5.2 Cascades and Modoc Plateau Province

5.2.1 Geophysical and Ecological Description of the Province

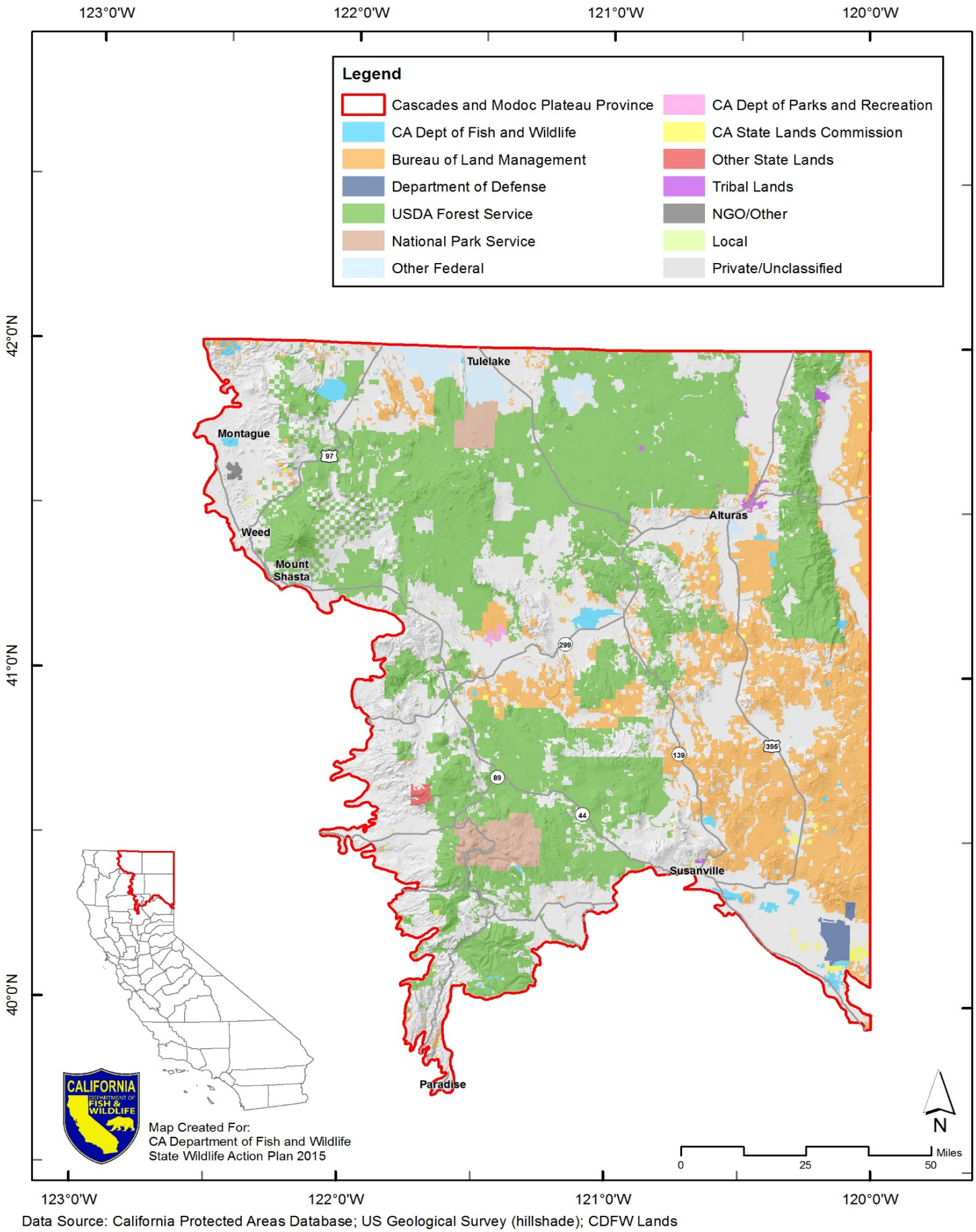
The Cascades and Modoc Plateau Province encompasses over 7 million acres in the far northeastern corner of California (Exhibit 5.2-1). This province is composed of two distinct geographic and ecological areas, the Modoc Plateau and the Southern Cascades. Elevations in the province average higher than other provinces, ranging from 3,000 feet throughout the Modoc Plateau to over 14,000 feet on mountain peaks of the Southern Cascades. Northeastern California is an outstanding region for wildlife, providing habitat for mountain lion, black-tailed deer, mule deer, pronghorn, elk, yellow-bellied marmot, porcupine, greater sage-grouse, and the colorful waterfowl of the Pacific Flyway that funnel through the area during their annual migrations. Golden eagles, prairie falcons, cascade frogs, southern long-toed salamander, Northern goshawks, Northern spotted owls, sooty grouse, sandhill cranes, and American white pelicans nest and hunt or forage in varied habitats in the province. The varied aquatic habitats and natural barriers along the Pit River and Klamath River and their tributaries have allowed the evolution of several unique aquatic communities that include endemic fish and invertebrates in the Cascades and Modoc Plateau Province.

Modoc Plateau

The Modoc Plateau is located in the northeastern corner of the state, framed by and including the Warner Mountains and Surprise Valley along the Nevada border to the east and west to the edge of the southern Cascades Range. The area extends north to the Oregon border and south to include the Skedaddle Mountains and the Honey Lake Basin.

A million years ago, layered lava flows formed the 4,000–5,000-foot elevation Modoc Plateau, separating the watersheds of the area from the Klamath drainage to the northwest. The waters of the western slope of the Warner Mountains and the Modoc Plateau carved a new course, the Pit River, flowing to the southwest through the Cascades and joining the Sacramento River at the site of Lake Shasta. Many of the springs and creeks of northeastern California drain via the Pit River.

Situated on the western edge of the Great Basin, the Modoc Plateau historically has supported high desert plant communities and ecosystems similar to that region—shrub-steppe, perennial grasslands, sagebrush, antelope bitterbrush, mountain mahogany, and juniper woodlands. Sagebrush plant communities are characteristic of the area, providing important habitat for sagebrush-dependent wildlife such as greater sage-grouse and pygmy rabbit. Conifer forests dominate the higher elevations of the Warner Mountains and the smaller volcanic mountain ranges and hills that shape the area. Wetland, spring, meadow, vernal pool, riparian, and aspen



Data Source: California Protected Areas Database; US Geological Survey (hillshade); CDFW Lands

Figure 5.2-1 Land Ownership of the Cascades and Modoc Plateau Province

communities scattered across the rugged and otherwise dry desert landscape support diverse wildlife. The area has varied aquatic habitats, from high mountain streams to the alkaline waters of Goose Lake and Eagle Lake to clear spring waters of Fall River and Ash Creek.

Jimmy Emerson, DVM

The 3-million-acre Pit River watershed is the major drainage of the Modoc Plateau and spans the border of northern California and Oregon as well as the Modoc Plateau and Southern Cascades ecoregions. It is of major importance to California water supply and fish populations as it provides 20 percent of the water to the Sacramento River. The upper reaches of the watershed are in creeks of the Warner Mountains that drain into Goose Lake and thus includes the Goose Lake watershed. Goose Lake itself occupies about 144 square miles with the majority of the water on the California side. All surface drainage in the basin is to Goose Lake. The major portion of the water comes from Dry, Mill, Drews, Antelope, Cottonwood, Thomas, Crane, Cogswell, Tandy, and Kelley Creeks. The north fork of the Pit River flows from Goose Lake southwest and merges with the south fork of the Pit River, which drains the southern Warner Mountains. The Pit River meanders across the plateau and farmlands, receiving the drainage of Ash Creek and the flows of Fall River and Hat Creek before weaving west across the southern Cascades Range. The river is checked and held by several dams and reservoirs but eventually drains into Lake Shasta. Unique fish and invertebrates have evolved in isolated springs and segments of the Pit River watershed and over 24 endemic species depend on the lower Pit River for their survival (Nature Conservancy 2015). Fourteen native fish species are found in various associated fish communities in segments of the watershed's rivers and creeks. Endemic species include the Modoc sucker, the Goose Lake redband trout, Goose Lake tui chub, Goose Lake lamprey, and the Shasta crayfish (Ellis and Cook 2001; Moyle 2002). Management issues within the Pit River watershed include threatened wild trout production, degraded forest health because of heavy fuels, degraded aquatic and riparian habitat, degraded water quality, unsustainable water supply, increased erosion and natural stream function, and invasive plant and animal species (SRWP 2015).

Another important watershed within the province that also spans two states (California and Nevada) is the Eagle Lake watershed. One of the few alkaline lakes in California, it is also the second largest lake in California at 15 miles long and more than 2 miles wide. Tributaries of Eagle Lake are Gleghorn Creek, Pappose Creek, Merril Creek and Pine Creek. Pine Creek, main tributary of Eagle Lake, is about 39 miles long and considered an intermittent stream. Pine and

cedar forests surround the south shore of Eagle Lake, while juniper and sage dominate the north side. The endemic Eagle Lake rainbow trout, as well as the Lahontan redside, Tahoe sucker, and tui chub attract thrive in the waters of Eagle Lake and its Basin. Western grebes, eared grebes, buffleheads, many diving ducks and cormorants, terns, ospreys, and bald eagles fish along its productive waters. Marshy areas near the shoreline provide available forage for American white pelicans, cinnamon teal, and other waterfowl in addition to egrets and muskrats.

Creeks of the northern Modoc Plateau, or Lost River watershed, drain to Clear Lake in Modoc County from the Lost River Diversion located in southern Oregon. The outlet of Clear Lake is the Lost River, which circles north into Oregon farmland and then joins the Klamath River system. The Lost River watershed encompasses an area of approximately 3,000 square miles in Klamath and Lake Counties in Oregon, and Modoc and Siskiyou counties in California. Sixty-miles-long, the Lost River winds through forests, meadows and fields providing important habitat for aquatic and terrestrial species alike providing habitat for 22 endemic species (Nature Conservancy 2015). Endemic aquatic fish and invertebrates include the federally endangered Lost River sucker, shortnose sucker, and Klamath pebblesnail.

Sixty percent of the Modoc Plateau is federally managed; U.S. Forest Service (USFS) manages 30 percent, U.S. Bureau of Land Management (BLM) manages 26 percent, and U.S. Fish and Wildlife Service (USFWS) and the U.S. Department of Defense (DOD) each manage about 2 percent of the lands. CDFW manages 1 percent of the Modoc Plateau as wildlife areas. About 37 percent of the lands are privately owned or belong to municipalities.

Southern Cascades

The Cascade Mountain Range starts in southern British Columbia and runs south through Washington and Oregon into northern California, merging just south of Mount Lassen with the northern reaches of the predominantly granitic Sierra Nevada. The most recent volcanic eruptions in conterminous United States have occurred in the Cascades, with eruptions of Mount Lassen in 1914-1915 and eruptions of Mount St. Helens in Washington in the 1980s and continuing. Within Northern California, the mostly volcanic southern Cascades contain two of the most active volcanoes in the state, Mount Shasta and Mount Lassen, both of which are considered active. The southern Cascades are bordered by the Klamath Mountains on the west side, bounded by the foothills of the Tuscan Formation to the southwest, by the Sierra Nevada Mountains to the south and finally to the east, they grade into the Modoc Plateau. Elevations range from about 2,000 feet in the adjacent foothills to 14,179 feet, the peak of Mt. Shasta which is the second highest peak in the Cascade Range. The mountain elevations then drop off gradually to the east.

In the Cascades, hundreds of creeks and streams of the western slope drain via a dozen major river basins to merge with the Klamath, Pit, McCloud, and Sacramento Rivers. On the eastern slope, creeks and rivers drain east onto the Modoc Plateau and Great Basin region. Battle Creek, which empties into the Sacramento River, has headwaters in the Mount Lassen area and its flows

are primarily derived from the Southern Cascades. Battle Creek has been the focus of major anadromous fish restoration projects because it has very cold, clean waters and excellent fish habitat. Springs and creeks of the southern Cascades support unique species or subspecies of fish such as the Modoc red-band trout, and invertebrates such as Shasta crayfish and endemic springsnails. These mountains receive substantial rainfall and snowfall, with Mount Lassen having the highest known winter snowfall amounts in California. The endangered willow flycatcher finds breeding and nesting habitat in the wet meadow valleys and broad meadow floodplains of mountain creeks. Because 40 percent of the state's surface water runoff flows from the Sierra Nevada and the Cascades, maintaining and restoring the ecological health of the Cascade watersheds and aquatic systems is important to ensure clean water for California.

Bold topography, the large elevation gradient, and varied climatic conditions of the Cascades support diverse plant communities. North of Mount Shasta, the Klamath Mountains absorb precipitation coming from the west, resulting dry west slopes of the Cascades that look more like the east slopes near Lassen Peak. Soils, like the Modoc Plateau, are generally volcanic in origin. These varied conditions, and floristically and structurally diverse plant communities, provide a large array of habitats important for maintaining California's wildlife diversity and abundance. Communities common to the Cascade area are conifer habitats dominated by ponderosa pine, white fir, red fir, and lodgepole pine. In general, mixed ponderosa pine, Douglas fir, and white fir forests occur on the western slopes at elevations below approximately 5,600 feet. Canyon live oak stands favor large, rocky canyons at mid to low elevations. On the xeric, east slopes of the Cascades, ponderosa pine, and Jeffrey pine form open stands on flats and mild slopes. At the highest elevations, lodgepole pine, white fir, and red fir are dominant. Big sagebrush and western juniper dominated habitats are more common on the eastern slopes and valleys of the ecoregion.

Common large mammalian inhabitants of the ecoregion include the black bear, mountain lion, Rocky Mountain and Roosevelt elk, pronghorn antelope, and mule deer. Species of Greatest Conservation Need (SGCN) include the Northern spotted owl, Sierra Nevada red fox, pacific fisher, American marten, American badger, and coastal tailed frog.

D.A. Buehler, NPS

Fifty-two percent of the Southern Cascades ecoregion in California are federally owned and managed with principal management by the USFS, BLM, and National Park Service (NPS). One percent is owned and managed by other governmental (state, tribal, and county) entities. Forty-seven percent is privately owned and managed with the majority of private ownership being among several large timber companies.

