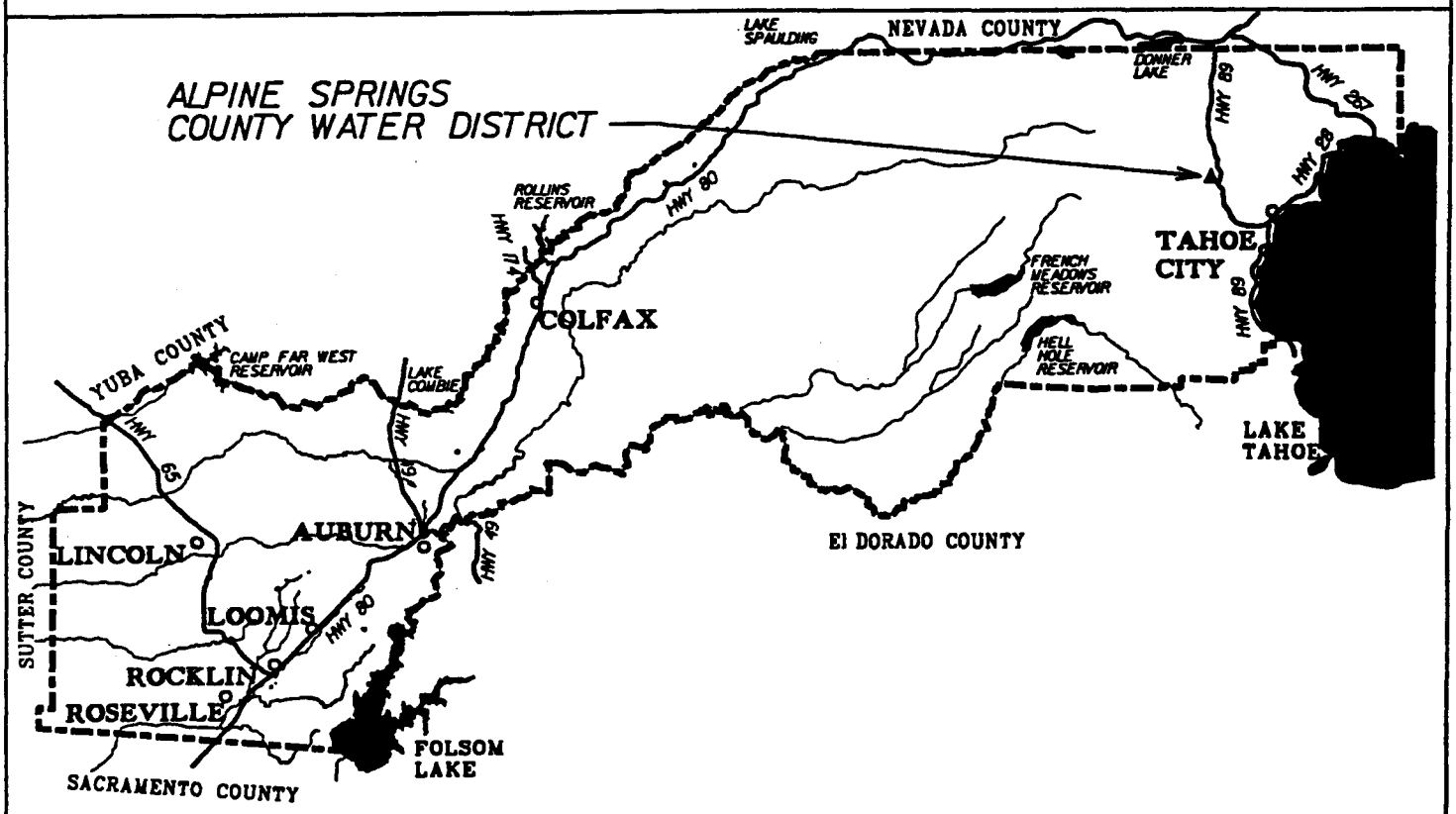
PLACER COUNTY WASTEWATER SYSTEMS



System Name: ALPINE SPRINGS COUNTY WATER DISTRICT

Address: P.O. BOX E, TAHOE CITY, CA 96145

Contact Name: THOMAS G. SKJELSTAD, GENERAL MANAGER Phone: (916)-583-2342

