Natural Resources

Fort Hunter Liggett's 164,261 acres contain exceptional natural resources and biological communities of a relatively undisturbed and expansive nature. The cantonment area on Fort Hunter Liggett has been intensively developed, but the surrounding hills and the mountainous western part of the installation have changed little despite periods of Army training and weapons testing.

The abundance and diversity of plant and animal species within Fort Hunter Liggett relate to several factors: the underlying diversity of geologic substrate, soils, water features, and topography; the relative lack of development and disturbance of the area; and the connectivity with larger surrounding ecosystems, primarily within Los Padres National Forest.

Topography and Drainage

Fort Hunter Liggett is situated between two northwest-trending mountain ranges, the Santa Lucia Range on the southwest and the Gabilan Range on the northeast. The southwestern boundary of Fort Hunter Liggett follows the crest of the Santa Lucia Range, along which elevations range from approximately 2,500 feet to 3,740 feet at Atlas Peak, the highest point in the installation. Junipero Serra Peak and Cone Peak, located 3 to 4 miles outside the installation along its north and northwest margins, respectively, are the highest points in the vicinity of Fort Hunter Liggett; both peaks have elevations in excess of 5,750 feet. These ranges are part of the Coast Ranges, the largest geomorphic province in California. (See Figure 8a. Topography and Drainage in the "Figures" section).

The major water courses of Fort Hunter Liggett are the San Antonio and the Nacimiento Rivers. These distinctly linear drainages are subparallel, about 5 miles apart, and flow southeast. The drainage divide separating the watersheds of these rivers extends from Bald Mountain (2,132 ft elev.) at the southeast boundary of Fort Hunter Liggett to the northwest corner of the installation. The San Antonio River has its headwaters in the vicinity of Cone and Junipero Serra Peaks and runs some 25 miles through the installation from its northwest to southeast corners. The Nacimiento River, located about 5 miles southwest of the San Antonio River, has its headwaters in the Santa Lucia Range south of Cone Peak, flows along or just outside of the installation's western boundary for about 5 miles, and continues southeast through the installation for about 15 miles. Both rivers are dammed about 15 to 20 miles southeast of the Fort Hunter Liggett boundary. The uppermost 2.5 miles of the 17-mile long San Antonio Reservoir is included within the southeast corner of the installation. This area has the lowest elevation in Fort Hunter Liggett, about 800 feet. The upper reaches of the Nacimiento Reservoir are located several miles outside and south of the installation. Below the reservoirs, both rivers drain into the Salinas River which flows northwest, in the opposite direction of the main rivers in Fort Hunter Liggett, and eventually empties into Monterey Bay.

Flow regimes of surface water on Fort Hunter Liggett are seasonal. The San Antonio and Nacimiento Rivers have perennial flow. There are a number of intermittent streams that feed these rivers. Spring -fed water flows through the upper portion of the San Antonio River throughout the year while lower reaches have intermittent flow. Much of the Nacimiento River surface remains dry during the summer. However, year round water can be found in various pools along portions of the river. In addition to the two rivers, there are numerous creeks, the Lake San Antonio shoreline, and 14 impoundments that provide aquatic and riparian habitats. The 14 impoundments are located throughout the installation in both watersheds. The impoundments were constructed to provide water sources for cattle, wildlife, fire fighting needs and flood control (US Army Reserve Training Center, Fort Hunter Liggett, 2003).

The western part of the installation, corresponding to the east slope of the Santa Lucia Range, is dominated by steep hillsides covered with chaparral, scrub, and live oak forest. The

area from vicinity of the Nacimiento River to the east, comprising about three-fourths of Fort Hunter Liggett, is mostly low hills intersected by flat to rolling river valleys of grassland, oak savanna, and oak woodland.

Climate

The climate is Mediterranean and generally semiarid. Hot periods (frequently 90–100° F and higher) of low humidity (20%) typically begin in mid-May and occur with increasing frequency into mid-October. Lows of 32° F and less usually occur by mid-November, although freezes can occur earlier. Most rain falls December through March. The beginning of winter season is marked by the arrival of the first cool storm system originating in the northern Pacific, typically in November or December. Rain concludes in April or May and is followed by a dry period lasting 6 to 7 months. Fort Hunter Liggett lies in the rain shadow of the Santa Lucia Range. Precipitation can be several times greater on the seaward slope and crest than in the eastern valleys. While the western slope of the Santa Lucia Range receives about 59 inches average annual precipitation (at Alder Creek), the cantonment area averages only about 19 inches annually.

