakes. Also common to abundant in these habitats are western and Gilbert's skinks, southern alligator lizards, and western fence lizards. The most common amphibian is the California slender salamander, which can be readily found during the rainy season but retreats far underground in summer (Appendix VI).

Numerous bird species either nest in Foothill Chaparral ecosystems or use them seasonally. Common breeding species include the blue-gray gnatcatcher, wrentit, California towhee, western scrub-jay, and Anna's hummingbird. Birds can be particularly abundant in Foothill Chaparral in winter, perhaps because it lies below the snow zone. Many native shrubs such as toyon and poison oak provide fruits that attract huge numbers of American robins, along with cedar waxwings, Townsend's solitaires, hermit thrushes, and sometimes varied thrushes. Ruby-crowned kinglets and Hutton's vireos are typical Foothill Chaparral birds that primarily forage in evergreen foliage (Appendix VI).

No Redlist animals are known to occur in Foothill Chaparral ecosystems of Nevada County (Figure 3-5). Yellowlist animals that may reside or forage in these ecosystems include: California horned lizards, golden eagles, purple martins, yellow warblers, long-eared myotis, long-legged myotis, pale Townsend's big-eared bat, and ringtails (Appendices V and VI).

Distribution and Status

The California distribution of Foothill Chaparral includes a fairly continuous band through the Transverse, Peninsular, and South Coast ranges and large areas of the interior slopes of the North Coast ranges. In the Sierra Nevada, it occupies a narrower and broken band along the middle and lower elevations of the western slope. Large intermittent patches also occur in the

Klamath, Siskiyou, and Cascade ranges. However, the species composition varies widely throughout the state, and many different types of Foothill Chaparral are recognized by Holland (1986) and Sawyer & Keeler-Wolf (1995) (Table 2-2).

In Nevada County, Foothill Chaparral ecosystems range from about 270 feet up to about 5,030 feet in elevation on the Washington Ridge Serpentine Soils. However, it is most common between the Foothill Hardwood Woodland and the Ponderosa Pine Forest between about 1,000 and 3,500 feet. Approximately 9,350 acres of Foothill Chaparral exist in Nevada County, representing almost 2% of the county's total land area; approximately 77% of this acreage is on private land (Table 3-1).

The largest stands of Foothill Chaparral in Nevada County are on the serpentine and gabbro formations southwest of Grass Valley and west of Nevada City (**Figure 3-13**). The 49er Fire and the recent fires near Rough & Ready and Smartville created many thousands of acres of mid-successional chaparral, particularly in the form of shrubby interior live oak chaparral. Much of this area is in succession to a mixed oak, oak-pine, or live oak woodlands. The proximity of the serpentine and gabbrodiorite Foothill Chaparral ecosystems to urban centers makes them more vulnerable to residential or commercial development than many other large- or small-patch ecosystems of Nevada County.

Montane Chaparral

Structural and Ecological Characteristics

In Nevada County, Foothill Chaparrals dominated by whiteleaf manzanita and other foothill species transition to Montane Chaparrals of greenleaf manzanita and other characteristically montane species at 3,000 to 4,000 feet elevation, where consistent accumulations of winter snow and moister soils are found. At elevations above approximately 7,500 to 8,000 feet, Montane Chaparral transitions to a low scrub of subalpine species, described under "Dwarf Subalpine Scrub." Montane Chaparral occurs as both a persistent ecosystem on soils too poor, rocky, or shallow to support conifer forests, and as a post-fire or logging successional stage to conifer forests on deeper, more productive soils. The structure of Montane Chaparral varies from small tree-like stands to prostrate shrubs (Mayer and Laudenslayer 1988).

On the exposed granitic bedrock common above 6,000 feet in Nevada County, Montane Chaparral occurs as a climax community of low, dense growth of huckleberry oak and pinemat manzanita. Montane Chaparral often

grows in association with widely scattered Sierra juniper, Jeffrey pine, or incense cedar. The herb layer may be diverse, but is generally confined to fractures, benches, and other areas where fines accumulate. Greenleaf manzanita and mountain whitethorn are common but of lower stature in these settings. Growth rates are also influenced by elevation; high elevation chaparrals mature slowly and individuals of longer-lived species, such as huckleberry oak, may be quite old. Leathery, evergreen shrubs may dominate, but several winter-deciduous species are also common in Montane Chaparral ecosystems (unlike Foothill Chaparral ecosystems that include relatively few deciduous species).

As a successional stage to Mixed-Conifer Forest, the shrubs tend to grow taller and faster, maturing in as few as 10 years. However, they are usually shorter-lived and eventually over-topped by conifer species. Chaparral may facilitate the germination of red firs (Barbour 1984) and other shade-tolerant conifers by providing protective cover, moderating microclimate, and improving soil conditions (Mayer and Laudenslayer 1988). Many Foothill Chaparral shrub species provide and conserve mutualistic soil fungi that promote conifer seedling establishment (Horton et al. 1999). Montane Chaparral shrubs also may be an essential link in forest succession by building up soil nutrient levels, particularly nitrogen, to the point where trees can survive (Zavitovski and Newton 1968). The herb layer of these successional chaparrals is typically sparse except in the few years following fire or logging (Holland 1986). In the drier soils and climate east of the Sierra crest, post-fire or logging chaparrals may persist for up to 50 years and are typically dominated by tobacco brush.

Plant Diversity

In Nevada County, persistent chaparrals that occur on poor soils, such as lava caps and granitic or metamorphic rock outcrops, are often quite diverse with native shrubs, perennial and annual herbs, and bunchgrasses. Good examples are seen on the volcanic ridges on Backbone-Graniteville Road, the massive granitic outcrops in the area between Cisco Grove and Donner Summit, and the colorful metamorphic rock in the Laing's Crossing area of the South Yuba River. On volcanic ridges, Klamath plum often co-dominates with greenleaf manzanita, Indian manzanita, deerbrush, shrubby canyon live oak, whiteleaf manzanita, and buckbrush. The herb layer is often well developed due to the intermittent cover of shrubs, and includes sulphur-flowered buckwheat, coyote mint, woolly sunflower, Applegate's paintbrush, three week fescue, rhomboid clarkia, and many annual forbs. Few noxious weeds are associated with these habitats except in disturbed soils and along roadsides where Klamath weed and yellow star-thistle may be locally abundant.

In the Laing's Crossing area north of Bear Valley on metamorphic rock, there is an interesting mix of foothill and montane species, where high elevation species such as Sierra juniper and pinemat manzanita grow side-by-side with California bay, bush monkeyflower, whiteleaf manzanita, and yerba santa. Greenleaf manzanita, Indian manzanita, Fremont's silk-tassel, Lemmon's keckiella, and a wide variety of rock ferns and perennial herbs such as Brewer's cliff-brake, Bridge's cliff-brake, imbricate phacelia, wedgeleaf goldenbush, Wright's buckwheat, azure penstemon, and rosy pussytoes are found there.

Montane Chaparral species characteristic of the granitic outcrops at higher elevations include huckleberry oak, pinemat manzanita, greenleaf manzanita, mountain whitethorn, Sierra chinquapin, bitter cherry, Sierra coffeeberry, mountain pride, prickly phlox, Parry's rush, and Sierra stonecrop. Barren rock often makes up a large portion of the cover.

East of the Sierra crest, where the winters are dry and cold, the species composition of Montane Chaparral becomes dominated primarily by tobaccobrush, with greenleaf manzanita, mahala mat, wax currant, Bloomer's goldenbush, western serviceberry, and woolly mule-ears also present. Noxious weeds are more prevalent here, including many introductions from the Great Basin states. Cheat grass is particularly widespread, although most weed infestations are found below 7,000 feet in the transition to Eastside Pine or Eastside Scrub. Good examples of this type are found in the Carpenter Ridge area and Boca Hill. The post-fire successional chaparrals around the Truckee area often contain a mix of species found on the west and east slopes of the crest. At elevations below about 6,500 feet in eastern Nevada County, Montane Chaparral transitions to an Eastside Scrub dominated by antelope bitterbrush and sagebrush with scattered Jeffrey pine and ponderosa pine trees.

Stebbins' phacelia is a Yellowlist plant that occurs on metamorphic soils of Nevada County, especially on northern exposures. The starved daisy is another Yellowlist plant that occurs on granitic outcrops. It is a species with a global distribution restricted to this region of Nevada County and northern Placer County (Appendices II and III).

Animal Diversity

No animal species are restricted to Montane Chaparral ecosystems, and most species that occur there can also be found in either Foothill Chaparral or Eastside Scrub ecosystems. While Montane Chaparral ecosystems provide abundant food supplies, shelter, and nesting sites, they are often covered by

snow in the winter, and few species find permanent residence there. Approximately 88 vertebrate species occur in these ecosystems including: 25 mammals, 47 birds, 14 reptiles, and two amphibians. Montane Chaparral ecosystems provide breeding habitat for only about 33 of these species (Appendix VI).

Bushy-tailed woodrats, California ground squirrels, and deer mice can be very common in Montane Chaparral ecosystems, and they provide abundant food for snakes and carnivores. In addition to these rodents, a number of other mammals occupy these dense thickets where they avoid disturbance from humans; these include mountain lions, black bears, gray foxes, and coyotes. Gopher snakes, California whipsnakes, western rattlesnakes, and California kingsnakes are readily found in Montane Chaparral ecosystems, along with smaller snakes such as racers, ringneck snakes, and sharp-tailed snakes. Also common to abundant in these habitats are western and Gilbert's skinks, northern alligator lizards, sagebrush lizards, and western fence lizards. The most common amphibian is the Pacific treefrog. Numerous bird species either nest in Montane Chaparral ecosystems or use them seasonally. Common breeding species include the green-tailed towhee, fox sparrow, and dark-eyed junco. (Appendix VI).

No Redlist animals are known to occur in Montane Chaparral ecosystems of Nevada County (Figure 3-5). Yellowlist animals that may forage in these ecosystems include: northern goshawks, golden eagles, yellow warblers, long-eared myotis, long-legged myotis, and pale Townsend's big-eared bat (Appendices V and VI).

Distribution and Status

The California distribution of Montane Chaparral includes an area between 3,000 and 9,000 feet in the northern portion of the state; in southern California it typically occurs above 7,000 feet elevation. It occurs from Siskiyou County to Kern County in the Cascade Range and Sierra Nevada and in the North Coast and Klamath Ranges to the west. Its southern California distribution is limited to the high mountains of the Transverse Ranges in San Bernardino, Riverside, and Los Angeles counties (Mayer and Laudenslayer 1988).

In Nevada County, Montane Chaparral has its highest concentration in the Mixed-Conifer Forest zone. However, it extends from about 2,840 feet in lower river canyons up to about 9,050 feet elevation in the subalpine zone (Table 3-1, **Figure 3-14**). Approximately 24,990 acres of Montane

Chaparral exist in Nevada County, representing about 5% of the county's total land area; about 45% of this acreage is on private land (Table 3-1).

Persistent chaparrals on rock outcrops are relatively secure since most are in public ownership and their rocky soils often precludes invasion by most noxious weed species (Table 3-2). However, silvicultural practices have a strong influence on the structure of Montane Chaparral ecosystems (Mayer and Laudenslayer 1988), primarily those chaparrals that occur as successional stages to Mixed-Conifer Forest.

Subalpine Dwarf-Scrub

Structural and Ecological Characteristics

On the higher peaks and ridges of Nevada County, at elevations above about 8,500 feet, Subalpine Dwarf Scrub is the dominant ecosystem. It is characterized by a low scrub of high elevation perennials, bunchgrasses, and sub-shrubs that occur on dry slopes, summits, and talus or scree slopes. Soils are gravelly and exposed, with no humus and a heavy snow cover in winter. The dry, cold, and windy sites are subject to intense solar radiation and freezing nights in summer. Windward slopes are often blown clear of snow, and exposed plants are subject to extremely low winter temperatures, severe winds, and the desiccating effects of alternate freezing and thawing in the early season (Whitney 1979).

The growing season in Subalpine Dwarf Scrub ecosystems is limited to approximately 7-9 weeks and takes place in July and August (Whitney 1979). The volcanic ridges between Castle Peak, Andesite Peak and Basin Peak, the ridge north of White Rock Lake, and the upper portions of Carpenter Ridge offer good examples of this ecosystem in Nevada County. However, Subalpine Dwarf Scrub also occurs on granitic and metamorphic substrates.

Subalpine Dwarf Scrub transitions to Subalpine Conifer Forest on moister, less exposed aspects. In what appears at first glance to be a timberline are actually habitats constrained by poor soils and exposed aspects, rather than true alpine habitats. Sawyer and Keeler-Wolf (1995) list the range for Subalpine Upland Shrub Habitat at 5,700-11,500 feet, from the Cascade Range to the Peninsular Ranges, except in the Coast ranges and Klamath Range.

True Alpine ecosystems do not occur in Nevada County (True 1973). However, Subalpine Dwarf Scrub ecosystems in the county may appear similar to Alpine ecosystems. Subalpine Dwarf Scrub ecosystems are

dominated by perennial plants and low, often cushion-like sub-shrubs that are less than 18 inches high. Trees and larger shrubs up to 3 feet high may occur but are a minor component of the overall cover. Cover may be dense in some areas near the transition to Subalpine Conifer Forests, but it is increasingly sparse at higher elevations or on poor sites. On mesic sites, a continuous turf of native sedges, rushes, and spikerushes may be found. Succession is quite slow, due to the harsh environmental conditions and short growing season, and is initiated following severe droughts, landslides, and other disturbances (Mayer and Laudenslayer 1988).

Plant Diversity

In Nevada County, species characteristic of the dry stands of Subalpine Dwarf Scrub include low sage, sulphur-flowered buckwheat, Bloomer's goldenbush, stemless haplopappus, alpine goldenbush, alpine ipomopsis, oval-leaved buckwheat, woolly mule ears, King's sandwort, Davis' knotweed, mountain sorrel, prickly phlox, Whitney's locoweed, spur lupine, Heller's sedge, straw-like sedge, mountain bunchgrass, Sierra lewisia, and many more.

Yellowlist plants that can occasionally be found in this ecosystem in Nevada County include: woolly-leaved milk-vetch, fell-fields claytonia, and long-petaled lewisia, the latter two of which are associated with snowmelt-fed scree slopes (True 1973). On mesic sites, several other sedges and rushes may be present, including Sierra hare sedge, black alpine sedge, native sedge, littleleaf sedge, Drummond's rush, and Pringle's bluegrass (Appendix II).

No invasive, non-native plants are known to occur in Subalpine Dwarf Scrub ecosystems of Nevada County (Table 3-2).

Animal Diversity

Few wildlife species reside in Subalpine Dwarf Scrub ecosystems year-round due to extreme winter conditions and the extended snowpack at high elevations. However, a number of species visit these areas during the summer flowering season and the later period of summer production of grass and wildflower seeds. Only about 60 vertebrate species occur in these ecosystems including 29 mammals, 28 birds, two reptiles, and one amphibian. Subalpine Dwarf Scrub ecosystems provide breeding habitat for only about 27 of these species (Appendix VI).

Golden-mantled ground squirrels are common residents of Subalpine Dwarf Scrub ecosystems where they consume seeds in the sunflower family.

Similarly, a variety of seed-eating birds can be observed during late summer, including western meadowlarks, horned larks, and dark-eyed juncos. Small birds and mammals attract a high diversity of raptors (especially individuals in migration) such as sharp-shinned and Cooper's hawks, prairie falcons, and red-tailed hawks. The summer flowering season coincides with an influx of hummingbirds (Mayer and Laudenslayer 1988) that are either in migration or seeking relief from the summer drought and heat of the foothills. Rufous (in migration) and calliope hummingbirds (high mountain breeders) can be abundant around particularly lush flower patches. Common mammals include pika, Belding's ground squirrels, and mountain pocket gophers (Mayer and Laudenslayer 1988).

Yellowlist raptors observed foraging in Subalpine Dwarf Scrub ecosystems of Nevada County include northern harrier, golden eagle, merlin, and prairie falcon. The extremely rare Redlist California wolverine and Sierra Nevada red fox may also visit these areas occasionally (Appendices V and VI).

Distribution and Status

In California, Subalpine Dwarf Scrub ecosystems exist in the subalpine zones of the Cascade Range, Sierra Nevada, Peninsular Ranges, and the White, Inyo, and Sweetwater Ranges (Mayer and Laudenslayer 1988). In Nevada County, the distribution of this ecosystem is quite limited, and it is restricted to the upper slopes of the highest peaks such as Mt. Lola, Castle Peak, Basin Peak, and the ridges above approximately 8,500 feet (**Figure 3-15**). Only about 800 acres of Subalpine Dwarf Scrub exist in Nevada County, representing about <1% of the county's total land area; approximately 6% of this acreage is on private land (Table 3-1). Threats to these sites are minimal and are limited to human disturbance of wildlife, trampling, erosion, and potential introduction of non-native plants along hiking trails and jeep trails.

Eastside Scrub

Structural and Ecological Characteristics

What may appear as a monotony of silvery-gray to olive-green shrubs in the lowlands east of Truckee is often a floristically diverse assemblage of Eastside Scrub plants, particularly near the edges of Montane Meadows or in rocky soils. Antelope bitterbrush and big sagebrush are the dominant shrubs, but a wide variety of other shrubs, perennial and annual forbs, and bunchgrasses may be found. Scattered emergent pines and large stands of curl-leaf mountain mahogany are also common. While all of Nevada County

occurs within the California Floristic Province (Hickman 1993), the Great Basin influence is apparent in this transitional zone.

Eastside Scrub ecosystems in Nevada County occur on flats and slopes with deep, well-drained, coarse alluvium and volcanic soils of primarily andesitic origin. On cooler or moister sites at higher elevations, Eastside Scrub transitions into Eastside Pine or Mixed-Conifer Forests or into Montane Chaparral ecosystems that are often dominated by tobacco brush. Curl-leaf mountain mahogany often forms pure stands on steep, dry, and rocky slopes (Smith 1994) such as the volcanic knobs and talus slopes common in the Truckee River canyon. In Nevada County, Eastside Scrub ecosystems occur in roughly the same elevation range as Eastside Pine Forests, between about 5,100 and 7,500 feet. However, it was also found above 8,900 feet on the southwest-facing slopes of the highest peaks (Table 3-1).

Throughout their range in the Great Basin, high desert scrublands of antelope bitterbrush and big sagebrush occur where summers are warm to hot and winters are cold and dry; annual precipitation ranges from 10 inches to 30 inches, primarily as snow (Holland 1986). Consequently, the shrubs are somewhat more widely spaced than Montane Chaparral shrubs but are denser than in drier regions to the east. In Nevada County, the shrubs are generally 2 to 4 feet high, although taller individuals are common. On higher, wind-swept slopes and ridges near Truckee, stands are often less than 18 inches high. Basins with restricted drainages or higher alkalinity give way to pure stands of big sagebrush; a narrow band of sagebrush often surrounds seasonally wet Montane Meadows, becoming bitterbrush-dominated on higher ground or in the understory of Eastside Pine Forests.

Antelope bitterbrush is an important browse species that tolerates considerable browsing by both deer and livestock. Shrubs that are moderately browsed when young become tightly hedged, which protects them from over-grazing. Unbrowsed or lightly browsed shrubs are open-crowned and more susceptible to damaging over-grazing and early death (Mayer and Laudenslayer 1988). Antelope bitterbrush reproduces primarily by seed in California, but seeds have a short period of viability, are often infertile from insect damage, killed by late spring freezes, consumed by rodents, or succumb to drought, particularly when competing with grasses. Consequently, years in which many seedlings become established are rare in California. Stands are often even-aged; thus, most plants become decadent and die without replacement over a short period. Most stands become decadent at 30 years of age and die out after about 40 or 50 years, but bitterbrush stands over 125 years old have been found on deep, well-drained soils (Mayer and Laudenslayer 1988).

Antelope bitterbrush may crown-sprout following low intensity fires (Smith 1994), but high intensity fires are generally fatal. Big sagebrush does not crown-sprout after fire, and for as much as 20 years after fire, burned stands may become dominated by rabbitbrush and grasses. Hot fires in degraded sites often result in a successional community dominated by annual grasses and forbs. Under light or moderate grazing these ephemeral communities are usually replaced by perennial bunchgrasses and open stands of shrubs. Following fire, infestation of the noxious weed, cheatgrass, is common in Eastside Scrub and can increase both fire frequency and fire intensity; many examples were observed in the Truckee River canyon (Table 3-2).

Plant Diversity

The sagebrush scrub of Nevada County appears more floristically diverse than the mid- to late-seral bitterbrush stands. Sagebrush scrub is usually dominated by mountain sagebrush in the county and is particularly diverse near the complex of vernally wet meadows north of Truckee along Highway 89. Characteristic species in the ground layer include colorful forbs such as woolen breeches, Nuttall's larkspur, Beckwith's violet, Torrey's blue-eyed mary, dwarf chamaesaracha, Holboell's rock cress, Brewer's lupine, western blue flax, staining collomia, and Sierra lomatium.

In dense stands of bitterbrush the understory may be limited to scattered clumps of Brainerd's sedge, mountain violet, Torrey's cryptantha, one-sided bluegrass, and occasional wax currant. Ponderosa pine and Jeffrey pine trees are common associates of bitterbrush stands. In the steep, rocky volcanic soils of the Truckee River canyon, bitterbrush and mountain sagebrush often co-dominate and both the shrub and herb layers are more diverse. Western serviceberry, curl-leaf mountain mahogany, western chokecherry, whitestem rabbitbrush, and tobaccobrush are often common in the shrub layer. Characteristic forbs and bunchgrasses include hoary aster, woolly mule's-ears, silvery lupine, coyote mint, blazing star, squirreltail, Wright's buckwheat, Applegate's paintbrush, prickly poppy, and large-flowered collomia.

Compared to most other large-patch ecosystems in Nevada County, relatively few Yellowlist plants occur in Eastside Scrub ecosystems of Nevada County. These include Plumas ivesia and Lemmon's clover (Appendices II and III).

The Eastside Scrub and Eastside Pine ecosystems east of Truckee are home to a 600-acre population of the federally rated noxious weed, musk thistle,

which was believed to be introduced on firefighting equipment during the Boca Fire of the 1960s. Several small satellite occurrences were also observed in the area near Hirschdale (Table 3-2). Railroad tracks and interstate highways are also important vectors for these and other noxious weeds. In these areas east of Truckee, common noxious weeds and other invasive non-native plants include many species characteristic of the Great Basin, such as spotted knapweed, Dyer's woad, Russian thistle, cutleaf nightshade, and tumble mustard. Other common weeds here include pigweed, Scotch thistle, bull thistle, field bindweed, tansy, and Klamathweed. Cheatgrass is widespread in many areas that have experienced hot fires in the last few decades (Table 3-2).

Animal Diversity

Eastside Scrub ecosystems provide an important source of food, cover, and breeding habitats for many wildlife species. They are considered some of the state's most important wintering and fawning habitat for migratory mule deer (Mayer and Laudenslayer 1988). While Eastside Scrub ecosystems offer abundant food supplies, shelter, and nesting sites, they are often covered by snow in the winter and few species maintain permanent residence there. Approximately 90 vertebrate species occur in Eastside Scrub ecosystems including 31 mammals, 47 birds, 10 reptiles, and two amphibians. This ecosystem provides breeding habitat for only about 47 of these species (Appendix VI).

A variety of small mammals can be common in Eastside Scrub ecosystems including desert cottontail, black-tailed jackrabbit, dusky-footed woodrat, pinyon mouse, deer mouse, brush mouse, western harvest mouse, and four species of chipmunks. Characteristic reptiles in these ecosystems are western fence lizards, sagebrush lizards, western skinks, racers, striped whipsnakes, gopher snakes, common garter snakes, and western rattlesnakes (Appendix VI).

Typical nesting birds in sagebrush and bitterbrush stands of the county are horned larks, green-tailed towhees, spotted towhees, Brewer's sparrows, and vesper sparrows. A variety of raptors such as American kestrels, red-tailed hawks, rough-legged hawks (winter only), Cooper's hawks, and prairie falcons forage for small birds and mammals in Eastside Scrub ecosystems. Mammalian predators that frequent these ecosystems include mountain lions, bobcats, coyotes, and long-tailed weasels (Appendix VI).

Only one Redlist animal, Swainson's hawk, has been documented as a rare, nonbreeding visitor to Eastside Scrub ecosystems of Nevada County.

Yellowlist animals that may forage in these ecosystems include northern harrier, northern goshawk, ferruginous hawk, golden eagle, prairie falcon, yuma myotis, long-eared myotis, long-legged myotis, and pale Townsend's big-eared bat (Appendices V and VI).

Distribution and Status

Throughout California, antelope bitterbrush-sagebrush habitats range from about 3,500 to 10,500 feet elevation east of the Cascade and Sierra Nevada crest from Modoc and Siskiyou counties south to Inyo County. Some examples of antelope bitterbrush exist west of the Cascades in Shasta and Siskiyou counties (Mayer and Laudenslayer 1988).

In Nevada County, Eastside Scrub ecosystems are common in the area from Truckee north to the Sierra County line and east through the Truckee River canyon (**Figure 3-16**). Approximately 11,740 acres of Eastside Scrub exist in Nevada County, representing about 2% of the county's total land area; about 62% of this acreage is on private land (Table 3-1). Several large areas of Eastside Scrub have been converted or are proposed for residential expansion around Truckee and in the Martis Valley.

Forested Ecosystems

Foothill Hardwood Woodlands

Structural and Ecological Characteristics

Foothill Hardwood Woodlands include a zone of oak-dominated ecosystems growing between the Annual Grasslands at the edge of the Central Valley and the Oak-Foothill Pine Woodlands and Ponderosa Pine Forests at higher elevations. Three distinct subtypes of Foothill Hardwood Woodland types are recognized by the CWHR system (Table 2-2): Blue Oak Woodlands, Interior Live Oak Woodlands, and Valley Oak Woodlands. These three types are discussed separately below, following an overview of oak woodland ecology and distribution.

Overview of Oak Woodlands

Blue oaks, interior live oaks, and valley oaks are endemic to California (Hickman 1993). Blue Oak Woodlands and Interior Live Oak Woodlands often occur in mixed stands down to about 300 feet elevation, and for this reason, Interior Live Oak Woodland is treated here as a Foothill Hardwood Woodland type, rather than a Montane Hardwood Woodland type. The ubiquitous pine and oak-dominant woodlands between approximately 1,000

and 2,500 feet elevation were mapped separately under Oak-Foothill Pine Woodlands (**Figure 3-17a**). Valley Oak Woodlands have a very restricted distribution in Nevada County and stands away from streams were mapped as a Foothill Hardwood Woodland type (**Figure 3-17b**). Stringers of valley oaks occurring on stream corridors were mapped as Foothill Riparian Woodlands and are discussed in that section.