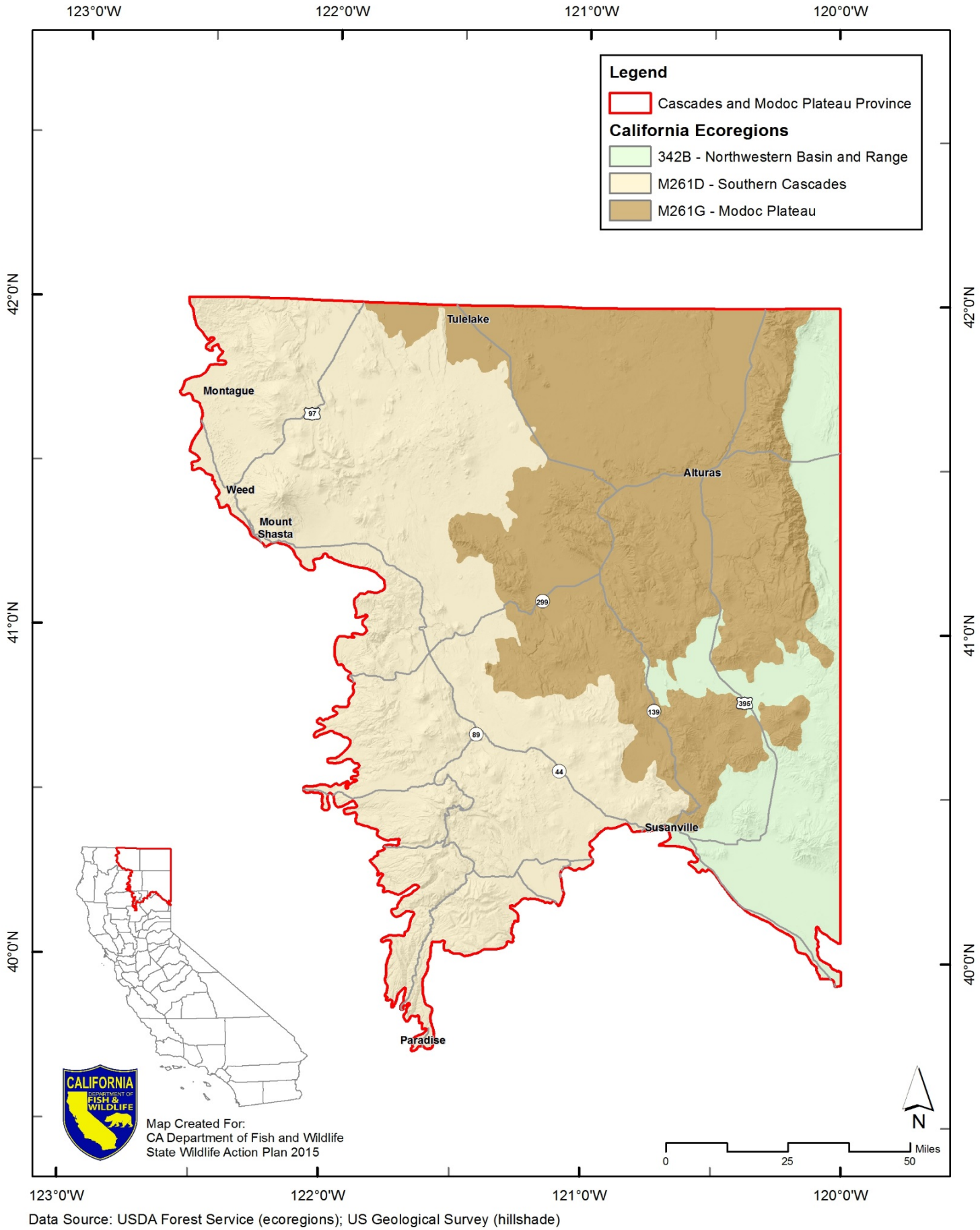
5.2.2 Conservation Units and Targets

The conservation units associated with the Cascades and Modoc Plateau Province include the Southern Cascades, Modoc Plateau, Northern Basin and Range Ecoregions (Figure 5.2-2), as well as portions of the North Lahontan hydrologic unit (HUC 1808) and the Sacramento hydrologic unit (HUC 1802) (Figure 5-2.3).

Patricia Bratcher, CDFW

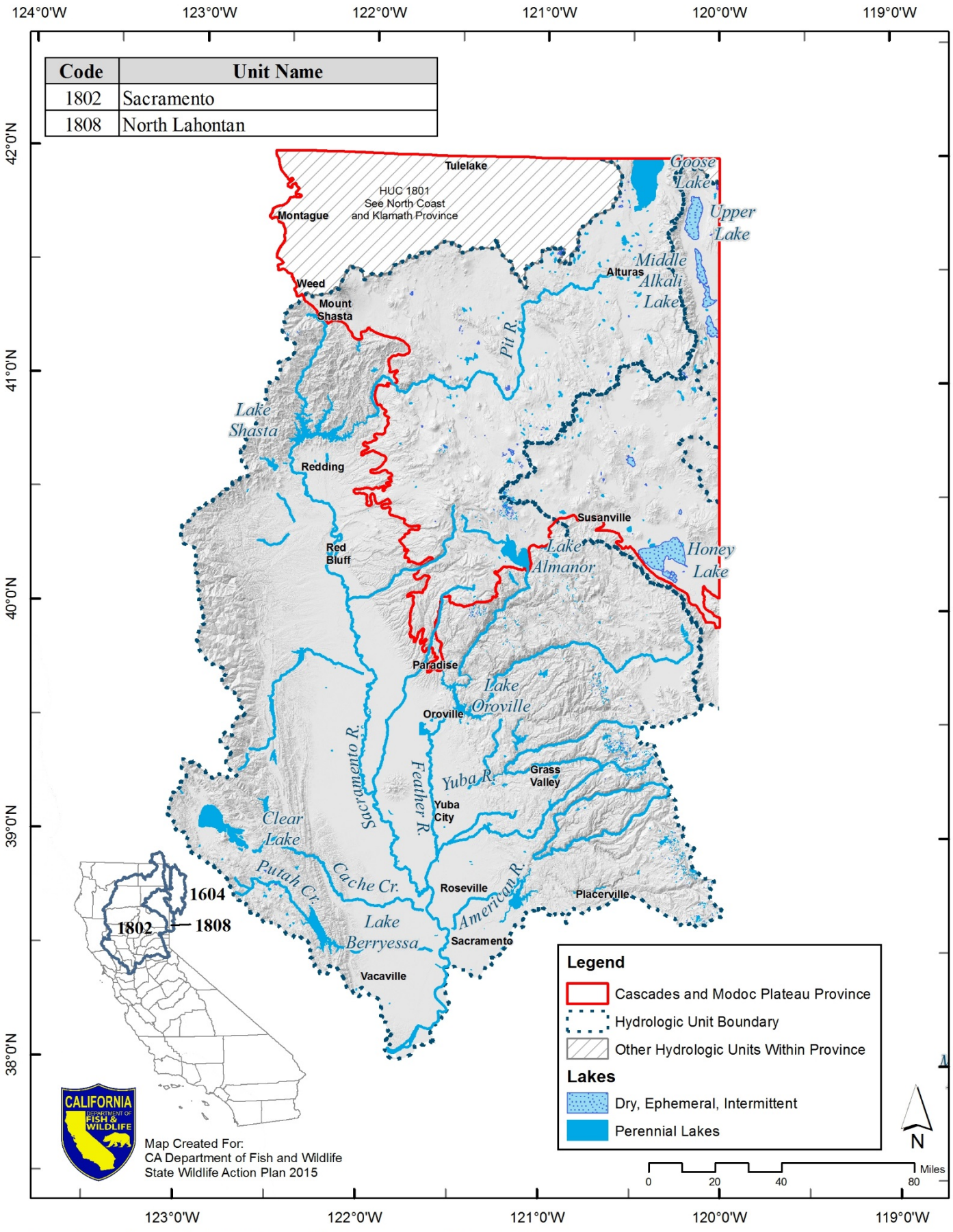
Eight conservation targets were selected in this province as important vegetation communities or native fish assemblages for conservation planning within the conservation units. These communities include: North Coastal Mixed Evergreen and Montane Coniferous Forests, Western Upland Grasslands, Big Sagebrush Scrub, Great Basin Dwarf Sagebrush Scrub, Great Basin Upland Scrub, Great Basin Pinyon-Juniper Woodland, Eagle Lake Native Fish Assemblage, and Goose Lake Native Fish Assemblage. The selected targets for the Cascade and Modoc Plateau Province are summarized in Table 5.2-1.

Figure 5.2-4 shows the distribution of the plant communities within the province.



Data Source: USDA Forest Service (ecoregions); US Geological Survey (hillshade)

Figure 5.2-2 Ecoregions of the Cascades and Modoc Plateau Province



Data Source: National Hydrologic Dataset (NHD); US Geological Survey (hillshade)

Figure 5.2-3 Hydrologic Units of the Cascades and Modoc Plateau Province

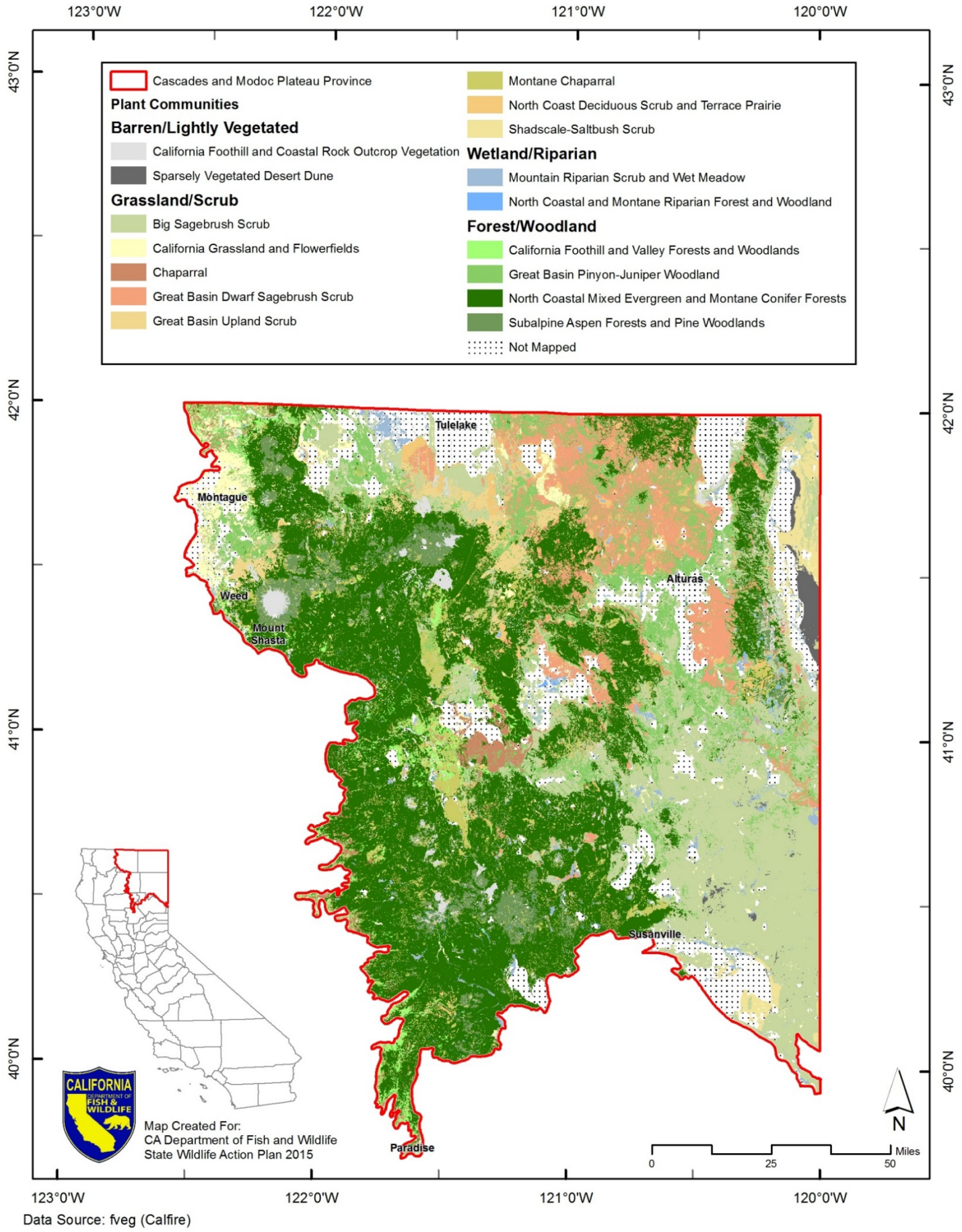
Table 5.2-1 Conservation Units and Targets – Cascades and Modoc Plateau Province*