Geology

This section describes the geologic setting and soils of Fort Hunter Liggett and adjacent contiguous land, the underlying geologic formations, and regional faults. Geological resources are described according to the geologic time scale (see illustration). Fort Hunter Liggett is part of the northwest-trending Coast Ranges geological province that stretches from Humboldt County in northern California 400 miles south to Santa Barbara County, where they meet the Transverse Ranges.

Fort Hunter Liggett is underlain by three distinctly different groups of pre-Quaternary rocks reflecting different origins and geologic history: The Salinan block, also known as the Salinian terrane or Sur series; the Franciscan complex, and late Cretaceous through late Tertiary sedimentary strata deposited in marine and non-marine basins along the Pacific margin of North America (See Figure 8b. Geology in the "Figures" section).

The Salinian block underlies the northern part of Fort Hunter Liggett and includes Mesozoic crystalline intrusive rocks (granitoid plutons) and metamorphic rocks whose protoliths (original rocks prior to metamorphism) range in age from Precambrian to Mesozoic.

The Franciscan complex (the "Franciscan") underlies the southwestern part of Fort Hunter Liggett in the Santa Lucia Range. The Franciscan rocks are dominated by graywacke (a type of sandstone) and span a range of ages from Jurassic through Cretaceous. Chert and greenstone (altered basaltic lava) commonly are found in association with graywacke. The Franciscan rocks formed during the Mesozoic era along a subduction zone, an area where oceanic crust was being subducted, or thrust beneath, continental crust along the edge of the North American continent.

The Franciscan rocks have been tectonically dismembered by faulting associated with subduction. Sediments deposited in basins along the subduction zone have been severely disrupted by faulting, with such displacement occurring concurrent with deposition. The faulting also interleaved fragments of oceanic crust with these sediments. As a result, these rocks are pervasively faulted, and also multiply folded, such that there exists minimal or no lateral continuity or vertical sequence.

Ultramafic rocks are widely distributed throughout the Franciscan complex. Strategic minerals such as nickel and chromium are associated with these rocks. The largest mass of ultramafic rocks on Fort Hunter Liggett is located at Burro Mountain in Training Area 23. This formation is uniquely exposed by Los Burros Creek which forms a deep gorge through its center. Narrow masses of ultramafic rocks, elongate to the northwest, also are found in the southern end of Fort Hunter Liggett. The ultramafic rocks, shown in Figure 8b: Geology

contain silicate minerals rich in magnesium (magnesian olivine and orthopyroxene), and are known by the general term peridotite (or olivine-rich rock — named after peridote, the gem form of olivine).

To varying degrees, the ultramafic masses have been replaced by serpentine, resulting in serpentinized peridotite, or "ultramafic serpentine" in the jargon of biologists. These rocks differ from rocks composed of nearly pure serpentine in that the texture and parts of the original minerals in serpentinized peridotite (with orthopyroxene preferentially retained over olivine) are often preserved. Small masses of serpentine are locally found along shear zones.