Since European settlement, oak woodlands in California have been managed primarily for livestock production. Historically, losses of oak woodlands occurred because of clearing for range improvements and agriculture; the major losses now are from intensive residential and industrial development. Poor oak recruitment and regeneration is a major problem in many areas. Oak woodlands have decreased in California by over 1,000,000 acres during the last 50 years because of agricultural, residential, and industrial development. Moreover, in many places, blue and valley oaks have reproduced poorly during this time period. Even when germination occurs, seedling survival often fails (Holland 1976).

Some ecologists think that the lack of regeneration in oak woodlands can be explained by the consumption of acorns and seedlings by cattle. However, the cessation of livestock grazing can result in a thatch accumulation of tall, weedy annual grasses, and does not always result in oak regeneration because wildlife and insects also cause heavy damage to acorns and seedlings. Urban populations of deer and certain other mammal and bird species eat acorns and young oaks, and they may be more abundant now than in the past because of land use changes and predator control. However, some of these species have positive effects on oak regeneration; acorns buried by western scrub-jays, yellow-billed magpies, western gray squirrels, and California ground squirrels are more likely to germinate because they root better and are less likely to be eaten (Griffin 1971).

Frequent fires historically occurred in oak woodlands, and fire suppression has affected regeneration negatively in both valley and blue oaks. Young trees of both species will sprout when fire damaged, but older trees will not. Thus, frequent fires tend to maintain oak stands of younger age classes, but a century of fire control has resulted in the predominance of older trees. When these stands eventually burn, they do not regenerate themselves. Furthermore, the absence of frequent, non-catastrophic ground fires encourages the invasion of evergreen oaks such as interior live oaks, and their seedlings seem to be more browse resistant than those of deciduous oaks (Griffin 1977).

Blue Oak Woodlands

Blue oaks are relatively slow-growing, long-lived trees that can reach 80 feet in height. Large blue oaks range in age from about 150 to 390 years (White 1966); however, the diameter/age relationship of individual trees varies tremendously depending on site quality. On shallower, well-drained upland soils, blue oaks form savanna-like stands on dry ridges and gentle slopes. They are well adapted to dry, hilly terrain where the water table is usually unavailable, and they have an unusual tolerance for severe drought, shedding their leaves under extreme moisture stress. The density of blue oaks on slopes is directly related to water stress, and both blue oaks and interior live oaks can be present where the soils are deeper or moister (Griffin 1973).

The shrub layer in Blue Oak Woodlands is usually sparse, often occurring only on rock outcrops or poor soils where trees are often very small. The understory is generally dominated by non-native Annual Grassland except on poor soils, such as serpentine. Blue Oak Woodland intergrades with Annual Grassland at lower elevations and with Oak-Pine Woodland, Foothill Chaparral, Montane Hardwood, or Ponderosa Pine Forest at higher elevations. Blue Oak Woodlands are generally grazed more intensively than Interior Live Oak Woodlands, due in part to higher limbs and a more sunlit and grassy understory. The leathery, evergreen leaves of blue oaks are deciduous and the leaf litter is faster to decompose, resulting in a more developed herbaceous layer. The added sunlight also allows for better development of the weedy, introduced annual grasses (Griffin 1973).

Above approximately 1,500 feet elevation in Nevada County, blue oak woodlands occur mainly on gently sloping, well-drained, nutrient-poor dry sites where they grow slowly. On nutrient-poor soils (such as serpentine), 8-inch diameter blue oaks may be as much as 100 years old (McCreary pers comm.). On shallower soils and south-facing slopes, Blue Oak Woodland is replaced by Foothill Chaparral or by Interior Live Oak Woodland on steep north-facing slopes or in areas burned by high-intensity fires.

Poor regeneration of blue oaks is well documented (White 1966, Holland 1976, Griffin 1977, Baker et al. 1981) and is evident in Nevada County as well. Most stands of blue oak sexist as medium or large tree stages with few or no young trees present. Age studies in the southern Sierra Nevada indicate that most blue oak stands are currently 80 to 120 years old (Brooks 1969). Poor oak reproduction may be related to competition for soil moisture from introduced and weedy annual grasses and the consumption of acorns and seedlings by insects, domestic livestock, and wildlife. Blue oaks are somewhat shade-intolerant, and disturbances producing openings in the

canopy may be necessary for seedling growth and survival in denser stands. Catastrophic fires, such as the Nevada County 49er Fire, tend to replace blue oak woodlands with Interior Live Oak Woodlands because live oaks are more vigorous stem-sprouters (Griffin 1977).

Interior Live Oak Woodlands

In Nevada County, Interior Live Oak Woodlands typically occur on north-facing slopes and in drainages and stream canyons interspersed within the Blue Oak Woodlands. However, at elevations above approximately 1,500 feet elevation, they occur in a wider variety of settings, from steep, rocky canyon slopes to gentle slopes or ridges on nutrient- poor soils such as gabbrodiorite. At middle elevations, Interior Live Oak Woodlands are generally characterized by dense stands of small diameter trees under 20 feet high. Directly under the oak canopy, dense shade and a thick, persistent layer of leaf litter typically precludes development of an herb layer. Few weedy annual grasses are found, and the shrub layer is often sparse or absent.

Usually situated on steep canyon slopes, Live Oak Woodlands are often ungrazed or only lightly grazed, and the stands are usually not thinned. The average tree diameters are usually small due in part to the high stand densities. Multi-trunked trees also suggest that these individuals have stump-sprouted following a wildfire or stand clearing (Griffin 1977).

Valley Oak Woodlands

Valley Oak Woodlands in California are best represented in the Central Valley on deep, well-drained alluvial soils, often along river bottoms, where they form nearly pure, park-like stands of large trees (Griffin and Critchfield 1976, Mayer and Laudenslayer 1988). In Nevada County, as in other Sierran counties, Valley Oak Woodlands have a very limited distribution, occurring primarily in large valley bottoms such as Penn Valley and in other smaller valleys where soils are deep and contain some subsurface soil moisture (Figure 3-17b). Here, as in the Central Valley, large and broad-crowned trees occur in savanna-like stands. These stands blend into foothill riparian forests of valley oak or mixed-riparian along stream courses and on active floodplains. These stringers of valley oaks along streams, in dense stands of smaller diameter trees, were mapped as Foothill Riparian Woodland and are discussed separately from Valley Oak Woodlands that occur some distance away from streams, and offer somewhat different wildlife habitat values. Valley Oak Woodlands intergrade with Blue Oak Woodland or Oak-Foothill Pine Woodland on shallower or drier sites (Griffin 1977, Mayer and Laudenslayer 1988).

Few young trees are seen in open, drier sites, although reproduction of valley oaks near streams with floodplain development can be good, particularly following a recent flood event. The lack of Valley Oak Woodland regeneration at most sites seems to be related to competition for soil nutrients and moisture between oak seedlings and introduced annuals, consumption of acorns and seedlings by wild and domestic animals, and by disking or plowing (Holland 1976). In the Central Valley, flood control projects also may play an important role in the regeneration problems of valley oak. Valley oaks are tolerant of flooding while other components of the community that are potential competitors are not; consequently, Valley Oak Woodlands thrive in areas that receive regular flooding (Griffin 1977).

Plant Diversity

Blue Oak Woodlands

Blue oaks generally dominate the tree layer, often with widely scattered, emergent foothill pines. However, there are many Nevada County examples of blue oak and interior live oak co-dominating the tree layers of individual stands. The shrub layer is generally sparse in this more heavily grazed habitat except for a few scattered poison oak, coffeeberry, buckbrush, redberry, California buckeye, and whiteleaf manzanita. Dominant species in the grassy understory include the non-native species wild oat, soft chess, ripgut brome, foxtail barley, hedgehog dogtail, rattail fescue, rose clover, hedge parsley, and winter vetch. Common noxious weeds include yellow star thistle, Italian thistle, and medusa-head. The understory of blue oak woodlands in Nevada County can also be home to a wide variety of colorful native bulbs and annual wildflowers. Characteristic native species include California poppy, common brodiaea, fiddleneck, popcornflower, winecup clarkia, soap plant, Ithuriel's spear, and gold nuggets.

Relatively few Yellowlist plants are known to occur in Blue Oak Woodlands in Nevada County. One rare species, Brandegee's clarkia, occurs on grassy slopes in this ecosystem (Appendix II).

Interior Live Oak Woodlands

Where light permits development of an herbaceous layer, dominant species in the understory of Interior Live Oak Woodlands include species that are somewhat shade-tolerant, such as the non-native hedgehog dogtail, hedge parsley, chickweed, and the noxious weed Italian thistle. Common native species include blue wildrye, miner's lettuce, foothill sanicle, hairy wood rush, and western buttercup. At woodland edges or in openings of the tree canopy such as rock outcrops, common shrubs include coffeeberry, redberry,

whiteleaf manzanita, poison oak, toyon, and hoary honeysuckle. In these canopy openings, common herb associates include non-native slender wild oat, yellow star-thistle, and ripgut brome, in addition to those mentioned above. Native forbs and bunchgrasses are best represented on poor, rocky soils, and include white globe lily, twining brodiaea, common brodiaea, round-tooth ookow, soap plant, California melic, one-sided bluegrass, purple needlegrass, common madia, and goldback fern.

Yellowlist plants known from Interior Live Oak Woodlands in, or just outside of, Nevada County occur in canopy openings such as road cuts and rock outcrops. These include Brandegee's clarkia, dubious pea, golden-anthered clarkia, Butte County fritillary, Sylvan microseris, and Humboldt lily (Appendix II).

Valley Oak Woodlands

In the small alluvial valleys of western Nevada County, valley oaks frequently co-occur with blue oaks away from the stream. The understory is often grazed and consists of a thick carpet of introduced annual grasses and forbs. The shrub layer, if present, contains bird-dispersed native species such as poison oak, coffeeberry, and toyon. However, brambles of the noxious weed, Himalayan blackberry, often are more common. Common non-native species in the understory include annual ryegrass, wild oats, Italian thistle, foxtail barley, yellow star-thistle, soft chess, and winter vetch. Occasional native forbs and grasses found in the understory of valley oak woodlands in Nevada County include blue wildrye, western buttercup, and popcornflower.

No Redlist or Yellowlist plants are specifically known to occur in Valley Oak Woodlands of Nevada County (Appendix II). However, in these alluvial settings, vernally moist depressions in grassland could support Cedar Crest popcornflower, which has not been collected since 1937. Scadden Flat checkerbloom could potentially occur in Valley Oak Woodland at the edge of an adjacent freshwater marsh.

Animal Diversity

Foothill Hardwood Woodlands (including Blue Oak, Interior Live Oak, and Valley Oak Woodlands) are one of the richest wildlife habitats in California (Mayer and Laudenslayer 1988). This statewide trend also seems to be true in Nevada County, because Foothill Hardwood Woodlands provide habitat for about 145 wildlife species, which rely on them for feeding, cover, or nesting sites during all or some part of the year. These species include 36 mammals,

86 birds, 18 reptiles, and five amphibians. About 96 of these species use oak-dominated ecosystems in the county for breeding (Appendix VI).

Amphibians and reptiles in Blue Oak Woodlands and Valley Oak Woodlands are mostly those of open Annual Grassland ecosystems. Amphibians include California slender salamanders and western toads, while reptiles include a wide variety of snakes (racers, common garter snakes, California whipsnakes, and gopher snakes), skinks, northern alligator lizards, and western fence lizards. The grassland component brings in species of birds such as lark sparrows, western meadowlarks, Bullock's orioles, and American kestrels, while oaks provide food for various songbirds and nesting sites for cavity nesters such as woodpeckers, oak titmouse, ash-throated flycatcher, house wren, Bewick's wren, and violet-green swallow. Typical mammals in these ecosystems include mule deer, California ground squirrels, and western gray squirrels (Appendix VI).

Interior Live Oak Woodlands often share many wildlife species with Foothill Chaparral (see that account for details) because these types often intermix on the same hillsides. The primary distinction between the two habitats is the presence of larger trees in the woodland that offer a structural framework and cavities for larger nesting birds such as red-tailed hawks and great horned owls.

No Redlist animals are associated with Foothill Hardwood Woodlands in Nevada County (Figure 3-5, Appendix VI). Yellowlist species that may be found in these ecosystems include northwestern pond turtle (near permanent water), white-tailed kite, golden eagle, yellow warbler, yuma myotis, pale Townsend's big-eared bat, and ringtail.

Non-native animals that may occur in Foothill Hardwood Woodlands of Nevada County include European starlings, wild turkeys, Virginia opossums, and wild pigs.

Distribution and Status

Foothill Hardwood Woodlands are widespread in western Nevada County (Figure 3-17a). Approximately 37,670 acres of this type exist here, representing about 6% of the county's total land area; about 90% of this acreage is on private land (Table 3-1).

The rarest Foothill Hardwood Woodland type, Valley Oak Woodland, is restricted to about 1,790 acres in Nevada County. These stands range in elevation from about 340 feet up to about 2,300 feet, and about 95% of the Valley Oak Woodlands in the county are on private lands (Table 3-3).

Blue Oak Woodlands

Blue Oak Woodland is the dominant interior foothill woodland, forming an almost continuous belt around the Central Valley (Holland 1986, Mayer and Laudenslayer 1988). Blue Oak Woodlands dominate the lower elevations of Nevada County (Figure 3-17a), and some of the larger examples are in or near the state-owned Spenceville Wildlife Management Area. Other examples are found west of Indian Springs Creek and in the Salt Creek watershed, east of Highway 49.

During the 1960s to the early 1980s, Blue Oak Woodlands were cleared extensively throughout the Sierra Nevada foothills for livestock grazing and for firewood cutting. A relatively recent trend towards rural residential development in the foothills has replaced agriculture as the primary reason for conversion of these stands. Additionally, the introduction and dominance of Mediterranean annual grasses and forbs has had a profound effect on the regeneration of oaks. Although Blue Oak Woodlands still cover a large number of acres in California, they are threatened by range-wide fragmentation and a lack of regeneration (The Nature Conservancy 1999).

Interior Live Oak Woodlands

Interior Live Oak Woodlands is widespread throughout the foothill region surrounding the Central Valley, from Shasta County south through the North Coast Range to Sonoma County and south through the Sierra foothills to the Kern River (Holland 1986). They are well distributed in Nevada County as well, from approximately 350 feet elevation to 2,500 feet and occasionally higher. Examples of Interior Live Oak Woodland in Nevada County can be found throughout the area burned in the 1989 fire, the Bridgeport area, on north-facing slopes of the Yuba River and Bear River corridors, and on moister aspects in the region between Spenceville Wildlife Management Area and Indian Springs Creek. The Tarr Ditch watershed, east of McCourtney Road, has examples of shrubby Interior Live Oak Woodlands on poor soils with a relatively diverse shrub and herb layer.

Valley Oak Woodlands

Valley Oak Woodlands are typically a Central Valley riparian forest type, and this ecosystem was formerly very extensive in the Sacramento and San Joaquin valleys (Holland 1986). Most of the historical stands in the Central Valley have been cleared for agriculture, flood control, and urban expansion. In the foothills of Nevada County, small pockets of Valley Oak Woodlands occur in valleys from 350 feet elevation at Spenceville Wildlife Management Area up to about 2,400 feet elevation at the headwaters of Squirrel Creek

(Figure 3-17b). Historic rangeland clearing for agriculture in these valley bottoms and residential development along streams in western Nevada County also has resulted in a reduction and fragmentation of Valley Oak Woodlands.

One of the largest remnant examples of Valley Oak Woodlands in Nevada County is along Highway 20 in Penn Valley. Other good examples can be found around the base of Pilot Peak in the Campbell Creek watershed. The Lake of the Pines area and Pleasant Valley contain examples of fragmented Valley Oak Woodlands that may have been much more extensive historically. In the valley-foothill bioregion, large stands of valley oak over 40 acres are nearly absent (Greenwood et al. 1993).

Oak-Foothill Pine Woodlands

Structural and Ecological Characteristics

Oak-Foothill Pine Woodlands are comprised of a wide range of structural types including park-like blue oaks on gentle, grassy slopes at lower elevations of the county and foothill pine woodlands on higher, rockier, and steeper slopes where oak trees may be sparse or absent. Blue oaks are intolerant of shade, and they generally do not occur in dense stands of foothill pines. Oak-Foothill Pine Woodlands are distinguished from Foothill Hardwood Woodlands by having a component of foothill pine that exceeds 10% of the total canopy cover (Mayer and Laudenslayer 1988).

Low elevation Oak-Foothill Pine Woodlands are usually dominated by scattered blue oaks, with foothill pines occurring sparsely in the more shallow and rocky soils (Mayer and Laudenslayer 1988). Most existing stands in the Sierra Nevada are in mature stages, with canopy cover ranging from 10 to 59% (Mayer and Laudenslayer 1988). At higher elevations, interior live oaks replace blue oaks, especially on steep, rocky soils on north-facing slopes. Large stands of Oak-Foothill Pine Woodlands composed largely of interior live oaks can be found around Englebright Reservoir.

Oak-Foothill Pine Woodlands usually have an understory layer of shrubs that is dominated by non-native annual grasses characteristic of Annual Grasslands. Native forbs are usually sparse and best represented on rock outcrops. At middle elevations, these ecosystems are often indicators of serpentine-derived soils and they also occur as chaparral-woodlands on extremely dry, shallow, non-serpentine soils, such as lava caps and gabbrodiorite. These soils are often associated with Redlist and Yellowlist plants and unusual plant associations (see "Small-Patch Ecosystems," below). At higher elevations, Foothill Pine Woodlands merge with Foothill Chaparral, Montane Hardwoods, or Ponderosa Pine Forest.

Foothill pines grow more rapidly than either blue oaks or interior live oaks following fires, clearing, or other disturbances, and the pines may mature into relatively large trees within 30 to 40 years. In the denser, often live oak-dominant stands, shrubs may mature in 10 to 15 years. Blue oaks tend to grow slowly at all stages, and acorn-producing trees may take decades to develop. In a study of blue oaks in Nevada, Shasta, and Placer Counties, they showed little or no growth after reaching 26 inches in diameter (Mayer and Laudenslayer 1988).

Researchers have expressed concern about this ecosystem because "little regeneration has occurred since the late 1800's, as livestock, deer, birds, insects, and rodents consume nearly the entire acorn crop each year"(Holland 1976), and there is a "general absence of secondary successional stages" (Mayer and Laudenslayer 1988).

Plant Diversity

The shrub and herbaceous layers of open Oak-Foothill Pine Woodlands at low elevations are characterized by Foothill Chaparral species including shrubby California buckeye, whiteleaf manzanita, buckbrush, hoary coffeeberry, and poison oak. Other frequently encountered species in this habitat in Nevada County are toyon, western redbud, redberry, and chaparral honeysuckle. Dominant species in the herb layer include the non-natives wild oat, slender wild oat, ripgut brome, and rose clover. Widely scattered native forbs include common brodiaea, Ithuriel's spear, fiddleneck, and California poppy. Noxious weeds are most common along road edges and other disturbed or ruderal areas. The most frequent noxious weeds and other invasive non-native species include yellow star thistle, Italian thistle, medusa-head, goat grass, woolly vetch, black mustard, and Klamathweed (Table 3-2).

As a dense woodland with a mix of foothill pine, interior live oak, blue oak, and black oak, the shrub layer is also more developed and the herb layer less dominant. In Nevada County, common shrubs here include whiteleaf manzanita, buckbrush, deer brush, poison oak, hoary coffeeberry, bush penstemon, silver bush lupine, hoary honeysuckle, chaparral honeysuckle, California buckeye, and western redbud. Native perennial bunchgrasses such as California melic, one-sided bluegrass, blue wildrye, and purple needlegrass are usually present in openings beneath the tree canopy rather than non-native annual grasses. Shade-tolerant forbs and grasses growing in the shade of the oaks are often sparse, and include miner's lettuce, western buttercup, foothill sanicle, goldback fern, and the nonnatives, hedgehog dogtail and hedge parsley.

Several Yellowlist plants are associated with Oak-Foothill Pine Woodlands in, or near, Nevada County (Appendices II and III). Brandegee's clarkia or golden-anthered clarkia could occur on open, grassy slopes, and Butte County fritillary, Humboldt lily, and dubious pea have been found on wooded slopes or flats at the middle elevations, generally on non-serpentine or gabbrodiorite soils. Oak-Foothill Pine Woodlands on serpentine or gabbro-derived soils could support two Redlist species known globally from only two areas in Nevada County and El Dorado County, Stebbins' morning-glory and Pine Hill flannelbush. Two other Yellowlist species associated with these habitats include Sanborn's onion and Bacigalupi's yampah.

Animal Diversity

Oak-Foothill Pine Woodlands provide habitat for a large number of animals, although no species are totally dependent on this type (Mayer and Laudenslayer 1988). A total of 140 native species use this habitat in Nevada County including 36 mammals, 82 birds, 16 reptiles, and six amphibians. About 90 of these species breed in Oak-Foothill Pine Woodlands of the county (Appendix VI).

Grass seeds, fruits of various shrubs, oak acorns, and foothill pine seeds all provide nutritious food sources for a wide variety of rodents, squirrels, larger mammals, and seed-eating birds. For this reason, western scrub-jays, acorn woodpeckers, western gray squirrels, and other seed specialists may be common in these mixed woodlands. Similarly, newly emerged leaves of oaks in the spring support an abundance of insects that attract large numbers of migrating and nesting warblers, vireos, flycatchers, and other insectivorous birds.

In areas where shrubs are present, another group of birds replaces the open grassland species and is represented by spotted towhees, California towhees, white-crowned and golden-crowned sparrows (winter only), wrentits, and blue-gray gnatcatchers. Characteristic amphibians include California slender salamanders and western toads, while reptiles include a wide variety of snakes (racers, common garter snakes, California whipsnakes, gopher snakes, and western rattlesnakes among others), skinks, southern alligator lizards, and western fence lizards (Appendix VI).

No Redlist animals are associated with Oak-Foothill Pine Woodlands in Nevada County (Figure 3-5). Yellowlist species that may be found in these ecosystems include northwestern pond turtle (near permanent water), yellow warbler (nonbreeding), yuma myotis, long-legged myotis, pale Townsend's big-eared bat, and ringtail (Appendix VI).

Non-native animals that may occur in Oak-Foothill Pine Woodlands of Nevada County include European starlings, wild turkeys, and wild pigs.

Distribution and Status

In California, Oak-Foothill Pine Woodlands form a nearly continuous ring around the outer perimeter of the Central Valley. They also can be found in the Pit River drainage of the Cascade Range, the foothills of the Klamath Range, widely scattered on the east slopes of the Coast Ranges, and in central San Bernardino County (Mayer and Laudenslayer 1988). These woodlands range from about 290 feet in extreme western Nevada County to an unusually high elevation occurrence at about 4,320 feet on serpentine soils of Washington Ridge (Table 3-1, **Figure 3-18**). Some of the largest examples of this ecosystem in the county can be found in the Colgate Powerhouse and Woods Creek watersheds. Approximately 43,590 acres of this type exist in Nevada County, representing about 7% of the county's total land area. About 91% of this acreage is on private lands (Table 3-1).

Montane Hardwood Woodlands

Structural and Ecological Characteristics

Most Montane Hardwood Woodlands in Nevada County are comprised primarily of canyon live oaks. These hardwood trees may represent 60% of the canopy on many sites and as much as 80% on poorer quality sites (Mayer and Laudenslayer 1988). The remaining canopy trees in these woodlands are usually a few conifer species. This ecosystem mostly occurs on rocky, south-facing slopes of major river canyons, but it is also well represented on north-facing slopes. On deeper soils, black oaks may be the dominant tree species in Montane Hardwood Woodlands, especially when they are found within or near Mixed-Conifer or Ponderosa Pine Forests. In these settings, Montane Hardwood Woodlands generally transition into Foothill or Montane Chaparral. Higher elevation, black oak-dominated stands often occur as a successional stage to Ponderosa Pine or Mixed-Conifer Forest in areas disturbed by fire, logging, or clearing (Mayer and Laudenslayer 1988).

The shrub and herb layers of Montane Hardwood Woodlands are often sparse, except beneath canopy openings. Stands are nearly always dense, with live oaks being well developed and filling in the canopy layer to the exclusion of most other species. This density makes these ecosystems prone to stand-replacing fires that convert the woodlands to Foothill or Montane Chaparral. Throughout the Sierra Nevada, however, this ecosystem is considered to be very stable over time (Mayer and Laudenslayer 1988).

Plant Diversity

In addition to canyon live oak, lower elevation trees that occur in Montane Hardwood Woodlands are foothill pine, ponderosa pine, tan oaks, Pacific madrone, and California laurel. Higher elevation associates include various conifers of Mixed-Conifer Forests, as well as black oaks.

The slope and aspect of individual sites usually determines the species composition of the shrub and herb layers. On the rocky, arid, south-facing canyon slopes, canyon live oak is often the sole dominant, and the thick, leathery, slowly-decomposing leaf litter and dense stands generally preclude development of a shrub or herb layer. Characteristic shrub species in the river canyons include deer brush, poison oak, whiteleaf or greenleaf manzanita, Lewis' mock orange, California buckeye, bush monkeyflower, gay penstemon, climbing bedstraw, one-sided bluegrass, western fescue, three week fescue, and some widespread exotic annual grasses such as rattail fescue, European silvergrass, and ripgut brome. Invasive, non-native species such as yellow star-thistle and Scotch broom generally occur near trailhead parking areas, residential or agricultural interfaces, and areas disturbed by fire or logging.

On cooler and moister north-facing slopes, the tree layer often includes a diverse mix of evergreen and winter-deciduous trees, such as black oak, big leaf maple, madrone, California bay, Douglas fir, and incense cedar. The sparse shrub layer is dominated by shade-tolerant species such as poison oak, California hazel, or white-barked raspberry, with deer brush, Lewis' mock orange, and whiteleaf manzanita best represented in canopy openings, resulting from road cuts, trails, or rock outcrops. In these mixed stands on moister aspects, the herb layer may be diverse, particularly near seeps or in drainages. Common species in the herb layer include thimbleberry, hoary honeysuckle, narrowleaf sword fern, wood fern, licorice fern, goldback fern, Pacific stonecrop, fringe cups, woodland star, Alaska onion grass, and the non-native species, common chickweed. Moss and lichen diversity is also rich in these ecosystems.