Conservation Unit	Geographic and Ecological Summary	Conservation Target	Target Summary	Focal CWHR Types Associated with Target
Southern Cascades Ecoregion	Consists of scattered mountains of low to high elevations. While there is no distinct range, the crest of the mountain chain is aligned toward the north-northwest between the Sierra Nevada and Mt. Shasta and toward the north from Mt. Shasta northward. Slow and moderately rapid rivers and streams are common throughout the ecoregion. Major rivers and lakes include the Klamath and Pit Rivers, Lake Almanor and Meiss Lake. Predominant vegetation communities in this section include ponderosa pine, big sagebrush, Idaho fescue, western juniper, mixed conifer, white fir, red fir, and lodgepole pine. Elevation range: 2,000 to 14,000 feet.	North Coastal Mixed Evergreen and Montane Conifer Forests	Representative of cool-temperate forests of northern California. These range inland from the immediate coast and experience warm, relatively dry summers and cool rainy to cool snowy winters. The interior mixed evergreen forests contain madrone, tan oak, Oregon oak and drier Douglas-fir with canyon-live oak mixes. At higher elevations, ponderosa pine mixes with incense-cedar. Further up in elevation are mixed white fir, sugar pine, and Jeffrey pine communities. The eastern slopes have open ponderosa and Jeffrey pine stands.	Douglas-fir, montane hardwood-conifer, montane hardwood, Klamath mixed conifer, eastside pine, Sierran mixed conifer, white fir, Jeffrey pine, ponderosa pine
		Western Upland Grasslands	Dominated by perennial grasses that are found in moist, lightly grazed, or relic prairie areas. Can be up to 100 percent cover. Includes native grasslands of Idaho fescue, blue wild rye, Great Basin wild rye, ashy ryegrass, Sandberg blue grass, big and bottlebrush squirreltail, one-sided bluegrass. Also includes the non-native grasslands such as creeping bentgrass, velvetgrass, Kentucky bluegrass, Harding grass, and cheat-grass.	Perennial grassland, annual grassland
Modoc Plateau Ecoregion	Fault-block mountains and ridges with non-marine sedimentary rocks and other formations of materials of volcanic origin. Rivers and streams follow alluvial and bedrock controlled channels to the Sacramento and Klamath Rivers or to basins within the Modoc Plateau. Predominant vegetation communities include big sagebrush, western juniper, Idaho fescue, bluebunch wheatgrass, ponderosa pine, white fir, low sagebrush, Jeffrey pine, lodgepole pine, aspen, and sedge meadow communities. Climate is generally dry and cold in the winter with annual precipitation from 8-30 inches. Summers are hot and dry. Elevation range: 3,000 to 9,900 feet.	Big Sagebrush Scrub	Emblematic of the valleys and lower slopes of the Great Basin Desert. It enters the province in the Modoc Plateau and continues south and east of the Cascades. Occupies dry slopes and flat areas within the ecoregion where annual precipitation is usually 16 inches or less. Dominated by shrubs. Most stands are dominated by big sagebrush and mountain sagebrush. Where the soil remains saturated through the spring, silver sagebrush dominates. On low flats with shallow soils and restricted drainage low sagebrush is dominant. Black sagebrush dominates sites with soils high in gravel and carbonates.	Sagebrush
		Great Basin Dwarf Sagebrush Scrub	Low subshrub sagebrush species. These species form stands on poor soils, or exposed slopes and ridges where larger sagebrush species are unable to grow. The main species in this macrogroup include low sage, (Lahontan sagebrush, and black sagebrush). Each of these species has different ecological requirements from calcarious shallow soils, deep clay-rich soils, and shallow rocky upland soils.	Low sage
		Great Basin Upland Scrub	Shrublands with cool desert affinities but has been segregated from sagebrush species. Predominant species include fire-sensitive, long-lived species such as blackbrush and mountain mahogany; species which recover well from disturbance include spiny hop-sage, winter-fat, Mormon-tea, and some species of bitterbrush. Shorter fire intervals are conducive to emphasizing perennial grass cover such as desert needlegrass, or indian rice grass (in sandy areas).	Bitterbrush, low sage, sagebrush

Table 5.2-1 Conservation Units and Targets – Cascades and Modoc Plateau Province*

Conservation Unit	Geographic and Ecological Summary	Conservation Target	Target Summary	Focal CWHR Types Associated with Target
Northwestern Basin and Range Ecoregion	Nearly level basins and valleys bordered by long, gently sloping alluvial fans with linear mountain ranges. Soils are formed mostly from rocks of volcanic origin. Moderately slow rivers and streams flow through deeply incised canyons with bedrock controlled channels (higher elevations) to alluvial channels (lower elevations). A few large lakes, such as Honey Lake, occur here. Vegetation consists of sagebrush and desert shrub cover types. Climate is dry with cold winters and annual precipitation from 4 to 20 inches. Summers are hot and dry. Elevation range: 4,000 to 8,000 feet.	Great Basin Pinyon-Juniper Woodland	Found on virtually all exposures and slopes but is common on level to gently rolling topography. Dominated by Utah or western juniper stands. Very little, if any single-leaf pinyon or California juniper, are present. Shrub species include sagebrush, mountain mahogany, bitterbrush and other cool-desert shrubs and grasses. Denser stands are associated with a grassier understory while more open stands have shrubs.	Pinyon-juniper, Juniper
North Lahontan Hydrologic Unit (HUC 1808)	Includes the eastern slopes of the Warner Mountains and the Sierra Nevada. Major watersheds in the North Lahontan Basin include the Eagle Lake and Susan River/Honey Lake watersheds. Dominant vegetation ranges from sagebrush to pinyon-juniper and mixed conifer forest at higher elevations. Wetland and riparian plant communities, including marshes, meadows, bogs, riparian deciduous forest, and desert washes. Elevation range: 4,000 to 7,600 feet	Eagle Lake Native Fish Assemblage	Lake habitats consist of closed basins with large, shallow alkaline water of high pH and warm summer water temperatures. Stream habitats are composed of low gradient, intermittent, streams that cross pine forest and sagebrush flats. The Eagle Lake Native Fish Assemblage consists of five species: • Eagle Lake rainbow trout • Eagle Lake tui chub • Tahoe sucker • Lahontan speckled dace • Lahontan redside	N/A
Sacramento Hydrologic Unit (HUC 1802)	The Sacramento River Basin covers much of northern California at 27,210 square miles and includes the entire area drained by the Sacramento River. All tributaries to the Sacramento River that are north of the Cosumnes River watershed are included in this watershed. The major lakes and streams of this watershed included in the Cascade-Modoc Plateau Province are Goose Lake, Lake Almanor, and the Pit River. The geology, climate, and associated vegetation are similar to those described for the North Lahontan watershed. Elevation range: 0 to 9,000 feet	Goose Lake Native Fish Assemblage	Lake habitats consist of semi-closed basins with large, shallow alkaline water of high pH and warm summer water temperatures. Stream habitats consist of high gradient mountain streams that enter low gradient meadows and grasslands or agricultural lands. Eight fish species are included in the Goose Lake Native Fish Assemblage. Four of these are endemic species unique to the Goose Lake Watershed: • Goose Lake redband trout • Goose Lake sucker • Goose Lake tui chub • Goose Lake lamprey These species are highly dependent upon stream habitat as refugia during drought and resilient to adverse water conditions. Tributary streams also provide important refuge habitat for these species during drought and low lake levels. The other four species are primarily stream-dwelling: • Pit-Klamath brook lamprey • Speckled dace • Northern roach • Pit sculpin	Lacustrine, Riverine

*Description referenced from CDFG 1988, USDA 1994, and USDA 2007.



Data Source: fveg (Calfire)

Figure 5.2-4 Plant Communities of the Cascades and Modoc Plateau Province

5.2.3 Key Ecological Attributes

Key ecological attributes (KEAs) were identified for each conservation target. These attributes are considered the most important for the viability of the targets and their associated species. The KEAs for the Cascade-Modoc Plateau Province are listed in Table 5.2-2. The most commonly identified attributes for the Cascade-Modoc Plateau Province are:

- area and extent of community;
- fire regime;
- successional dynamics;
- native versus non-native diversity; and
- soil and sediment deposition regime.

Table 5.2-2 Key Ecological Attributes – Cascades and Modoc Plateau Province

Key Ecological Attributes	Southern Cascades		Modoc Plateau			Northwestern Basin and Range	North Lahontan HUC 1808	Sacramento HUC 1802
	North Coastal Mixed Evergreen and montane Conifer Forests	Western Upland Grasslands	Big Sagebrush Scrub	Great Basin Dwarf Sagebrush Scrub	Great Basin Upland Scrub	Great Basin Pinyon-Juniper Woodland	Eagle Lake Native Fish Assemblage	Goose Lake Native Fish Assemblage
Area and extent of community		X	X	X	X		X	X
Fire regime	X	X	X	X	X	X		
Connectivity among communities and ecosystems							X	X
Successional dynamics	X	X	X	X	X	X		
Community structure and composition								
Key species population levels							X	X
Structural diversity						X		
Endemic diversity								X
Native versus non-native diversity	X	X	X	X	X	X	X	X
Age class heterogeneity	X							
Hydrological regime	X						X	X
Soil and sediment deposition regime			X	X	X		X	X
Surface water flow regime							X	X
Water temperatures and chemistry								X
Water level fluctuations							X	X
Nutrient concentration and dynamics								X

5.2.4 Species of Greatest Conservation Need in the Cascades and Modoc Plateau Province

The SWAP regional team identified species that would benefit from the conservation strategies for each target within the province. These species are the focus of the conservation strategies and will benefit from the actions taken to implement the conservation strategies. Not all of the focal species meet the criteria to be considered SGCN. The criteria used to determine SGCN are described in Section 2.4 and the complete list of SGCN for California is presented in Appendix C. Table 5.2-3 lists the focal species for each conservation unit and target within the Cascades and Modoc Plateau Province. SGCN are indicated with an asterisk.

Table 5.2-3 Focal Species of Conservation Strategies Developed for Conservation Targets in the Cascades and Modoc Plateau Province

Common Name	Scientific Name	Conservation Units[1]							
		Southern Cascades		Modoc Plateau			Northwestern Basin and Range	North Lahontan HUC 1808	Sacramento HUC 1802
		North Coastal Mixed Evergreen and Montane Conifer Forests	Western Upland Grasslands	Big Sagebrush Scrub	Great Basin Dwarf Sagebrush Scrub	Great Basin Upland Scrub	Great Basin Pinyon-Juniper Woodland	Eagle Lake Native Fish Assemblage	Goose Lake Native Fish Assemblage
Fishes									
Goose Lake lamprey*	*Entosphenus sp.*								X
Pit-Klamath brook lamprey*	*Lampetra lethophaga*								X
Eagle Lake rainbow trout*	*Oncorhynchus mykiss aquilarum*							X	
Northern Pit roach*	*Lavinia mitrulus*								X
Lahontan speckled dace	*Rhinichthys robustus*							X	
Lahontan redside	*Richardsonius egregius*							X	
Eagle Lake tui chub*	*Siphateles bicolor ssp. 1*							X	
Goose Lake tui chub*	*Siphateles bicolor thalassinus)*								X
Goose Lake sucker*	*Catostomus occidentalis lacusanserinus*								X
Tahoe sucker	*Catostomus tahoensis*							X	
Pit sculpin	*Cottus pitensis*								X
Amphibians									
Coastal tailed frog*	*Ascaphus truei*	X							
Northern leopard frog*	*Lithobates pipiens*		X						
Foothill yellow-legged frog*	*Rana boylii*	X							
Cascades frog*	*Rana cascadae*	X	X						
Oregon spotted frog*	*Rana pretiosa*		X						
Reptiles									
Northern western pond turtle*	*Actinemys marmorata*	X	X	X					

Table 5.2-3 Focal Species of Conservation Strategies Developed for Conservation Targets in the Cascades and Modoc Plateau Province

Common Name	Scientific Name	Conservation Units[1]							
		Southern Cascades		Modoc Plateau			Northwestern Basin and Range	North Lahontan HUC 1808	Sacramento HUC 1802
		North Coastal Mixed Evergreen and Montane Conifer Forests	Western Upland Grasslands	Big Sagebrush Scrub	Great Basin Dwarf Sagebrush Scrub	Great Basin Upland Scrub	Great Basin Pinyon-Juniper Woodland	Eagle Lake Native Fish Assemblage	Goose Lake Native Fish Assemblage
Rubber boa	*Charina bottae*	X							
California mountain kingsnake	*Lampropeltis zonata*		X						
Gopher snake	*Pituophis catenifer*		X	X	X	X			
Birds									
Greater white-fronted goose	*Anser albifrons*		X						
Greater sage-grouse*	*Centrocercus urophasianus*			X	X	X	X		
Sooty grouse	*Dendragapus fuliginosus*	X							
Great egret	*Adea alba*		X						
Osprey	*Pandion haliaetus*	X							
Northern goshawk*	*Accipiter gentilis*	X							
Golden eagle	*Aquila chrysaetos*	X	X	X	X	X	X		
Ferruginous hawk	*Buteo regalis*		X				X		
Northern harrier*	*Circus cyaneus*		X						
White-tailed kite*	*Elanus leucurus*		X						
Bald eagle*	*Haliaeetus leucocephalus*	X							
Sandhill crane	*Grus canadensis*		X						
Short-eared owl*	*Asio flammeus*		X						
Long-eared owl*	*Asio otus*		X	X	X	X			
Burrowing owl*	*Athene cunicularia*		X	X	X	X	X		
Spotted owl	*Strix occidentalis*	X							
Vaux's swift*	*Chaetura vauxi*	X							
Black swift*	*Cypseloides niger*	X							
American peregrine falcon*	*Falco peregrinus anatum*			X	X	X	X		
Olive-sided flycatcher*	*Contopus cooperi*	X							
Gray flycatcher	*Empidonax wrightii*			X	X	X			
Loggerhead shrike*	*Lanius ludovicianus*		X	X	X	X	X		
Purple martin*	*Progne subis*	X	X						
Common yellowthroat	*Geothlypis trichas*		X						
Yellow warbler*	*Setophaga petechia*	X							
Rufous-crowned sparrow	*Aimophila ruficeps*		X						
Sage sparrow	*Artemisiospiza belli*			X	X	X			
Lark sparrow	*Chondestes grammacus*			X	X	X			
Savannah sparrow	*Passerculus sandwichensis*		X						
Green-tailed towhee	*Pipilo chlorurus*			X	X	X			

Table 5.2-3 Focal Species of Conservation Strategies Developed for Conservation Targets in the Cascades and Modoc Plateau Province

Common Name	Scientific Name	Conservation Units[1]							
		Southern Cascades		Modoc Plateau			Northwestern Basin and Range	North Lahontan HUC 1808	Sacramento HUC 1802
		North Coastal Mixed Evergreen and Montane Conifer Forests	Western Upland Grasslands	Big Sagebrush Scrub	Great Basin Dwarf Sagebrush Scrub	Great Basin Upland Scrub	Great Basin Pinyon-Juniper Woodland	Eagle Lake Native Fish Assemblage	Goose Lake Native Fish Assemblage
Brewer's sparrow	*Spizella breweri*			X	X	X			
Western meadowlark	*Sturnella neglecta*			X	X	X			
Yellow-headed blackbird*	*Xanthocephalus xanthocephalus*		X						
Mammals									
Vagrant shrew	*Sorex vagrans*		X						
Long-eared myotis*	*Myotis evotis*	X					X		
Fringed myotis*	*Myotis thysanodes*						X		
Western mastiff bat	*Eumops perotis californicus*		X						
American pika*[1]	*Ochotona princeps*		X				X		
Pygmy rabbit*	*Brachylagus idahoensis*			X	X	X			
Snowshoe hare	*Lepus americanus*	X							
Black-tailed jackrabbit	*Lepus californicus*		X	X	X	X			
Western white-tailed jackrabbit	*Lepus townsendii ownsendii*			X	X	X			
Mountain beaver	*Aplodontia rufa*	X							
Northern flying squirrel	*Glaucomys sabrinus*	X							
Little pocket mouse	*Perognathus longimembris*			X	X	X			
Desert woodrat	*Neotoma lepida*			X	X	X	X		
Dusky-footed woodrat	*Neotoma fuscipes*	X							
Mountain lion	*Puma concolor*	X							
Gray wolf*	*Canis lupus*	X	X						
Sierra Nevada red fox*	*Vulpes vulpes necator*		X						
Ringtail*	*Bassariscus astutus*	X							
California wolverine*	*Gulo gulo*	X	X						
Pacific marten*	*Martes caurina (=Americana)*	X	X						
Pacific fisher - West Coast DPS*	*Pekania [=Martes] pennanti*	X	X						
American badger*	*Taxidea taxus*	X	X	X	X	X	X		
Western spotted skunk	*Spilogale gracilis*	X					X		
Pronghorn antelope*	*Antilocapra americana*			X	X	X			
Roosevelt elk	*Cervus canadensis roosevelti*		X						
Rocky Mountain elk*	*Cervus elaphus*	X							

[1] A species is shown for a particular conservation unit only if it is associated with specific conservation targets identified for the unit.