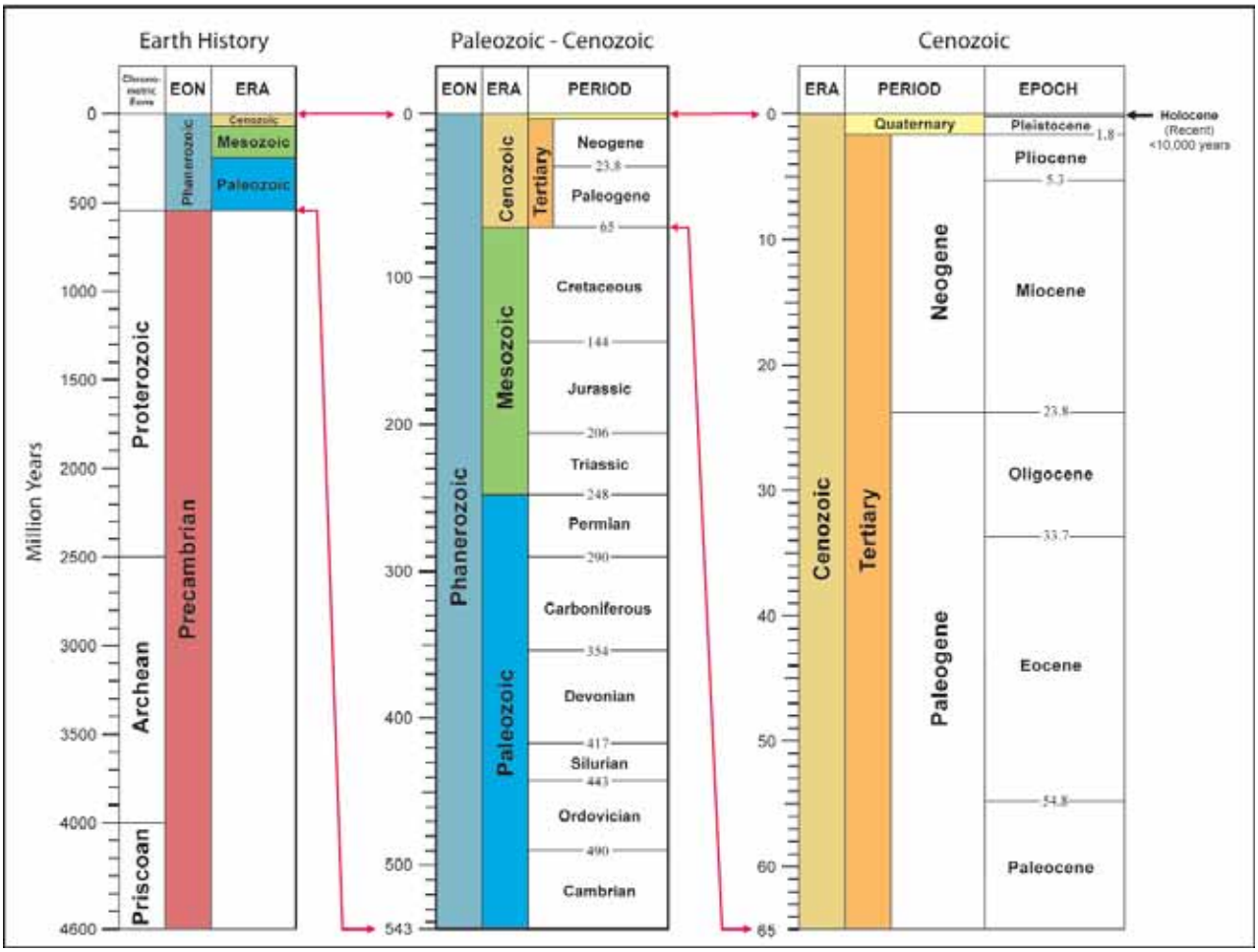
Serpentinitic rocks, including those rocks that retain their original texture and even original mineralogy (serpentinized peridotite) as well as small areas of serpentine lacking any vestige of the original parent rock, play an important role in the endemism of the California floristic province. More than 20 percent of California's endemic plant species are associated with serpentinitic soils. Such plants have adapted to the combination of high toxicity (high chrome and nickel contents), as well as the low mineral nutrients (extremely low K2O), of serpentinitic soils. Within Fort Hunter Liggett, plant communities mapped as associated with serpentinitic soils show a broader distribution than do outcrops of serpentinized peridotite. The toxicity and nutrient deficiency of serpentinitic rocks are translated down slope as colluvium or as alluvium within drainages. The upper Burro Creek watershed harbors an exceptionally high diversity of rare and endangered plants.

Late Cretaceous and younger sedimentary strata underlie the eastern two-thirds of the installation. Upper Cretaceous and Paleocene deposits of sandstone, shale, and conglomerate, and the Miocene Monterey Formation form subparallel northwest-trending belts. These groups of rocks are likely tilted to the northeast or southwest in order to form this linear map pattern, and possibly they are truncated by major faults. The Upper Cretaceous and Paleocene deposits underlie much of the watershed of the Nacimiento River. An unnamed formation of the Paleocene era consists of massive and medium-to-coarse grained sandstone, conglomerate, mudstone and siltstone of marine origin up to 3,500 feet thick. Fossils in sandstone beds, *Turritella pacheoensis*, date this formation to the Paleocene age (Durham 1965).

Miocene deposits of the Vaqueros Formation and the Monterey Shale form the divide between the watersheds of the Nacimiento and San Antonio Rivers. The Vaqueros Formation of the early Miocene age consists primarily of marine sandstone, siltstone and mudstone about 850 feet thick. Overlaying the Vaqueros formation is Monterey Shale which consists of marine porcelaneous rocks, mudstone, chert dolomitic carbonate beds, concretions, shale, siltstone and sandstone. This formation is dominated by porcelanite and porcelaneous mudstone which comprises three-fourths of the Monterey Shale. The dominant calcerous beds in the lower part of the Monterey Shale constitute the Sandholdt Member which is comprised mostly of calcareous mudstone and shale deposits up to 480 feet thick. The Monterey Shale ranges in thickness up to 6,600 feet (Durham 1965).