Two Yellowlist plants, Butte County fritillary and Humboldt lily, are associated with mixed stands of Montane Hardwood on deeper soils on higher slopes above the river canyons in Nevada County (Appendix II). A third Yellowlist plant, Cantelow's lewisia, is found on cool, moist, mossy north-facing cliffs of slates and schists. Stebbins' phacelia is also associated with cooler aspects on metamorphic rock in Montane Hardwood.

Noxious weeds are most common on the moister aspects, particularly Himalayan blackberry, cut-leaf boysenberry, and other horticultural escapees such as periwinkle and English ivy (Table 3-2). Non-native species are most frequent around recreational trails and facilities, particularly parking areas, and near homes or historical mining sites.

Animal Diversity

Montane Hardwood Woodlands support a high number of animals species as compared to most other large-patch ecosystems in Nevada County, although no species are totally dependent on this type (Mayer and Laudenslayer 1988). A total of 140 native species use this habitat in the county including 37 mammals, 78 birds, 19 reptiles, and six amphibians. About 99 of these species use Montane Hardwood Woodlands for breeding (Appendix VI).

The high diversity of animals in these ecosystems is driven by an abundance of nutrient-rich acorns. Accordingly, acorn-disseminating species such as western scrub-jay, Steller's jay, acorn woodpecker, and western gray squirrel are found here. Acorn-eating species including mountain quail, band-tailed pigeon, California ground squirrel, dusky-footed woodrat, black bear, and mule deer are well represented in this ecosystem. In addition to acorns, oaks carry a heavy invertebrate load that, in turn, feeds large numbers of migrating and nesting insect-eating birds such as warblers, vireos, and flycatchers. Characteristic amphibians include California slender salamanders and western toads, and reptiles include a wide variety of snakes (racers, common garter snakes, California whipsnakes, gopher snakes, and western rattlesnakes among others), skinks, southern alligator lizards, and western fence lizards (Appendix VI).

No Redlist animals are associated with Montane Hardwood Woodlands in Nevada County (Figure 3-5). Yellowlist species that may be found in these ecosystems include northwestern pond turtle (near permanent water), California spotted owl (nonbreeding), yellow warbler (nonbreeding), yuma myotis, long-legged myotis, pale Townsend's big-eared bat, and ringtail (Appendix VI).

Non-native animals that may occur in Montane Hardwood Woodlands of Nevada County include European starlings, wild turkeys, and wild pigs.

Distribution and Status

Montane Hardwood Woodlands are fairly widespread in California except for desert or lowland areas, and they occur in a broad band along the length of the Sierra Nevada (Mayer and Laudenslayer 1988). They occupy a wide

elevational gradient in Nevada County. At their lowest limits, a few stands occur on north-facing slopes down to about 530 feet along Englebright Reservoir. Stands dominated by canyon live oak also occur on the rocky, south-facing slopes along river canyons, larger creeks, and high ridgelines as high as about 6,490 feet in the county (Table 3-1). However, the largest concentrations of this habitat occur between about 1,500 to 3,500 feet elevation, and especially large stands exist along the South Yuba River canyon. Approximately 29,250 acres of this type exist in Nevada County, representing almost 5% of the county's total land area. About 72% of this acreage is on private lands (Table 3-1).

In Nevada County, mature stands of Montane Hardwood Woodlands are characteristic of steep canyon slopes (**Figure 3-19**). Most of these stands are dense and at great risk of stand-replacing fires. The steep rocky nature of these slopes precludes nearly all human activity, meaning that soils, plant communities, and wildlife values have remained little disturbed except by the effects of fire suppression. On more level, black oak-dominated sites, Montane Hardwood Woodlands are generally at higher risk of being cleared for development or fire abatement. Near urban and residential areas, infestations of Scotch broom are common in Montane Hardwood Woodlands that have been disturbed by fires or range clearing, particularly in the San Juan Ridge area.

Foothill Riparian Woodlands

Structural and Ecological Characteristics

Foothill Riparian Woodlands are defined as all stands of deciduous trees in elevation Zones 1 and 2 of Nevada County up to about 3,000 feet elevation that occur within approximately 150 feet of a perennial stream (**Figure 3-20**). This definition includes widely-distributed riparian ecosystems such as Fremont cottonwood riparian woodlands and willow scrub stands, as well as those with a very limited extent in the county such as valley oak riparian stands. Sycamore riparian forest is not found in Nevada County, but a large example of this sensitive plant community exists just outside the county on Dry Creek in Yuba County (CDFG 2002a).

In Nevada County, Foothill Riparian Woodlands are most common on perennial tributaries to the major rivers, particularly in those reaches with shallow to moderate gradients. On the Yuba and Bear River corridors, significant stands are generally restricted to low-gradient, depositional reaches. Elsewhere on high energy, bedrock-constrained river systems, the riparian corridors are patchy and quite narrow, limited laterally by steep side slopes, and they rarely exceed a single tree canopy in width (GANDA 2000).

Stands of valley oak riparian forest in Nevada County generally occur as "stringers" on shallow to moderate gradients, fine-textured soils, and some floodplain development (e.g., Penn Valley, Pleasant Valley, low-gradient portions of the Wolf Creek and Dry Creek corridors, and similar settings). Fremont cottonwood-dominant riparian forests are also found on depositional reaches of rivers and creeks, generally closer to active stream channels than mixed riparian forest (Holland 1986). One of the few examples of mature Fremont cottonwood riparian forest is on the west side of Highway 49 at the confluence of Wolf Creek and South Wolf Creek. Willow scrubs are also found closer to the active channel, on sand, gravel, or cobble bars. Willow scrub is generally persistent, but it is also found as an early successional stage to a riparian forest type near the water's edge, eventually over-topped by valley oaks, cottonwoods, or alders (Mayer and Laudenslayer 1988).

Two or more age classes may be present in valley oak, Fremont cottonwood, or mixed riparian forests. Age classes and structural diversity are reduced in riparian forests heavily impacted by livestock use, development adjacent to the stream, or noxious weed infestations. The herb layer of Foothill Riparian Woodlands is often sparse, due to a well-developed and sometimes diverse shrub layer, and often contains much downed wood and debris from previous flood events. In areas where the shrub layer has been removed or grazed, these ecosystems may have a grassy understory of both native and introduced grasses, grass-like plants, and other herbs. Riparian systems that have been disturbed by historical or current grazing also have a significantly higher proportion of noxious weeds, particularly Himalayan blackberry in the understory. This species can dominate many miles of a stream corridor, crowding out native vegetation and reducing its diversity and wildlife habitat values.

Riparian areas perform vital ecological functions such as dissipating stream energy associated with high water, filtering sediment, capturing bedload, aiding floodplain development, and improving ground-water recharge (Gregory et al. 1991). Many species, including a large number of Redlist and Yellowlist species, are dependent on Foothill Riparian Woodlands during some or all of their life cycles. Riparian ecosystems also play a crucial role in maintaining fish habitat, and research has repeatedly demonstrated linkages between riparian condition and fish habitat quality. Streamside forests with overhanging vegetative cover benefit fish by providing shade to cool the water as well as instream woody debris and root masses for escape cover and breeding sites. Leaf drop is also an important nutrient input to streams (Moyle et al. 1976).

Plant Diversity

The tall, dense canopies of mature valley oak and Fremont cottonwood riparian forest in the Sierra Nevada typically have a sub-canopy tree layer of white alder, Oregon ash, red willow, or California walnut, occasionally with lianas of wild grape up to 50 feet high, which add to the habitat values (Mayer and Laudenslayer 1988).

Species composition in a riparian corridor is largely determined by the depth of the summer water table and the local flooding frequency. On frequently flooded low terraces at or near the active channel, common riparian species in Nevada County include sandbar willow, buttonwillow, mannagrass, water smartweed, ciliate willowherb, tall nutsedge, torrent sedge, horsetail, Pacific rush, an occasional white alder and arroyo willow, and at the lowest elevations, mulefat.

Riparian forests are most diverse at mid-terrace, away from the scouring effects of the active channel. Characteristic species in the overstory and sub-canopy layer are red willow, arroyo willow, shining willow, Oregon ash, California black walnut, Fremont cottonwood, wild grape, white alder, and valley oak. Compared to other nearby counties, Box elders are uncommon in Nevada County, as are western sycamores. Several non-native cottonwood species, silver poplar and Lombard poplar, are often abundant in riparian habitats in urbanized stream reaches and near old town or mining sites. Common shrubs associated with multi-layered Foothill Riparian Woodlands include the noxious weed, Himalayan blackberry, and the native species snowberry, wild rose, poison oak, spice bush, western ninebark, California blackberry, shrubby willows, and occasionally at the upper portions, western azalea. Characteristic herbs include mugwort, Santa Barbara sedge, clustered field sedge, blue wildrye, deer grass, common yarrow, bracken fern, stinging nettle, and the weedy, non-native species purple-top vervain, velvet grass, Bermuda grass, bouncing-bet, and pennyroyal.

Interior live oaks can be important components of some Foothill Riparian forests, but they generally occur on high terraces or in the transition to upland vegetation, often in association with bigleaf maple, incense cedar, black oak or blue oak. In this zone, common understory species include poison oak, California buckeye, hoary coffeeberry, blue elderberry, and coyote brush.

No Redlist plants are specifically associated with Foothill Riparian in Nevada County (Figure 3-1). However, Yellowlist plants known from the adjacent woodlands in upland settings could potentially occur in this transition zone,

particularly shade tolerant species such as Humboldt lily. Brandegee's clarkia, dubious pea, and Butte County fritillary could also occur in well-lighted portions of this transitional zone (Appendix II).

In addition to Himalayan blackberry, now a dominant species in many riparian areas of the foothills, another noxious weed rapidly becoming a serious pest in Foothill Riparian Woodlands in Nevada County is the horticultural escapee scarlet wisteria. Portions of a several mile-long reach of Rock Creek in the Bear River watershed is infested with this species, especially in riparian areas that receive heavy use by cattle. Other noxious weeds and non-native species found in drier portions of riparian areas include black locust, tree-of-heaven, Scotch broom, periwinkle, English ivy, spotted knapweed, poison hemlock, bull thistle, black mustard, woolly mullein, and edible fig (Table 3-2).

Animal Diversity

Foothill Riparian Woodlands provide food, water, migration and dispersal corridors, and escape, nesting, and thermal cover for a high diversity of wildlife species. In Nevada County, these ecosystems may support up to 172 vertebrate species. Montane Riparian Woodlands are the county's only large-patch ecosystems that support more species (Figure 3-3). Foothill Riparian Woodland species include 36 mammals, 113 birds, 16 reptiles, and seven amphibians. About 110 of these species use these ecosystems in the county for breeding (Appendix VI).

An especially high diversity and abundance of birds are found in Foothill Riparian Woodlands of Nevada County. Characteristic breeding birds include: the fish-eating belted kingfisher; the trunk-dwelling downy woodpecker; the flycatching black phoebe; and the foliage-gleaning warbling vireo, western scrub-jay, bushtit, Bewick's wren, house wren, American robin, orange-crowned warbler, and yellow-breasted chat. Typical seed-eating species include: black-headed grosbeak, lazuli bunting, spotted towhee, song sparrow, house finch, and lesser goldfinch. Riparian areas are also attractive to migratory species including a diversity of flycatchers, vireos, warblers, tanagers, and grosbeaks (Appendix VI).

Most mammals, amphibians, and reptiles use riparian corridors for cover, shade, and a source of water. These ecosystems are especially important for migratory mule deer (Zeiner et al. 1990). Bats frequently forage for insects over riparian areas and many individuals may roost in riparian trees. Amphibians and reptiles in Foothill Riparian Woodlands include ensatina, California slender salamanders, Pacific treefrogs, and western toads. Reptiles

include a wide variety of snakes (racers, common garter snakes, California whipsnakes, gopher snakes, and western rattlesnakes among others), skinks, southern alligator lizards, and western fence lizards (Appendix VI).

Two Redlist animals are associated with Foothill Riparian Woodlands in Nevada County (Figure 3-5, Appendix VI). Yellowlist species that may be found in these ecosystems include: foothill yellow-legged frog, northwestern pond turtle, white-tailed kite, willow flycatcher, yellow warbler, yellow-breasted chat, yuma myotis, pale Townsend's big-eared bat, and ringtail (Appendix V).

Non-native animals that may occur in these woodlands include: European starlings, wild turkeys, Virginia opossums, and wild pigs. Foothill Riparian Woodlands are attractive nesting areas for the parasitic brown-headed cowbird (see "Montane Meadows," above).

Distribution and Status

Foothill Riparian Woodlands occur along rivers and creeks in the Central Valley and the lower foothills of the Sierra Nevada, Cascades, Coast Ranges, and Transverse Ranges (Mayer and Laudenslayer 1988). In Nevada County, Foothill Riparian Woodlands occur as narrow and generally discontinuous bands of deciduous trees along most perennial streams from about 270 feet up to roughly 2,500 feet elevation (**Figure 3-20**). Accurate mapping of Foothill Riparian Woodlands from aerial photographs is difficult, as the narrow riparian corridors are often over-topped by the adjacent woodlands or forests. Based on these mapping limitations, approximately 5,850 acres of this type were mapped in western Nevada County. These areas represent <1% of the county's total land area, and about 90% of this acreage is on private land (Table 3-1).

Foothill Riparian Woodlands are sporadic on the county's major rivers and the largest examples are on depositional reaches. This ecosystem rarely occurs on intermittent streams and never on ephemeral streams that only flow during storm events. Representative examples of Foothill Riparian Woodlands (including willow scrub) can be found at Bridgeport State Park on the Yuba River and along Dry Creek at Spenceville Wildlife Management Area. However, the Highway 49 crossing of the South Yuba River is a more representative example of the patchy, alder and boulder riparian habitat characteristic of the county's major rivers.

Throughout the Sierra Nevada, including the Nevada County foothill region, riparian habitats have been reduced, fragmented, or degraded by a variety of human activities. The primary factors include historical gold mining, heavy

livestock use of some riparian corridors, vegetation removal on the stream and floodplain, introduction and spread of noxious weeds, road and home development, alterations in the hydrologic regime due to hydroelectric and water storage reservoirs, gravel mining, and groundwater extraction (Kondolf et al. 1996).

Riparian ecosystems are recognized throughout California as important natural communities because of their limited extent compared to historical distributions, their importance to dependent plant and wildlife species, and threats facing remaining stands. This status is supported by the DFG policy promoting "no net loss" of wetland habitats, which includes Foothill Riparian Woodlands (California Fish and Game Commission 1987). Portions of some riparian habitats may also qualify as jurisdictional wetlands under Section 404 of the federal Clean Water Act. Section 404 is enforced by the U.S. Army Corps of Engineers (USACE 1987) that consults with the USFWS and/or NMFS concerning possible take of federally-listed plants and animals that may result from the fill of jurisdictional wetlands or Waters of the United States.

Montane Riparian Woodlands

Structural and Ecological Characteristics

Riparian zones are defined as the ecotone between aquatic and upland ecosystems (Swanson et al. 1982). For the purposes of this report, the term "riparian" includes areas that exhibit vegetation or physical characteristics that reflect a permanent surface or subsurface water influence. Individual riparian species are adapted to a range of conditions along gradients of water table depth, soil moisture, and frequency of disturbance. Typical characteristics of "obligate" riparian vegetation (i.e., species found only in riparian or wetland areas) include dependence on a high water table, tolerance of flooding or anaerobic soil conditions, tolerance to physical damage from floods and burial by sediment, and ability to colonize and grow in substrates with few soil nutrients (Swanson et al. 1982). Willows, cottonwoods, and alders are typical riparian trees.

Montane Riparian Woodlands in Nevada County are comprised of a diverse group of riparian ecosystems including common, well-distributed types and uncommon sensitive types with limited distributions. Well-distributed Montane Riparian Woodland ecosystems include white alder riparian forests and mountain alder scrub types. Examples of types with a more limited distribution include aspen riparian forests (see "Aspen Woodlands," below),

stringers of montane or subalpine willow scrub, and large stands of mature black cottonwoods.

Steep-sided, bedrock-constrained stream and river canyons generally confine Montane Riparian Woodlands to narrow, patchy corridors, and in these "V-shaped" canyons, they are rarely more than a single canopy wide. White alder riparian forest, montane black cottonwood woodlands, and mountain alder are the most common riparian ecosystems in these settings (Holland 1986).

On smaller tributaries, meadow streams, and along small natural lakes and ponds, riparian vegetation is often more extensive than along the larger rivers of the Sierra Nevada. On the relatively fine-textured alluvium of smaller tributaries and snowmelt-fed streams in the upper headwaters, dense, shrubby riparian thickets of mixed willows or mountain alder are the dominant riparian vegetation. Willow and alder thickets also can be quite extensive on meadow streams or large seeps and springs.

Black cottonwood forests may reach 75 to 100 feet in height, and they often have a diverse, multi-layered, and well-developed understory of shrubs and herbs. Conifers from the adjacent forests (particularly incense cedars and lodgepole pines) are common associates of riparian trees growing on the higher terraces. The wind-borne seeds of cottonwoods and willows are produced in spring and are generally dispersed as floodwaters recede and expose moist scour zones or deposition that are ideal for seed germination. The seeds may be carried several hundred feet by wind, aided by the "cotton" that is attached to the seed capsules (Holland 1986).

In Nevada County, white alder riparian forest is the dominant riparian type along the lower reaches, replaced by black cottonwood and mountain alder above about 5,500 feet elevation. White alder trees may reach heights up to 100 feet, but they are generally less than 50 feet high in the bedrock-constrained environments of montane streams. The shrub and herb layers are generally sparse or absent along these higher steams due to the coarser substrate. Nitrogen-fixing riparian trees (e.g., alders) are shallow rooted and are typically found near the water's edge where they have a perennial source of water (GANDA 2000). Big-leaf maple is an upland tree species that often co-occurs with alders on the rivers and tributaries in lower montane Nevada County. The upper (lateral) limit of mature white alder often corresponds to the extent of normal high water. In Riverine settings, white alder stands generally are not successional. Mature stands do not become dominated by upland vegetation but are lost to erosion and replaced by newly established seedlings.

Low-order, snowmelt streams of the upper watersheds above 5,500 feet are often dominated by dense, often impenetrable thickets of mountain alder generally less than 12 feet high. Montane riparian scrub ecosystems often take the form of stringers of vegetation along seeps and springs (Mayer and Laudenslayer 1988) and in montane or subalpine meadows. In subalpine settings above approximately 8,000 feet, willow scrubs of high-elevation species, generally less than 4 feet high, replace the taller thickets of mountain alder as the dominant riparian type.

Riparian areas are among the most ecologically productive and diverse terrestrial environments (Naiman et al. 1993). Although Montane Riparian Woodlands are usually restricted to relatively narrow bands along streams, their hydrologic and ecological relationships are dependent on watershed-level processes. Nutrients in surface runoff from adjacent uplands are absorbed by riparian vegetation and converted into particulate organic material that constitutes a food source for instream organisms. The filtering effects of riparian vegetation also remove particulate inorganic sediments and toxic nutrients in runoff thereby benefiting instream water quality and productivity. Riparian vegetation also helps anchor soil and protect streambanks from the erosive effects of high water (Kondolf et al. 1987).

Plant Diversity

In the lower Montane Riparian Woodlands, white alders are usually the dominant species above about 2,500 feet elevation. In steep canyons they often co-occur with upland species such as black oak, bigleaf maple, canyon live oak, and various conifers. Pacific yews are uncommon associates of these ecosystems in Nevada County. Indian rhubarb, horsetail, and torrent sedge are common herbs growing in crevices between boulders on rivers. Common species on smaller tributaries include giant chain fern, lady fern, elk clover, black-fruited dogwood, western azalea, spice bush, Sierra currant, scouring rush, Pacific rush, and Bolander's sedge.

In the higher elevation riparian habitats of black cottonwood and mountain alder, exotics are nearly absent. Common shrub associates include red osier dogwood, shining willow, arroyo willow, dusky willow, and Sierra currant. Common herbs include horsetail, ciliate willow herb, woolly sedge, torrent sedge, and slender hairgrass.

Stringers of willow scrub or alder thickets on seeps and springs or in montane or subalpine meadows often have a diverse and sometimes colorful herb layer of native bulbs and perennial wildflowers as well as grasses and grass-like plants. These same species are also sometimes present in the

herb layer of aspen groves. Examples include white-stemmed gooseberry, monks-hood, western columbine, leopard lily, Sierra lily, broadleaf lupine, Fendler's meadow rue, California corn lily, small-fruited bulrush, giant red paintbrush, and the nonnative Kentucky bluegrass.

No Redlist or Yellowlist plants are specifically associated with Montane Riparian Woodlands in Nevada County (Figures 3-1 and 3-2). However, several Yellowlist species are known from seeps and springs and wet meadows, and they may occur in montane riparian scrub ecosystems (Appendices II and III). These include Cantelow's lewisia, which occurs on rocky cliffs of river corridors, and California pitcher plant, Davy's sedge, and rare sundews. Yellowlist plants known from riparian habitats near Nevada County include American mannagrass, Sheldon's sedge, subalpine fireweed, saw-toothed lewisia, and rare moonworts.

Near towns and mining sites, the noxious weed, Himalayan blackberry, may be a dominant species in the shrub layer of Montane Riparian Woodlands. Another horticultural escapee, bouncing-bet, is becoming a common weed on some portions of the rivers here, as well as on several other northern and central rivers of the Sierra Nevada (GANDA 2002).

Animal Diversity

Of the total 401 species of mammals, birds, reptiles, and amphibians that occur regularly in the Sierra Nevada, 21% depend on riparian areas near water, and many more use them occasionally (Graber 1996). In Nevada County, Montane Riparian Woodlands may support up to 178 vertebrate species, the highest total for any large-patch ecosystem in the county (Figure 3-3). These species include 51 mammals, 101 birds, 19 reptiles, and seven amphibians. About 133 of these species use these ecosystems in the county for breeding, also the highest total for any large-patch ecosystem (Appendix VI, Figure 3-4).

Despite their relatively small acreage in Nevada County, Montane Riparian Woodlands support a disproportionately high number of animals because they provide all of the habitat requirements for many species: food, cover, and a source of water. Cottonwoods and willows offer a rich insect fauna that attracts many insectivorous birds. The tall trees are also good perching and nesting substrate for many other avian species. Some characteristic insectivorous birds include the flycatching western wood-pewee and Pacific-slope flycatcher and the foliage-gleaning warbling and Cassin's vireos, Wilson's, MacGillivray's, and yellow warblers, Steller's Jay, house wren, American robin, and hermit thrush. Typical seed-eating species include

black-headed grosbeak, purple finch, and song, fox, and Lincoln's sparrows. Riparian areas are also attractive to migratory species including a diversity of flycatchers, vireos, warblers, and tanagers (Appendix VI).

Most mammals, amphibians, and reptiles use riparian corridors for cover, shade, and a source of water. These ecosystems are especially important for migratory mule deer (Zeiner et al. 1990). Bats frequently forage for insects over riparian areas, and many individuals may roost in riparian trees. Amphibians and reptiles in Montane Riparian Woodlands include ensatina, Pacific treefrogs, and western toads. Reptiles include a wide variety of snakes (racers, common and western terrestrial garter snakes, and western rattlesnakes among others), skinks, northern alligator lizards, and western fence lizards (Appendix VI).

Bald eagles and willow flycatchers (migration only) are two Redlist birds that may be associated with Montane Riparian Woodlands in Nevada County (Appendix VI). Yellowlist species that may be found in these ecosystems include: mountain yellow-legged frog, northwestern pond turtle, yellow warbler, yuma myotis, long-legged myotis, pale Townsend's big-eared bat, mountain beaver, American marten, and Pacific fisher (Appendix V). No non-native animals occur regularly in Montane Riparian Woodlands of the county. However, these ecosystems are attractive nesting areas for the parasitic brown-headed cowbird (see "Montane Meadows, above).

Distribution and Status

White alder riparian forest occurs on perennial streams in incised canyons of the lower Sierra Nevada, Coast Ranges, and Transverse and Peninsular Ranges, usually below 6,000 feet (Holland 1986). Black cottonwood riparian forest is widely scattered in the Sierra Nevada and even more sporadically in the higher parts of the Transverse and Peninsular Ranges. It is more common in the North Coast and Klamath Ranges south to Monterey County. Montane riparian scrub ecosystems include both mountain alder and willow-dominated montane riparian habitats. They are widely distributed above 5,000 feet throughout the Sierra Nevada, Klamath Ranges, and southern California mountains. Many of these riparian forest types have been heavily impacted throughout their range by water diversions from small hydro projects and livestock grazing (Holland 1986).

In Nevada County, elevations of Montane Riparian Woodlands range from about 2,160 feet up to the subalpine willow scrub ecosystems at about 7,970 feet near the Sierra crest (Table 3-1). Accurate mapping of Montane Riparian Woodlands from aerial photographs is difficult, as the narrow riparian

corridors are often over-topped by the adjacent conifer forests. Based on these mapping limitations, about 4,010 acres of this ecosystem exist in Nevada County. These areas represent about <1% of the county's total land area, and about 81% of this acreage is on private land (Table 3-1).

White alder riparian forests are found on the forks of the Yuba and Bear rivers, as well as on the perennial tributaries to those rivers at elevations up to approximately 5,500 feet (**Figure 3-21**). There it transitions to a mountain alder dominant ecosystem with scattered stands of black cottonwood. The largest example of black cottonwood forest in Nevada County is on the north side of the South Yuba River between Kingvale and Cisco Grove. Other examples of white alder riparian forest in montane areas of the county can be found at Bear Valley on upper Bear River.

Riparian areas in the Sierra Nevada have been impacted or functionally impaired by gold mining, gravel mining, hydroelectric development, land clearing, and water diversions for irrigation. They have also been affected by land drainage, vegetation clearing for flood protection, timber harvest, construction of roads and railroads, urbanization, livestock grazing, and groundwater extraction (Kondolf et al. 1996).

Riparian ecosystems are recognized throughout California as important natural communities because of their limited extent compared to historical distributions, their importance to dependent plant and wildlife species, and the threats facing remaining stands. This status is supported by the DFG policy promoting "no net loss" of wetland habitats, which includes Montane Riparian Woodlands (California Fish and Game Commission 1987). Portions of some riparian habitats may also qualify as jurisdictional wetlands under Section 404 of the federal Clean Water Act. Section 404 is enforced by the U.S. Army Corps of Engineers (USACE 1987) that consults with the USFWS and/or NMFS concerning possible take of federally-listed plants and animals that may result from the fill of jurisdictional wetlands or Waters of the United States.