* Denotes a species on the SGCN list. Non-asterisked species are not SGCN but are identified as important species by CDFW staff.

5.2.5 Pressures on Conservation Targets

If the KEAs are degraded, then the target is experiencing some type of stress. Stresses are caused by pressures, anthropogenic (human-induced) or natural drivers that could result in impacts to the target by changing the ecological conditions. Pressures can be positive or negative depending on intensity, timing, and duration. The priority pressures identified as affecting the viability of conservation targets in the Cascades and Modoc Plateau Province are summarized in Table 5.2-4. The most commonly addressed pressures identified for the province (i.e., those that affect several targets) are discussed below. The relationship between the stresses and pressures are unique for each conservation target and are identified in Section 5.2.6.

Table 5.2-4 Key Pressures on Conservation Targets – Cascades and Modoc Plateau Province

Pressure	Conservation Units and Targets							
	Southern Cascades		Modoc Plateau			Northwestern Basin and Range	North Lahontan HUC 1808	Sacramento HUC 1808
	North Coastal Mixed Evergreen and Montane Conifer Forests	Western Upland Grasslands	Big Sagebrush Scrub	Great Basin Dwarf Sagebrush Scrub	Great Basin Upland Scrub	Great Basin Pinyon-Juniper Woodland	Eagle Lake Native Fish Assemblage	Goose Lake Native Fish Assemblage
Annual and perennial non-timber crops		X	X	X	X			
Climate change						X		
Dams and water management/use			X	X	X		X	X
Fire and fire suppression	X	X	X	X	X	X		
Housing and urban areas			X	X	X			
Introduced genetic material							X	X
Invasive plants/animals		X	X	X	X	X	X	X
Livestock, farming, and ranching	X	X	X	X	X		X	X
Logging and wood harvesting	X	X					X	X
Other ecosystem modifications						X		
Parasites/pathogens/diseases			X	X	X			
Recreational activities			X	X	X			
Renewable energy	X		X	X	X			
Roads and railroads							X	X
Utility and service lines	X		X	X	X			

Most Commonly Addressed Pressures in the Cascade and Modoc Plateau Province

- Annual and Perennial Non-Timber Crops
- Dams and Water Management/Use
- Fire and Fire Suppression
- Housing and Urban Areas
- Invasive Plants/Animals
- Livestock, Farming, and Ranching
- Logging and Wood Harvesting
- Problematic Native Species-Western Juniper Expansion

Annual and Perennial Non-Timber Crops

Farming is limited because of the rugged terrain and thin rocky soils within the province. In the Shasta Valley, there are some 500 square miles of wheat, barley (dry farming), and other crops on irrigated land. Dairies have existed in the province since the 1920s to bring milk to local markets in the Pit River and Goose Lake watersheds. Habitat in valleys and watersheds that was once meadows, shrublands, grasslands, and foothill woodlands has been converted to farmland. The local extinction of sharp-tailed grouse is attributed to the conversion of lands to farming and ranching and the subsequent loss of riparian habitat (Shilling et al. 2002; Williams 1986).

Nutrient runoff from farms has degraded creeks and rivers, negatively affecting ecosystems that support aquatic and riparian species. Grazing and farm waste runoff have increased water temperature and polluted the Fall and Pit River drainages and the Bear Creek drainage with excessive nutrients, lowering dissolved oxygen. Many Pit River tributaries suffered similar degradation from land-use practices. Agricultural water use has resulted in low flows and has dried up river segments within the province. Even pesticide drift has been speculated to have contributed to declines in Cascades frogs in the Modoc Plateau (Davidson 2004).

NPS

Marijuana cultivation is also having deleterious effects on habitat for fish and wildlife. Many illegal and legal sites for growing marijuana include illegal water diversions which are reducing tributary streams to levels inhospitable to fish and other aquatic organisms (Bauer et al. 2015). The use of concentrated fertilizers that leach into streams can be toxic to amphibians, fish, or invertebrates at high concentrations or promote excessive algal growth leading to reduced oxygen levels. The excessive use of herbicides and their surfactants used on these farms can also be toxic to these organisms. Use of pesticides and rodenticides kill target and non-target animals indiscriminately and even bioaccumulate in predators in which the concentration of toxins can lead to illness or death. Please see the description of marijuana cultivation in the North Coast-Klamath Province section for more detail.

Dams and Water Management/Use

Dams and diversions for hydroelectric power and agricultural diversions have disrupted normal flow patterns, increased water temperatures, and blocked spawning migrations within the

province waterways. Large and small dams have fragmented creeks and rivers, permanently isolating subpopulations of aquatic species such as the Shasta crayfish, Eagle Lake rainbow trout, and Lost River sucker. The seasonal fluctuation in river water levels caused by hydropower operations affects fish, reptiles, amphibians, invertebrates, and plants. Rapid reductions in water flows strand spawning salmon and trap young salmon in pools on their journey to the sea. Rapid releases also have detrimental effects on herptofaunal by scouring away amphibian egg masses and tadpoles and inundating turtle nests. Thousands of miles of rivers and streams no longer support salmon and steelhead because migration is blocked by hydropower dams. Radical stream flow fluctuations and higher-than-normal flows from peaking hydropower projects can drown deer and other animals if high-flow releases are improperly timed with migratory or reproductive seasons. Hydropower project operations have major consequences for rivers and riverine ecosystems of the Cascades, contributing to the decline of endangered salmon, steelhead, and other fish populations. Similar to the barriers mentioned above, hydropower operations affect water from rivers and streams, changing natural flow regimes of rivers, altering water temperature, and blocking fish passage and migration. Many of locally endemic fish within this province are now either listed as threatened or as species of special concern, such as the Eagle Lake and Goose Lake rainbow trout and tui chubs.

Major dams in the province include those within the Pit River and Lost River watersheds. The lower Pit River is one of California's most significant hydroelectric rivers because of its perennial flow and steep elevation drop near Shasta Lake. It generates 13 percent of California's hydropower through a series of dams. Hat Creek and Fall Rivers further up the watershed also have powerhouse dams along them. The Fall River emerges as spring water in the southern Cascades, receives the Bear Creek drainage, and then joins the Pit River. Fall River is known for its premiere wild trout fishery; however, sediment runoff from past land-use practices in the Bear Creek watershed has polluted Fall River (State Water Resources Control Board [SWRCB] 2003). Large sediment loads, erosion, and declining water quality have degraded habitat essential to the Shasta crayfish and has led to its extremely reduced current range. The several dams and reservoirs within the watershed have degraded the main stem and tributaries of the Pit River. The SWRCB listed the Pit River and Fall River as impaired in 2002 for failing to meet state water quality standards (SWRCB 2003).

Clear Lake Dam on the Lost River provides storage for irrigation and reduces flow into the reclaimed portion of Tule Lake and the restricted Tule Lake Sumps in Tule Lake National Wildlife Refuge. Surface waters in the Lower Lost River and its tributaries are listed as impaired for nutrients and impaired for high pH levels (more acidic) as per the 2008-2010 Section 303(d) List (North Coast Regional Water Quality Control Board [NCRWQCB] 2015). The combined effects of damming of rivers, instream flow diversions, draining of marshes, dredging of Upper Klamath Lake, and other water manipulations have threatened both the endangered Lost River and shortnose sucker species with extinction (California Department of Pesticide Regulation [CDPR] 2015). Additionally, water quality degradation in the Klamath Basin watershed through inappropriate grazing and logging techniques, dams, levees, channelization, roads, etc. has led to large-scale fish kills related to algal bloom cycles.

Watershed Fragmentation and Fish Barriers

Aquatic species depend upon the ability to move within watersheds as a way to survive temperature changes and catastrophic events and to access different habitats at different stages in their lives. Upstream tributary habitats offer breeding and rearing grounds, and downstream habitats usually provide expanded nurseries with an abundance of nutrients. This annual mixing and migration allows recolonization of tributary or downstream habitats following catastrophic events such as floods or fires. Aquatic connectivity is an important part of overall watershed function, one that has been disrupted by many activities. Present populations of numerous fish species are confined below or above dams or separated by other fish barriers such as poorly designed culverts. These artificial barriers prevent genetic mixing between populations and block recolonization of areas within the watershed. Within these fragmented watersheds, native minnows and other fish and amphibian populations are listed either as threatened or endangered or as species of special concern. Improving fish passage is of particular concern in the Eagle and Goose Lake watersheds within this province.

The Goose Lake watershed is home to four endemic species of fish: the Goose Lake redband trout, sucker, tui chub, and lamprey. Goose Lake tributaries are important refugia for these species during extensive dry periods when the lake dries up, and the removal of water diversions and fish passage barriers from roads, diversions for livestock and agriculture, levee and other human activities are critical for maintaining these fish populations without human intervention (e.g., trapping and hatchery production). Because of apparent declines in these native fish populations and the concern over federal and state endangered species listings, the Goose Lake Watershed Council was formed to protect habitat and fish species in the basin. The Goose Lake Fishes Conservation Strategy was prepared in 1996, which continues to guide management priorities for this watershed that include protecting and restoring aquatic and terrestrial habitat and native fish populations. Since its formation, a large number of habitat improvement projects, riparian fencing, grazing management projects, diversion replacements, fish passage improvements, and installations of fish screens have occurred throughout the watershed basin (Lake County Watershed Councils 2015).

Small-Scale Diversions and Groundwater Use

The cumulative effects of small-scale surface water diversions have substantial consequences for some of the province's river systems including Goose Lake, Eagle Lake, and Lost River watersheds. Agricultural and domestic water use has resulted in low flows and has dried up river segments. Small-scale diversions to provide livestock water sources have depleted instream flows in some waterways, such as the Eagle Lake and Goose Lake watersheds. These changes will be compounded by longer, drier summers brought on by the effects of climate change.

Major water management issues within the Eagle Lake watershed include the management of Eagle Lake rainbow trout which requires the removal of water diversions and impoundments along Pine Creek, one of their major spawning areas. The Eagle Lake rainbow trout is uniquely adapted to tolerate the high levels of alkalinity and only occurs naturally in Eagle Lake. Current and ongoing

water management pressures to the species include a hatchery weir which blocks access to Pine Creek, water diversions for livestock grazing and other uses along Pine Creek that dewater the lower reaches. Local wells are also potentially at fault by reducing groundwater, drawing water from the aquifer and lower Eagle Lake during extensive dry years. The increasing water salinity as a result threatens the survival of the native trout and other fish species in the lake.

Fire and Fire Suppression

Fire is an ecologically important disturbance that shapes and maintains native plant communities and wildlife habitats. Fire frequency and intensity are determined by the pattern and density of vegetation (fuel loading), landscape topography, fuel moisture, and long-term weather trends. In turn, fire affects ecological processes, the vegetative mosaic of the landscape, the structural diversity of habitats, and the accumulation of organic material. Specific plant communities or habitats have evolved within ranges of fire-return intervals. At higher elevations, natural wildlife habitats of northeastern California are adapted to specific fire return intervals of between 12 and 30 years. At lower elevations and drier sites dominated by shrubs, with less dense fuel, natural fire return intervals may be 30 to 100 years (Brooks and Pyke 2001; Chang 1996; Young et al. 1988); however, for the past 150 years, land-use activities, native and non-native plant invasions, and fire suppression have increased or decreased fire frequencies, upsetting fire regimes and degrading habitat for native species (Arno and Fiedler 2005). Coupled with selective harvest of large trees, road building, and intensive grazing, suppression of fire over the last 100 years has affected fire frequency and intensity and thus dramatically reshaped forest structure and altered ecosystems throughout the region.

For example, in native shrub-grass communities, overgrazing in the years between the 1860s and the 1930s reduced native perennial grasses, providing conditions more beneficial to invasive annual grasses and to shrub expansion. The proliferation of flammable annual grasses such as cheatgrass and medusahead have led to increased fire frequency in many areas, reducing less fire-tolerant shrubs, such as big sagebrush, mountain mahogany and lower-elevation bitterbrush. More-frequent fire disturbance has facilitated additional invasions of non-native plants, further transforming the plant community to a monoculture of invasive grasses less suitable for native wildlife (Brooks and Pyke 2001; McAdoo et al. 2002). Additionally, with the absence of fire on the landscape, native juniper has succeeded into the once treeless sagebrush shrublands. As the trees proliferate and their density increases, the intensity of fire as it moves through the landscape increases proportionally, causing higher-intensity fire than previously observed and enhancing the power of invasive annual grasses to succeed post-fire.

One of the major management challenges for this province is sustaining ecosystem functionality, including those provided from the fire regime (timing, frequency, intensity and extent), while ensuring safety and avoiding catastrophic events. Strategies needed to address this issue include coordination with partner stakeholders to search for mutual solutions by revisiting and updating the current fire management protocols so that the future Best Management Practices

(BMPs) of forests would also embrace measures that benefit fish and wildlife. To restore native communities in the Cascades and on the Modoc Plateau, forest ecologists generally agree that fire needs to be returned to forests and shrublands at intervals consistent with historical fire regimes. Returning fire to the forests presents the greatest of challenges. The fire threat to people and expanding communities in the forests, excessive fuel loads created by fire suppression and past forest management practices, effects on air quality and conflicts with clean-air laws, and liability all impose difficult constraints on the increased use of prescribed fire and allowing natural fires to burn. Even with the best efforts to reduce fire conflicts and risks, in many areas, reintroducing fire will not be practical or politically possible, at least as a first treatment. Certainly in some locations, selective timber harvest may have to serve as the surrogate for natural fire to begin the process of restoring ecological diversity to forests. Mechanical thinning, however, will not provide all of fire's ecological benefits.

Housing and Urban Areas

Pressures with growth and development have particularly occurred in the lower elevations of the province within the Southern Cascades ecoregion with subdivisions of one to twenty acres as part of rural development on the margins of larger urban and suburban zones around cities outside the ecoregion. The greatest growth and development have occurred in the mostly privately owned western foothills, such as those east of Redding. Development pressure is strong in the foothills adjacent to the metropolitan centers such as Redding, particularly along the foothill river corridors near these cities.