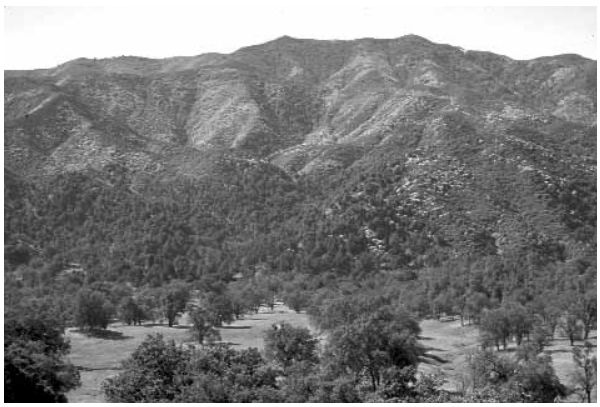
Pliocene and Pleistocene marine sediment underlies much of the eastern third of Fort Hunter Liggett, except where covered by alluvial deposits associated with the San Antonio River. An unnamed formation of the Pliocene era overlies the Monterey Shale consisting mostly of very fine-grained sandstone and diatomaceous mudstone. Mollusk shells are abundant throughout this formation indicating Pliocene age and marine origin. The Paso Robles Formation that overlies the Monterey Shale and the unnamed Pliocene formation are exposed south of the San Antonio River. The thickness of the Paso Robles Formation in the San Antonio River Valley varies from a few feet to more than 150 feet. This formation is comprised mostly of non-marine, conglomerate, pebble conglomerate, conglomerate sandstone, and sandstone. (Durham 1965).

Geologic Time Scale



Geologic Time Scale. Younger time intervals are successively expanded to the right; arrows point to correlative ages in adjacent columns. Scale and boundary ages are in million years (boundary "pick ages" are from compilation by A. R. Palmer and John Geissman, Geological Society of America, 1999; layout adapted from A. MacRae, Univ. Calgary, 1996).

San Antonio River delta, NPS photo



Santa Lucia Range, NPS photo

The southern reaches of the San Antonio River on Fort Hunter Liggett are underlain by alluvium. The irregular map pattern of the Pliocene and younger units suggest that these units are sub-horizontal and have not undergone significant structural deformation except locally in close proximity to major faults. Pleistocene and Holocene formations that underlie the San Antonio River are characterized by unconsolidated alluvial deposits to 40 feet thick, consisting of sand gravel with variable amounts of sand and clay (Durham 1965).

Fort Hunter Liggett is situated west of the San Andreas Fault and has been translated northwestward since motion on the San Andreas Fault began, probably between 10 and 6 million years ago. The 320 km of displacement of the volcanic rocks of the Pinnacles National Monument (dated at approximately 21 million years ago and located about 30 miles north of Fort Hunter Liggett) from correlative rocks in the western Mojave known as the Neenach volcanics applies to all pre-middle Miocene rocks in the installation, and possibly to all rocks of Miocene age and older. Thus, except for the Pliocene and younger rocks along the eastern side of the installation, Fort Hunter Liggett was located in the western Mojave Desert not earlier than 10 million years ago and possibly as recently as 6 million years ago. The granitic and metamorphic terrane of the Salinian block / Sur series likely has been translated even further. It perhaps represents a segment of the southern Sierra Nevada that was translated westward prior to formation of the San Andreas Fault not earlier than 10 millions years ago.

Faults. The Jolon, Nacimiento, and several other small faults underlie Fort Hunter Liggett. Epicenters of historic earthquakes are located close to the main traces of both the Rinconada and Nacimiento Faults (see Figure 8b). These faults trend subparallel to the San Andreas Fault.

The Rinconada and Nacimiento faults control the fundamental geomorphology and hydrology of the installation, namely, the linear northwest-trending valleys of the San Antonio and Nacimiento Rivers. The Nacimiento Fault separates marine sediments in the eastern third of Fort Hunter Liggett from Franciscan greenstone in the western portion of the installation. The Rinconada Fault, which traverses the southern end of the San Antonio Reservoir, has experienced Quaternary movement (i.e. within the last 11,000 years). Small faults on Fort Hunter Liggett generally trend northwest paralleling the San Andreas Fault.