Eastside Riparian Woodlands

Structural and Ecological Characteristics

Riparian areas are the water-dependent habitats along streams, rivers, and lake margins in the transition zone between aquatic and terrestrial habitats. Riparian vegetation deflects the erosive power of flowing water and provides important bank stability. Roots also add substantial structural strength to the stream bank soil. Riparian zones usually contain a gradient of soil moisture from the stream edge through the floodplain and sometimes up onto the terraces, depending on the geomorphology and hydrology of the particular site (Kondolf et al. 1996). Consequently, riparian species found in the wettest areas are generally different than those found on the floodplain or adjacent upper terraces. Species found nearest to the stream are better adapted to frequent inundation or scouring flows; those found at the outer edge are typically adapted to drier soils in summer.

For the purposes of this report, Eastside Riparian Woodlands are distinguished from Montane Riparian Woodlands that occur west of the Sierra crest. Eastside Riparian Woodlands usually have relatively broad floodplains compared to west slope rivers and creeks that often support narrow and discontinuous riparian habitats on moderate to steep gradients in "V-shaped" canyons.

Plant species typical of riparian areas generally share a set of distinct ecological characteristics: broad-leaved, winter-deciduous, fast-growing, and often short-lived. They also share a requirement for high soil moisture to support high rates of transpiration, ability to tolerate seasonal flooding and low-oxygen conditions, and the ability to produce sprouts, suckers, and new root systems. Cottonwoods and willows have dormant root buds in their stem tissue that allow them to root readily from branches carried downstream during flood events and that lodge into wet banks or bars. Many species, such as black cottonwoods and willows, require for successful germination the fresh, unvegetated fluvial surfaces left behind by floodwaters. Under natural flow regimes, frequent disturbance by various levels and durations of flooding results in a diverse mix of riparian plant species in various age classes (Swanson et al. 1982).

The streams and rivers east of the crest all occur within the Lahontan drainage and contain a different fauna than is found in the Central Valley drainages to the west. Floristically, the species composition of both the Eastside Riparian Woodlands and upland ecosystems begins to change east of Truckee, below about 6,000 feet elevation, where Eastside Scrub and Eastside Pine Forest become the primary large-patch ecosystems. The

dominant tree species in Eastside Riparian Woodlands are generally the same species in Montane Riparian Woodlands—black cottonwoods and aspens—but the associated species are often quite different.

The Truckee River, including the Little Truckee River, is the dominant hydrologic feature east of the crest, and it runs a relatively low-gradient course through Nevada County, terminating at Pyramid Lake in Nevada. Most of the Eastside Riparian Woodlands west of Truckee are confined within relatively narrow canyons with a discontinuous corridor of white alder. In contrast, the rivers and creeks east of Truckee flow through deep glacial valleys with broad flats and scattered meadows, and they may have braided channels. Braided conditions also can form on the alluvial fans of the eastern slope (Kattelmann and Embury 1996).

Alluvial bottomlands and depositional river reaches of large flow-rate streams are optimum sites for black cottonwood riparian forest, the dominant riparian forest type in the Eastside Zone in Nevada County. Aspen riparian forest is also well-represented on the eastside, generally above 6,500 feet on tributaries to the Truckee and Little Truckee rivers. Willow scrub ecosystems are also found on young fluvial surfaces of the low-gradient streams, on sandbars or gravelbars, and as stringers along the steeper tributaries to the Truckee River. Montane meadows are often encountered adjacent to the streams on the valley bottoms; on the steeper tributaries, the corridor of vegetation influenced by the stream is much narrower and often transitions abruptly to Eastside Pine or Mixed- Conifer Forests.

Black cottonwood forests typically reach heights of 50 to 75 feet, but examples up to 125 feet with a diameter of 5 to 6 ft are encountered occasionally (Sudworth 1967). Like most riparian trees, black cottonwoods are short-lived relative to coniferous species; trees two to three feet in diameter are from 85 to 110 years old. Typical physiographic settings for this riparian forest type are river bottoms, sandbars, and banks. Black cottonwoods reach their greatest heights and diameter in sandy, humus-rich soils on alluvial floodplains. On the steeper tributaries of the east slope, small stands of black cottonwood forests occur in moist, sandy, or gravelly soil, sometimes ascending slopes up to 7,000 feet. They generally occur in pure stands along low-gradient reaches, but in narrow canyons black cottonwoods often co-occur with conifers at the stream’s edge. Good examples of this riparian forest type are seen in scattered stands along the lower Truckee River near the Nevada border. Aspen riparian forests on the eastside are generally found on tributaries at higher elevations (see “Aspen Woodlands,” below).

Plant Diversity

Eastside Riparian Woodlands are usually dominated by black cottonwoods. However, on the Truckee River, characteristic species of Great Basin riparian woodlands begin to appear. Narrow-leaved willow, also known as sandbar willow, reappears as a dominant species after a hiatus above approximately 3,000 feet on the west slope. Similarly, individual Fremont cottonwoods, a valley-foothill species, are occasionally found near the Nevada border. Large patches of the native riparian grass, creeping wildrye, also reappear here after a gap in the montane region of the Sierra. On high and dry cobble bars, rubber rabbitbrush, mountain sagebrush, wax currant, and other east slope species are common.

Willow scrub ecosystems, which are most common in full sun on sandbars or gravel bars on the Truckee River, are generally represented by sandbar willow, red willow, and arroyo willow. Other characteristic species in the shrub layer include interior rose, western chokecherry, Sierra currant, and Geyer's willow. Dominant species in the herb layer include silver wormwood, hoary aster, Hooker's evening primrose, horsemint, Canada goldenrod, and hoary nettle. Stringers of Montane Meadow or Fresh Emergent Wetlands include beaked sedge, Nebraska sedge, woolly sedge, slender beak sedge, Baltic rush, cattail, and occasionally salt grass. At slightly higher elevations (e.g., on the Truckee River), mountain alder and other species more characteristic of Montane Riparian Woodlands appear in the understory of black cottonwoods.

No Redlist plants are known to occur in Eastside Riparian Woodlands (Figure 3-1). A Yellowlist plant, Davy's sedge, is known from historic collections in meadow habitats along the Truckee River. Many rare vascular plants, and at least two rare non-vascular plants, are associated with the many fens and seeps that occur along several of the major tributaries of the Truckee River (Appendices II and III). These highly specialized habitats are discussed under "Small-patch Ecosystems" below. Other rare plants known from similar riparian habitats near Nevada County include American mannagrass, Sheldon's sedge, and rare moonworts.

Noxious weeds and other non-native species are more common in Eastside RiparianWoodlands than in higher elevation riparian forests. Cheatgrass is widespread in the disturbed and drier portions of the Truckee River corridor. Other noxious weeds found in the Truckee River corridor include spotted knapweed, musk thistle, whitetop, Dyer's woad, Russian thistle, and Italian thistle. Additional invasive non-native herbs here include tumble mustard, poison hemlock, bouncing-bet, tansy, Klamathweed, yellow sweet clover, and many more (Table 3-2).

Animal Diversity

In general, more species and greater numbers of wildlife are found in riparian environments than most other ecosystems. Their configuration as natural corridors promotes their use as migratory routes for animals and aids in plant dispersal. In the well-studied Sagehen Creek basin, a tributary of the Little Truckee River, almost 40% of the vertebrates are strongly dependent on riparian habitats (Morrison et al. 1985). All of the six amphibians, five of 12 reptiles, 17 of 54 mammals, and 46 of the 120 birds found in the Sageben Creek basin depend on riparian ecosystems (Kattelmann and Embury 1996).

In the lower elevations of the east slope of Nevada County, Eastside Riparian Woodlands offer oasis-like conditions compared to the surrounding sagebrush or bitterbrush scrub.

In the county, these ecosystems support about 130 vertebrates including 43 mammals, 71 birds, 12 reptiles, and four amphibians. About 94 of these species use Eastside Riparian Woodlands in the county for breeding (Appendix VI).

The presence of open water and associated edge effects, abundant food resources of terrestrial and aquatic invertebrates, and diversity of vegetation contribute to the desirability of riparian areas for birds (Carlson et al. 1991). Riparian habitats are important for both breeding birds and migratory species. Numbers of migratory birds in cottonwood-willow riparian areas are higher than in any other Sierra Nevada ecosystem (Gaines 1992). Riparian areas are often the first areas to resprout following catastrophic fires, such as the recent fires in the Lower Truckee River canyon, and therefore, are usually the first areas to be reoccupied by wildlife.

Characteristic birds in Eastside Riparian Woodlands are the cavity-excavating hairy woodpecker and northern flicker, the flycatching western wood-pewee and Dusky flycatcher, and the foliage-gleaning warbling and Cassin's vireos, yellow-rumped MacGillivray's, and yellow warblers, Steller's Jay, house wren, American robin, and hermit thrush. Typical seed-eating species include: black-headed grosbeak, lazuli bunting, and song and fox sparrows. Riparian areas are also attractive to migratory species including a diversity of flycatchers, vireos, warblers, and tanagers (Appendix VI).

Most mammals, amphibians, and reptiles use riparian corridors for cover, shade, and a source of water. Eastside Riparian Woodlands are especially important for migratory mule deer (Zeiner et al. 1990). Bats frequently forage for insects over riparian areas and many individuals may roost in

riparian trees. Amphibians and reptiles in Eastside Riparian Woodlands include Pacific treefrogs and western toads. Reptiles include a wide variety of snakes (racers, common and western terrestrial garter snakes, and western rattlesnakes among others), skinks, northern alligator lizards, and sagebrush lizards (Appendix VI).

Bald eagles and willow flycatchers are two Redlist birds that may be associated with Eastside Riparian Woodlands in Nevada County (Appendix VI). Yellowlist species that may be found in these ecosystems include northwestern pond turtle, yellow warbler, yuma myotis, long-eared myotis, long-legged myotis, pale Townsend's big-eared bat, mountain beaver, American marten, and ringtail (Appendix V).

Non-native animals that may occur in Eastside Riparian Woodlands include European starling, house sparrow, house mouse, and black rat.

Distribution and Status

Eastside Riparian Woodlands dominated by black cottonwoods are found along the larger streams of the eastern Sierra Nevada and Great Basin, usually below 7,000 feet (Holland 1986). Their distribution ranges from Inyo County north to the Modoc Plateau and southern Oregon. However, black cottonwoods are also found in Montane Riparian Woodlands, usually widely scattered and often senescent stands, throughout the Sierra Nevada and the higher parts of the Transverse and Peninsular ranges (Mayer and Laudenslayer 1988).

In Nevada County Eastside Riparian Woodlands occur intermittently along the major east slope rivers and creeks (**Figure 3-22**). Only about 650 acres exist in Nevada County, representing about 0.1% of the county's total land area; about 46% of this acreage is on private land (Table 3-1).

The broader, flatter areas in eastern Nevada County and throughout the Sierra have become attractive for various human activities, with a corresponding loss of some of the highest quality riparian ecosystems. If meadow streams become incised and water tables fail to rise during the wet season, the source of low-season streamflow is lost (Kattelmann and Embury 1996). Many, if not most, of the broad valleys in the Sierra with formerly extensive riparian areas have been developed or inundated. Approximately 600 miles of riparian corridors have been submerged under reservoirs in the Sierra Nevada (Kattelmann and Embury 1996).

More than a century of water diversions, combined with other impacts on the Little Truckee River, have resulted in a wide, unstable channel unprotected

by riparian vegetation (Erman 1992). Riparian areas often suffer from overgrazing because of food preferences of cattle and the availability of water and shade (Kattelmann and Embury 1996). However, fenced exclosures along streams often can result in rapid and dramatic recovery of riparian vegetation in some areas.

The ecological effects of roads in riparian areas are often severe. A study of logging impacts on stream invertebrates showed that the worst effects occurred below failed roads and culverts (Erman et al. 1977). The lower Truckee River in particular has suffered from the direct and indirect effects of road construction in the floodplain. Nearly the entire length of the lower Truckee River in Nevada County is sandwiched between a major highway, railroad tracks, and dirt roads. A flume has replaced the riparian vegetation along a portion of the river course. The Truckee and Little Truckee rivers were also denuded during the Gold Rush era for transporting logs (Erman 1992).

Forested Ecosystems *(continued)*

Aspen Woodlands

Structural and Ecological Characteristics

Aspen Woodlands form the sole deciduous, broadleaved forests of the high mountain regions of the Sierra Nevada (Griffin and Critchfield 1976). The pale, light green leaves or yellow autumn hues, and white bark provide a dramatic contrast to the various coniferous forest communities that span the range of Aspen Woodlands.

Aspen Woodlands may occur as upland ecosystems on mesic soils or areas with high subsurface moisture content. These stands do not occur on saturated soils and they are not found within or restricted to streamside zones or influenced by stream hydrology. Aspen Woodlands are common in drainage bottoms and gentle slopes near basin flats and they are often associated with Montane Meadows or Eastside Scrub ecosystems where a high water table exists. They also occur commonly near hillside seeps and springs, mountain toe slopes, and on the bottoms or lower side slopes of intermittent or permanently wet drainage ravines. Suitable aspen soils are usually fine textured, well-drained sandy or clay loams, usually formed in alluvial, colluvial, or glacial deposits. They are high in organic matter,

calcium, magnesium, potassium, and nitrogen. Because of their rapid growth and high nutrient demands, quaking aspens have an important role in nutrient cycling (Burns and Honkala 1990, Potter 1998). Mature trees produce abundant leaf litter, and the litter decays rapidly forming a nutrient-rich humus layer. The humus reduces runoff and aids in percolation and recharge of ground water.

Sexual reproduction and regeneration from seed is rare in the western U.S., and most quaking aspen stands reproduce vegetatively by suckering from lateral, generally shallow, cord-like roots connected to a common parent root system. Some roots may be up to 150 feet long, and entire groves covering hillsides may have been derived from a single clone. Aspen Woodlands may contain some of the oldest organisms in the Sierra Nevada. Although individual quaking aspens trees may be short lived, individual clones resulting from this process can persist for thousands of years, and most current clones in the Great Basin may be at least 8,000 years old (Jones and DeByle 1985, Potter 1998).

In Nevada County, Aspen Woodlands are generally found as small pocket stands rarely larger than 5 acres, and more commonly, closer to 1 acre in size. They are widespread but only sporadic in their distribution on both slopes of the Sierra crest (**Figure 3-23**), and most of the largest stands on the east slope are within the Red Fir and Mixed-Conifer Forests (Potter 1998).

Stand densities are variable but generally higher than any other forest community. Mature stands are often comprised solely of quaking aspens, mainly between 16 inches dbh and 24 inches dbh, with the largest individuals sometimes exceeding 28 inches dbh (Potter 1998). Many stands may be overtopped by scattered large conifers, primarily red firs, white firs, or lodgepole pines on moist sites and Jeffery pines and western junipers in drier settings. This creates a multi-layered canopy represented by several age classes of trees. Open Aspen Woodlands may have a significant shrub component or may contain many small conifers that will eventually overtop and out-compete the shade-intolerant quaking aspens. However, where Aspen Woodlands occur at meadow edges, near seeps on rocky talus slopes, or within Eastside Scrub ecosystems, they may form a climax community that persists for centuries (Potter 1998).

Quaking aspens have thin bark and little heat resistance. They are easily top-killed by fire, and moderate-severity surface fires kill most of them. However, most fire-killed stands are promptly revegetated by root sprouts (suckers). Following a fire, a new, even-aged stand can develop within a

decade. Aspen Woodlands are generally considered a fire-dependent community in that stand-replacing fire has played a major, albiet infrequent role in the development and maintenance of stands (Kilgore1981, Jones and Debyle 1985). However, because of the types of sites that aspen generally occupy, the occurrence of many stands may be unrelated to fire (Rundel et al. 1977, Potter 1998). Quaking aspens are highly competitive on burned sites, and they readily colonize after fire. For example, in the Emigrant Wilderness Area (Stanislaus National Forest), red fir stands on north slopes have converted to quaking aspen after fire (Brittan 1993).

Plant Diversity

Aspen Woodlands generally exist as small, discrete stands. Because of their wide distribution, they are often found either within or in close association with most of the major vegetation types within their elevation range. In Nevada County, this range extends from about 5,140 feet on the west slope up to about 7,890 feet elevation on both sides of the Sierra crest (Table 3-1). Aspen Woodlands often contain species from many other neighboring plant communities, and species diversity is high (Potter 1998). Associated species include black cottonwood, mountain alder, willows, and lodgepole pine (on wet sites), red fir, white fir, incense cedar, Douglas fir, and mountain hemlock (mesic or moist soils). On dry soils, Jeffrey pine, ponderosa pine, and western juniper are common associates.

Because of the variability of stand densities and surface soil moistures, plants requiring either sun or shade and permanent or seasonally-moist soil conditions are all well represented in Aspen Woodlands. In drier settings and more open stands, common shrub associates in Nevada County include wax currant, western serviceberry, western chokecherry, interior wild rose, Scouler's willow, and mountain snowberry. Characteristic forbs include silver wormwood, hoary aster, rigid hedge-nettle, mountain pennyroyal, woolly mule-ears, Bolander's bluegrass, dwarf lousewort, blue wild rye, and mountain brome. In moister settings, the dense canopy generally precludes a shrub layer except for occasional Lemmon's willow, Geyer's willow, or Eastwood's willow.

The herbaceous layers of Aspen Woodlands are often rich and varied. Common forbs and grasses include Kentucky bluegrass, rough bentgrass, California corn lily, leopard lily, Fendler's meadow rue, leafy aster, heartleaf arnica, five-finger cinquefoil, mountain sweet cicely, Bolander's bluegrass, and many more.

No Redlist or Yellowlist Plants are known to be associated with Aspen Woodlands in Nevada County (Appendix III).

Animal Diversity

Although no wildlife species is entirely dependent on habitats dominated by aspen, this cover type adds significantly to the richness of the wildlife in areas where it occurs (Mayer and Laudenslayer 1988). The moist conditions that permit quaking aspens to establish also result in higher insect production compared to adjacent forests or shrublands. Such insect production, together with a high rate of fungal infection of trees, is thought to account for the greater variety and abundance of birds in Aspen Woodlands than in adjacent forests and shrublands (Winternitz 1980). Aspens commonly occur adjacent to Eastside Scrub habitats and other montane shrub types, where they are often the only tree species present (Mayer and Laudenslayer 1988).

In Nevada County, Aspen Woodlands support about 97 vertebrates including 30 mammals, 55 birds, 10 reptiles, and two amphibians. About 70 of these species use Aspen Woodlands in the county for breeding (Appendix VI).

Aspen Woodlands provide important breeding, resting, and foraging habitat for a diverse array of birds that eat the buds, flowers, seeds, and catkins of quaking aspens. Aspen buds, catkins, and leaves provide an abundant and nutritious year-long food source for blue grouse. Nesting birds include the mountain quail, downy and white-headed woodpeckers, red-breasted sapsuckers, dusky flycatcher, warbling vireo, tree and violet-green swallows, black-throated gray warbler, and Yellowlist yellow warbler. Breeding raptors may include great horned owl, Cooper’s hawk, and Yellowlist osprey and northern goshawk (Appendix VI).

Quaking aspens are highly palatable for all browsing livestock and wildlife species, and common understory vegetation such as mountain snowberry, mountain tansy mustard, Brewer’s angelica, large mountain brome, and Bolander’s bluegrass are all staple browse species (Potter 1998). Quaking aspen is important forage for mule deer that consume the leaves, buds, twigs, bark, and sprouts. They also use quaking aspen stands for fawning grounds. Aspen bark is also a preferred food of the American beaver, a species that alters stands with dams in streamside settings (Zeiner et al. 1990). Although many animals browse quaking aspen year-round, it is especially valuable during fall and winter when protein levels are high relative to other browse species. In winter, Sierra Nevada snowshoe hare

and Nuttall's cottontail rabbits also eat quaking aspen buds, twigs, and bark (Chainey pers. comm.).

Mammals are represented by nine out of the 10 known Nevada County bat species, all of which breed in this habitat. These include four Yellowlist species: yuma myotis, and long-legged, long-eared, and pale Townsend's big-eared bats. Other mammals include black bear, gray fox, and American beaver. Other Yellowlist mammals that may occur in Aspen Woodlands are the mountain beaver and Sierra Nevada snowshoe hare (Appendix VI).

Representative reptile species in Aspen Woodlands are the sagebrush and western fence lizards, common, western terrestrial, and Sierra garter snakes, rubber boa, racer, common kingsnake, and gopher snake (Appendix VI).

Distribution and Status

In California, Aspen Woodlands are found from the interior Klamath Ranges to the Warner Mountains, Cascade Range, and on the crest and east slope of the Sierra Nevada from Lassen to Tulare counties (Mayer and Laudenslayer 1988). In Nevada County, they occur sporadically above 6,000 feet (Figure 3-23), with a large example in the upper Loney Meadows complex and in the Sagehen Creek basin where it is fed by seeps that also support a large, adjacent fen (see "Small-Patch Ecosystems," below). Other examples of Aspen Woodlands on talus slopes can be found just northeast of Hirschdale, where they grow up through linear tracts of volcanic boulder fields and spill-down steep chutes on hillside slopes. Aspen Woodlands occupy about 385 acres representing <1% of the county's total land area; about 74% of this land is in private ownership (Table 3-1).

Throughout the Great Basin, many Aspen Woodlands appear to be following a successional sequence that will eventually lead to their replacement by conifer forests. This pattern appears to result from both suppression of fires over the past several decades and from grazing pressure that keeps aspen sprouts severely hedged and favors conifers that are not grazed as heavily (Potter 1998). Stands sometimes occur adjacent to meadows and other moist areas where livestock congregate in the summer season for shade, forage, and access to water. In many existing stands, quaking aspen seedlings are heavily browsed by livestock, seriously reducing their ability to regenerate (Potter 1998).

Aspen Woodlands are a community of concern to several National Forests in the Sierra Nevada because they are of limited extent, do not appear to reproduce sexually, and because they require disturbances, such as periodic

fires, to reproduce (USDA 2000). To maintain existing stands could require management to reduce grazing pressure (e.g., through fenced exclosures), and to encourage regeneration and growth, possibly through the reintroduction of fires (Potter 1998).

Ponderosa Pine Forest

Structural and Ecological Characteristics

Ponderosa Pine Forests generally occur in a broad band above the Oak-Foothill Pine Woodlands and below the higher elevation Mixed-Conifer Forests. Within this range, chaparral and hardwood species (both foothill and montane) intermingle with pines and other conifers. At its lower elevational limits, Ponderosa Pine Forests are primarily restricted to cool, moist sites on north-facing slopes in canyon bottoms, while Foothill Hardwood Woodlands and Foothill Chaparral usually occupy adjacent ridge tops and south-facing slopes (Whitney 1985). At higher elevations, Ponderosa Pine Forests occupy south-facing slopes all the way to its upper limits at Erie Point (just south of Graniteville at 5,100 feet). At intermediate elevations, this ecosystem occupies non-rocky soils on a wide variety of slopes and aspects. Ideal site conditions for Ponderosa Pine Forests are coarse, well-drained soils of a granitic or basaltic base (Holland 1986).

Historically, Ponderosa Pine Forests featured open, park-like stands with scattered understory trees and shrubs growing beneath 150-200-foot tall pines (Holland 1986). Frequent fires cleaned out the massive needle accumulations that collect under the canopy and eliminated invading seedlings and competing young trees. These forests experienced frequent low-to-mid-intensity wildfires (primarily surface fires) that were a primary factor influencing stand density, structure, and species composition. A policy of fire exclusion or suppression during the 20th century, along with the selective harvest of many large pines, has significantly changed fire behavior and led to an increase in fire severity and the number of infrequent but high-intensity, stand-destroying fires (Skinner and Chang 1996, McKelvey et al. 1996).

Many decades of fire suppression and overstory removal have dramatically altered the Ponderosa Pine Forest. These formerly open stands have been replaced by much denser thickets of early- to mid-successional ponderosa pines mixed with great numbers of oaks, firs, incense cedars, and manzanita species that have become established in the absence of periodic fires (Whitney 1985). Such stands are especially susceptible to outbreaks of bark beetles (Scolytus). Historically, the shrub understories of open forest stands

were comprised of a diverse mix of species with variable density depending on light and soil conditions. Decades of fire suppression and shading by young conifers have reduced the diversity and abundance of the shrub understory in these forests (Holland 1986).

Plant Diversity

By convention, mixed-species stands that closely resemble Mixed-Conifer Forest are categorized as Ponderosa Pine Forest when more than 50% of the canopy is ponderosa pine (Mayer and Laudenslayer 1988). One of the more common associates of the Ponderosa Pine zone is black oak, which also occurs in pure stands as a seral stage to ponderosa pine in areas disturbed by fire or logging (Holland 1986), or on drier, rockier sites. Other canopy associates include white fir, incense cedar, sugar pine, Douglas fir, canyon live oak, and Pacific madrone; the understory of Ponderosa Pine Forests is usually composed of younger trees of the same species.

Species composition of the understory of Ponderosa Pine forest varies widely with elevation and aspect. The shrub and herb layers primarily occur at forest edges or in canopy openings such as rock outcrops and other natural or artificial clearings. At lower elevations below approximately 3,000 feet characteristic native shrubs include whiteleaf manzanita, deerbrush, hoary coffeeberry, redberry, poison oak, toyon, buckbrush, Klamath plum, and western redbud. Common herbs in these settings include Hartweg's iris, mariposa lily, Sierra milkwort, American vetch, mountain violet, blue wild rye, rhomboid clarkia, and the non-native species, hedgehog dogtail. Poison oak, mountain misery, and bracken fern are native species of this habitat that are often indicators of earlier disturbance, such as fire and logging.

At elevations above about 3,000 feet, the understories of Ponderosa Pine Forests are dominated by species more characteristic of montane habitats such as greenleaf manzanita, Indian manzanita, deerbrush, mountain whitethorn, birchleaf mountain mahogany, manzanita and ceanothus species, mountain misery, poison oak, Sierra gooseberry, and mahala mat, bitter cherry, Sierra coffeeberry, Sierra gooseberry, thimbleberry, and pine violet.

Fire suppression and high levels of disturbance from human settlement have greatly increased the number of weedy exotic species in Ponderosa Pine Forest compared to Mixed-Conifer Forest. These invasive and often resinous non-native species displace native vegetation and may increase ignition sources and alter the frequency or intensity of wildfires. This is particularly true in the Grass Valley and Nevada City areas and in other wildlands that

are near urban or residential development. Along roadsides and in areas disturbed by fire, logging, historic mining, and brush cutting, Scotch broom is often a serious pest (e.g., areas in and around North San Juan). On moister aspects near towns, common noxious weeds in the understory of Ponderosa Pine Forests include Himalayan blackberry, cut-leaf boysenberry, periwinkle, Mehaleb cherry, sweet cherry, Washington thorn, English ivy, and Klamathweed. These invasive species often dominate the understory of disturbed Ponderosa Pine forests.