Ranchette and residential communities are expanding from metropolitan area of Redding within the Cascades region. New development along highway corridors is displacing wildlife habitat and creating barriers in important wildlife migration areas. Key wildlife corridors in the region are crossed by highways. Major highways, such as State Routes 44, 89, 97, and 299, traverse the Southern Cascades and are seeing increased levels of vehicle traffic each year. As development expands on the private lands adjacent to these highways, and traffic increases, migrating mule deer, elk, and antelope will be less able to move between seasonal ranges. Increased traffic loads also increase the frequency of bird, small mammal, reptile, and amphibian mortalities as they attempt to cross the highways. Without conservation planning, future development along these corridors will likely have a significant impact on the region's wildlife.

In the Southern Cascades Ecoregion, development is also expanding into the forest. New golf courses, single-family homes, commercial properties, ski resorts, industrial sites, and new roads are replacing and fragmenting wildlife habitat. Where development occurs, fire is suppressed, preventing regeneration of fire-dependent vegetation and altering plant communities. Development also requires new water diversions and creates new sources of pollution. Mountain meadows, oak woodlands, and riparian streams are places of high wildlife diversity, and they are also preferred sites for development. As seasons change, the survival of many mammal, bird, amphibians, reptiles, and fish species depends on their ability to migrate between higher and

lower elevations. Because of development and even roads, these species are cut off from necessary uplands or aquatic habitats. For instance, turtles and garter snakes inhabiting streams leave to nest and overwinter in the uplands, and pond-breeding amphibians migrate en masse from the uplands to aquatic habitat when winter rains commence. Opportunities to migrate successfully have been compromised by dams, reservoirs, highways, altered stream flows, residential community development, and predation by free-roaming domestic pets.

Invasive Plants/Animals

Invasive Plants

Numerous exotic grasses and plants, like perennial pepper weed, cheatgrass, medusahead, red brome, and various non-native thistles and aquatic weeds, such as Eurasian watermilfoil, have displaced native plants and altered local plant communities. One species, cheatgrass, has had a particularly dramatic impact on native shrub and grassland communities on the Modoc Plateau. Native to southern Europe, North Africa, and southwestern Asia, cheatgrass was first dispersed in northeastern California sometime in the early 1900s, probably via contaminated grain seeds. Cheatgrass displaces native grasses and forbs by more effectively tapping soil moisture and hinders seedling establishment of native shrubs by reducing moisture and nutrients in surface soils (Norton et al. 2004). Once established and abundant, cheatgrass facilitates frequent fires by providing a carpet of fine fuels, which carries fire more efficiently than well-spaced native perennial grasses and native shrubs (Pellent 1996). Plant species slow to recolonize following fire, like bitterbrush and sagebrush, decline with increased fire frequencies. Cheatgrass has converted native vegetation to fire-prone grasslands, destroying sagebrush, bitterbrush, and mountain mahogany plant communities. The invasion of cheatgrass, medusahead, and other exotic plants has contributed to the wholesale conversion of thousands of acres of sagebrush, bitterbrush, and mountain mahogany plant communities to annual grasslands less supportive of native wildlife (Henstrom et al. 2002; Miller et al. 1994; Schaefer et al. 2003; Young 2000).

In the Modoc Plateau ecoregion, the annual grass medusahead is also invading dry shrublands, causing changes in vegetation diversity and fire frequency. Medusahead competes and replaces other annual invasives, such as cheatgrass, leading to monocultural stands of medusahead that are avoided by most native species of terrestrial animals. Medusahead plants are palatable to livestock when the plants are young, but become unpalatable as they mature and silica concentrates in their inflorescence. The high silica content causes the dead plants to resist decay, leading to build up of dense thatch that is composed primarily of medusahead plants. Other plant species cannot germinate beneath this thatch, proliferating the cycle of an ever expanding monoculture of medusahead. This dense thatch and monoculture is very susceptible to fire and increases fire risk and frequency within these lands. Once burned, the seed bank is composed primarily of medusahead seeds which resprout vigorously and repeat the cycle. Native animal and plant diversity is reduced and threatened in these areas.

Introduced Non-Native Fish

The introduction of non-native fish to lakes and streams may significantly affect the aquatic life in the province. Specifically, non-native brown and/or brook trout that prey upon or compete with the native species such as Goose Lake redband trout, may reduce populations of native fishes. Brook trout and brown trout in Davis and Pine creeks have been particularly problematic to the native aquatic assemblages. Brook trout are problematic in Pine Creek in the Eagle Lake Watershed and brown trout within Davis and Pine Creeks in the Goose Lake Watershed. In Pine Creek with the Eagle Lake Watershed specifically, brook trout limit populations of Eagle Lake rainbow trout through competition and predation. Brook and brown trout are present in many of the cold water streams and creeks within the region and CDFW has begun an eradication program within this province to remove these fish from critical native fish spawning and rearing habitat (McAlexander, pers. comm. 2015). Other species, both native and non-native, such as largemouth bass, blue chub, yellow perch, fathead minnows, and rainbow trout may reduce recruitment of other SGCN such as the Lost River and shortnose suckers. These and other non-native aquatic species may reduce or extirpate populations of sensitive endemic crayfish, amphibians and fish within the province.

Problematic Native Species – Western Juniper Expansion

Livestock grazing between 1880 and 1930 likely facilitated the expansion of native western juniper. Grazing consumed fine fuels, decreasing fire frequency and reducing competition from herbaceous species. (This process began 30 to 50 years before invasive grasses increased fire frequencies in the early 1900s.) The reduced fire frequency allowed western juniper to expand its coverage into sagebrush, bitterbrush, mountain mahogany, riparian, and aspen plant communities (BLM 2004; Miller and Rose 1999). Juniper has flourished by outcompeting other vegetation for water and nutrients and altering ecosystems to such an extent that other once-abundant native plants and wildlife are now scarce in these areas. In the last 130 years, juniper has increased its coverage in the plant communities tenfold and now covers more than 2.5 million acres of northeastern California (Eastern Oregon Agricultural Research Center 2004; USFS 2004; OSU 2005). The expansion and increased density of this tree reduces shrubs, herbaceous cover, and plant diversity, decreasing habitat for shrub-affiliated native wildlife (Miller et al. 2000; Miller 2001). As juniper crowds out shrubs and forbs, ground- and shrub-nesting birds are absent or in low numbers. With the increase in juniper dominance and the decline of sagebrush communities on the Modoc Plateau, greater sage-grouse populations have plummeted.

Jeannie Stafford, USFWS

There have been limited efforts to reduce western juniper to encourage the growth of shrubs and grass for forage. The Big Sage Fire Management Unit, which overlies portions of the Devil's Garden and Doublehead Forest Districts, has a fire plan that allows lightning caused fires to burn with

minimum suppression effort. This practice has reduced juniper on several hundred acres. Since 1980, the Doublehead Ranger District of the Modoc National Forest has removed about 150 acres per year of western juniper through firewood sales (USFS 1991a). The Cooperative Sagebrush Steppe Restoration Initiative, launched by a coordinated effort of BLM and USFS, is preparing plans for landscape treatments to reestablish the shrub communities that are more important for wildlife. Reestablishing native shrubs and grasses where juniper now dominates is not as simple as cutting down or burning acres of juniper. Invasive annual grasses, rather than native plant communities, are likely to replace the juniper unless conditions are appropriate to benefit the native plants. Conversion of juniper to alternate native plant communities will require careful field testing and analysis of results, followed up with adaptive management (Belsky 1996; Miller 2011).

Livestock, Farming, and Ranching

Incompatible Livestock Grazing

Livestock production is a major economic activity of northeastern California. The Modoc Plateau and the adjacent forested lands have been grazed since the late 1800s. While livestock grazing practices have improved over the last few decades, excessive grazing continues to degrade shrublands, riparian plant communities and aquatic ecosystems in the province (USFS 1991b, 2000b, 2001b). Today, there are very few areas in the province that are not grazed. Grazing allotments cover nearly all public forest and rangelands that can support large herbivores. For example, the Warner Mountain Range is currently managed as rangeland for cattle and sheep, with 28 grazing allotments covering nearly the entire landscape, including much of the South Warner Wilderness Area (USFS 2000b). According to the U.S. Department of Agriculture (USDA) 2013 agricultural statistics, approximately 146,600 cattle are produced within Lake, Lassen, Modoc, Plumas, and Shasta Counties; this includes rangeland cattle and feed cattle (USDA 2014). Approximately 50,000 cattle graze in Lassen County on the grasses in the sagebrush areas and on irrigated pasture (DWR 2013). Livestock in the region are typically grazed on private lands in the winter and moved to BLM and USFS lands in the spring and summer. Grazing continues to occur throughout USFS and BLM lands throughout the region.

Excessive livestock grazing has both short-term and long-term impacts. Seasonally, grazing reduces available herbaceous vegetation required by native herbivores, and it reduces nesting- and escape cover for birds and other wildlife. As upland grasses and forbs dry in the summer, livestock grazing intensifies around riparian and meadow habitats, and browsing shifts to other higher-protein sources such as bitterbrush, mountain mahogany, and aspen; annual bitterbrush leaders and willow and aspen shoots are consumed (Loft et al. 1998; Menke et al. 1996; USFS 1991b; Young and Clements 2002). Excessive grazing removes vegetation and causes erosion along springs, creeks, meadows, and riparian corridors of the Modoc Plateau Ecoregion (Moyle 2002).

Decades of excessive livestock grazing have also contributed to long-term ecosystem and habitat changes in the region. Since the late 1800s, overgrazing has triggered change in composition and abundance of grasses, herbs, shrubs, and tree species. Livestock carried seeds of invasive species

such as cheatgrass into the region. Grazing pressure created conditions for invasive grasses to outcompete native species and facilitated shrub growth over perennial grasses. Exotic annual grasses, particularly cheatgrass, carpet the landscape with fine fuels conducive to more frequent fires in shrub-grass plant communities (Pellent 1996 and 2002). Intentional clearing of sagebrush stands to improve range conditions for livestock also contributed to the transformation of shrub habitats. This combination of grazing-associated pressures has caused landscape-level changes, resulting in steep declines in the sagebrush, bitterbrush, and mountain mahogany plant communities that once supported abundant populations of greater sage-grouse and other shrub-dependent species. Grazing has also degraded wildlife habitat in areas like the sagebrush steppe on the Devil's Garden, the forestlands of the Warner Mountains, and the forest meadows throughout the region, reducing habitat values for native species (Menke et al. 1996; Miller et al. 1994; Young and Clements 2002).

Reduced fire frequency and incompatible livestock grazing throughout the growing season have contributed to the decline of aspen communities in the region. Livestock, along with deer and elk, consume aspen suckers and shoots and compact soft soils, preventing the successful regeneration of aspen stands. Like riparian habitats, aspen stands represent a small area of the landscape, but they are very important for supporting wildlife diversity. The multilayered vegetative structure found in the understory of aspen stands consists of herbs, shrubs, and woody debris which provides abundant food and shelter for wildlife. Cottontail rabbit, snowshoe hare, porcupine, beaver, mule deer, blue grouse, quail, flycatchers, bluebirds, and Northern goshawk are among the animals that utilize and rely on aspen communities (FRAP 2003; Loft et al. 1987).

Riparian and aquatic ecosystems are particularly affected by livestock grazing today (USFS 1991b, 2001b). Sedimentation cause through over grazing on stream or erosion through trampling has cause water quality issues in many of the watersheds within the province including Eagle and Goose Lake watersheds. Water diversions to allow livestock access to fresh water have also cause dewatering of streams of creeks important to critical aquatic species such as those in the Eagle and Goose Lake fish assemblages. Various public and private efforts are under way in the region to restore stream habitats or to prevent further damage from livestock. The Central Modoc Resource Conservation District and the Pit River Watershed Alliance are working with land owners on stream restoration projects. USFS has fenced some streams to protect the endangered Modoc sucker and other species. Rotational grazing systems that provide periodic cessation of grazing pressure on a regular basis have been implemented to restore riparian habitats on many grazing allotments on the Modoc National Forest. The Goose Lake Watershed Council has worked on many habitat improvement projects toward this goal of reducing livestock impacts such as riparian fencing, grazing management projects, and diversion replacements (Lake County Watershed Councils 2015).

Excessive Feral Horse Grazing

While grazing by wild horses is very limited compared to cattle and sheep grazing in the region, it adds to the total impact of livestock and wildlife grazing. Since the arrival of settlers in the late 1800s, horses have escaped or been released, and today horses roam as wild herds throughout the Modoc Plateau Region. More than 2,300 wild horses graze year-round in northeastern California and border areas of Nevada on BLM and USFS land in eight Herd Management Areas. Wild horses graze riparian and aquatic plant communities in late season, when these habitats are most vulnerable to damage (Beever 2003). One of the largest herds in the region is on the Modoc National Forest's 236,000-acre Devil's Garden Wild Horse Territory, overlapping 10 livestock-grazing allotments. Many of the Devil's Garden horses are descendants of draft horses, large animals with big hooves. The heavier animals consume more forage and likely cause more trampling damage to delicate soils and creek beds than smaller horses.

For the past 30 years, USFS, with the help of BLM, has tried to maintain horse numbers in the Wild Horse Territory within appropriate management levels. Excessive horse numbers contribute to overgrazing in the region, leaving less forage for wildlife, degrading range condition, and adding to grazing impacts on seeps, springs, riparian habitat, and aspen stands. The lack of resources to maintain limited horse herd sizes means horses contribute to overgrazing of the region; thus, the combined grazing of livestock and horses far exceeds grazing levels that are compatible with maintaining wildlife diversity and abundance.

Logging and Wood Harvesting

Forest management practices, including even-aged tree production, road building, and fire suppression, significantly affect forest ecosystems and wildlife in the Modoc Plateau and Cascade Province, as they do in the Sierra Nevada.

For the last century, forest management practices have adversely affected wildlife and plant communities of the Sierra Nevada, Cascades, and the Modoc Plateau regions. The cumulative effects of even-aged timber-harvest practices, elimination of older trees, snags and brush, logging-road construction, and fire suppression have changed forest plant communities and ecosystem processes. Old-forest conditions (old-growth and late-seral forest) has been drastically reduced throughout the Sierra, Cascades, and Modoc regions (USFS 2001). Fire suppression has allowed denser forests to persist with more shade tolerant trees in the understory causing heightened fire risk and risk of larger, catastrophic fires. While some of these pressures have been reduced in recent years, they all continue to affect the forests' ecosystems and wildlife.