In 1991, a seismic study by the U.S. Army Corps of Engineers predicted the Rinconada Fault could generate an earthquake with a potential 7.5 magnitude on the Richter scale, with rock (ground) accelerations ranging from 0.5 to 1.0 gravity (g) near the eastern boundary of Fort Hunter Liggett to 0.3 g along the western boundary. Given its proximity to the San Andreas and Rinconada faults and the overall geologic activity in the region, Fort Hunter Liggett is in Seismic Risk Zone II, defined by the California Division of Mines and Geology as an earthquake zone of moderate risk to people and structures (US Army Corps of Engineers 2000b).

Mineral Resources. Mining played an important role in the settlement of areas around the Santa Lucia Range and Fort Hunter Liggett. Much of the area is underlain by rocks of the Franciscan Formation that contain dark sandstone that is the chief host rock of gold-bearing deposits. In addition to gold, silver and copper deposits were also found in this region (Clark 1998).

Documented history of gold in the Santa Lucia Range dates back to the 1850s when small amounts of placer gold were recovered from streams in the Jolon area. Chinese miners played a key role in placer mining during this time. These industrious miners were known to have sold several thousand dollars worth of gold to the local store in Jolon. Placer prospecting in the Jolon area ended around 1914. This form of mining only occurred in small alluvial deposits and had less economic importance in the region (Reinstedt 1977; Eidsness and Jackson 1994a).

Mining continued in the western portion of Fort Hunter Liggett following the establishment of the Los Burros Mining district in 1875. The Los Burros Mining District was located in the southwest corner of Monterey County stretching from the Pacific Coast east to the Nacimiento River. A portion of the mining district is located on Fort Hunter Liggett. In 1887, lode gold was discovered by W.D. Cruikshank just west of Fort Hunter Liggett's current boundary at the Buclimo Mine near the head of Alder Creek. Most placer gold in the Los Burros Mining District came from Willow Creek with small amounts found in Alder, Plaskett, and Salmon Creeks. Ore from the Los Burros Mining district was transported from the mines to Jolon and into King City. Most mining activity related to gold was conducted between 1887 and 1892 (Reinstedt 1977; Clark 1998)

Serpentine outcroppings in Fort Hunter Liggett have been successfully mined for asbestos and chromite (Eidsness, 1994a). Asbestos is a nonmetallic mineral that was used heavily by construction and transportation industries in the manufacture of asbestos-cement products such as pipe, shingles, wallboard, corrugated sheets, floor tiles and brakes. Chromite is the only economic source of chromium, an essential component for steel alloys (California Division of Mines and Geology 1966).

Small scale mining for cinnabar, serpentine and lime deposits continued into the 1950s (Eidsness and Jackson 1994a). Cinnabar is the principal mercury ore mineral. Mercury's mineral qualities are valuable for industrial production and were in heavy demand during World War I, World War II and the Korean War (California Division of Mines and Geology 1966).

Soils

The diversity of soils at Fort Hunter Liggett reflects the geologic and topographic variety of the region. Fort Hunter Liggett contains more than 130 soil types in 57 soil series (US Army Reserve Training Center, Fort Hunter Liggett, 2003). Steep highlands in the west consist of rock outcrops and shallow soils derived from the underlying parent material. The rolling hills that make up most of the central and eastern portions of Fort Hunter Liggett consist primarily of alluvial terraces or soils associated with marine sedimentary rocks.

Soil erosion at Fort Hunter Liggett is primarily the result of natural processes, existing training and testing activities, prescribed burns on the steep-sloped chaparral and woodland areas, past grazing practices, and borrow pit excavations. Except for portions of the cantonment area, the Natural Resource Conservation Service classifies most of Fort Hunter Liggett as having high or moderate erosion hazard. The erosion hazard on the San Antonio River Valley floor, which includes the cantonment area, is minimal because of its relatively gentle topography. The surrounding hills, however, are much more susceptible to erosion. The steep uplands have a very severe erosion potential.

Biological Resources

Fort Hunter Liggett includes a diversity of rare species and habitats. The following section describes the habitat and species that can be found at Fort Hunter Liggett.

Vegetation

Fort Hunter Liggett contains a variety of plant communities containing more than 1,000 vascular species, many of which are rare and sensitive (see Table 2: Vegetation Communities on Fort Hunter Liggett and Table 3: Federally and State Listed Threatened and Endangered Species that May Occur on Fort Hunter Liggett). The high species diversity is a result of the soil diversity, geology, and Fort Hunter Liggett's primarily undeveloped state.