Several Yellowlist plants are known to occur in the lower elevations of Ponderosa Pine forests in Nevada County including Butte County fritillary, Humboldt lily, Brandegee's clarkia, and narrow-petaled rein orchid (Appendix III). These species are more likely to occur at forest edges or in canopy openings. Cedar Crest popcorn flower is a rare plant and Nevada County endemic known from only two collections in Nevada County in the late 1930's in a vernally moist, grassy clearing of Ponderosa Pine Forest near Cedar Ridge (Appendix III).

Animal Diversity

Late-successional Ponderosa Pine Forests of Nevada County have potential to support one of the highest vertebrate diversities of any of the county's large-patch ecosystems. Approximately 145 vertebrate species could occur in these forests including 44 mammals, 76 birds, 20 reptiles, and five amphibians. About 108 species use Ponderosa Pine Forests for breeding (Appendix VI).

Historically, the wildlife management focus of Ponderosa Pine Forests was on the value of this habitat to migratory deer herds for critical feeding and wintering habitat (Mayer and Laudenslayer 1988). The mix of nutritious shrubs, as well as the fact that the Ponderosa Pine belt occurs mostly below the level of deep winter snows, contributes to its value as critical deer habitat (Zeiner et al.1990).

Other large mammals that frequent this habitat include coyotes, black bears, mountain lions, bobcats, and a variety of smaller rodents, shrews, and squirrels, all of which seem to favor the mix of shrub thickets and open patches. Ensatina, California newt, long-toed salamander, Pacific treefrog, and western toad are the primary amphibians, and a large number of reptiles occur in Ponderosa Pine Forests including western fence lizards, northern alligator lizards, gopher snakes, common and mountain kingsnakes, common and western terrestrial garter snakes, and western rattlesnakes (Appendix VI).

Birds are represented in Ponderosa Pine Forests by a variety of warblers, vireos, flycatchers, tanagers, grosbeaks, sparrows and many other species. Canopy-dwelling species include western tanager, olive-sided flycatcher, and golden-crowned kinglet (in winter only). Ponderosa pines provide nesting sites high in the branches for some bird species and large snags (i.e., > 24 inches dbh) and decaying portions of living trees offer nesting cavities for pileated woodpeckers, western screech owls, and northern flickers. They also provide nutritious sap that exudes from maturing cones and wounds in the bark caused by insects, tree falls, fire, sapsuckers, and woodpeckers. The sap provides feeding opportunities for redbreasted sapsuckers, and for many other bird species. The high-protein seeds are eaten by a long list of birds including pygmy, white-breasted and red-breasted nuthatches, chestnut-backed and mountain chickadees, dark-eyed junco, some woodpeckers (primarily white-headed woodpecker), spotted towhees, mourning doves, and black-headed and evening grosbeaks (Appendix VI).

Yellowlist species that may occur in Ponderosa Pine Forests include northern goshawks, California spotted owls, yellow warblers, American martens, Pacific fishers, ringtails, and several bat species (e.g., long-eared myotis, long-legged myotis, and yuma myotis), and northwestern pond turtles (Appendices V and VI). Some of these species including the northern goshawk, California spotted owl, American marten, Pacific fisher, and many bats, depend, at least to some degree, on large conifer trees and/or blocks of undisturbed forest (Verner and Boss 1980, Zeiner et al. 1990).

Distribution and Status

Similar to many other montane forest ecosystems in the Sierra Nevada, Ponderosa Pine Forest occurs along the Sierra-Cascade axis with an extension in the northwestern corner of the state. Unlike the many other Sierra forest types, however, Ponderosa Pine Forest also extends southward along the Coast Range as far south as Santa Barbara County (Griffin and Critchfield 1976, Mayer and Laudenslayer 1988).

In Nevada County, Ponderosa Pine Forest forms a rather broad band above about 1,400 feet and below about 5,160 feet, but isolated stands can be found down to about 500 feet elevation along river drainages in the western county (**Figure 3-24**, Table 3-1). Above about 5,100 feet, Mixed-Conifer Forests dominated by Jeffrey pines, largely replace the Ponderosa Pine Forests in the county.

A total of about 65,150 acres of Ponderosa Pine Forest occur in Nevada County, representing about 10% of the county's total land area. About 80%

of this acreage is on private land (Table 3-1). Much like Mixed-Conifer Forest, this forest type is a primary timber-producing zone and many stands been converted to an early- or mid-successional stages due to logging activities or have been modified by their proximity to human development (McBride et al. 1996). Few examples of late-successional Ponderosa Pine Forest currently exist in the county (**Figure 3-33**).

Mixed-Conifer Forest

Structural and Ecological Characteristics

Mixed-Conifer Forest is a highly variable and species-rich assemblage of conifers and hardwoods that dominates middle elevations of Sierra Nevada. In addition to a diverse mix of trees, this ecosystem supports a rich assortment of shrubs, forbs, and animal species (Mayer and Laudenslayer 1988, Zeiner et al. 1990).

Throughout much of its range in the Sierra Nevada, Mixed-Conifer Forest blankets entire regions regardless of slope, aspect, or soil characteristics. This is the only large-patch ecosystem that covers entire watersheds in Nevada County. Unlike most other forest types, Mixed-Conifer Forest is not defined by a single or a few species, but by a broad mix of co-dominant species in the overstory and sub-canopy layers that may include any of the following species: white fir, Douglas fir, ponderosa pine, Jeffrey pine, sugar pine, incense cedar, and California black oak. All of these tree species occur on most soil types at middle elevations of the western Sierra Nevada. Some combination of these six conifers and one hardwood might be locally dominant depending on the elevation, disturbance and fire history, and physical characteristics of a given site (Griffin and Critchfield 1976, Mayer and Laudenslayer 1988).

Based on the variable composition of Mixed-Conifer Forests, different authorities have classified this habitat according to whether white firs, ponderosa pines, or Jeffrey pines dominate in specific stands (Barbour and Major 1988, Holland 1986, Mayer and Laudenslayer 1988, Sawyer and Keeler-Wolf 1995). In the system that was developed for Nevada County (NCWHR), the general distributional limits of Mixed-Conifer Forest were defined by the elevation limits of white firs. Shade-tolerant white firs are characteristic of dense, shaded stands with relatively moist soils, and they span a broad elevation range. They occur as low as 1,030 feet on north-facing slopes of some river canyons, and a few individuals grow up to above 8,980 feet near the Sierra crest. The relatively low passes in Nevada County permit Mixed-Conifer Forest (with white firs present) to extend over the

crest, where it occurs on the slopes of higher east-slope ridges and peaks (Table 3-1, **Figure 3-25**).

Tree species composition of Mixed-Conifer Forests varies considerably depending on elevation, slope, and fire history. Incense cedar and Douglas fir are ubiquitous species in these forests, while sugar pine is found in much reduced numbers. Ponderosa pines are present in most low-elevation Mixed-Conifer Forests, and they become the dominant pines below about 5,000 feet in Nevada County. Lower-elevation conifer stands were classified Ponderosa Pine Forest if ponderosa pine trees comprised 50% or more of the canopy. At higher elevations on the west slope, Jeffrey pines replace the ponderosa pines. Jeffrey pines also grow abundantly east of the Sierra crest where they are major components of Eastside Pine Forest. Black oak is a widespread but minor component in fully developed Mixed-Conifer Forest on the west slope, although it dominates the canopy in many areas that have been disturbed by fire, logging, clearing, or that are characterized by poor soils (Mayer and Laudenslayer 1988).

Late- and mid-successional Mixed-Conifer Forest is often characterized by high stand density, with tree crowns often touching (Holland 1986). Older stands are typically multi-layered with each age class well represented in the forest mix. Mature trees can reach 200 feet (Mayer and Laudenslayer 1988), while young conifers and hardwoods like black oak, canyon live oak, dogwoods, and bigleaf maple, grow up to 50 feet. Shrubs are somewhat suppressed in the shade of fully-developed stands, and the understory is typically limited to needle litter and widely-scattered saprophytes. Understory shrubs and herbs are more common adjacent to, or in, canopy openings where they may form dense thickets up to 10-15 feet tall. Mixed-Conifer Forest is among the longest lived of any Sierra Nevada forest type with some individual trees readily reaching 500+ years (Griffin and Critchfield 1976,Whitney 1985).

Since early in the last century, fire suppression became the standard forest management practice in Mixed-Conifer Forests of the Sierra Nevada. Since that time the risk of high-intensity, stand-destroying wildfire has increased significantly. Historically, these forests were comprised of larger, thicker-barked, fire-resistant trees that were more widely spaced and had more open understories (Skinner and Chang 1996, Leiberg 1902, Sudworth 1900). Fire suppression in the Sierra Nevada has greatly reduced the number and frequency of beneficial, low-to-moderate-intensity fires. Fires of this type were characteristic of a natural fire regime; they may have burned for weeks, or even months, cleansing the forest of the excess buildup of small trees and brush (Agee 1993).

A consequence of reducing the frequency of low-intensity fires is that much larger areas are now burned by infrequent but higher-intensity stand-destroying wildfires. Fire exclusion has been most effective and had the greatest impact in Mixed-Conifer and Ponderosa Pine Forests of the Sierra Nevada. Infrequent fire favors an increase in the amounts of shade-tolerant and fire-intolerant white fir and incense cedar that replace more fire-resistant species such as ponderosa pine, sugar pine, Jeffrey pine, and black oak. A reduction in the natural fire frequency, coupled with the selective harvest of many large pines, has produced denser forests with generally smaller trees. These changes have almost certainly increased the levels of fuel on the forest floor and the "ladder fuels," small trees and brush that carry the fire into the forest canopy and result in severe crown fires (McKelvey, et.al.1996).

Plant Diversity

In Nevada County, the composition of the overstory and understory of Mixed-Conifer Forest varies with soil, aspect, elevation, and stand density. White fir and Douglas firs are abundant on moist sites. In these settings, bigleaf maple and Pacific dogwood are characteristic of the sub-canopy layer, with a shrub layer dominated by shade-tolerant species such as California hazel, hoary honeysuckle, thimbleberry, and Sierra currant. Mountain whitethorn, mahala mat, bitter cherry, Sierra gooseberry, and Sierra chinquapin may be common where more light is available. Common species in the herb layer on moister soils include bracken fern, particularly on disturbed sites, Bolander's bedstraw, hawkweed, trail plant, Solomon's seal, dogbane, creeping snowberry, rattlesnake plantain, Pacific starflower, and several species of melic grass.

On warm, dry, south-facing slopes and ridge tops, ponderosa pine is the clear dominant, although incense cedar may be an important component. Black oak and canyon live oak also may be well represented in the tree layer, and greenleaf manzanita is the most frequently encountered shrub species, particularly at canopy openings. Above 5,000 feet, huckleberry oak is also a conspicuous component of the shrub layer. Other characteristic shrubs on dry sites include deer brush, poison oak, and mountain misery, particularly in disturbed settings or following fire. Characteristic species in the herb layer on drier sites include Hartweg's iris, bowl-tubed iris, multi-stemmed sedge, Bolander's bedstraw, Sierra milkwort, rhomboid clarkia, woolly sunflower, American vetch, blue wildrye, western fescue, and California brome.

A Yellowlist wild orchid, clustered lady's-slipper, is known from a few occurrences in Nevada County on mesic slopes in Mixed-Conifer Forests (Appendices II and III). Most Yellowlist plants that are associated with Mixed-Conifer Forests in Nevada County occur in canopy openings, such as rock outcrops, grassy clearings, open sandy flats, and along moist drainages. These include rare moonworts, woolly violet, Butte County fritillary, closed-throated beard-tongue, Stebbins' phacelia, Jones' muhly, Humboldt lily, and narrow-petaled rein orchid. Bolander's bruchia, a rare moss, occurs on damp soils and it may occur on road cuts.

Disturbed sites, such as roadsides, recreational areas, hydro facilities, transmission line corridors, and log decks also may include several noxious weed species and other invasive non-native plants such as bull thistle, Klamathweed, woolly mullein, and orchard grass. Scotch broom is occasionally seen in lower elevation Mixed-Conifer Forest below about 3,500 feet. Yellow star-thistle, an invasive species once considered not to reproduce at higher elevations, is now found above 7,000 feet on OHV roads on the Tahoe National Forest (California Native Plant Society unpubl. data).

Animal Diversity

Mixed-Conifer Forest is particularly rich habitat for wildlife, with around 355 species reported using the habitat within California (Mayer and Laudenslayer 1988). In Nevada County, approximately 142 vertebrate species have been documented in this ecosystem including 52 mammals, 70 birds, 15 reptiles, and five amphibians. Mixed-Conifer Forest provides breeding habitat for about 109 vertebrates species in Nevada County (Appendix VI).

Characteristic birds of Mixed-Conifer Forest include flycatchers, vireos, warblers, grosbeaks, and tanagers that feed on the rich invertebrate biomass of these forests. Predatory birds include great horned owls, Cooper's hawks, northern goshawks, and red-tailed hawks. Mammals are well represented by western gray squirrels, Douglas squirrels, northern flying squirrels, bushy-tailed woodrats, and many small rodents and shrews. Mule deer, coyotes, black bears, mountain lions, and other larger mammals are also present in these forests. Ensatina, long-toed salamander, Pacific treefrog and western toad are the primary amphibians, but a large number of reptiles occur in Mixed-Conifer Forest including western fence lizard, northern alligator lizard, gopher snake, common and western terrestrial garter snakes, sharp-tailed snake, ringneck snake, and western rattlesnake (Appendix VI).

Yellowlist species that occur in Mixed-Conifer Forest include northern goshawk, California spotted owl, yellow warbler, American marten, Pacific fisher, ringtail, and several bat species: long-eared myotis, long-legged myotis, and yuma myotis (Appendices V and VI). Many of these declining species depend to some degree on large conifer trees and/or blocks of undisturbed forest (Verner and Boss 1980, Zeiner et al. 1990). No Redlist or Yellowlist amphibian or reptile species are known to occur in Mixed-Conifer Forests of Nevada County.

Exotic and invasive bullfrogs occur in ponds and other wetlands within Mixed-Conifer Forest, where they usually out-compete the native amphibians (Jennings and Hayes 1994, Zeiner et al. 1990). European starlings are rare visitors to higher forests of the Sierra Nevada, and they do not presently nest in Mixed-Conifer Forest of the Sierra Nevada (Beedy and Granholm 1985, Gaines 1992). These forests also are attractive nesting areas for the parasitic brown-headed cowbird, especially near livestock grazing areas (see "Montane Meadows," above).

Distribution and Status

Mixed-Conifer Forest is widespread in California, encompassing the entire length of the Sierra Nevada and extending into the mountains of northwestern California (Mayer and Laudenslayer 1988). These forests in Nevada County today are generally comprised of smaller, second- or third-growth trees. Such forest stands usually feature dense canopies with a suppressed understory tree layer with high levels of shade-tolerant species such as white firs and/or incense cedars.

In Nevada County, Mixed-Conifer Forest on the west slope extends from about 1,030 feet up to about 8,980 feet elevation (Table 3-1). However, most stands in the county are between about 4,800 feet and 7,500 feet elevation, and from about 6,000 feet to about 7,600 feet on the east slope. At low elevations on the west slope, Mixed-Conifer Forest is restricted to cool, moist sites such as north-facing slopes in river canyons. Its lowest elevation in the county is just above 1,000 feet along the Middle Yuba River (just west of North San Juan) and 1,400 feet along the Bear River (just west of Highway 49). The county's highest elevation Mixed-Conifer Forest is above 8,980 feet on the slopes of Andesite Peak near Donner Summit (Figure 3-24).

Mixed-Conifer Forest occupies the largest land area of any large-patch ecosystem in Nevada County. About 197,700 acres were mapped as being this forest type, representing about 32% of the county's total land area.

Approximately 52% of this acreage is on private land (Table 3-1). Much like Ponderosa Pine Forest, this forest type is a primary timber-producing zone, and many stands have been converted to early- or mid-successional stages due to logging activities or have been modified by fire suppression and their proximity to human development (McBride et al. 1996). Few examples of late-successional Mixed-Conifer Forest currently exist in the county (Figure 3-33).

Red Fir Forest

Structural and Ecological Characteristics

Red Fir Forest is characterized by an almost complete dominance of red fir trees in the upper canopy layer. This habitat type forms a distinctive forest band across the higher elevations of the Sierra Nevada, where it grows primarily in deep, moist soils (Mayer and Laudenslayer 1988, Barbour and Major 1988, Potter 1998). Young Red Fir Forests can be quite dense, while older stands are less dense but still maintain a nearly 100% canopy cover. Mature stands are impressive, with 150-foot trees in close formation creating shaded, cool environments below. Understory shrubs and herbs are usually absent or sparse, and only a few other conifer species are present. However, in areas that have been logged or swept clean by avalanche, dense thickets of shrubs or lodgepole pines can become established.

At lower elevations, Red Fir Forest transitions into Mixed-Conifer Forest, and it blends into Subalpine Conifer Forest at higher elevations. The distribution of red fir-dominated forests is highly correlated with the location and depth of the average annual snow pack. The relative density of red fir trees increases with snow depth and the amount of soil water content measured in early April (Potter 1998).

In the main portion of its distribution, Red Fir Forest forms large stands that cover many slopes and aspects, while at their lower limit they are mostly restricted to cool, north-facing slopes or to moist soil areas on south-facing slopes. Red fir trees are primarily restricted to deep, well-watered but not soggy, soils. Within Red Fir Forest, the presence of other conifer species is often an indication that soil conditions are unfavorable for red firs. For example, in rock outcrops areas, red firs are restricted to pockets of deeper soils, leaving rocky soils to pines and other conifer species.

Mature Red Fir Forests may appear to be uniform in age and stand structure. However, the shade tolerant nature of the species allows reasonable growth to occur under a variety of conditions, and similar-sized trees can vary in age by more than 100+ years (Laacke and Tappeiner 1996). Prolific seed

production ensures that newly-exposed sites on the forest floor are quickly saturated with seeds. The first generation of dense seedlings eliminates the germination of subsequent generations until a fire, avalanche, or other disturbance clears the forest floor of saplings and litter and a new round of seedlings can become established. Unless a stand-clearing fire occurs, dense needle litter keeps the forest floor fairly clear of shrubs and herbs. A few saprophytic (i.e., living on dead and/or decaying material) herbs and pockets of shrubs usually occupy less than 5% of the forest floor except in areas where stand-replacing fires or extensive logging have disturbed this natural cycle.

Since Red Fir Forest is found at relatively high elevations with short summers, cool temperatures, and short fire seasons, it is perhaps surprising that historical wildfire frequencies there were not signficantly different from forests at lower elevations (Laacke and Tappeiner, SNEP 1996). Historical fire patterns in Red Fir Forest appear to be primarily low and moderate intensity fires, although high-severity fires did occur in this forest type (Agee 1990, Taylor 1993).

The surface layer of Red Fir Forests is often sparse and compact and is usually not conducive to rapid fire spread (Parker 1984). Even when considerable dead organic matter and fuel concentrations were present in Red Fir Forests, intense, stand-replacing fires covering large areas were uncommon (Laacke and Tappeiner 1996). Through fire suppression in the 20th century, however, limited areas of Red Fir Forest in Nevada County have burned, and the natural cycle has been changed from historical conditions. Before the period of European settlement of the Sierra Nevada, about 60 times as much area burned within the Red Fir Forest compared with the amount burned in the 20th century (McKelvey et.al. 1996).

The size and continuity of Red Fir Forest stands vary from landscape to landscape depending on the fire and disturbance history and on local site conditions. In many areas of the Sierra, more than 50% of the Red Fir Forests are intermingled with rock outcrops, meadows, shrub patches, and lakes, creating a mosaic of relatively small forest stands comprised of discrete plant associations intermingled among non-forested areas (Richards 1959, McKelvey et.al. 1996).

The variability of stand size and seral stages also can be attributed to the high rate of recurrent lightning fires, wind throws, and insect outbreaks that kill groups of trees simultaneously (Mayer and Laudenslayer 1988). Lightning assumes importance in the upper montane forests because of the high frequency of strikes on ridgelines. In Yosemite National Park,

approximately 70% of all lightning fires occurred between 6,000 and 9,000 feet elevation, and the maximum number of fires occurred in the Red Fir Forest type (van Wagtendonk 1993). Insect outbreaks regulate species composition and stand structure by thinning individuals and creating openings. These mortality factors create spatial diversity across the landscape and can provide opportunities for shrubs, forbs, and other low vegetation to maintain plant species diversity through time (Potter 1998).

Plant Diversity

While red firs are the dominant tree species on deep, moist soils, they form mixed associations at other sites. At lower elevations, red firs occur with increasing numbers of white firs, while at higher elevations they occur with mountain hemlocks. Throughout this elevational range western white pine is a constant, though scarce, associate. On moist sites, lodgepole pines can occur in monotypic pockets within the Red Fir Forest, while Jeffrey pines and occasional western junipers occupy rocky soils and outcrops (Mayer and Laudenslayer 1988).

The shrub layer, where present around meadows, open glades, rock outcrops, or temporary openings, is comprised of a mix of species including tobacco brush, mountain whitethorn, chinquapin, greenleaf manzanita, Sierra gooseberry, creeping snowberry, and huckleberry oak. Characteristic forest floor wildflowers include the saprophytes snowplant, pinedrops, and spotted coralroot. White-veined wintergreen and rattlesnake orchid are also common forest floor associates.

Rare plants associated with Red Fir Forests are more likely to be found in edge habitats such as dry forest openings or meadow edges. Closed-throated beard-tongue, hidden-petal campion, and Kellogg's lewisia are Yellowlist species that are associated with drier Red Fir Forest openings in Nevada County, while rare moonworts and Siskiyou Mountains huckleberry are more likely to be found on mesic sites such as wet meadow edges or riparian areas (Appendices II and III).

Noxious weeds are generally restricted to road edges, recreational facilities, or the disturbed soils associated with logging staging areas, and they rarely escape into the adjacent, undisturbed forest floor. Typical weeds associated with disturbed Red Fir Forests include Klamathweed, bull thistle, cheat grass, sheep sorrel, and woolly mullein (Table 3-2).

Animal Diversity

Despite the long, cold winters and the relatively uniform structure, Red Fir Forest is used by a surprising variety of wildlife species. Compared to other large-patch ecosystems of Nevada County, Red Fir Forest supports a moderately high animal diversity (Figure 3-3). Approximately 116 vertebrate species occur in these forests including 45 mammals, 63 birds, five reptiles, and three amphibians. These forests provide breeding habitat for about 79 vertebrates species in Nevada County (Appendix VI). However, the number of permanent resident vertebrate species in Red Fir Forest is significantly less than in lower elevation Mixed-Conifer and Ponderosa Pine Forest (Laudenslayer and Grenfell 1983, Laacke and Tappeiner 1996).

A number of birds are year-round residents in Red Fir Forest including Blue grouse, hairy woodpecker, Steller's jay, Clark's nutcracker, mountain chickadee, Townsend's solitaire, and Cassin's finch. Summer breeding species include hermit thrush, western tanager, olive-sided flycatcher, and yellow-rumped warbler. Mammals are best represented by two species of chipmunks, and golden-mantled ground squirrels, and Douglas's squirrels. There are often obvious signs of mountain pocket gophers around meadows and other openings in these forests. Amphibians and reptiles are less common than in lower elevation Mixed-Conifer Forest. The long-toed salamander, Pacific treefrog, and western toad are uncommon in these forests, and western fence lizards, northern alligator lizards, and western terrestrial garter snakes occur there (Appendix VI).

The Redlist great gray owl has been observed in Nevada County a few times as a nonbreeding visitor, and this species could potentially use Red Fir Forest. The Yellowlist northern goshawk also is known to use this habitat in the county. Yellowlist mammals with potential to occur in Red Fir Forest in the county include the Sierra Nevada snowshoe hare, American marten, and Pacific fisher, and Redlist species include Sierra Nevada red fox and California wolverine. The Yellowlist mountain yellow-legged frog occurs around lakes and ponds within the Red Fir Forest. No exotic wildlife species are known to occur in this habitat type in the county (Appendices V and VI).

Distribution and Status

Red Fir Forest is found on high mountain slopes the length of the Sierra Nevada and in Trinity and Siskiyou Counties of northwestern California (Griffin and Critchfield 1976, Mayer and Laudenslayer 1988). In Nevada County, Red Fir Forest is found on both slopes of the Sierra crest (**Figure 3-**

26). It occupies about 35,170 acres, representing about 6% of the county's total land area. About 45% of this acreage is on private land (Table 3-1).

This ecosystem is most fully developed between 7,500 feet and 8,500 feet, but Red Fir Forest grows up to about 9,060 feet and as low as 5,600 feet just east of Graniteville. On the east slope, it occurs down to about 7,000 feet in the hills above Sagehen Creek, and there is an isolated population in the Carson Range in the extreme southeast corner of the county (Figure 3-26). The highest elevation occurrences of this forest type in Nevada County are at 8,800 feet on the north side of Basin Peak, and at 9,045 feet on the north slope of Mt. Lola.

In the Sierra Nevada, logging of Red Fir Forest began in the early 1940s (Oosting and Billings 1943), but significant harvesting did not begin until the 1950s and 1960s when road systems were established (Bolsinger 1980, Potter 1998). Red Fir Forest in the Sierra Nevada is coming under increasing pressure from intensive logging activity (McKelvey et al. 996). In Nevada County, the largest Red Fir Forest stands have been logged to the extent that few late-successional stands now remain (Figure 3-33).

Lodgepole Pine Forest

Structural and Ecological Characteristics

Lodgepole Pine Forest typically occurs at high elevations with long, snowy winters and cool, dry summers. This forest type is especially successful along margins of lakes and meadows where damp soils discourage competing conifer species (Whitney 1985). On most sites where lodgepole pines are the dominant species they are usually the only overstory trees (Potter 1998). Lodgepole Pine Forest is most closely associated with wet or saturated soils, but it also thrives on a broad spectrum of other soil types including well-drained glacial outwashes (Critchfield and Wheeler 1985). Lodgepole pine trees are very shade intolerant, and on sites where deep, fertile soils prevail, shade-tolerant conifers such as red fir and white fir eventually outcompete the lodgepole pines and become the climax forest species.