Maintaining diverse wildlife requires forests that contain, in adequate distribution, all sizes and ages of trees, areas of open and closed canopies, and a varied landscape shaped by natural disturbance. Much of the Sierra Nevada, Cascades, and Modoc mixed-conifer forests need to be thinned to restore complex forest structure, improve conditions for wildlife, and reduce the risk of catastrophic fires (Smith 2001).

In addition to treatments of forest stands, regeneration practices following timber harvests or fire are very important in shaping the future forest structure. While timber harvest strategies on public lands are beginning to incorporate wildlife and habitat needs, regeneration practices have generally not made similar changes. In some national forests, regeneration treatments clear shrubs and herbaceous vegetation to promote growth of tree species. Yet shrubs and herbaceous vegetation are particularly important for wildlife. These kinds of post-harvest treatments are more common on private forest lands. The National Forest Management Act and federal regulations prescribe the method and speed of reestablishing the next generation of trees on federal lands (Tappeiner and McDonald 1996). State Forest Practice Rules have similar prescriptions for private forest lands. These regeneration prescriptions are generally designed to enhance timber production and do not generally support regeneration practices specifically to benefit wildlife and restore diverse native plant communities. For example, if a land owner wishes to restore aspen stands following the removal of conifers, the State Forest Practice rules on regeneration may conflict with this activity.

Climate Change

Temperature

Annual average temperatures are expected to increase by 1.8 to 2.2°C (3.2 to 4.0 °F) by 2070 in the Southern Cascades, and 1.7 to 2.4°C (3.0 to 4.3°F) by 2070 in the Modoc Plateau (PRBO 2011). January average temperatures throughout the province are projected to increase 0.3 to 2.2°C (0.5 to 3.2°F) by 2050 and 1.7 to 3.3°C (3.0 to 5.9°F) by 2100, while July average temperatures are projected to increase 1.7 to 3.1°C (3.0 to 5.6°F) by 2050 and 4.4 to 5.6°C (7.9 to 10.0°F) by 2100, with larger temperature increases in the mountainous areas in the northeastern portion of the region (CalEMA 2012). Mean maximum and minimum temperatures are projected to increase by 2.7 and 2.5°C (4.9 and 4.5°F), respectively (Bell et al. 2004).

The projected impacts of climate change on thermal conditions in this region will be warmer winter temperatures, earlier warming in the spring, later cooling in the fall, and increased summer temperatures (PRBO 2011).

Precipitation and Snowpack

Annual precipitation is projected to decline approximately 2.5 cm (1 inch) by 2050 and 5 cm (2 inches) by 2100 for most of the province. Warmer temperatures are projected to result in earlier snowmelt, and March snowpack is projected to disappear by 2090 for most of the province, with the exception of higher elevation areas near Mt. Shasta (DWR 2008; CalEMA 2012).

Change in Freshwater Hydrologic Regimes

Loss of snowpack in this region would suggest a potential decrease in duration and magnitude of flows (PRBO 2011). Shifts in timing of runoff are projected to occur in the Cascades, with more occurring in winter/early spring, less in spring/summer. As runoff timing changes, lower

base stream flows are projected in summer and seasonally higher water temperatures are projected to occur in the fall (CNRA 2009; DWR 2008).

Wildfire Risk
Substantial increases in the likelihood of wildfires are projected in most of the region, especially in Shasta and Siskiyou counties where risks may be multiplied 6 to 14 times by the end of the century (CalEMA 2012). Areas burned could increase up to 50 percent in the northern portion the Southern Cascades (PRBO 2011).

5.2.6 Conservation Strategies

Conservation strategies were developed for six conservation targets in the Cascades and Modoc Plateau Province. The goals for each target are listed below. The strategies to achieve the goals for the target are provided, along with the objectives of the strategies and the pressures intended to be reduced by implementing the strategies. When specific actions have been identified for the strategies, they are also listed. Tables 5.2-5 through 5.2-10 show the relationships between the stresses and the pressures for each target. Table 5.2-11 summarizes conservation strategies for the province.

Target: North Coastal Mixed Evergreen and Montane Conifer Forests

Goals:
- By 2025, acres where native species are dominant are increased by at least 5 percent from 2015 acres.
- By 2025, acres with desired stages of succession are increased by at least 5 percent from 2015 acres.
- By 2025, acres with desired age class heterogeneity are increased by at least 5 percent from 2015 acres.
- By 2025, acres with desired structural diversity are increased by at least 5 percent from 2015 acres.
- By 2025, acres with desired fire regime are increased by at least 5 percent from 2015 acres.
- By 2025, miles with desired level of water yield are increased by at least 5 percent from 2015 miles.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect land through acquisition and conservation easements.

Objective(s):
- Increase the amount of key conifer areas protected through purchase or conservation easement. Key conifer areas are old-growth forest, watercourse zones, and nest sites.

Intended pressure(s) reduced: Logging and wood harvesting.

Conservation action(s):

- Identify potential key conifer areas for purchase or conservation easement.
- Develop a habitat conservation plan.
- Develop database to track acquisition.
- Develop protection criteria for conservation easement language: standardize, complete, doable, executable, legally enforceable, protection criteria.
- Develop Conceptual Area Protection Plan (CAPP) or Land Acquisition Evaluation (LAE).

Conservation Strategy 2 (Data Collection and Analysis): Conduct research (data management) to identify areas with restoration potential to allow prioritization for protection and restoration. Work with other agencies doing restoration in sagebrush steppe habitat throughout the region. Map vegetation following standard protocol and fill information gaps into what has already been mapped. Prioritize for restoration areas of encroachment that have not crossed over to juniper woodland.

Objective(s):

- Research efficacy of different techniques to manage forest and reduce catastrophic fire.
- Document the response of wildlife post-fire and to different types of logging techniques.
- Document baseline conditions and monitor trends of SGCN using occupancy as a metric.
- Document baseline conditions and monitor trends of the conifer forest ecosystem.

Intended pressure(s) reduced: Fire and fire suppression; logging and wood harvesting.

Conservation action(s):

- Work with federal agencies and add wildlife component to ongoing/funded research.
- Document the response of wildlife post-fire.
- Document response of wildlife to different types of logging.
- Document baseline conditions and monitor trends of SGCN using occupancy as a metric.
- Document baseline conditions and monitor trends of the conifer forests ecosystem.

Conservation Strategy 3 (Outreach and Education): Provide outreach and education for the conservation of natural resources.

Objective(s):

- Educate public on the ecological effects of fire and on recent landscape changes within the province.
- Relate fire management to beneficial uses of wildlife.

Intended pressure(s) reduced: Fire and fire suppression.

Conservation action(s):

- Conduct field trips and workshops.
- Develop brochures and web content.
- Encourage small landowners to do proper thinning.

Conservation Strategy 4 (Law and Policy): Advocate for laws and policies that protect and enhance natural resources.

Objective(s):

- Coordinate with agencies to allow fires to burn when possible.

Intended pressure(s) reduced: Fire and fire suppression.

Conservation action(s):

- Prioritize areas that can be allowed to burn.

Conservation Strategy 5 (Law and Policy): Engage in decision-making process, through cooperation with federal agencies and private landowners on where controlled burns and forest thinning would be most beneficial to wildlife. Coordinate with state and federal agencies, tribal entities, the non-governmental organization community and other partners to establish a decision-making process to achieve shared objectives and broader coordination across overlapping areas.

Objective(s):

- Cooperate with federal agencies and private landowners on where controlled burns and forest thinning would be most beneficial to wildlife.

Intended pressure(s) reduced: Fire and fire suppression.

Conservation action(s):

- Coordinate with Fire Science Centers.
- Engage in forest treatment priorities and elevate wildlife to a higher priority.
- Work with USFS to identify possible treatment areas.
- Establish ways to identify and prioritize high value wildlife habitat.

Conservation Strategy 6 (Management Planning): Develop management plans to improve existing fire management plans and identify high value wildlife habitat.

Objective(s):

- Improve existing fire management plans by identifying high value wildlife habitat.

Intended pressure(s) reduced: Fire and fire suppression.

Conservation action(s):

- Coordinate with state and federal agencies.
- Engage USFWS with respect to listed species and management indicator species.
- Identify high value forested wildlife habitats.

Table 5.2-5 Stresses and Pressures for North Coastal Mixed Evergreen and Montane Conifer Forests					
Priority pressures	Stresses				
	Changes in geophysical and disturbance regime	Ecosystem changes			
	Change in natural fire regime	Change in biotic interactions (altered community dynamics)	Changes succession processes and ecosystem development	Habitat fragmentation	Change in community structure or composition
Fire and fire suppression		X	X	X	X
Livestock, farming, and ranching		X			X
Logging and wood harvesting	X		X	X	X
Renewable energy				X	
Utility and service lines		X	X		X

Target: Western Upland Grasslands

Goals

- By 2025, acres of habitat are increased by at least 5 percent from 2015 acres.
- By 2025, acres where native species are dominant are increased by at least 5 percent from 2015 acres.
- By 2025, acres with desired structural diversity (remove in-growth trees from within grassland habitats) are increased by at least 5 percent from 2015 acres.
- By 2025, acres with desired fire regime are increased by at least 5 percent from 2015 acres.

Conservation Strategy 1 (Land Acquisition/Easement/Lease): Protect and restore land through acquisitions or conservation easements.

Objective(s):

- Within 10 years restore 5,000 acres perennial grasslands.

Intended pressure(s) reduced: Annual and perennial non-timber crops.

Conservation action(s):

- Conduct assessment of parcels for potential restoration of perennial grasslands.
- Develop LAE or CAPP.
- Complete management and restoration plan.

Conservation Strategy 2 (Data Collection and Analysis): Baseline data collection and analysis on effect of natural fire on grasslands.

Objective(s):

- Collect and analyze data to understand the optimal fire return interval to promote perennials, control invasive species using fire (timing, intensity), and understand dynamic of fire disturbance regime.

Intended pressure(s) reduced: Fire and fire suppression.

Conservation action(s):

- Collaborate with USFS Fire Laboratory.
- Develop study design for fire response in grassland habitat.
- Coordinate with CAL FIRE and USFS to conduct study.

Conservation Strategy 3 (Economic Incentives): Provide economic incentives by providing restoration grants, collaborating with federal agencies to identify opportunities to implement joint conservation actions, develop a habitat conservation plan or voluntary local program, or implement candidate conservation agreement to protect candidate species that are vulnerable.

Objective(s):

- Provide restoration grants to incentivize landowners to conserve and restore habitat.
- Collaborate with federal agencies and identify opportunities to implement joint conservation actions.
- Develop a Habitat Conservation Plan (HCP) or voluntary local program such as a Candidate Conservation Agreement. The Candidate Conservation Agreement would focus on protecting candidate species that are vulnerable.

Intended pressure(s) reduced: Annual and perennial non-timber crops; livestock, farming, and ranching.

Conservation action(s):

- Coordinate development of Private Land Management Plans with CDFW and private landowners.

Conservation Strategy 4 (Law and Policy): Advocate for laws and policies by influencing land use policies and coordinating with federal agencies to reduce grassland conversion.

Objective(s):

- Coordinate with federal agencies to influence land use policies to reduce grassland conversion.

Intended pressure(s) reduced: Livestock, farming, and ranching; fire and fire suppression.

Conservation action(s):

- Partner with California Rangeland Conservation Coalition.
- Provide input on federal regulation governing grazing allotments.
- Engage USFS in review of BMPs.
- Identify laws and regulations governing perennial grasslands and work with governing agencies to apply.
- Evaluate the efficacy of creating new policies and regulations protecting grasslands.
- Make recommendations to enhance enforcement of existing laws and regulations.

Conservation Strategy 5 (Land Use Planning): Provide input on local planning regarding the conservation of natural resources.

Objective(s):

- Influence local planning by commenting on general plan updates.

Intended pressure(s) reduced: Strategy acts directly on target.

Conservation action(s):

- Engage county planning staff on local land use policy.

Conservation Strategy 6 (Direct Management): Manage invasive species.

Objective(s):

- Control or eradicate invasive species.

Intended pressure(s) reduced: Invasive plants/animals.

Conservation action(s):

- Conduct assessment of number and species of invasive species.
- Develop plan to control invasive species.
- Implement management plan to control invasive species.

Conservation Strategy 7 (Direct Management): Manage grazing.

Objective(s):

- Improve community composition of perennial grasslands.

Intended pressure(s) reduced: Livestock, farming, and ranching.

Conservation action(s):

- Conduct pilot project to implement grazing BMPs.

Table 5.2-6 Stresses and Pressures for Western Upland Grasslands

Priority pressures	Stresses				
	Changes in geophysical and disturbance regime	Changes in soil characteristics	Ecosystem changes		
	Change in natural fire regime	Change in soil moisture	Change in spatial distribution of habitat types	Change in community structure or composition	Changes succession processes and ecosystem development
Annual and perennial non-timber crops			X	X	
Fire and fire suppression	X			X	
Invasive plants/animals				X	
Livestock, farming, and ranching	X	X			X
Logging and wood harvesting	X				

Target: Big Sagebrush Scrub, Great Basin Dwarf Sagebrush Scrub, Great Basin Upland Scrub

Goals:

- By 2025, acres where native species are dominant are increased by at least 5 percent from 2015 acres.
- By 2025, acres of habitat are increased by at least 5 percent from 2015 acres.
- By 2025, acres with desired fire regime are increased by at least 5 percent from 2015 acres.
- By 2025, acres with suitable soil characteristics are increased by at least 5 percent from 2015 acres.
- By 2025, acres with desired stages of succession are increased by at least 5 percent from 2015 acres.

Conservation Strategy 1 (Data Collection and Analysis): Conduct research (data management) on restoration to inform prioritization of potential restoration areas.

Objective(s):

- By 2025, the restoration potential of sagebrush habitat is known.
- By 2025, coordinate data management efforts between agencies.
- By 2025, utilize mapping by CDFW and federal agencies to inform prioritization for restoration activities.

Intended pressure(s) reduced: Parasites/pathogens/diseases.

Conservation action(s):

- Fill gaps in current mapping to inform prioritization for restoration activities.

Conservation Strategy 2 (Outreach and Education): Advocate for wildlife-friendly fire management.

Objective(s):

- Develop management practices with USFS that include measures to reduce invasive species by including post-fire treatments.
- USFS post-fire treatments prioritize restoring native vegetation to increase fire resistance.