Interspersed valley oaks and grasslands are the predominant vegetation on the valley floors while chaparral dominates the western mountainous areas. Major watercourses support riparian vegetation comprised mainly of sycamore, cottonwood, willow, and alder. Rolling hills and the more gentle slopes are predominantly covered with blue oak woodland. The steeper slopes, such as those rising from the Nacimiento River Valley

to the crest of the Santa Lucia Range, typically support dense chaparral composed mainly of deer brush and chamise (See Figures 9a. Habitat Types and 9B. Habitat Relationships to Underlying Geology in the "Figures" section). Plant communities on Fort Hunter Liggett provide suitable habitat for 9 state and Federally-listed threatened and endangered wildlife species and 1 species that is a candidate for federal listing (see Table 3: Federally and State Listed Threatened and Endangered Species that May Occur on Fort Hunter Liggett).

Wetlands. Wetlands support a prevalence of hydrophytic vegetation, hydric soils, and wetland hydrology. Fort Hunter Liggett has several types of wetland communities, both natural and human-made. These wetlands support a variety of plants. They are also vital for supporting animal resources at Fort Hunter Liggett including a high diversity of migratory waterfowl. Wetland types on Fort Hunter Liggett include vernal pool, vernal swale, ephemeral, drainage, wet meadow, freshwater marsh, stock pond, creek, and river.

Vernal pools are considered rare and endangered habitat. Approximately ninety percent or more of California's vernal pools have been lost (Ferren, et al., 1996). These losses are continuing as ranches and other undeveloped lands are plowed or developed (CEMML 1999). Vernal pools are found throughout Fort Hunter Liggett. They provide the sole habitat for a number of plant taxa and the Federally-listed endangered, vernal pool fairy shrimp (*branchinecti lynchi*). Santa Lucia mint (*Pogogyne clareana*) is a state-listed endangered species found only along stream banks and at the edges of vernal pools on Fort Hunter Liggett.

Riparian Communities. Riparian communities can be found along the rivers and streams at Fort Hunter Liggett. Fort Hunter Liggett's riparian communities include sycamore alluvial woodlands, cottonwood, and willow. Sycamore alluvial woodlands have been determined to be a "special-status community" of limited distribution by the California Department of Fish and Game (CDFG) because they provide important habitat for rare or unusual plant and wildlife species (US Army Reserve Training Center, Fort Hunter Liggett, 2003). Riparian communities typically support high species diversity. California's riparian communities have been reduced to less than 10% of their former range, due to development and irrigation practices.

Grassland. Grassland on Fort Hunter Liggett includes annual, valley needlegrass, and ruderal (disturbance tolerated, introduced grasses). In much of California, native grasses have been replaced by exotic annual grasses (Hamilton, 1997; Stevens, et al., 1998). On Fort Hunter Liggett, the native grasses are often extensive, and are significant components of a number of rare community types. For example, "barrens" and grasslands associated with serpentine soils have been documented on the installation.

Native grasses include three species of Nassella, five species of Melica, two species of Muhlenbergia, as well as other native bunchgrasses and annual grasses. Fort Hunter Liggett natural resource managers consider valley needlegrass (*Nassella*) grassland to be an important rare natural community on Fort Hunter Liggett (CEMML 1999). These native bunchgrasses have survived despite the area's history of grazing (Hoover 2001).

Chlorogalum purpureum var. *purpureum* (purple amole) is a Federally-listed threatened species associated with grassland and oak communities. It is known only from Fort Hunter Liggett and nearby Camp Roberts. The U.S. Fish and Wildlife Service proposed a critical habitat area of 15,000 acres at Camp Roberts and Fort Hunter Liggett in November 2001. It was later found that direct and indirect costs to the Army would exceed the benefits of critical habitat designation on Department of Army land. On October 24, 2002, the U.S. Fish and Wildlife Service designated 1,532 acres of critical habitat for the purple amole on private land near Jolon Road (67 Federal Register No. 206, October 24, 2002). Fort Hunter Liggett has conducted long-term studies on purple amole. These studies have shown a low level of disturbance over time to plots of purple amole.

Recovery from some level of disturbance is considered likely as purple amole occurs in both undisturbed and highly disturbed areas (US Army Reserve Training Center, Fort Hunter Liggett, 2003).

Coastal scrub. Westman (1987) and O'Leary (1990) identified coastal scrub as a rare plant community type in need of conservation. On Fort Hunter Liggett, coastal scrub exists only in small patches (CEMML 1999). At least one rare plant species (*Malacothamnus davidsonii*) is frequently associated with coastal scrub on Fort Hunter Liggett. Fort Hunter Liggett contains a rare instance of coast rock cress (*Arabis belpharophylla*). This species is typically found in northern areas from Santa Cruz to Sonoma Counties.