Lodgepole pine trees often dominate in marginal habitats, places that are too cold, too hot, too dry, or too wet for other conifers (Whitney 1985). In such locales they are commonly the climax trees. In some areas, lodgepole pines may be the most abundant species in the Subalpine Conifer Forest where open stands grow in dry soils up to timberline. Lodgepole pines are an important pioneer on barren, granite outcrops, where they colonize moist, soil-filled crevices that form along structural joints within rock outcrops. The

pine's roots probe deeply in the rock and help widen the crevices, thereby hastening the weathering process and, by extension, the ultimate transition from bare rock to forest soil (Whitney 1985).

Within lower Red Fir and Mixed-Conifer Forest, patches of pure lodgepole pine can dominate cooler microsites and areas of poor drainage (Mayer and Laudenslayer 1988). In such situations, lodgepole pines may be abundant on mesic soils, but they rarely dominate larger areas. Instead, lodgepole pines are an opportunistic species that rapidly colonize localized areas of disturbance such as tree falls, windthrows, avalanche, lightning stirkes, areas of tree kills from insect outbreaks or pathogens, and burn sites. However, many stands may have several widely separated age classes suggesting multiple disturbance and germination events that created an uneven stand structure. In this way, lodgepole pines establish and maintain themselves through time mostly as small, discrete stands within other forest types. Lodgepole Pine Forest is rarely a climax type in such situations (Potter 1998).

In other parts of North America, lodgepole pines are closed-cone conifers that require the heat of fires to open their cones. In contrast, Sierra Nevada lodgepole pine cones open and their seeds germinate, in the absence of fire (Lotan and Critchfield 1990). Sierra lodgepole pine trees begin to produce seeds after about 4 to 8 years. They are prolific and reliable seed producers, with good seed crops usually occurring every 1 to 3 years (Critchfield 1978 and 1980; Krugman and Jenkinson 1974). Lodgepole Pine Forests are often so dense that individual trees grow straight and rather tightly packed, reaching heights of 40-65 feet (Mayer and Laudenslayer 1988). Older stands are often characterized by large numbers of standing snags and tangles of fallen logs and other wood debris on the ground.

Prior to fire suppression in the 20th Century, Lodgepole Pine Forests probably experienced infrequent, low or moderate intensity fires. The combination of heavy, early seed production and the ability to reseed in any openings give lodgepole pines a competitive advantage over most other conifers following fires, whether the intensity was low, medium, or high (Husari 1980). Lodgepole pines have thin, resinous bark, and stands may have high levels of fuel accumulation, making them highly susceptible to fire. John Muir, for example, noted that on calm days of fall in Lodgepole Pine Forests, fires crept quietly along the ground until a larger lodgepole pine tree was encountered, then the entire tree often burned. This pattern repeated itself at irregular intervals for "weeks at a time" (Muir 1894, Potter 1998).

In the absence of frequent fires, lodgepole pines have been able to invade the margins of meadows throughout the Sierra (Whitney 1985). Historically, moderate-intensity fires were an important factor maintaining the meadow-forest boundary (Vankat and Major 1978), and some meadows are now being lost to lodgepole pine invasion in the absence of fires (Husari 1980). Similary, intensive grazing of Montane Meadows can cause soil erosion, stream entrenchment, and lowering of water tables, thereby creating drier and more suitable conditions for tree seedling establishment (Vankat and Major 1978).

Plant Diversity

Since Lodgepole Pine Forest is often dominated by dense growths of saplings and seedlings, the shrub and herb layers of these forests are best developed at forest edges or in canopy openings. In Nevada County, characteristic shrub and herbaceous plants in Lodgepole Pine Forests include huckleberry oak, mountain whitethorn, greenleaf manzanita, pinemat manzanita, Ross' sedge, Sierra penstemon, white-veined wintergreen, and pinewoods lousewort. In the seasonally moist to saturated soils of Lodgepole Pine Forests on the edge of montane or subalpine meadows, typical shrubs and herbs include mountain heather, Labrador tea, Sierra laurel, mountain spiraea, bilberry, and introduced meadow grasses such as Kentucky bluegrass and rough bentgrass.

Yellowlist plants that could potentially occur along the exposed edges of Lodgepole Pine Forests in Nevada County include hidden-petal campion, rare moonworts, cluster-flower cryptantha, and Bolander's bruchia (Appendix III). Noxious weeds and other introduced species, particularly bull thistle, Klamathweed, and sheep sorrel, are more likely to occur along road edges or in heavily-grazed meadows adjacent to Lodgepole Pine Forest.

Animal Diversity

Because Lodgepole Pine Forest exists in harsh climates and has little structural or vegetative diversity, its wildlife diversity is moderately low compared to other conifer forest types in the Sierra Nevada (Mayer and Laudenslayer 1988). In Nevada County, approximately 99 vertebrate species occur in these forests including 44 mammals, 48 birds, four reptiles, and three amphibians. Lodgepole Pine Forest provides breeding habitat for about 61 vertebrates species in Nevada County (Appendix VI). The proximity of many stands to meadows, streams, and/or wetlands often accounts for the diversity of wildlife species that might be seen there. This is especially true in perennially-wet areas where willow thickets form an understory layer or

where black cottonwoods or quaking aspens are adjacent to, or mix, in the forest canopy.

Woodpeckers are drawn to Lodgepole Pine Forests due to the abundance of dead and dying trees and to the frequent insect outbreaks that provide their primary food source. Hairy, downy, white-headed, and black-backed woodpeckers, plus Williamson's sapsucker and northern flicker are all common residents. Lodgepole pine trees growing at the edges of wet meadows and streams provide important nesting strata and cover for species closely associated with riparian habitats (this includes many migrating neotropical songbirds such as flycatchers, vireos, warblers, etc.). The abundance of nesting songbirds draws predatory birds such as Cooper's and sharp-shinned hawks and northern goshawks. These hawks may nest in lodgepole pine stands; more often, they use them as hunting sites for ambushing prey, primarily birds and small rodents (Zeiner et al. 1990).

Characteristic breeding mammals in Lodgepole Pine Forests include the Allen's and lodgepole chipmunks, northern flying and Douglas' squirrels, California and golden-mantled ground squirrels, and ermine, long-tailed weasel, black bear, and mule deer. Amphibians and reptiles are poorly represented in this habitat with only a few species such as Pacific treefrogs and western toads, sagebrush lizards, northern alligator lizards, and western terrestrial garter snakes occurring there (Appendix VI).

Yellowlist raptor species that could potentially occur (at least for foraging or roosting) in Lodgepole Pine Forests of Nevada County include the northern goshawk (a possible nester), golden eagle, prairie falcon, and merlin. Yellowlist mammal species that could occur in this habitat include: American badger, Pacific fisher, American marten, Sierra Nevada snowshoe hare, long-legged myotis and long-eared myotis. The Redlist California wolverine and Sierra Nevada red fox are extremely rare but also could potentially occur in Lodgepole Pine Forest of the county (Appendices V and VI).

Distribution and Status

In California, Lodgepole Pine Forest occurs from mid- to high elevations, and it straddles the Sierra crest from Sierra County south to Tulare County (Griffin and Critchfield 1976, Mayer and Laudenslayer 1988). Approximately 4,740 acres of Lodgepole Pine Forest exist in Nevada County, representing <1% of the county's total land area; approximately 55% of this acreage is on private land (Table 3-1).

In Nevada County, these forests extend from about 5,660 feet up to about 8,290 feet, but most stands in the county are above about 6,700 feet where

they are fairly widespread (Table 3-1, **Figure 3-27**). Some extreme western and lower-elevational occurrences of Lodgepole Pine Forests are found near Graniteville (5,800 feet) and at Pat Yore Flat (6,200 feet). One of the county's lowest elevation stands is at Milton Reservoir (5,700 feet).

Some of the largest concentrations of Lodgepole Pine Forest in Nevada County can be found along the higher ridgelines between Castle Peak and Mt. Lola. Large stands also can be found in the headwaters, floodplain, and wet meadows of the South Yuba River, from Lake Van Norden through Kingvale and west to Cisco Grove (Figure 3-27). In the South Yuba River drainage these forests are often found in close association with adjacent upland communities of Mixed-Conifer and Montane Chaparral. On flats along the river, lodgepole pines are frequently associated with black cottonwoods, while in adjacent upland sites with drier soils, they are found in close proximity to less water-tolerant species such as white fir, Jeffrey pine, mountain whitethorn, ceanothus, and greenleaf manzanita.

Since the railroad building era in the late 1800s intensive harvesting in Lodgepole Pine Forest has not been of sufficient duration and scope to have made substantial long-term changes in the species composition and major structural elements of these forests. In most cases, harvesting operations did not begin in upper montane forests of the Sierra Nevada until the mid-1950's. Rangewide, limited clear cutting has occurred in these forests; few clear cuts are larger than 25 to 30 acres, and most are smaller than 10 acres (Potter 1998).

Subalpine Conifer Forest

Structural and Ecological Characteristics

In the northern Sierra, Subalpine Conifer Forest ranges from about 7,000 feet to 9,500 feet in elevation (Mayer and Laudenslayer 1988). At lower elevations, Subalpine Conifer Forest transitions into Red Fir and other montane forests, and their borders can be defined by the presence of several distinctive indicator species. In Nevada County, these indicator species are the relatively widespread mountain hemlocks, but the more scarce and restricted western white pines and whitebark pines are also distinctive elements of this forest type. Red firs and lodgepole pines also may be present in Subalpine Conifer Forest of Nevada County, but these species are also dominant elements of the Red Fir and Lodgepole Pine Forest types.

The line of demarcation between the upper Subalpine Conifer Forest and the treeless Alpine zone is known as "timberline," the point where trees cease to

exist due to extremes in climate and elevation. Air temperature is the most important factor governing the location of timberline; the interplay of wind, topography, and snow is more important in determining the local distribution and growth habits of timberline trees (Whitney 1985). In Nevada County, extremely rocky areas with shallow soils support very few trees or large shrubs, and these areas may create a false impression of a localized "Alpine Zone." True Alpine habitats in the Sierra reach their northernmost extent in Placer County, and they are not found in Nevada County or farther north (Mayer and Laudenslayer 1988, True 1973).

Lower elevation Subalpine Conifer Forests of Nevada County grow in areas with relatively deep soils that may support dense stands of mature mountain hemlock and other large conifers. Especially good examples of such stands occur on the toe slopes of Mt. Lola and in the upper Sagehen Creek basin below Carpenter Ridge. These stands contain red fir and lodgepole pine as scattered individuals or as co-dominants to a greater extent than higher elevation stands. The lowest elevation stands are mostly restricted to cold pockets such as those found on north-facing slopes. Many sites, especially at the higher elevations, are characterized by rock outcrops and thin, gravelly soils with little or no humus layers. Shallow soils promote an open woodland effect, with trees often being restricted to small, island groves.

On dry, exposed aspects, Subalpine Conifer Forest gives way to Subalpine Dwarf Scrub (low sage) vegetation communities or barren land. The highest elevation stands are usually dominated by widely-spaced mountain hemlocks, but the shade-intolerant western white pine can be found in open portions of the stands, usually as scattered individuals or small groups. While a few large stands of mountain hemlock occur in Nevada County, they are usually represented by small, homogenous aggregations scattered across the landscape.

Forest stands of whitebark pine, the classic timberline tree, are regionally scarce and are known only from a few locations in Nevada County. They are found on Basin Peak and along a high ridgeline which connects Castle and Basin peaks, and they also occur at about 8,600 feet on a crest overlooking White Rock Lake to the southeast. Overall, lodgepole pine may be the most abundant tree species in Subalpine Conifer Forest of Nevada County, and it occurs throughout this forest type and across its elevational range. Lodgepole pine dominates many of the low-lying areas and small glacial basins with high soil moisture content, and it is especially common along streams and wet meadow and lake margins. Red fir may also be present in Subalpine Conifer Forest, but it is mostly restricted to lower elevations

where deeper soils occur. A few white fir and Jeffrey pine trees may also be present at low-elevations of this forest type.

Subalpine Conifer Forest is generally low in stature and slow growing. Only in protected areas do trees exceed 50-100 feet in height. On exposed ridge tops, where gale force winds often prevail, individual trees may be short and frequently stout and twisted in form, having been shaped by the extreme conditions. Winds damage trees by breaking limbs or, in winter, by blasting them with flying ice pellets and snow crystals. Abrasion is so intense that the windward sides of timberline trees commonly show bare, polished wood where the bark has been stripped away (Whitney 1985).

In dense, lower elevation Subalpine Conifer Forests, the shrub and herbaceous cover is usually similar to adjacent montane forests except that midslope conifers are gradually replaced by large quantities of distinctively subalpine species. The shrub and herbaceous layers in the understories of these closed forest types are sparse due to the harsh climatic conditions and lack of available sunlight. Perennials, bunchgrasses, and small, cushion-like sub-shrubs may be present but are usually widely dispersed. More open woodlands of steeper, high elevation slopes are usually more open and park-like, and they support a higher diversity of stunted and sprawling shrubs at timberline (Whitney 1985).

The annual snowfall in Subalpine Conifer forests is about 350 inches in the central Sierra Nevada and about 550 inches in the northern Cascades; little or no precipitation falls during the summer months. The mean summer high temperatures usually do not exceed 65° F in these forests. Killing frosts are possible during all months, and the growing season lasts only seven to nine weeks (Whitney 1979).

Plant Diversity

The understory of Subalpine Conifer Forest is typically of relatively low diversity and is usually dominated by conifer seedlings and saplings. In Nevada County, the most commonly encountered shrubs and perennials include widely-scattered mountain heather, red elderberry, and mountain gooseberry on mesic sites; wax currant is a more typical shrub on drier sites. Other characteristic species include Sierra penstemon, straw-like sedge, Parry's rush, Drummond's rush, pimpernel willowherb, Pringle's bluegrass, Sierra primrose, and snow plant. Introduced and invasive species are essentially absent from these remote high elevation areas.

Two Yellowlist plants that could potentially occur on scree slopes within the Subalpine Conifer Forests of Nevada County are the long-petaled lewisia and

fell-fields claytonia (Appendices II and III). Whitebark pines are locally scarce but not rare from a statewide perspective; however, they are so limited in Nevada County that occasional pure stands may be regarded as sensitive habitat (see "Small-Patch Ecosystems," below; **Figure 3-35**).

Animal Diversity

Though Subalpine Conifer Forest supports fewer wildlife species than the other large-patch forest types in Nevada County (Figure 3-1), the overall numbers still remain remarkably high considering the harsh conditions that exist there. In the county, this habitat has potential to support up to 83 vertebrate species including 39 mammals, 37 birds, four reptiles, and three amphibians. Subalpine Conifer Forest provides breeding habitat for up to 51 vertebrate species in Nevada County (Appendix VI).

Although a large percentage of the landscape is rocky and barren, water sources and water-dependent plant species are usually present in scattered locations, and they are particularly valuable to wildlife. Riparian and herbaceous vegetation occurs along seeps, springs, pockets of small wet meadows, and the fringes of small lakes and snow-melt pools. In late spring or summer, soon after snow melt, these areas experience a burst of vigorous growth of the many native forbs and grasses as well as dramatic increases in insect populations. These support an abundance of rodent species including: lodgepole chipmunk, mountain pocket gopher, western harvest and deer mice, bushy-tailed woodrat, and heather and montane voles. This abundance of small mammals, in turn, attracts larger, predatory mammal species such as ermine, long-tailed weasel, coyote, bobcat, mountain lion, and black bear. (Appendix VI).

A number of birds make seasonal use of Subalpine Conifer Forest when nesting or passing through in migration. However, only a few species find semi-permanent residence there including the hardy mountain chickadees that nest in cavities and feed on various bark and needle insects; Clark's nutcracker, a pine nut specialist; Steller's jay, an omnivore with a very adaptable diet; and common ravens, a predator on small birds and mammals and a carrion feeder (Verner and Boss 1980, Beedy and Granholm 1985). Transient bird species, such as pine siskin, Cassin's finch, red crossbill, and pine and evening grosbeaks also feed on pine (and other conifer) seeds. Other classic high-elevation inhabitants include blue grouse, mountain bluebird, black-backed woodpecker, and calliope hummingbird. Red-tailed, Cooper's, and sharp-shinned hawks and northern goshawks also exploit the bounty of small mammals and/or bird species that concentrate

within the many forest clearings and meadows of Subalpine Conifer Forests (Appendix VI).

Amphibians and reptiles are represented by just a few species due to the extremely harsh climatic conditions of Subalpine Conifer forests. The long-toed salamander, Pacific treefrog, and western toad are uncommon in these forests, and western fence lizards, sagebrush lizards, northern alligator lizards, and western terrestrial garter snakes only sometimes occur there (Appendix VI).

Yellowlist birds with potential to occur in Subalpine Conifer Forests of Nevada County include golden eagle, northern goshawk, and merlin. Yellowlist mammals that might have been documented in these forests include American marten, Pacific fisher, American badger, and Sierra Nevada snowshoe hare; extremely rare Redlist carnivores such as the California wolverine and Sierra Nevada red fox, might also occur there (Appendix VI). Long-eared and long-legged myotis, breed and roost in Subalpine Conifer Forest, and they have been documented near Independence Lake and at Sagehen Creek (Appendix V).

The Yellowlist Mount Lyell salamander has been documented in the Sierra Buttes, Sierra County, to the north and in El Dorado County to the south. While some potential habitat may exist within the talus slopes of the highest peaks, this species has not yet been observed in Nevada County (Jennings and Hayes 1994, Appendix V). No exotic wildlife species are known to occur in this habitat type in the county (Appendix VI).

Distribution and Status

Subalpine Conifer Forest in California forms an irregular band that stretches from Siskiyou and Trinity Counties to Mt. Shasta and down the Cascade-Sierra axis to a few of the highest peaks east of Los Angeles (Mayer and Laudenslayer 1988). In Nevada County these forests grow on the slopes of the highest peaks; they are generally above 7,500 feet, but a few small stands grow in cold pockets down to about 6,590 feet (Table 3-1, **Figure 3-28**). The overall extent of Subalpine Conifer Forest is limited in the county due to the relatively small land area that extends above 7,000 feet (**Figure 3-42**). This is especially true when compared to the central Sierra, where many peaks and an extensive land area extend above 10,000 feet. Another factor limiting the extent of Subalpine Conifer Forest in Nevada County is that most of the highest ridges and peaks have volcanic origins and are now composed of unconsolidated talus or scree slopes that preclude the colonization of forest stands.

In Nevada County, Subalpine Conifer Forest occupies about 2,440 acres, representing <1% of the county's total land area. About 26% of this acreage is on private land (Table 3-1). This ecosystem is mostly concentrated around the high peaks and ridges of the Sierra crest which spans the width of the eastern portion of the county between Castle Peak (9,103 feet) and Mt. Lola (9,148 feet) where the county's two highest stands occur. A few isolated stands occur in the extreme southeast corner of the county in the Carson Range, while a few other isolated stands occur west of the Sierra crest; the westernmost stand is on the north slope of Pinoli Peak at about 7,250 feet (Figure 3-28).

The effects of human activities in Subalpine Conifer Forest have been relatively minor, recent, and concentrated into a short time frame compared to impacts on most other large-patch forest ecosystems of Nevada County. Due to the short growing season and lower productivity, these forests have been less affected by historical fire suppression than the county's other forest types. Subalpine Conifer Forest is generally located in remote and relatively inaccessible regions, and they are widely distributed across rough terrain, limiting the extent of timber harvest activities. However, many of the county's larger or more contiguous forest stands have had many of the large-stature trees removed within the last few decades. Some mid-to-late-seral stands still exist, including some large tracts of the locally scarce mountain hemlock (mapped as part of LSOG Red Fir, Figure 3-33).

The slow growth and longevity of most Subalpine Conifer Forest conifers is well known. Both mountain hemlock and whitebark pine have been recorded at more than 800 years old (Arno 1967, Means et al. 1988). The large girth and ancient gnarled appearance of many of these trees is one indication that they may be among the oldest remaining trees in the county.

Eastside Pine Forest

Structural and Ecological Characteristics

Eastside Pine Forest occurs entirely east of the Sierra crest where it is generally more open and has smaller trees than the similar Ponderosa Pine Forest of the west slope. Eastside Pine Forest in Nevada County is dominated overwhelmingly by Jeffrey pines, but ponderosa pine trees are sometimes found as scattered individuals or as isolated pockets within larger Jeffrey pine stands. Other tree species associated with Eastside Pine Forest include western juniper, red fir, white fir, and lodgepole pine. Eastside Pine Forest often has a dominant understory containing many shrub and herb species with strong Great Basin floristic affinities (Mayer and Laudenslayer 1988, Hickman 1993).

In Nevada County, ponderosa pine trees are near their southernmost extension on the east slope (Griffin and Critchfield 1976). Farther south, they are almost entirely replaced by Jeffrey pines where higher elevations and associated colder temperatures combine to make soils drier. Ponderosa pines are absent from the higher elevation Eastside Pine Forest of Nevada County, and few pure stands of ponderosa pine are found anywhere east of the Sierra crest. Compared to ponderosa pines growing on the west slope of the Sierra, those on the east slope have adapted to the longer, colder, and drier winters by developing shorter, thicker needles, smaller, denser cones, and greater cold tolerance (Holland 1986).

Eastside Pine Forest in Nevada County frequently borders open, shrub-dominated sites. Prior to fire exclusion early in the 20th Century, fire frequency in dry Eastside Pine Forest was probably 5-20 years and frequent, cool underburns kept these communities open and park-like and fuel accumulations low (Biswell 1972, Mayer and Laudenslayer 1988, Hall 1977). Frequent low-intensity fires performed the function of maintaining the open stands, cycling nutrients, reducing pathogens, and facilitating infrequent natural pine regeneration. Fire exclusion allows a succession of small pines, often growing to pole or sapling size in extremely dense stands (i.e., thousands of stems per acre). These fire-suppressed understories provide fuel ladders to the overstory and facilitate the spread of pathogens such as dwarf mistletoe, root diseases, and bark beetles. Mortality and fuel loading is high, and fires often escalate into stand-replacing fires that the original stands rarely, if ever, experienced (Smith 1994).

Because of their economic value, many acres of Eastside Pine Forest have been logged for over a century (Shevock 1996). This forest type was extensively railroad-logged early in the 20th century (Laudenslayer and Darr 1990) , and several stand-destroying fires have occurred in Eastside Pine Forest of Nevada County in the last fifty years. For example, a 1960 fire destroyed about 44,000 acres, mostly within this forest type. Due to the extensive amounts of logging and fire history, most of the county's Eastside Pine Forest now consists largely of second- or third-growth trees, many from older plantations; many younger plantations have followed more recent fires.

Fire exclusion in Eastside Pine Forest seems to favor the eventual dominance of white firs over pines, since young fir saplings are easily killed by even low-intensity fires. Selective pine overstory removal has also favored white fir succession, and many thousands of acres of former Eastside Pine Forest in the eastern Sierra Nevada have become dominated by white firs in the past 100 years (Smith 1994).

Montane Chaparral and Eastside Scrub are two shrub-dominated plant communities that occupy much of the unforested regions within the range of Eastside Pine Forests in Nevada County. They sometimes form large, homogenous tracts or smaller clumps within forest clearings. The representative species of these communities have become dominant in the understory of many stands as a result of long-term fire suppression policies that have eliminated frequent low-intensity fires. In areas where high intensity wildfires have occurred, Montane Chaparral has replaced Eastside Pine and Mixed-Conifer Forest over large areas. In such habitats, a dominance of ceanothus or manzanita is indicative of disturbance from past fire or logging and occurs as a successional stage to conifer forests, rather than as a climax ecosystem (Barbour and Major 1988). Other human-induced changes in Eastside Pine Forest include historical sheep grazing that expanded the range of the herbaceous perennial plant, wooly mule's ears, that chemically inhibits the regeneration of conifer seedlings (Yoder-Williams and Parker 1987, Yoder-Williams and Parker 1989).

In recent years the U.S. Forest Service has conducted many fuel reduction projects in Eastside Pine Forests of Nevada County. These include the thinning of overstocked stands, mechanical treatments of understory fuels, and prescribed burning in the Prosser Creek and Boca Reservoir areas. These treatments have been extensive and widespread and appear to be concentrated within the high-use recreational areas where ignition sources are greatest. However, these areas now appear to lack important wildlife elements such as large, standing snags and fallen logs and, due to the young age of current forest stands, new recruitments are not forthcoming.

Plant Diversity

Large stands of Eastside Pine Forest are found along the Highway 89 corridor, north of Truckee, and along the I-80 corridor east of Truckee. Within these stands, bitterbrush is the dominant shrub, but the shrub and herb layers are more diverse on open, rocky sites, or in other canopy openings. Characteristic species in Nevada County include sagebrush, curl-leaf mountain mahogany, wax currant, western serviceberry, tobacco brush, greenleaf manzanita, Wood's rose, mahala mat, rabbitbrush, woolly mule-ears, Brewer's lupine, Sierra lomatium, timberline phacelia, hoary aster, pussy paws, western needlegrass, and the noxious weed cheatgrass. In Nevada County, other noxious weeds and invasive non-native species characteristic of Great Basin habitats found in Eastside Pine Forest include poverty weed, Scotch thistle, Russian thistle, tumble mustard, and a large infestation of the federally-rated noxious weed, musk thistle (Table 3-2).

Relatively few Yellowlist plants are known to occur in Eastside Pine Forests of Nevada County (Figures 3-1 and 3-2; Appendix III). These include Lemmon's clover and, in vernally wet depressions, Plumas ivesia. Several other Yellowlist plants with occurrences just outside the county line, which could potentially occur in openings of Eastside Pine Forests, include Dog Valley ivesia, Webber's ivesia, Sierra Valley ivesia, Lemmon's milk-vetch, golden violet, sticky pyrrocoma, hill buckwheat, and Sierra Valley evening-primrose. Distribution patterns for rare and/or endemic species differ considerably from river basin to river basin, and the distribution of these plants between habitat types is also varied (Shevock 1996).

Animal Diversity

Compared to other large-patch ecosystems of Nevada County, Eastside Pine Forest supports only a moderate animal diversity (Figure 3-3). Approximately 99 vertebrate species occur in these forests including 37 mammals, 50 birds, 10 reptiles, and two amphibians. This forest type provides breeding habitat for about 75 of these species (Appendix VI).

Some characteristic birds of these forests include dusky flycatchers, pygmy nuthatches, Clark's nutcrackers, and red crossbills. Bat species are well represented in this habitat with nine out of the ten known Nevada County species breeding in Eastside Pine Forests. Large predatory mammals are represented by mountain lion, bobcat, black bear, ringtail, and coyote. Eastside Pine Forests are particularly productive for reptiles including: sagebrush lizard, western skink, western whiptail, rubber boa, racer, striped whipsnake, and common gopher snake (Appendix VI).