Intended pressure(s) reduced: Fire and fire suppression; parasites/pathogens/diseases.

Conservation action(s):

- Coordinate with fire agencies to develop BMPs for active and post-fire treatment.
- Review and provide input on firefighting practices.
- Develop comprehensive sage habitat map identifying quality and recommended action during fire.

Conservation Strategy 3 (Outreach and Education): Provide education and outreach for the ranching public and CDFW staff; educate staff on rangeland science; and educate ranching public on the need and status of BMPs.

Objective(s):

- Provide education and outreach for the ranching public and CDFW staff.
- Educate CDFW staff on rangeland science.
- Educate the ranching public on the need and status of BMPs.

Intended pressure(s) reduced: Livestock, farming, and ranching.

Conservation action(s):

- Coordinate with Natural Resource Conservation Service (NRCS) and the California Rangeland Conservation Coalition.

Conservation Strategy 4 (Economic Incentives): Provide economic incentives for improved resource management.

Objective(s):

- Provide incentives for implementing grazing BMPs on private and public lands.

Intended pressure(s) reduced: Livestock, farming, and ranching.

Conservation Strategy 5 (Economic Incentives): Obtain funding for resource management.

Objective(s):

- Obtain funding for restoration on public and private lands for NRCS sage-grouse initiative.

Intended pressure(s) reduced: Parasites/pathogens/diseases.

Conservation Strategy 6 (Law and Policy): Develop BMPs for improved resource conservation.

Objective(s):
- Co-developed BMPs with land management agencies.
- Put policies in place that benefit wildlife and sustain sage habitats.

Intended pressure(s) reduced: Livestock, farming, and ranching.

Conservation action(s) include:
- Create a sagebrush steppe working group.
- Identify and review existing grazing management policies.
- Develop Memorandum of Understanding (MOU)/Memorandum of Agreement (MOA) between partners.
- Provide input to land management agencies on grazing policies.

Conservation Strategy 7 (Direct Management): Conduct controlled burns for fire/fuel reduction and habitat management in conifer/sagebrush areas (like those encroached by pinyon-juniper).

Objective(s):
- By 2025, 1,000 acres of higher elevation mountain big sage habitat are treated for cheatgrass and medusahead.

Intended pressure(s) reduced: Parasites/pathogens/diseases.

Conservation action(s):
- Coordinate with land management agencies and CAL FIRE to remove cheatgrass and medusahead.
- Identify and prioritize candidate treatment areas.

Conservation Strategy 8 (Direct Management): Implement habitat restoration and enhancement.

Objective(s):
- By 2025, 1,000 acres of sagebrush steppe habitat is restored and functional.

Intended pressure(s) reduced: Strategy acts directly on the target.

Conservation action(s):
- Protect "wet spots" in the high desert (e.g., springs, seeps, riparian zones, meadows) through fencing or other means.
- Select appropriate methodology for priority restoration sites.
- Coordinate with local Resource Conservation District, BLM, and USFS.

Conservation Strategy 9 (Direct Management): Manage invasive species.

Objective(s):

- Agencies and landowners remove pockets of invasive grasses from otherwise intact sagebrush steppe habitat.

Intended pressure(s) reduced: Invasive plants/animals; fire and fire suppression.

Conservation action(s):

- Coordinate with land management agencies to reduce spread of invasive grasses such as cheatgrass and medusahead.
- Use tools to guide restoration and enhancement efforts.
- Set priorities for treatment of invasive species.

Conservation Strategy 10 (Management Planning): Provide input on grazing management plans, including review and comment on California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) documents for grazing management plans to help slow or reverse habitat degradation because of the negative impacts of certain grazing practices.

Objective(s):

- By 2025, USFS management plans address how to reduce negative impacts from allotment grazing practices.
- By 2025, USFS grazing allotments are issued with requirements for sustainable grazing practices.

Intended pressure(s) reduced: Livestock, farming, and ranching.

Conservation action(s):

- Build capacity within CDFW in range sciences.
- Identify rangeland experts.
- Coordinate with federal agencies.
- Conduct review of proposed allotment leases.
- Coordinate with development of Total Maximum Daily Loads (TMDL).

Conservation Strategy 11 (Partner Engagement): Implement management partnership/coordination.

Objective(s):

- By 2025, 50 percent of highest priority sagebrush habitat areas are restored.
- By 2025, funding and management is pooled across agencies for habitat restoration and sage-grouse management.

Intended pressure(s) reduced: Parasites/pathogens/diseases.

Conservation action(s):

- Coordinate with potential partners to agree on objective and priorities for habitat restoration and sage-grouse management.
- Identify areas needing restoration from annual grasses or invasive juniper.

Table 5.2-7 Stresses and Pressures for Big Sagebrush Scrub, Great Basin Dwarf Sagebrush Scrub, Great Basin Upland Scrub

Priority pressures	Stresses					
	Climate factors		Changes in geophysical and disturbance regime	Ecosystem changes		
	Change in spring average precipitation	Change in annual average precipitation	Change in natural fire regime	Change in community structure or composition	Changes succession processes and ecosystem development	Habitat fragmentation
Annual and perennial non-timber crops						X
Dams and water management/use	X	X				X
Fire and fire suppression			X	X	X	X
Housing and urban areas			X	X		X
Invasive plants/animals				X		
Livestock, farming, and ranching					X	X
Parasites/pathogens/diseases			X			
Recreational activities				X		
Renewable energy						X
Utility and service lines						X

Target: Great Basin Pinyon-Juniper Woodland

Goals:

- By 2025, acres with desired native species dominance and desired structural diversity are increased by 5 percent within the presettlement range of pinyon-juniper and juniper habitats in the ecoregion.
- By 2025, acres of desired successional stage are increased by 5 percent from presettlement habitat acreage.
- By 2025, acres with desired fire return interval are increased by at least 5 percent from 2015 acres.

Conservation Strategy 1 (Data Collection and Analysis): Conduct research on climate change.

Objective(s):

- Conduct research on climate change impacts to Great Basin pinyon-juniper woodland within the ecoregion and increase CDFW knowledge on climate change/greenhouse gas emissions.
- Within three years of the start of research, land management agencies, NGOs, and research scientists are able to access the data.
- Within five years of the start of research, areas have been prioritized for restoration, protection or fuels treatments.
- By the end of research, data are being used to prioritize areas of restoration, rehabilitation and protection.
- Within 10 years of research, findings are used to design management action.

Intended pressure(s) reduced: Climate change.

Conservation action(s):

- Develop or collect additional information needed on climate change projections for target habitat health and distribution within the Northwestern Basin and Range ecoregion.
- Collect data to answer relevant questions on climate change impacts on the conservation target within the Northwestern Basin and Range ecoregion.
- Prepare white papers on research of underlying mechanisms and climate change impacts.

Conservation Strategy 2 (Direct Management): Identify highest priority areas for restoration and rehabilitation to protect from annual grass or weed invasion.

Objective(s):

- By 2025, restoration is implemented on 5,000 acres of burn areas.
- By 2025, invasive species are treated on 5,000 acres.

Intended pressure(s) reduced: Climate change; invasive plants/animals.

Conservation action(s):

- Restore areas of burned presettlement habitats by planting native shrub, forbs and grasses to restrict invasion by annual invasive species.
- Treat and control invasive species.

Conservation Strategy 3 (Direct Management): Identify highest priority areas for restoration and rehabilitation to lower or eliminate fire risk; conduct controlled burns and managed thinning in areas of post-settlement (1860) pinyon-juniper and juniper expansion or old growth stands with high canopy cover and fire risk; protect old growth juniper and pinyon-juniper; and continue implementation of Bi-state Action Plan.

Objective(s):

- By 2025, the following management actions are implemented:
  - identify and remove priority areas of post-settlement habitat that threaten other macrogroup habitats;
  - identify and thin presettlement habitat and old growth that require thinning to protect them from high intensity fire; and
  - identify areas of old growth pinyon-juniper and juniper stands.
- By 2025, place fuels treatments around identified old growth stands for protection from fire.
- By 2025, the highest areas for fire risk of the pinyon-juniper are prioritized for management.

Intended pressure(s) reduced: Fire and fire suppression.

Conservation action(s):

- Identify and remove 10 percent of target vegetation in post-settlement sagebrush and scrub target habitat that threaten other sagebrush and scrub target habitats.
- Identify and thin 10 percent of target vegetation that was sagebrush and scrub target habitat presettlement and areas of old growth pinyon-juniper and juniper that require thinning to protect them from high intensity fire.
- Identify areas of old growth pinyon-juniper and juniper and place fuels treatments around 10 percent of them for protection.

Conservation Strategy 4 (Partner Engagement): Maintain partnerships through the Bi-state Action Plan, BLM, USFS, NPS, and U.S. Geological Service (USGS) to help coordinate data collection and implement a management plan.

Objective(s):

- By 2025, current partnerships such as the Bi-State Action plan are maintained, a management plan is being implemented and data is being collected for the plan.
- By 2025, areas of removal, restoration or protection of pinyon-juniper vegetation are prioritized and implemented with data collected.

Intended pressure(s) reduced: Climate change; invasive plants/animals; fire and fire suppression.

Conservation action(s):

- Prioritize and implement areas of removal, restoration or protection of sagebrush and scrub target habitat.
- Collect data and coordinate with partnership groups.

Table 5.2-8 Stresses and Pressures for Great Basin Pinyon-Juniper Woodland									
Priority pressures	Stresses								
	Climate factors		Changes in geophysical and disturbance regime		Changes in soil characteristics	Ecosystem changes			
	Change in CO_2 levels	Change in annual average precipitation	Change in natural fire regime	Change in extreme events	Change in soil moisture	Change in spatial distribution of habitat types	Change in community structure or composition	Changes succession processes and ecosystem development	Change in biotic interactions (altered community dynamics)
Climate change	X	X		X	X				
Fire and fire suppression			X			X		X	X
Invasive plants/ animals			X				X	X	
Livestock, farming, and ranching			X			X	X	X	
Other ecosystem modifications						X			

Target: Eagle Lake Native Fish Assemblage

Goals:

- By 2025, miles of streams with target fish population (Eagle Lake rainbow trout [ELRT]) are increased by at least 5 percent from 2015 miles.
- By 2025, miles of river with native species dominant are increased by at least 5 percent from 2015 miles.
- By 2025, population of key species (ELRT) are increased by at least 5 percent from the 2015 population size.
- By 2025, acres with desired genetic connectivity between lower Pine Creek and lake populations during spawning and migration period, are increased by at least 5 percent from 2015 acres.
- By 2025, miles connected are increased by at least 5 percent from 2015 miles.

Conservation Strategy 1 (Data Collection and Analysis): Prepare groundwater assessment.

Objective(s):

- Identify location, direction of movement, and quantity of ground-water.

Intended pressure(s) reduced: Dams and water management/use.

Conservation action(s):

- Coordinate with USFS, DWR, Regional Water Quality Control Board, and private landowners.
- Conduct groundwater assessment.

Conservation Strategy 2 (Outreach and Education): Provide education and outreach by educating the public on the development, status, and need for BMPs and about invasive species.

Objective(s):

- Educate public on the need for BMPs and keep them informed on development and status of BMPs.
- Educate public about invasive species.

Intended pressure(s) reduced: Livestock, farming, and ranching; invasive plants/animals.

Conservation action(s):

- Coordinate with NRCS.
- Coordinate with USFS and Pine Creek Coordinated Resource Management Process.

Conservation Strategy 3 (Economic Incentives): Provide economic incentives for grazing on public lands to follow BMPs.

Objective(s):

- Grazing on private and public lands is incentivized to follow BMPs.

Intended pressure(s) reduced: Livestock, farming, and ranching.

Conservation action(s):

- Design or support existing incentive programs.

Conservation Strategy 4 (Law and Policy): Develop grazing BMPs for managed grazing, including barriers to sensitive areas, fencing timing, and grazing rotations.

Objective(s):

- Co-develop BMPs with land management agencies.
- Have policies that benefit wildlife and sustain habitats.

Intended pressure(s) reduced: Livestock, farming, and ranching.

Conservation action(s):

- Develop MOU/MOA between partners.
- Develop BMPs including enforcement policy.
- Provide input to land management agencies on grazing policies.

Conservation Strategy 5 (Direct Management): Improve road maintenance to reduce sediment from roads entering streams.

Objective(s):

- Reduce sediment from roads entering streams. (Sediment degrades stream habitat by filling interstitial spaces in gravel affecting fish spawning habitat and invertebrate production, and filling pools.)

Intended pressure(s) reduced: Roads and railroads.

Conservation action(s):

- Coordinate with USFS.
- Conduct road inventory and evaluation.

Conservation Strategy 6 (Direct Management): Manage dams and other barriers by installing control structures (gate or gate valve) to allow more bypass flows and fish passage.

Objective(s):

- Allow more bypass flows to improve in-stream flows.
- Allow fish passage on CDFW lands.
- Have management plan with BMPs.
- Remove Pine Creek Weir and old USGS gauging station.

Intended pressure(s) reduced: Dams and water management/use.

Conservation action(s):

- Coordinate with USFS.
- Identify dams or other barriers to modify or remove to improve fish passage.
- Coordinate with USFS to remove USGS gauging weir.

Conservation Strategy 7 (Direct Management): Manage invasive species.

Objective(s):

- Remove brook trout from Pine Creek.

Intended pressure(s) reduced: Invasive plants/animals.

Conservation action(s):

- Update data on extent of brook trout in Pine Creek.
- Develop strategy for removal of brook trout from Pine Creek.
- Coordinate with USFS and private landowners.

Conservation Strategy 8 (Direct Management): Manage grazing.

Objective(s):

- Reduce grazing impacts to stream(s)/corridor.

Intended pressure(s) reduced: Livestock, farming, and ranching.

Conservation action(s):

- Construct exclusionary fencing in highly impacted areas to reduce grazing impacts to streams or their corridors.
- Coordinate with USFS and private landowners.
- Consult with University of California, Extension.
- Identify ways to achieve better compliance of BMPs.

Conservation Strategy 9 (Direct Management): Encourage use of alternative water sources (wells if sufficient ground water is present), water conservation practices, and reduce the impacts of water loss at water treatment sites.

Objective(s):

- Identify best locations to locate wells and develop 10-20 wells to replace stream diversions.
- Large diversions can be switched from direct use of stream water to wells, improving in-stream flow.
- Stock water ponds using stream-flow could be switched to wells.

Intended pressure(s) reduced: Dams and water management/use.

Conservation action(s):

- Coordinate with local districts and USFS on the use of alternative water source (wells).
- Identify problematic sites and candidate alternate water sources.