Chaparral. Chaparral communities consist of drought-resistant evergreen shrubs that grow on California slopes and coastal mesas. Chamise and mixed chaparral are the dominant types on Fort Hunter Liggett, found on 39% of the installation. On Fort Hunter Liggett, chaparral is typically found on ridgetops, south facing slopes and the western mountain range (US Army Reserve Training Center, Fort Hunter Liggett, 2003). Cooper and Perlman (1997) pointed out that Fort Hunter Liggett has "endemic-rich serpentine chaparral." Fort Hunter Liggett's serpentine chaparral is generally dominated by *Arctostaphyllos obispoensis*, *Adenostoma fasciculatum*, *Quercus durata*, and/or *Ceanothus* spp.

Rare chaparral communities are associated with serpentine areas found along the Coast Ridge Road (at the southwestern boundary with Los Padres National Forest) in training areas 23, 26 and 28 and along the Nacimiento River in Training Area 19. These include both wetland and upland communities. Burro Mountain in training area 23 contains the largest serpentine bed on Fort Hunter Liggett. Wetland communities can be found at Los Burros and Salmon Creeks. Unique endemic plant communities are associated with these formations. The California Native Plant Society lists 285 endemic taxa found mostly or only on serpentine. These taxa make up a major component of California's endemic species (Skinner & Pavlik 1994, Faber 1997).

Oak Woodlands and Savanna. The oak woodland and oak savanna areas are visually dominant features of the Fort Hunter Liggett landscape, and provide valuable habitat for many species of wildlife. Oak woodlands can be found along the hillsides, protected ravines and canyons and cover 46% of the installation (US Army Reserve Training Center, Fort Hunter Liggett, 2003). Oak savanna is found on flat and alluvial terraces. Fort Hunter Liggett may contain the widest diversity of oak taxa of any area of its size in California. The 12 oak taxa found on Fort Hunter Liggett include valley oak (*Quercus lobata*), blue oak (*Q. douglasii*), coast live oak (*Q. agrifolia* var. *agrifolia*), canyon live oak (*Q. chrysolepis*), interior live oak (*Q. wislizeni* var. *wislizeni*), shrub interior live oak (*Q. wislizeni* var. *frutescens*), scrub oak (*Q. berberidifolia*), leather oak (*Q. durata* var. *durata*), Tucker's oak (*Q. john-tukeri*), Shreve oak (*Q. parvula* var. *shrevei*), Alvord oak (*Q.* × *alvordiana*), and Jolon oak (*Q.* × *jolonensis*) (Painter 2000).

Blue oak woodlands and savanna are the most prevalent oak communities on Fort Hunter Liggett. The installation contains approximately 52,000 acres of blue oak communities, almost one-third of the total land area. While many blue oaks are part of foothill woodlands, pure stands can be found throughout training areas 25 and 29 in the southwestern portion of Fort Hunter Liggett (US Army Reserve Training Center, Fort Hunter Liggett, 2003).

The Valley oak (*Quercus lobata*) plant community, which occurs only in California, is considered by the California Department of Fish and Game to be a rare community type. Less than 100 high quality stands and less than 10,000 acres of high quality habitat remain in California, a significant portion of which is located on Fort Hunter Liggett (California Department of Fish and Game 1999). The valley oak series is also included in the rare California series listed by Sawyer and Keeler- Wolf (1995).

Fort Hunter Liggett has outstanding examples of valley oak savanna and woodland (Pavlik et al.,

1991). Over 17,000 acres of valley oak communities straddle the boundary between Fort Hunter Liggett and Los Padres National Forest (see Figure 9a: Habitat Types in the "Figures" section). In an effort to control valley oak loss, the Army implemented a Valley Oak Replacement Program in 1997, with the objective of planting and irrigating at least 50 oak seedlings per year. The two-year survival rate is 80% (Clark 2000).

Live oak communities comprise 1,800 acres (or 3%) of Fort Hunter Liggett, occurring frequently in foothill woodlands. Shrub varieties of live oak occur most commonly in the higher elevations. Dominant species include coast live oak, canyon oak and interior live oak (US Army Reserve Training Center, Fort Hunter Liggett, 2003).

California oaks are currently threatened by the disease known as sudden oak death. First identified in 1995, sudden oak death is caused by the pathogenic fungus, *Phytophthora ramorum*. This pathogen has caused widespread dieback of tanoak and several oak species in the central and northern coastal counties of California, and has to date been associated with 26 different plant species. Infections occur on trunks, branches and leaves. Cankers, brown spots on leaves, and dieback of the tree crown are symptoms of the disease.