The Yellowlist osprey and Redlist bald eagle are now primarily restricted to reservoir foraging, since large runs of Lahontan cutthroat trout, once common in eastside streams, have been eliminated by dams on the major streams. Large snags or large trees with dead tops used for nesting now appear to be scarce, and breeding populations there are sporadic (Williams 1997). Similarly, the relative lack of large trees and mature stands in Eastside Pine Forests reduces their value for the Yellowlist northern goshawk. Other Yellowlist bird species that are associated with this habitat include merlin, prairie falcon, and golden eagle. Other Yellowlist animals that are strongly associated with Eastside Pine Forests include the American badger, and four bat species: yuma, long-legged, and long-eared myotis, and pale Townsend's big-eared bat (Appendices V and VI).

Historically, the management focus of Eastside Pine Forest was on its value to migratory deer herds for foraging and breeding habitat (Mayer and

Laudenslayer 1988). Areas with antelope bitterbrush are of particular benefit to deer. Migratory and breeding ranges of deer are based, in part, on the plant's presence and desirable nutritional values (Zeiner et al.1990).

Distribution and Status

Eastside Pine Forest occurs east of the Sierra-Cascade axis south to Lake Tahoe, with another large patch in the Mammoth Lakes region in Mono and Inyo counties (Mayer and Laudenslayer 1988). In Nevada County, it occurs between about 5,100 and 7,500 feet, and the lowest elevation stands are found in the Truckee River canyon at state line (Table 3-1, **Figure 3-29**). Approximately 29,610 acres of Eastside Pine Forest exist in Nevada County, representing about 5% of the county's total land area. About 50% of this acreage is on private land (Table 3-1).

In Nevada County, the largest stands of Eastside Pine Forest occur in a series of intersecting glacial basin shallows separated by gently-rolling hills and peaks (Figure 3-29). These forest stands occupy hilltops and basin slopes where dry, well-drained soil conditions exist. The bottomland or low-lying areas of these glacial moraines often contain areas of shallow, fine-grained soils and high moisture content that support either ephemeral wetlands (with a coverage of low herbs) or wet meadow systems (comprised of perennial grasses and often containing fens) flanked by forest stands. Eastside Scrub communities (containing antelope bitterbrush and big sagebrush) can also be found extensively within these basin flats, where they occupy areas of deep, coarse, and well-drained alluvium soils.

The Truckee River canyon is characterized by steep, rocky terrain and dry soil conditions and extreme changes between summer and winter climates. Eastside Pine Forest there is comprised almost entirely of Jeffrey pines that are well-adapted to harsh conditions. At higher elevations, Eastside Pine Forest begins to intergrade with the Mixed-Conifer Forest that predominates at higher elevations above the river canyon. In transitional areas, Mixed-Conifer Forest occupies the north slopes and shady glens with moist soils, while Eastside Pine Forest is mostly restricted to drier, more southerly aspects (Holland 1986). In regions around Boca and Prosser Creek reservoirs, as well as in the Russel Valley and Hobart Mills areas, Eastside Pine Forests predominate over broad areas. The highest elevation Eastside Pine Forests extend up to the east slope Red Fir Forests, where the stands are small and widely scattered and often contain a mix of conifer species.

Historic logging and many stand-destroying fires have reduced the extent of Eastside Pine Forest by converting many stands to Eastside Scrub or Montane Chaparral. Much development on the east side of the Sierra in

Nevada County has occurred within this forest type. Most Eastside Pine Forests in Nevada County are highly roaded (**Figure 3-46**), and many road systems on Forest Service land are designated for OHV use. The three largest reservoirs, in close proximity to each other (Stampede Reservoir, just outside the Nevada County line, and Prosser Creek and Boca reservoirs), inundated large areas of land in a highly-concentrated area of Eastside Pine forest and eliminated a minimum of 12 miles of the two largest perennial streams in this habitat.

Developed Ecosystems

Urban and Residential Areas

Structural and Ecological Characteristics

Areas mapped as Urban include commercial, high-density residential development, and the patchy mosaic of ornamental plantings, vacant lots, and remnant native habitats that occur between structures. The urban centers of Grass Valley, Nevada City, and Truckee are included, as well as outlying residential communities such as Lake of the Pines, Lake Wildwood, Penn Valley, Alta Sierra, the North Bloomfield Road area, and the Hirschdale and Glenshire areas outside of Truckee (**Figure 3-30**). The extent of landscape maintenance and the replacement of native plant species by ornamental plants usually control the habitat characteristics of urban vegetation (Mayer and Laudenslayer 1988). Urban habitat is not limited to any particular physical setting, but in Nevada County it often occurs in valleys, gentle to moderately-sloping areas, and level ridges.

Ornamental plantings in the older neighborhoods of Grass Valley and Nevada City are often mature, introduced evergreen and winter-deciduous trees that may be as much as 100 years old. These ornamental species range in height from approximately 20 to 50 feet at maturity, and they are typically much smaller and younger than the occasional remnant oaks, pines, or incense cedars in these neighborhoods. Small lawns and mature hedges are also characteristic and include many introduced fruiting species that may be attractive to birds and other wildlife.

Urban neighborhoods that were built in the last 40 or 50 years tend to have much younger or smaller trees and less structural diversity than older neighborhoods. In outlying suburban areas, mature native oaks and pines are also present between the structures. The North Bloomfield and Donner Lake residential areas, for example, have a tall, intermittent to dense canopy of older native pines that dominate the tree layer. Some areas around Lake Wildwood still contain many large, mature native oaks.

Parks in western Nevada County range from the 70-acre Condon Park of mid-seral Ponderosa Pine Forest with a diverse and multi-layered understory to small lots with lawn grass and a few mature trees. Watt Park in Penn Valley contains many good examples of large-diameter heritage oaks, including valley oaks. Undeveloped lots in suburban areas may have remnant patches of mature Foothill or Montane Hardwood Woodland, Ponderosa Pine Forest, or Eastside Pine Forest, unless they have been cleared previously. Urban vegetation is relatively short-lived compared to remnant pines and oaks, which may live for centuries. However, some native species, particularly oaks, may die prematurely as a result of regular surface irrigation, grading near the base of trees, and roots damaged by trenching and excavation (Mayer and Laudenslayer 1988).

Plant Diversity

Plant species composition often varies with the age of a community as the preferences of homeowners and designers change. In the older parts of Grass Valley and Nevada City, common tree species include sugar maple, red maple, Deodar cedar, linden tree, Washington hawthorne, and English holly. In newer developments, these have been replaced by liquidambar, European birch, weeping willow, coast redwood, purple-leaf plum, or eastern dogwood. Locally native oak and conifer species are rarely planted, and most of these species are not available for sale in local nurseries.

Ornamental plants are introduced much less frequently in higher elevation residential communities such as Truckee, Donner Lake, or Tahoe-Donner. However, invasive non-native species are quite common in urban-residential areas, particularly in vacant lots, on road edges, and along streams. In other areas, large lots may have most of the native vegetation removed, and replaced with mowed Annual Grassland, lawns, and widely-scattered trees, often to reduce the risk of fire.

Large ungrazed lots in Urban areas often become infested with weedy, non-native species. Many of these exotic plants are horticultural escapees that were introduced during the Gold Rush era as well as horticultural species that are still commercially available. Characteristic horticultural and pasture species that are known to invade wildlands locally include Scotch broom, French broom, tree-of-heaven, black locust, English ivy, Italian poplar, periwinkle, pampas grass, scarlet wisteria, perennial sweet pea, ox-eye daisy, pennyroyal, winter vetch, orchard grass, annual ryegrass, rose clover, red-stemmed filaree, wild oats, tall fescue, and several aquarium species, such as parrot’s feather. Many other unintentional introductions are also common in Urban and residential areas of the county including fennel, black

mustard, yellow star-thistle, Italian thistle, hedgehog dogtail, hedge parsley, dove-foot geranium, ripgut brome, red brome, cheat grass, knapweeds, velvet grass, dallis grass, Klamathweed, field bindweed, bull thistle, medusa-head, woolly mullein, and many more.

Animal Diversity

Many Urban areas of Nevada County still maintain moderately high wildlife diversities, especially in older neighborhoods that provide an abundance of mature trees and native landscaping. Approximately 75 native vertebrates may use Urban areas in Nevada County including 19 mammals, 53 birds, three amphibians, and one reptile. About 40 of these species breed in Urban areas of the county (Appendix VI).

Riparian or stream habitats occurring within Urban landscapes usually accommodate the greatest number of species (Ehrlich et al. 1988). Strips of habitat (greenbelts) along streams can make urban areas much more hospitable to birds and other wildlife as well as to people. Some of the native species that might be found in Urban greenbelt areas of Nevada County include mule deer, Douglas and western gray squirrels, western bluebird, Bullock's oriole, house finch, black-headed grosbeak, cedar waxwing, Anna's hummingbird, and American robin. Native species that may occur at unnaturally high densities and that may pose a nuisance or be dangerous to humans in urban and residential areas of the county include black bear, mountain lion, coyote, raccoon, Botta's pocket gopher, American beaver, striped skunk, cliff swallow, American crow, common raven, Steller's and western scrub jays, brown-headed cowbird, and Brewer's blackbird. Non-native animals that frequent these areas include house sparrow, European starling, wild turkey, bullfrog, Virginia opossum, black rat, Norway rat, and house mouse (Appendix VI).

No Redlist animals are known to occur in Urban areas of Nevada County (Figure 3-5). However, six Yellowlist species use these habitats including four bat species that use manmade structures for breeding or roosting. Two Yellowlist birds, the white-tailed kite and purple martin, are also known to use Urban and residential areas (Appendix VI). The relatively low number of Redlist and Yellowlist animals in Urban areas may be related to human disturbance and the high numbers of native and introduced predators that thrive (often with increased population densities) there (Ehrlich et al. 1988).

Distribution and Status

In California, Urban areas occur throughout the state and are not limited to any particular setting. In Nevada County the greatest extent of Urban and

residential development occurs between about 1,400 and 3,400 feet elevation in the western foothills of the western county. However, these areas are mapped as low as about 530 feet in the western county, and as high as about 7,685 feet near Truckee (Figure 3-30). Approximately 33,000 acres of Urban areas were mapped in Nevada County, representing about 5% of the county's total land area. About 89% of this acreage is on private land; Urban areas in public ownership include ski areas and leased cabins (Table 3-1).

In the foothill regions, newer residential developments in outlying areas most often replace Foothill Hardwoods or Annual Grasslands, and some areas may have been previously modified for agricultural uses. Truckee has experienced considerable expansion recently, with many new developments planned in the Martis Valley and other outlying areas. In the Truckee area, Eastside Pine and Eastside Scrub communities, Montane Meadows, and Subalpine Forests are the habitats most typically converted to urban and residential types.

On both sides of the Sierra crest Urban areas often have disproportionate effects on stream environments. Some development projects in the county have been permitted to encroach into floodplain environments within 10 or 20 feet of active steam channels. Placement of bridges, roads, paved areas, and structures within the lower floodplains of perennial streams often results in the removal of native vegetation and unnaturally narrowed channels that make them more prone to flooding and erosion. Often the native riparian species in Urban areas are replaced by noxious weeds and other invasive non-native species such as Himalayan blackberry, and these species can form single-species monocultures over miles of affected stream corridor. In outlying communities, suburban developments often have more mature vegetation and greater wildlife species diversity (Mayer and Laudenslayer 1988).

Orchards

Structural and Ecological Characteristics

Orchards in Nevada County are often found within Annual Grasslands, Montane or Foothill Hardwood Woodlands, or Ponderosa Pine Forest. They are also frequently adjacent to streams or irrigation canals. Deep, well-drained soils of volcanic origin and gentle to moderately sloping hills in the middle elevations are characteristic of orchards in Nevada County. Loamy soils mapped as "Aiken" and "Cohasset" series are the most common or preferred substrate for orchards, and they range in elevation from about

1,400 feet to about 3,000 feet in Nevada County. "Sites" series, a soil of metamorphic origin that occurs between 2,000 and 4,000 feet elevation and supports Mixed-Conifer Forest, Montane Hardwoods, and Montane Chaparral is also recommended for orchard production (Brittan 1993).

Orchards are generally a single species, tree-dominated habitat, although pruning to facilitate harvest results in trees that range in height from 15 to 30 feet (Mayer and Laudenslayer 1988). The crowns do not overlap, and trees are planted in straight rows and at uniform spacings. The understory may be sprayed to control herb growth or allowed to grow along tree rows. Most are sprinkler irrigated and intensively managed. Trees are replaced when they become old or diseased; most are replaced by the time they reach 35 to 40 years in age. There are a few, very small, abandoned orchards in Nevada County and other Gold Rush towns in the Sierra Nevada foothills.

Plant Diversity

Apples, pears, and peaches are the most commonly planted Orchard crops in Nevada County orchards (Brittan 1993). Aside from the fruit trees, the understory is either bare soil or a periodically mowed herb layer of non-native species, such as soft chess, annual ryegrass, wild oats, orchard grass, winter vetch, black mustard, filaree, dove-foot geranium, little hop clover, bur clover, or rose clover. In moist areas near irrigation ditches and farm ponds, agricultural weeds such as Johnson grass, dallis grass, and Bermuda grass are often present.

No Redlist or Yellowlist plants are known to occur in Orchards (Figures 3-1 and 3-2), because they do not provice suitable habitat for any species (Appendix III).

Animal Diversity

The wildlife habitat values of Orchards are lower than other agricultural crops or rangelands, but they are somewhat higher than Vineyards. About 42 native vertebrates use Orchards in Nevada County for feeding and resting including four mammals, 37 birds, one reptile, and one amphibian. Only eight of these species breed in actively managed orchards (Appendix VI).

A few mammals such as broad-footed moles, Botta's pocket gophers, desert cottontails, and California ground squirrels may have burrows along the margins of orchards. Orchards often experiene damage from both mule deer and black bear. Typical birds that forage in the county's orchards include red-tailed hawk, American kestrel, mourning dove, American crow, yellow-

billed magpie, Brewer's blackbird, house finch, and the introduced European starling. Reptiles and amphibians are represented only by the gopher snake and Pacific treefrog, respectively.

No Redlist or Yellowlist animals are known to breed in orchards of the county (Figures 3-5 and 3-6), but the Yellowlist white-tailed kite may forage and roost there (Appendix VI). Nonnative animals that may be destructive to Orchards in the county include European starling, Virginia opossum, and wild pig.

Distribution and Status

In California, Orchards are found in nearly every county except Alpine County, with only a few farms represented in Lassen, Modoc, Mono, Plumas, San Francisco, and Trinity counties (USDA 1997). Orchards have a small distribution of about 120 acres in Nevada County, and it is all in private ownership. Several large orchards exist in the Chicago Park area and smaller orchards elsewhere in the county range from about 1,600 to over 3,000 feet elevation (Table 3-1, **Figure 3-31**).

Orchard soils in the mid-elevations of Nevada County formerly supported ponderosa pine and black oak stands with an understory of brush, forbs, and sparse grasses (Brittan 1993). The habitat values of the conifer-hardwood habitats prior to conversion to Orchards vary depending on their proximity to urban or residential areas, degree of human disturbance, and integrity of the understory (Mayer and Laudenslayer 1988).

Vineyards

Structural and Ecological Characteristics

Rolling hills of deeper, well-drained soils in the middle elevations are the most likely setting for Vineyards in Nevada County. Locally, they occur on well-drained metamorphic soils mapped as "Sites loam" and granitic soils mapped as "Sierra sandy loam", although other soils are also represented (Brittan 1993).

Vineyards have a relatively small distribution in Nevada County compared to many other counties in California. However, in many counties there has been a dramatic increase in conversion of Annual Grassland or Foothill Hardwoods to Vineyards. The largest Vineyards in Nevada County occur between approximately 1,170 feet and 2,520 feet elevation (Table 3-1). Aerial photos from the late 1960's suggest that many Vineyards in California previously

supported either Annual Grasslands of non-native annual grasses or native Foothill Hardwoods (Brittan 1993).

Structurally, Vineyards are composed of single species planted in rows and supported on wood and wire trellises. Vineyards are managed intensively and the soil under the vines is generally sprayed and barren to prevent the growth of grasses and other herbs that may transmit pests and diseases to the grapevines. Herbs may be allowed to grow between the rows as a cover crop to control erosion and usually consist of introduced legumes and annual winter grasses. Irrigation is often accomplished through drip irrigation. The overall cover is somewhat sparse, composed of young to mature, long-lived woody vines that may persist for over 40 years but are generally replaced earlier due to either fluctuations in product prices or decreases in productivity (Mayer and Laudenslayer 1988).

Plant Diversity

Aside from the grape cultivars the sparse herb layer, if present, typically consists of introduced species annual weeds, unless they are specifically seeded with a cover crop. Typical Annual Grassland species, which also occur in the understory of Foothill Hardwood Woodlands, include soft chess, black mustard, annual ryegrass, wild oat, orchard grass, red-stemmed filaree, dove-foot geranium, little hop clover, and rose clover. Agricultural weeds, found particularly in moist areas, include Bermuda grass, Johnson grass, and dallis grass.

No Redlist or Yellowlist plants are known to occur in Vineyards of Nevada County because no suitable habitat is present (Figures 3-1 and 3-2).

Animal Diversity

Vineyards support the lowest number of vertebrates and breeding species of any large-patch ecosystem in Nevada County (Figures 3-3 and 3-4). Only 19 native vertebrates use Vineyards in the county including two mammals, 15 birds, one reptile (western fence lizard), and one amphibian (Pacific treefrog). Only one native animal, the California ground squirrel, regularly breeds in Vineyards in the county (Appendix VI). Typical native birds that forage in the county's Vineyards include mourning dove, western scrub-jay, American crow, western bluebird, white-crowned sparrow, golden-crowned sparrow, dark-eyed junco, and house finch. Flocks of introduced European starlings may visit Vineyards, especially in fall when they may cause damage to ripening grapes (Zeiner et al. 1990). Due to the potential economic losses from wildlife foraging, most Vineyards are well-fenced to preclude their use by larger mammals.

No Redlist or Yellowlist plants are known to occur in Vineyards of Nevada County because no suitable habitat is present (Figures 3-1 and 3-2).

Distribution and Status

In California, Vineyards are found in every county except Alpine, Lassen, Modoc, Mono, Plumas, San Francisco, and Trinity counties (Mayer and Laudenslayer 1988). In Nevada County their distribution is still small, as Vineyards occupy only about 550 acres (Table 3-1). However, there is a sharp increase regionally and statewide in the number of new Vineyards in production (USDA 1997).

Vineyards usually support fewer wildlife species than other agricultural crops or rangelands in Nevada County (Appendix VI). The overall effects of converting native habitats to Vineyards vary depending on whether they were Annual Grassland or Foothill Hardwood Woodlands (Mayer and Laudenslayer 1988).

Croplands

Structural and Ecological Characteristics

Croplands generally occur on deep, fertile soils in alluvial valley bottoms or gently rolling terrain in the low to mid-elevations of Nevada County. Alluvial soils can be derived from a variety of parent rock types, but many granite-derived soils as well as a few soil series from metamorphic parent rock are recommended for herb-dominated crops (Brittan 1993).

The majority of the agricultural lands in Nevada County are irrigated and dryland pasture that are on the most fertile soils, often near or on the floodplain of a stream, and these were mapped as Annual Grasslands in this study (Figure 3-10). Small acreages of hay and vegetable crops also are grown in the county (USDA 1997). The vicinity of Pilot Peak near Penn Valley contains a high proportion of higher quality farm soils than many other areas in Nevada County. Areas mapped as croplands in the county occur between about 1,175 feet and 2,980 feet elevation (Table 3-1). The majority of the county's croplands occur on soils that once supported either Annual Grasslands or Foothill Hardwood Woodlands (Brittan 1993).

Croplands are herb-dominated habitats, varying from 1 to 6 feet high, often consisting of a single species that may be annual or perennial. Those mapped as part of this study such as hay, alfalfa, and row crops are primarily planted in straight rows. Most crops are planted in the spring and harvested in the summer or fall. They are generally grown as monocultures,

using tillage or herbicides to eliminate unwanted vegetation (Mayer and Laudenslayer 1988). However, some small, organic vegetable farms also exist in Nevada County (Figure 3-31).

Croplands in Nevada County are often adjacent to Annual Grassland, ephemeral or perennial streams, or irrigation canals. Foothill Riparian habitats are also found nearby, along with Foothill Hardwood Woodlands or Oak-Foothill Pine ecosystems.

Plant Diversity

The dominant species in fallow croplands include a variety of introduced grasses and legumes, but noxious weeds such as yellow star-thistle or Italian thistle may also be present. In moist areas near irrigation ditches and farm ponds agricultural weeds such as Johnson grass, dallis grass, and Bermuda grass are often present.

No Redlist or Yellowlist plants are known to occur in Vineyards of Nevada County because no suitable habitat is present (Figures 3-1 and 3-2).

Animal Diversity

Croplands support relatively few native wildlife species compared to all native, large-patch ecosystems in Nevada County (Figure 3-3). About 45 native vertebrates use Croplands in Nevada County for feeding and resting including eight mammals, 35 birds, 1 reptile, and 1 amphibian. Only about seven of these species breed in Croplands of the county (Appendix VI).

Crop types and schedules of field operations determine their animal diversity. A few mammals such as pocket gophers, black-tailed jackrabbits, desert cottontails, and California ground squirrels have burrows along the margins of agricultural fields. Typical birds that forage in the county's croplands include great blue heron, northern harrier, red-tailed hawk, American kestrel, California quail, mourning dove, western kingbird, American crow, western meadowlark, Brewer's blackbird, and red-winged blackbird. Reptiles and amphibians are represented by only the gopher snake and Pacific treefrog, respectively.

No Redlist or Yellowlist animals are known to nest in Croplands of the county (Figures 3-5 and 3-6), but several Yellowlist birds may forage there including white-tailed kite, northern harrier, golden eagle, merlin, prairie falcon, and loggerhead shrike (Appendix VI). Exotic animals that may be destructive of agricultural crops in the county include wild turkeys, European starlings, house sparrows, Virginia opossums, and wild pigs.

Croplands can experience significant damage from herbivores, primarily browsing mule deer, and many land owners fence their property to reduce this problem.

Distribution and Status

In California, harvested Croplands occur on about 8.5 million acres, and croplands are found in every county except for San Francisco (USDA 1997). Croplands have a very limited distribution in Nevada County, and there are only about 375 acres, all in private ownership. Croplands in the county range in elevation from about 1,175 feet to about 2,980 feet (Table 3-1, Figure 3-31).

The effects of converting native habitats to Croplands vary depending on whether they previously existed as Annual Grassland, Foothill or Montane Hardwood. Annual Grasslands are usually the least sensitive, since they support the lower numbers of native plants and animals than most other terrestrial, large-patch ecosystems in the county (Figures 3-3 and 3-4).

Small-Patch Ecosystems

Small-patch ecosystems are defined in this report as isolated or unique communities that are small (usually < 10 acres), and that have unusual qualities or species associated with them. In this study, small-patch ecosysems are generally mapped as point-locations within the county's large-patch ecosystems (Table 3-3). Some of these ecosystems may support Redlist or Yellowlist plants and animals, or they may be locally or regionally scarce and therefore vulnerable to disturbance and loss. For these reasons, most of the following small-patch ecosystems are recognized by state and/or federal resource agencies as sensitive habitats in California (CNDDB 2002a).

Seeps and Springs

This category includes permanent, intermittent and ephemeral Seeps and Springs. Seeps are water that passes through or emerges from the ground along a line or surface in contrast to a Spring where the water emerges from a localized spot. In Nevada County, Seeps and Springs are encountered most frequently on volcanic cliffs or on the north-facing cliffs of metamorphic rocks in the major river drainages; they also may be associated with wet Montane Meadows (**Figure 3-32**). Approximately 85 Springs, Seeps, and Fens (see "Fens and Bogs," below) were mapped in the county. These range in elevation from about 690 feet up to about 6,600 feet, and about 68% of them are privately owned (Table 3-3).

Seeps on rock outcrops typically occur on slopes over 70% with little soil. Plant species composition varies with aspect and elevation and to a lesser degree, substrate. Some common plant species encountered in these small-patch ecosystems include seep-spring monkeyflower, fragile fern, ciliate willow herb, water chickweed, California maidenhair fern, western bittercress, liverworts, and a wide variety of mosses. In Montane Meadow settings, common plant species associated with Springs include small-fruited bulrush, tinker's penny, and the mosses, *Philanotis* spp. and *Rhychosposa* spp.

Seeps and Springs enhance the wildlife value of the surrounding area by providing water and lush vegetative growth that attract deer and other browsers. They also can produce an abundant supply of insects for bats, violet-green and tree swallows, and other insectivorous birds.

Springs with constant temperatures and flows, fine substrates, and clear water can support unusual or endemic invertebrates, including some Yellowlist species (Moyle 1996). For example, the Cold Creek caddisfly is a Yellowlist species that was first discovered in a tributary of Sagehen Creek (Erman and Nagano 1992). Several permanent springs can unite to form meadow streams, a phenomenon particularly common in the Sagehen Creek basin.

Fens and Bogs

Fens are nutrient-rich (minerotrophic), spongy, spring-fed peatlands located on hillsides and dominated by non-sphagnum mosses and sedges. By contrast, true bogs are generally very acidic, marshy, rain-fed wetlands with no outflow that are characteristically dominated by sphagnum mosses and carnivorous plants (Sawyer and Keeler-Wolf 1995, Moyle 1996). In California, some locally wet areas are called bogs, even though they do not satisfy the standard definition (Sawyer 1986); true bogs have yet to be identified in Nevada County.

The California distribution of fens includes occurrences in the North Coast ranges, Klamath Range, and montane and subalpine regions of the Cascade and Sierra Nevada ranges (Sawyer and Keeler-Wolf 1995). Nevada County supports a large number of fens that are rich in rare and endemic plant and invertebrate species including carnivorous plants (**Figure 3-32**).

Characteristic plants species include primrose monkeyflower, capitate sedge, Oregon willowherb, bog bilberry, mountain alder, Labrador tea, and the moss, *Philanotis* spp.