Conservation Strategy 10 (Management Planning): Develop BMPs for water management and conservation in the Pine Creek watershed. Coordinate with USFS to create enhanced wetlands and multi-use management (wildlife, livestock, and fish) policy. Managed water could better be used for fish as there are alternative water sources for wildlife and livestock in the Pine Creek watershed.

Objective(s):

- Co-develop BMPs with USFS for enhanced wetland management and agree to the best use of the water.

Intended pressure(s) reduced: Dams and water management/use.

Conservation action(s):

- Engage Pine Creek Coordinated Resource Management Process working group.
- Identify and review existing enhanced wetland management policies.
- Develop and implement BMPs.
- Develop MOU/MOA between partners.

Conservation Strategy 11 (Management Planning): Promote domestic water efficiency and conservation through reducing water use by increased efficiency from residence and businesses.

Objective(s):

- Reduced water use by increased efficiency from residences and businesses.

Intended pressure(s) reduced: Dams and water management/use.

Conservation action(s):

- Coordinate with local and state water management agencies and stakeholders.
- Review available information on potential water savings for the North Lahontan watershed.
- Develop water conservation campaign.

Conservation Strategy 12 (Partner Engagement): Engage in decision-making process.

Objective(s):

- Reduce grazing pressure by animal numbers and duration.
- Influence grazing allotment and management plans to reduce livestock impacts on streams.

Intended pressure(s) reduced: Livestock, farming, and ranching.

Conservation action(s):

- Coordinate with USFS on allotment management plans to reduce grazing impacts on streams and reduce grazing pressure within the watershed.

Conservation Strategy 13 (Direct Management): Implement the Eagle Lake Rainbow Trout Conservation Strategy (ELRTCS), which was developed amongst the USFWS, USFS, and CDFW.

Objective(s):

- Conserve and enhance the sustainability of the Eagle Lake Fish Assemblage.

Intended pressure(s) reduced: Livestock, farming, and ranching; dams and water management/use; invasive plants/animals.

Conservation action(s):

- Improve passage into and through Pine Creek for migration and spawning of Eagle Lake rainbow trout.
- Remove or control of the brook trout population in the headwater reaches of Pine Creek and the subsequent establishment and management of a stream based population of Eagle Lake rainbow trout.
- Provide improved passage through the trap/weir structure at the mouth of Pine Creek as well as effective coordination with hatchery operations.
- Implement artificial spawning program and monitor genetic integrity to ensure retention of adequate genetic diversity to maintain lake and creek populations.
- Implement effective habitat restoration projects and management strategies to improve watershed function and riparian and aquatic habitat conditions. Adaptive management and monitoring of land use activities in coordination with ELRT conservation objectives.
- Develop and support research projects to inform adaptive management and success criteria of conservation actions outlined in the plan.
- Expand outreach and education programs relating to Eagle Lake rainbow trout and the conservation of its habitats.

Table 5.2-9 Stresses and Pressures for Eagle Lake Native Fish Assemblage

Priority pressures	Stresses				
	Changes in geophysical and disturbance regimes	Changes in hydrology and water characteristics	Ecosystem changes		
	Change in sediment erosion-deposition regime	Change in runoff and river flow	Habitat fragmentation	Change in community structure and composition	Change in biotic interactions (altered community dynamics)
Dams and water management/use		X	X		
Introduced genetic material					X
Invasive plants/animals				X	X
Livestock, farming, and ranching	X				
Logging and wood harvesting	X				
Roads and railroads	X				

Target: Goose Lake Native Fish Assemblage

Goals:

- By 2025, acres connected are increased by at least 5 percent from 2015 acres by improving access to habitat in all lake tributaries and enhancing fish passage.
- By 2025, populations of key species are increased by at least 5 percent from 2015 population.
- By 2025, miles of river in Pine and Davis Creeks with native species dominant are increased by at least 5 percent from 2015 miles.
- By 2025, miles connected between stream and lake populations during spawning and migration period are increased by at least 5 percent from 2015 miles.

Conservation Strategy 1 (Data Collection and Analysis): Design and implement inventory and assessment of fish populations and fish habitat.

Objective(s):

- Collect baseline information on fish populations and fish habitat for the Goose Lake Native Fish Assemblage.

Intended pressure reduced: Strategy acts directly on target.

Conservation action(s):

- Coordinate with Oregon Department of Fish and Wildlife, USFS, and the Goose Lake Fishes Working Group.

Conservation Strategy 2 (Outreach and Education): Education and outreach; inform public of restoration plans and why treatment is necessary.

Objective(s):

- Raise public awareness and support by starting education and outreach before the restoration project is implemented.
- Continue education and outreach after restoration.
- Target land owners, anglers, and agencies for outreach.

Intended pressure(s) reduced: Invasive plants/animals.

Conservation action(s):

- Coordinate with USFS, Goose Lake Fishes Working Group and with agricultural organizations in the area.

Conservation Strategy 3 (Law and Policy): Develop grazing BMPs and conduct managed grazing.

Objective(s):

- Reduce grazing impacts to streams, stream corridors, and assemblage habitat.

Intended pressure(s) reduced: Livestock, farming, and ranching.

Conservation action(s):

- Coordinate with USFS, NRCS, private landowners to develop BMPs that reduce grazing impacts to stream(s)/corridors and impacts on habitat.
- Consult with University of California, Extension.

Conservation Strategy 4 (Direct Management): Reduce livestock access to natural water features with wells and alternative water sources.

Objective(s):

- Provide off-stream watering sources and construct exclusionary fencing (to exclude livestock).

Intended pressure(s) reduced: Livestock, farming, and ranching.

Conservation action(s):

- Coordinate with Oregon Department of Fish and Wildlife.
- Coordinate with USFS and private landowners on use of alternative watering locations and exclusionary fencing.
- Quantify impact of livestock having access to watercourses.
- Identify alternative watering structures and water sources.
- Identify locations to develop off-stream water sources and exclusionary fencing.
- Update Goose Lake Conservation Strategy.
- Obtain permits and conduct environmental reviews.
- Implement contract for construction.
- Develop budget, identify grant sources, and apply for funding.

Conservation Strategy 5 (Direct Management): Manage invasive species.

Objective(s):

- Remove brown trout from Davis and Pine Creek.

Intended pressure(s) reduced: Invasive plants and animals.

Conservation action(s):

- Update data on extent and distribution of native and non-native species in Davis and Pine Creeks.
- Initiate long-term monitoring and management plan.

Conservation Strategy 6 (Direct Management): Manage dams and other barriers.

Objective(s):

- Allow more bypass flows through water conservation to improve flows in streams.
- Gather and analyze data on water use and fish connectivity; gather baseline information on the current conditions of water use, water use efficiency, and fish passage, including allocating the major barriers.
- Develop restoration and management plans to investigate the impact to stream flow from water diversion, including stream flow modification and fish passage barriers.
- Investigate the potential to develop water conservation and fish passage barrier modification measures, and evaluate the effectiveness of these measures.
- Prioritize the conservation scope by deciding the timeframe of restoration and the appropriate restoration tools and methodology. Find funding to contract the plan development and implementation of restoration and management.

Intended pressure(s) reduced: Dams and water management/use.

Conservation action(s):

- Coordinate with private landowners.
- Inventory barriers and assess flow and water condition.
- Obtain permits and conduct environmental review.
- Implement water conservation flow.

Table 5.2-10 Stresses and Pressures for Great Basin Pinyon-Juniper Woodland

Priority pressures	Stresses								
	Changes in geophysical and disturbance regimes		Changes in hydrology and water characteristics				Ecosystem changes		
	Change in natural fire regime	Change in sediment erosion-deposition regime	Change in runoff and river flow	Change in water levels and hydroperiod	Change in water chemistry	Change in groundwater tables	Habitat fragmentation	Change in biotic interactions (altered community dynamics)	Change in community structure and composition
Dams and water management/use	X			X			X		
Introduced genetic material								X	
Invasive plants/animals								X	X
Livestock, farming, and ranching		X		X	X	X			
Logging and wood harvesting	X		X						X
Roads and railroads		X					X		

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Table 5.2-11 Conservation Targets and Strategies for the Cascades and Modoc Plateau Province

Target	Goals	Key Ecological Attributes (KEAs)	Pressures[1]	Strategy Categories
North Coastal Mixed Evergreen and Montane Forests	▪ By 2025, acres where native species are dominant are increased by at least 5% from 2015 acres. ▪ By 2025, acres with desired stages of succession are increased by at least 5% from 2015 acres. ▪ By 2025, acres with desired age class heterogeneity are increased by at least 5% from 2015 acres. ▪ By 2025, acres with desired structural diversity are increased by at least 5% from 2015 acres. ▪ By 2025, acres with desired fire regime are increased by at least 5% from 2015 acres. ▪ By 2025, miles with desired level of water yield are increased by at least 5 % from 2015 miles.	▪ Fire regime ▪ Successional dynamics ▪ Native versus non-native diversity ▪ Age class heterogeneity ▪ Hydrological regime	▪ Fire and fire suppression ▪ Livestock farming and ranching ▪ Logging and wood harvesting ▪ Renewable energy ▪ Utility and service lines	▪ Data Collection and Analysis ▪ Management Planning ▪ Land Acquisition/ Easement/ Lease ▪ Law and Policy ▪ Outreach and Education
Western Upland Grasslands	▪ By 2025, acres of habitat are increased by at least 5% from 2015 acres. ▪ By 2025, acres where native species are dominant are increased by at least 5% from 2015 acres. ▪ By 2025, acres with desired structural diversity (remove in-growth trees from within grassland habitats) are increased by at least 5% from 2015 acres. ▪ By 2025, acres with desired fire regime are increased by at least 5% from 2015 acres.	▪ Area and extent of community ▪ Fire regime ▪ Successional dynamics ▪ Native versus non-native diversity	▪ Annual and perennial non-timber crops ▪ Fire and fire suppression ▪ Invasive plants/animals ▪ Livestock farming and ranching ▪ Logging and wood harvesting	▪ Data Collection and Analysis ▪ Direct Management ▪ Economic Incentives ▪ Land Acquisition/ Easement/ Lease ▪ Land Use Planning ▪ Law and Policy
Big Sagebrush Scrub Great Basin Dwarf Sagebrush Scrub Great Basin Upland Scrub	▪ By 2025, acres where native species are dominant are increased by at least 5% from 2015 acres. ▪ By 2025, acres of habitat are increased by at least 5% from 2015 acres. ▪ By 2025, acres with desired fire regime are increased by at least 5% from 2015 acres. ▪ By 2025, acres with suitable soil characteristics are increased by at least 5% from 2015 acres. ▪ By 2025, acres with desired stages of succession are increased by at least 5% from 2015 acres.	▪ Area and extent of community ▪ Fire regime ▪ Successional dynamics ▪ Native versus non-native diversity ▪ Soil and sediment deposition regime	▪ Annual and perennial non-timber crops ▪ Dams and water management/use ▪ Fire and fire suppression ▪ Housing and urban areas ▪ Invasive plants/animals ▪ Livestock farming and ranching ▪ Parasites/pathogens/diseases ▪ Recreational activities ▪ Renewable energy ▪ Utility and service lines	▪ Data Collection and Analysis ▪ Partner Engagement ▪ Management Planning ▪ Direct Management ▪ Economic Incentives ▪ Law and Policy ▪ Outreach and Education
Great Basin Pinyon-Juniper Woodland	▪ By 2025, acres with desired native species dominance and desired structural diversity are increased by at least 5% within the presettlement range of pinyon-juniper and juniper habitats in the ecoregion. ▪ By 2025, acres of desired successional stage are increased by at least 5% from presettlement habitat acreage. ▪ By 2025, acres with desired fire return interval are increased by at least 5% from 2015 levels.	▪ Fire regime ▪ Successional dynamics ▪ Structural diversity ▪ Native versus non-native diversity	▪ Climate change ▪ Fire and fire suppression ▪ Invasive plants/animals ▪ Livestock farming and ranching ▪ Other ecosystem modifications	▪ Data Collection and Analysis ▪ Partner Engagement ▪ Direct Management
Eagle Lake Native Fish Assemblage	▪ By 2025, miles of streams with target fish population (Eagle Lake Rainbow Trout - ELRT) are increased by at least 5% from 2015 miles. ▪ By 2025, miles of river with native species dominant are increased by at least 5% from 2015 miles. ▪ By 2025, population of key species (ELRT) are increased by at least 5% from the 2015 population size. ▪ By 2025, acres with desired genetic connectivity between lower Pine Creek and lake populations during spawning and migration period are increased by at least 5% from 2015 acres. ▪ By 2025, miles connected are increased by at least 5% from 2015 miles.	▪ Area and extent of community ▪ Connectivity among communities and ecosystems ▪ Key species population levels ▪ Native versus non-native diversity ▪ Hydrological regime ▪ Soil and sediment deposition regime ▪ Surface water flow regime ▪ Water level fluctuations	▪ Dams and water management/use ▪ Introduced genetic material ▪ Invasive plants/animals ▪ Livestock farming and ranching ▪ Logging and wood harvesting ▪ Roads and railroads	▪ Data Collection and Analysis ▪ Partner Engagement ▪ Management Planning ▪ Direct Management ▪ Economic Incentives ▪ Law and Policy ▪ Outreach and Education
Goose Lake Native Fish Assemblage	▪ By 2025, acres connected are increased by at least 5% from 2015 acres by improving access to habitat in all lake tributaries and enhancing fish passage. ▪ By 2025, populations of key species are increased by at least 5% from 2015 population size. ▪ By 2025, miles of river in Pine and Davis Creeks with native species dominant are increased by at least 5% from 2015 miles. ▪ By 2025, miles connected between stream and lake populations during spawning and migration period are increased by at least 5% from 2015 miles.	▪ Area and extent of community ▪ Connectivity among communities and ecosystems ▪ Key species population levels ▪ Endemic diversity ▪ Native versus non-native diversity ▪ Hydrological regime ▪ Soil and sediment deposition regime ▪ Surface water flow regime ▪ Water temperatures and chemistry ▪ Water level fluctuations ▪ Nutrient concentration and dynamics	▪ Dams and water management/use ▪ Introduced genetic material ▪ Invasive plants/animals ▪ Livestock farming and ranching ▪ Logging and wood harvesting ▪ Roads and railroads	▪ Data Collection and Analysis ▪ Direct Management ▪ Law and Policy ▪ Outreach and Education

[1] Pressures can be positive or negative depending on the intensity, timing, and duration of the action on the target habitat.