Sudden oak death is present in northern Monterey County; however there are no confirmed reports on Fort Hunter Liggett. The California Oak Mortality Task force has documented sudden oak death in portions of northern Monterey County including Pfeiffer Big Sur State Park, Prunedale, and Torrey Canyon (California Oak Mortality Task Force 2003).

Mixed- evergreen forest. Mixed-evergreen forest is found at higher elevations on Fort Hunter Liggett on northfacing slopes. It is dominated by coast live oak (*Quercus agrifolia*), black oak (*Quercus kelloggii*), canyon live oak (*Quercus chrysolepsis*), bay (*Umbellularia californica*), madrone (*Arbutus menziesii*), tanoak (*Lithocarpus densiflora*), and maple (*Acer macrophyllum*).

Coniferous forest. Coniferous forest on Fort Hunter Liggett includes closed- cone pine - cypress forest and yellow pine forest. Closed-cone pine-cypress includes Sargent cypress (*Cupressus sargentii*), generally found on serpentine (Kruckeberg 1984). Sargent cypress is included in the rare California series listed by Sawyer and Keeler- Wolf. Yellow pine forest is dominated by ponderosa pine (*Pinus ponderosa*) and Coulter pine (*Pinus coulteri*). A single stand of Santa Lucia fir (*Abies bracteata*) located on Fort Hunter Liggett appears to have been first discovered here in the 19th century. Santa Lucia fir is included in the rare California series listed by Sawyer and Keeler- Wolf.

Rock Outcrops. Rock outcrops on Fort Hunter Liggett are common in the Nacimiento watershed where two larger formations known as the Palisades and the Piedras Atlas are known to occur. Rock outcrops provide unique substrates for plant communities and serve as roosting and nesting sites for raptor species (US Army Reserve Training Center, Fort Hunter Liggett, 2003).

Table 2: Vegetation Communities on Fort Hunter Liggett

TYPE	AREA	LOCATION	ASSOCIATED PLANTS	ASSOCIATED WILDLIFE
Grassland: annual, valley needlegrass, and ruderal	10%	Cantonment, main gate, Stony Valley, Gabilan Valley, along San Antonio River	Miscellaneous forbs and grasses	California vole, California ground squirrel, black-tailed hare, western meadowlark, horned lark, savanna sparrow, American pipit, western kingbird (forage)
Chaparral: chamise and mixed	39%	Hillsides and ridges	Chamise, yerba santa, backbrush, manzanita, holly leaf cherry, mountain mahogany, poison oak	Orange-crowned warbler, wrentit, California thrasher, brush rabbit, Merriam's chipmunk, California mouse, west spotted skunk, grayfox, small carnivores, western fence lizard, southern alligator lizard
Oak Communities	46%	Hillsides and protected ravines and canyons	Overstory - Valley oak, blue oak, coastal live oak Understory - miscellaneous forbs and grasses	Deer, western gray squirrel, dusky footed woodrat, grayfox, striped skunk, wild turkey, acorn woodpecker, western bluebird, American kestrel, bushtits
Riparian: mixed; willow-cottonwood; willow, valley oak; sycamore alluvial	3%	San Antonio River, Nacimiento River, and many intermittent streams	Cottonwood, California sycamore, alder, valley oak, willow, muletat, California wild rose, Pacific blackberry, elderberries, and giant creek nettle	Wood duck, wild turkey, California quail, red-shouldered hawk, Nattal's and downy woodpecker, northern oriole, Bewick's wren, rufous-sided towhee, deer, western gray squirrel, opossum, raccoon, long-tailed weasel, shrew, mountain lion, Pacific tree frog, California newt
Wetlands: vernal pool; vernal swale, ephemeral drainage; wet meadow; freshwater marsh; stockpond; creek; and river.	< 1%	Areas that are permanently or seasonally inundated or saturated by surface water or ground water in low-lying areas and open water areas	Hydrophytic vegetation	Vernal pool fairy shrimp, California tiger salamander
Rock outcrop	< 1%	Stony Valley and Training Areas 3, 90 and 23	Patches of sedimentary, granite or ultramafic rocks (serpentine) lichens and mosses and unique vegetation	American kestrels, red-tailed hawk, turkey vulture, western fence lizard, striped racer, various bat species
Sources: US Army Reserve Training Center, Fort Hunter Liggett, 2003; CEMML, 1999				