Nevada County is reported to be the southernmost distributional limit of the California pitcher plant (CNPS 2001), a Yellowlist plant that occurs on fens and bogs primarily in northwestern California and southern Oregon, with a small number of occurrences in the northern Sierra Nevada on fens. Other Yellowlist plants that may be associated with fens in the county include: white-beaked rush, shore sedge, slender sedge, moonworts, the rare mosses *Meesia triquetra* and *Meesia uliginosa*, English sundew, and round-leaved sundew (USFS 2000, CNDDB 2002a, Calflora 2002).

Fens also provide important wildlife resources by supplying a permanent source of surface water in Montane Meadows.

Vernal Pools

A few small, scattered vernal pools are found on volcanic mudflows of andesitic origin in the valleys of eastern Nevada County and north to Sierra County in the Sierra Valley area (CNDDB 2002a). Vernal pools are shallow depressions that temporarily fill with water during winter and spring rains and dry up during the summer months. They are characterized by an impermeable substrate near the surface that restricts percolation and a barrier to overland flow that causes water to collect and pond. Vernal Pools were not mapped for this report due to the scale of the available aerial photography. Thus, there are currently no estimates of the number or acreage of these small-patch ecosystems in Nevada County.

Vernal Pools often contain a unique flora of annual plants and invertebrates that are especially adapted to the extremes of drought and inundation. Volcanic soils, particularly mudflows and ashflows, are the most common substrates for Vernal Pools in Nevada County. Regional Vernal Pool floras vary in consort with soil variation (Holland and Dains 1990).

Plumas ivesia is a Yellowlist plant associated with vernal pools and vernally-wet meadows in Nevada County. Characteristic plants here include the toothed downingia, least navarretia, Kellogg's knotweed, pull-up muhly, popcornflower, and yampah (CNDDB 2002a). Unidentified fairy shrimp also were observed in Vernal Pools of the county during the watershed surveys.

Late-Successional Forest

Late-successional and old-growth (LSOG) conifer forests are relatively rare in Nevada County (**Figure 3-33**). These stands occupy only about 4,050 acres and represent <1% of the county's land area (Table 3-3). Of this LSOG acreage, about 850 acres (0.1% of the county) consist of Ponderosa Pine and Mixed-Conifer Forests, with Red Fir and Subalpine Forests occupying about 3,200 acres and representing about 0.6% of the county's total land area. About 29% of the remaining LSOG lands in the county are in private ownership (Table 3-3).

These stands all meet the specific type and site productivity definitions for old-growth forests in the Sierra Nevada (Beardsley et al. 1999, Fites-Kaufmann and Franklin 1996). Generally, such stands are greater than 150 years old, with dense, usually multi-layered canopies. These LSOG forests are further characterized by more than five trees per acre greater than 30 inches in diameter at breast height, massive standing snags, and many downed logs on the forest floor.

Almost all known remaining Ponderosa Pine and Mixed-Conifer Forest LSOG stands occur in the South Yuba River Canyon and its tributaries, Spring and Devil's Canyon creeks. A stand also occurs on Grizzly Creek, about 4 miles upstream from its confluence with the Middle Yuba River. Red Fir and Subalpine LSOG stands are concentrated in the Sierra crest Region. Stands also occur in the Grouse Lakes Roadless Area, southwest of Lake Faucherie (Figure 3-33).

Late-successional and old-growth forests are important resources for a number of wildlife species that require large-diameter trees or snags or that prefer high canopy closure and multilayered, multi-aged forests. Yellowlist species, such as northern goshawk and California spotted owl, prefer large trees or snags for nesting, a closed canopy for protection and thermal cover, and open spaces allowing maneuverability below the canopy. Other species that may be associated with LSOG forest stands include American marten, Pacific fisher, and pileated woodpecker. These characteristics are often provided in LSOG stands, however, other late-successional forest types will also be used by these species (Zeiner et al. 1990).

McNab Cypress Stands

Many of California's cypress communities are quite rare or restricted (Sawyer and Keeler-Wolf 1995). Although McNab cypress is the most common of the California cypresses, it is restricted in the Sierra Nevada to a relatively small number of small stands, often separated by hundreds of

miles (Griffin and Critchfield 1976). The Nevada County occurrences of McNab Cypress Stands represent the southernmost extent of their distribution in the Sierra Nevada, with the exception of a stand in Amador County (Griffin and Critchfield 1976).

In Nevada County, McNab Cypress Stands are restricted to serpentine and gabbrodiorite soils (**Figure 3-34**), although they are also found on greenstone and basalts in other parts of the state. These stands occupy only about 174 acres in the county, and they range in elevation from about 2,010 feet up to about 3,110 feet. About 71% of the known stands of McNab cypress in the county are on private land (Table 3-3).

Locally, small, shrubby McNab cypress trees are generally less than 25 feet high, and they occur as pure stands of fewer than 10 trees to as many as several hundred trees (Griffin and Critchfield 1976). Foothill pine, interior live oak, blue oak, and scattered ponderosa pines may also occur nearby, and the stands are nearly always associated with a small component of serpentine or gabbro chaparral. The stands are often dense with a sparse herbaceous layer; common associates include Indian warrior and Brainerd's sedge.

McNab Cypress Stands typically occur in frequently-burned habitats throughout their range on ridges, slopes, and flats. However, they may also be found along the upper slopes of intermittent drainages. Examples of burned stands in Nevada County suggest that they respond favorably to fire with increased germination. However, an unusual disjunct population of a North Coast Range butterfly, Muir's hairstreak (*Mitoura muiri*), has been found in Nevada County on several stands of McNab cypress, and nearly always occurs on stands no less than approximately 50 years old (Shapiro 2000).

Whitebark Pine Stands

Whitebark pines are classic timberline trees, growing at elevations up to 12,000 feet in the central Sierra Nevada (Whitney 1985). Where regionally present, they are often the most commonly encountered species in areas of transition to the treeless Alpine zone, with an ability to grow in the most extreme conditions where other trees cease to exist. Near timberline, they are often found on exposed, windswept ridgetops, often subject to gale forces and intensely abraded by flying ice pellets and snow crystals. These trees are usually dwarfed and contorted, sometimes forming sprawling shrubs, and the windward sides of trees commonly show bare, polished wood where the bark has been stripped away (Whitney 1985, Lanner 1999).

Whitebark pine trees are slow growing and long lived, and often they reach 400 to 700 years old, with the oldest individuals possibly attaining 1,000 years (Arno and Hoff 1990). The large girth and ancient gnarled appearance of many of these trees is one indication that these may be among the oldest remaining trees in Nevada County. Only 32 acres of Whitebark Pine Stands exist in the county, and they are entirely on public land (Table 3-3).

There is little interest in whitebark pines for commercial timber, and their greatest values are for wildlife habitat, watershed protection, and aesthetics. They are an important component of the picturesque Subalpine settings that lure thousands of visitors to the high mountain regions of the Sierra. In the county, this small-patch ecosystem is restricted to an elevational range from about 8,650 feet up to about 9,009 feet on the slopes of Castle Peak (Table 3-3).

Whitebark pine has an interesting co-evolutionary, symbiotic relationship with the Clark's nutcracker (Lanner 1980). The nutcracker can carry as many as 150 seeds in its sublingual throat pouch and may cache over 32,000 seeds (in groups of one to five, approximately 2.5 inches below the soil surface) over a 42-day period. Whitebark pines are almost always multi-trunked as a result of several trees emanating and growing together from a single nutcracker seed cache (Weaver and Dale 1974).

Whitebark Pines Stands are found scattered in the Klamath Ranges and extend southward where they occur on the slopes of Mt. Shasta and Mt. Lassen. Their southernmost extension is in the central Sierra near Mt. Whitney (Griffin and Critchfield 1976). While Whitebark Pine Stands are not rare from a statewide perspective, they are regionally scarce and only occur in two Nevada County locations in the Castle and Basin Peaks areas (**Figure 3-35**). The Tahoe National Forest, as well as several other national forests, considers whitebark pine to be a watch list species under their sensitive plant program.

Knobcone Pine Stands

Knobcone Pine Stands are not rare from a statewide perspective, and they are fairly common in the Klamath and Cascade Ranges. However, their occurrence in the Sierra Nevada is restricted to widely scattered, small occurrences from Tehama County south to Yosemite National Park (Griffin and Critchfield 1976).

Only a few small stands of this fire-maintained species are found in Nevada County in the Yuba River canyon, Chalk Bluff, and Red Dog areas (**Figure 3-36**). These stands occupy only about 74 acres in the county, and they range

in elevation from about 2,457 feet up to about 3,600 feet. About 17% of the known Knobcone Pine Stands in the county are on private land (Table 3-3).

Knobcone Pine Stands are restricted to open, rocky, infertile metasedimentary soils (Brittan 1993). At least two small stands occur in hydraulic diggings. At least one diggings occurrence, near the Nevada County line in Placer County, also supports a population of the Yellowlist California horned lizard, with a reported occurrence in the Chalk Bluff diggings (Witham pers. comm).

Most of the local occurrences of Knobcone Pine Stands are dense and even-aged. Associate species locally include foothill pine, whiteleaf manzanita, yerba santa, bush monkeyflower, poison oak, purple sanicle, three week fescue, and frosty paintbrush. Knobcone pine is known for its persistent, closed-cone habit, but the percentage of trees in a stand with closed cones varies greatly among stands throughout its range (Sawyer and Keeler-Wolf 1995). Knobcone pine is one of California's most fire-adapted conifers, although it is known to germinate without fire in some areas (Lanner 1999).

Leather Oak Chaparral

Leather Oak Chaparral is listed as a community with a high inventory priority by the CDFG (Holland 1986, CNDDB 2002a). It is a serpentine endemic chaparral with its primary distribution in the north and central Coast Ranges with scattered occurrences in the Sierra Nevada. Throughout its range, leather oak chaparrals are known to support restricted species and are often associated with unique stands, such as McNab cypress or Sargent cypress (Sawyer and Keeler-Wolf 1995). Where leather oak chaparral does occur, it is found on shallow, rocky serpentine soils.

As with some other serpentine endemic plant communities, leather oak chaparral is associated with some unusual insect species, including the leather oak skipper (*Erynnis brizo lacustra*). This species was formerly believed absent from the Sierra until found on leather oak in scattered occurrences in Nevada, Placer and El Dorado counties (Shapiro 1996). New populations also have been found on serpentine soils in Tehama and Butte counties. This particular race of the leather oak skipper is only found in the northern part of its range, on Leather Oak Chaparral growing on ultramafic soils.

In Nevada County, Leather Oak Chaparral extends from about 2,175 feet up to about 2,700 feet elevation (Table 3-3). It occurs on a band of Serpentine Soils extending from Cypress Hill down into the Deer Creek Canyon, just south of the Sierra Nevada Memorial Hospital, and near Rollins Resevoir

(CNDDB 2002, **Figure 3-37**). This small-patch ecosystem occupies only about 197 acres in the county, and about 86% of this acreage is on private land (Table 3-3).

Serpentine Soils

Many of Nevada County's and California's rarest plants and natural communities occur on its most hostile soils, serpentinite. Serpentine soils are deficient in calcium, nitrogen and phosphorus but high in concentrations of heavy metals chromium and nickel. These nearly toxic conditions provide a challenge for successful adaptation of a species (Kruckeberg 1984). The result of this severe and challenging environment is a plant community characterized by a high degree of endemism and sparse vegetative cover. Serpentine Soils, with their high rate of endemism, function as ecological "islands," and even species not restricted to serpentine may evolve serpentine-tolerant races (Kruckeberg 1984).

Serpentine ecosystems occur in a variety of physiographic settings, from steep slopes to level flats. However, plant species composition may be driven as much by soil chemistry as elevation or aspect. The majority of the county's serpentine soils are found between 1,020 feet and 4,500 feet elevation in west-central Nevada County. A massive outcrop of serpentine is found on Washington Ridge at elevations up to 4,495 feet that supports unusually high elevation occurrences of Oak-Foothill Pine Woodland and examples of serpentine "barrens." Serpentine soils occur over about 4,553 acres in Nevada County, representing about 0.7% of the county's total land area. About 70% of this acreage is on private land (Table 3-3). These soils were mapped as a small-patch ecosystem overlapping with the variety of chaparral and woodland communities that grow on this soil type (**Figure 3-38**).

In Nevada County, plant communities associated with the typically shallow, rocky Serpentine Soils range from sparse, open Oak-Foothill Pine Woodlands with a shrub or herb-dominated understory to dense thickets of Foothill Chaparral with scattered emergent foothill pine. Plant diversity is often low, and there is a clear demarcation between serpentine and non-serpentine habitats. There is no evidence for successional status of serpentine vegetation, or that serpentine woodland-chaparrals are fire-dependent communities (Kruckeberg 1984).

Serpentine ecosystems include plants that may be restricted to those soils ("endemics"), plants that are strong indicators (plants largely confined to serpentine in parts of their range), and plants that are found both on and off serpentine soils ("indifferent" species). Most native and non-native plant

species in Nevada County are excluded from serpentine soils because of their harsh soil chemistry. Strong local indicators of serpentine soils include the shrub chaparral pea and leather oak. However, dominant and characteristic species also include many indifferent species that are both tolerant of serpentine soils and also flourish away from serpentine. Examples of indifferent species include foothill pine, buckbrush, toyon, hoary coffeeberry, and occasional stands of stunted, small diameter blue oak. An 8-inch diameter blue oak may be 100 years old or more on Serpentine Soils (McCreary pers comm).

The sparse cover and lack of competition from non-adapted, exotic species results in a rich display of native wildflowers on serpentine soils. Characteristic species in the foothill region include frosty paintbrush, cutleaf owl's clover, Sierra fawn lily, rosin weed, white hyacinth brodiaea, common brodiaea, Hartweg's sidalcea, bladder parsnip, naked buckwheat, Bear Valley buckwheat, deer grass, California melic, and squirreltail. The dwarf foothill pine mistletoe is common on the often small and stunted pines.

On serpentine soils at higher elevations, characteristic species include: mountain jewelflower, harvest brodiaea, Lobb's buckwheat, naked buckwheat, Fresno ceanothus, imbricate phacelia, small-flowered flax, and Sierra morning-glory. Wedgeleaf violet occurs here as the single disjunct Sierran occurrence of a species otherwise known only from northwest California. Few noxious weeds tolerate the harsh soil chemistry of serpentine soils. However, a few non-native species such as goat grass, medusa-head, and red brome can invade these habitats from road edges and other disturbed areas.

In California, approximately 300 rare plant taxa, representing over 14% of all rare plants in California, are associated with Serpentine Soils (CNPS 2001). However, compared to serpentine soils in other parts of the state, Nevada County serpentines have only a few Redlist or Yellowlist species, most of which are known from just a few scattered, small occurrences. Follett's monardella is a serpentine endemic in Plumas County, but the historic specimen from Nevada County has not yet been re-discovered since it was collected in the 1930's. Sanborn's onion may be found on both Serpentine and Gabbrodiorite soils in Nevada County, as well as on volcanic mudflow soils. Congdon's onion is known in Nevada County only from the Washington area serpentines. A species formerly listed as Ceanothus x arcuata was recently referred to as Fresno ceanothus, a Yellowlist species, and occurs on higher elevation serpentine soils in Nevada and Plumas counties. Bacigalupi's yampah is found on serpentine soils, but it is more common on gabbrodiorite soils (Appendices II and III).

While there is no evidence of mammal or avian species being closely associated with these habitats in Nevada County, serpentine ecosystems are home to one of the most unusual, and threatened, butterfly faunas in the Sierra Nevada (Shapiro 1996). Additionally, many of the California horned lizard observations locally have been in serpentine ecosystems (CNDDB 2002). Both butterflies and reptiles are heliotherms (warmed by the sun) and are attracted to the open, sunny, and rocky habitats. A phenotypically and phenologically-distinct population of the comma skipper (a butterfly) occurs on serpentine in Nevada County and flies in the fall, in contrast to its populations elsewhere. Lindsey's skipper, a bunchgrass feeder, occurs in serpentine or gabbrodiorite ecosystems. Occurrences of the autumn-flying Lindsey's skipper have also been found on ultramafic soils from Nevada to Amador counties, although the El Dorado occurrences may be extinct (Shapiro 1999).

Gabbrodiorite Soils

Gabbrodiorite-derived soils were mapped as small patch ecosystems within large-patch woodland and chaparral ecosystems that are found on Gabbrodiorite Soils (**Figure 3-39**).

Approximately 9,900 acres of gabbrodiorite soils exist in Nevada County, representing about 1.6% of the county's total land area. These soils range in elevation from about 1,190 feet up to about 3,670 feet elevation, and about 87% of them are on private lands (Table 3-3).

Gabbrodiorite Soils can vary considerably in plant endemism depending on the soil chemistry. Most contain no Redlist or Yellowlist species (Figures 3-1 and 3-2, Appendix III). However, Gabbrodiorite Soils are extremely diverse and they contain a very high proportion of native bunchgrasses and forbs with relatively few non-native species usually present.

Overall vegetative cover is denser than on Serpentine than on Gabbrodiorite Soils and often consists of impenetrable thickets of leathery-leaved, evergreen shrubs. Most gabbrodiorite chaparral species sprout vigorously following fire. The absence of natural fire in urban, residential, or rural areas of Nevada County has led to the decline of this fire-maintained community and the rare plant species associated with it.

Although they are also found on Serpentine Soils, widely scattered stands of McNab cypress are generally strong indicators of Gabbrodiorite Soils. California flannelbush is generally found only on gabbrodiorite soils locally, as well as Bolander's wyethia. Other locally dominant species on these soils include: Fremont's silk-tassel, whiteleaf manzanita, shrubby interior live

oaks, western redbud, Lemmon's ceanothus, redberry, shin oak, pitcher sage, buck brush, coffeeberry, creeping sage, deltoid balsamroot, one-spike oatgrass, squirreltail, and a wide variety of native bunchgrasses, bulbs and other wildflowers. In addition to Bolander's wyethia, the colorful spring and early summer display of wildflowers on gabbrodiorite soils includes blue-eyed grass, deltoid balsamroot, Lewis' lomatium, paper onion, white hyacinth brodiaea, chaparral clematis, gold wire, harvest brodiaea, Bridge's brodiaea, Indian warrior, common paintbrush, bush poppy, and many more.

Although Gabbrodiorite Soils cover a relatively small area in Nevada County, they contain a disproportionately large number of its rare and threatened species and natural communities (Environment and Planning Associates 1998). Redlist plants known from Nevada County's gabbrodiorite soils are extremely rare and restricted to just a few very small occurrences. Thus, the presence of these soils does not necessarily infer a high potential for Redlist species. Redlist plants associated with these soils in Nevada County, particularly the "Secca" soil series, include Stebbins' morning-glory, a species known globally from only two small areas in El Dorado and Nevada counties (CNDDB 2002a). Pine Hill flannelbush, the local occurrences of which are morphologically distinct from the only other occurrence of this species in El Dorado County. It may be a hybrid between the common flannelbush and Pine Hill flannelbush, and further study is required to confirm the genetic and taxonomic relations of the Pine Hill flannelbush in Nevada County. Yellowlist plant species found primarily on gabbrodiorite soils in Nevada County include Bacigalupi's yampah and Sanborn's onion (Appendix III).

Noxious weeds and other non-native species are generally absent or infrequent on undisturbed gabbrodiorite soils. However, the noxious weeds goat grass, yellow star-thistle, and medusa-head are often found invading disturbed areas such as roadsides, mining sites, and along OHV roads.

Volcanic Lava Caps and Mudflows

"Lava cap," is a generic term used to describe the ridges of thin volcanic soils, usually "tuff-breccia" andesitic ashflows or mudflows, found in Nevada County and elsewhere in the state. Rhyollitic rock and ash is also present, although more limited. The annual herb-dominated vegetation is underlain by thin, poorly-developed, and often impermeable soils that are seasonally saturated and have a rich flora of native wildflowers. Some of these wildlflowers include species typically associated with Vernal Pools, such as Orcutt's quillwort, dwarf woolly marbles, bractless hedge-hyssop, and pansy monkeyflower (True 1973). The general occurrence of these ecosystems in

Nevada County is mapped in **Figure 3-40**. Many of these sites are known for their spectacular spring displays of wildflowers, such as Hell's Half-Acre (in Grass Valley) and Sand Ridge.

Plant cover in these ecosystems is often sparse and averages approximately two to six inches in height. Dominant species vary between one site and the next, depending largely on elevation and soil depth, which is typically only 4 to 10 inches deep. Introduced species are generally less prevalent on lava caps due to the limitations of shallow, stony soils that are poorly drained.

Variation in plant associates is found even within a single site, and the unique flora found in these ecosystems includes some rare and endemic species and species not found elsewhere in Nevada County such as Klamath daisy (Calflora 2002). Nevada City buckwheat is known from a small number of occurrences on lava caps in Nevada, Amador, and Tuolumne counties (CalFlora 2002). Where soils are sufficiently deep to support woody species, typical associates often include small and stunted foothill pine, buck brush, whiteleaf manzanita, Indian manzanita, and canyon live oak. The Yellowlist Klamath daisy has also been recorded on lava caps near Hell's Half-Acre.

Common wildflowers in Volcanic Lava Cap and Mudflow ecosystems include: white meadowfoam, Ramm's madia, johnny-tucks, Hartweg's sidalcea, paper onion, white hyacinth brodiaea, common brodiaea, candelabra monkeyflower, cowbag clover, pansy monkeyflower, vernal pool popcornflower, spinster's blue-eyed mary, sky lupine, purple milkweed, Douglas' sandwort, and a variety of crustose and foliose lichens.

Volcanic Lava Cap and Mudflow ecosystems cover about 73 acres, or less than 0.01% of the county. Elevations range from 2,369 to 2.640 feet. About 95% of the ecosystem occurs on private land (Table 3-3).

Caves and Mine Shafts

According to data from the U.S. Geological Survey, about 210 Caves and Mine Shafts exist in Nevada County. These range in elevation from about 600 feet up to about 7,400 feet, and about 80% are on private land (Table 3-3). Additional natural caves and crevasses are locally abundant on "Barren" ecosystems, but these were not mapped since they are not visible on aerial photographs. Mine shafts are concentrated in the Grass Valley/Nevada City area, north and east of the town of Washington, and near Fordyce Reservoir (**3-41**).

In natural settings, roosting bats will aggregate on open surfaces inside darkened chambers, such as caves or large tree hollows. Mine shafts provide

an analog to natural caves that are also by roosting bats. Nine Yellowlist bat species may occur in Nevada County, and seven of those species may use natural Caves or artificial Mine Shafts as diurnal or maternity roosting sites. These may include yuma myotis, long-eared myotis, fringed myotis, pallid bat, pale Townsend's big-eared bat, and western mastiff bat (Zeiner et al. 1990).

Other Data Themes

Elevation Range

Nevada County is characterized by a large range of elevations from its western border with Yuba County to the Nevada stateline to the east (**Figure 3-42**). The lowest regions occur in the southwestern part of the county near Camp Far West Reservoir (about 250 feet). In the central-east, a series of peaks along the Sierra crest approach 9,000 and the county's highest location is Mount Lola (9,142 feet), northwest of Truckee.

Slope

Nevada County is characterized by having many high peaks and several steep river gorges, along with many more gradual slopes (**Figure 3-43**). The county's western regions are generally gently sloping, with the exception of the South Yuba River canyon, which cuts from east to west through the northwestern parts of the county. The west-central part of the county north of Highway 20 is generally very steep and rugged. The high elevation center of the county supports the highest and steepest peaks. The east slope is an extremely steep escarpment, with more gradual slopes to the east of Truckee. However, the lower Truckee River canyon also has very steep slopes.

Public and Private Lands

Private lands cover about 402,500 acres and represent about 65% of Nevada County (Table 3-1). Primary concentrations of private lands exist in the western and eastern portions of the county, while the central portions of the county are mostly public land, or a checkerboard of private/public lands (**Figure 3-44**). Public lands are concentrated in the central and eastern parts of the county, and generally occur at higher elevations. The exception is DFG's Spenceville Wildlife Management Area (WMA) at low elevations in the southwestern part of the county. Public lands cover about 220,700 acres or about 35% of the county (Table IX-3). Public lands in Nevada County are owned and managed by USFS (Tahoe National Forest), BLM, DFG, the County of Nevada, and the cities of Grass Valley and Nevada City and the Town of Truckee.

Roads and Roadless Areas

Roads are very abundant and widespread throughout Nevada County, except in the South Yuba Canyon and the Grouse Lakes and Castle Peak/Basin Peak Regions (**Figure 3-45**). Roads visible from aerial photos extend over 4,268 miles in the county (Table IX-3). This total does not cover all logging and skid roads which are not consistently visible on aerial photographs or tracked by state and federal agencies.

Roadless Areas were defined as roadless regions greater than 250 acres where no place is less than 328 feet from a road (Henjum et al. 1994). In Nevada County Roadless Areas cover 273,101 acres or about 44% of the county's total land area (Table IX-3). They are concentrated in the extreme southwestern regions, along the South Yuba River canyon, and in the Grouse Lakes and Castle Peak Regions. Some roadless areas also occur in the extreme eastern parts of the county along Interstate 80 (**Figure 3-46**).

Contiguous Unimproved Private Lands Greater Than 80 Acres

Large, contiguous tracts of undeveloped private land greater than 80 acres cover about 242,140 acres, or about 39% of Nevada County (Table IX-3). These lands are either in large parcels or comprised of smaller, undeveloped parcels that are directly adjacent to other large, undeveloped parcels. The largest tracts of undeveloped private land occur in the southwest part of the county near the Spenceville WMA, in the Steephollow Creek region, along the northwest border of the county, north of Interstate 80 near the Sierra crest, and in the extreme eastern parts of the county north and south of I-80 (**Figure 3-47**).

Arable Lands

Arable Lands are those soils and slopes that are best suited to agriculture. The Nevada Irrigation District (NID) commissioned a study of the Arable Lands of Nevada County. Based on mapping from this study, Arable Lands cover about 35,150 acres, or about 5.6% of the county (Table IX-3). They are mostly concentrated in a north-south running belt east of the Spenceville WMA and west of Highway 49 (**Figure 3-48**).

Irrigated Lands

Irrigated Lands were mapped to include the subset of Arable Lands that receive irrigation water from NID (**Figure 3-49**). This total does not include lands that may receive irrigation water from sources other than NID, but these are not tracked accurately by any local, state or federal agency. NID-irrigated lands cover 6,115 acres or about 1% of the county (Appendix IX).

Canals

More than 300 miles of public Canals exist in Nevada County (Appendix IX). Most of these are operated by NID, but other private canal and aqueduct systems also exist in the county that were not mapped or included in the Canal distance calculations. Most of the county's Canals are concentrated in the regions south of Highway 20 and west of Highway 49 (**Figure 3-50**).