Service Area Size: 4.5 sq. mi. No. Connect.: 535 Population Served: _____

Services Provided: WASTEWATER COLLECTION AND EXPORT

Summary System Description

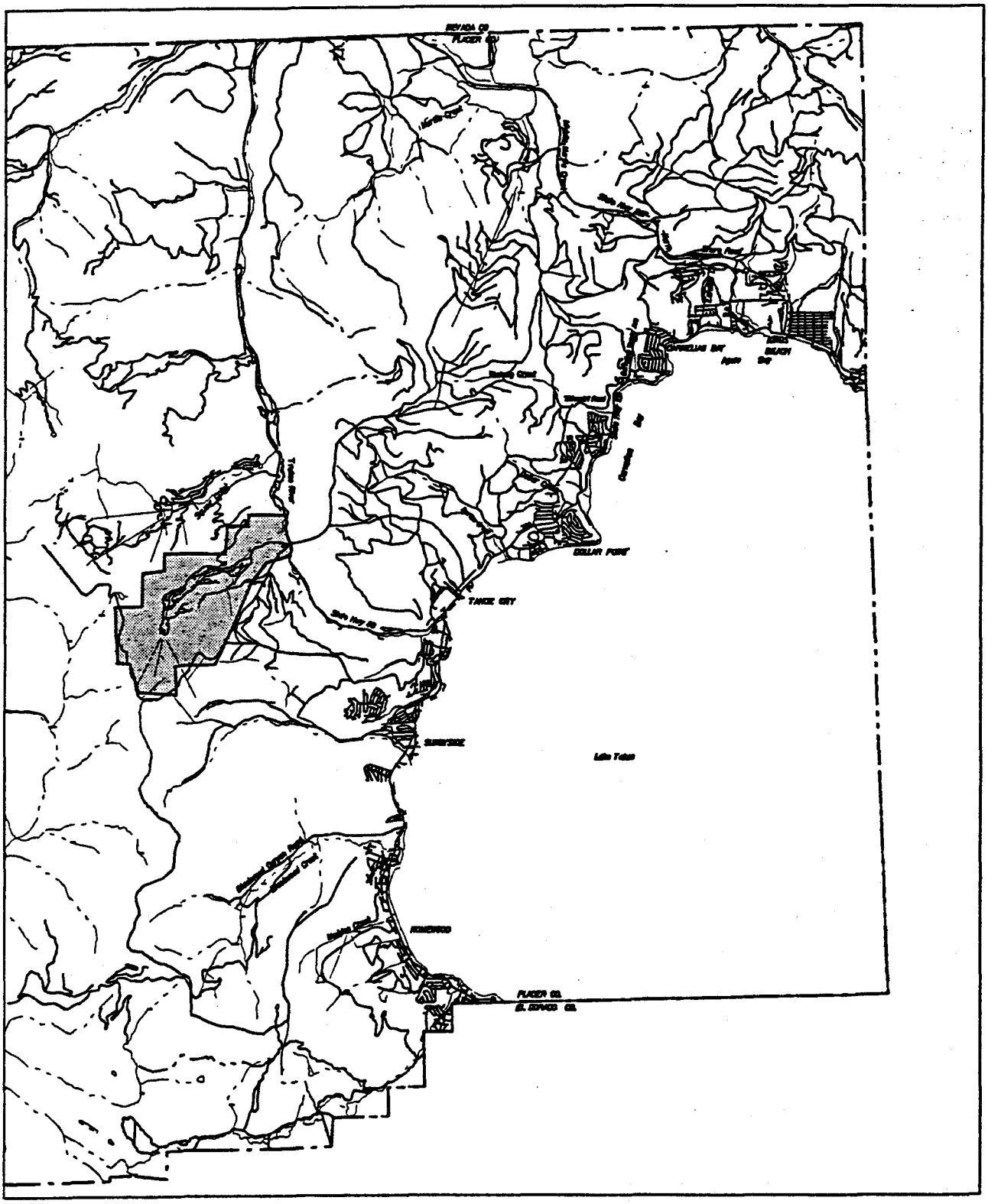
Service Area Characteristics: SIERRA NEVADA MOUNTAIN LOCATION. WELL FORESTED. THE ALPINE SPRINGS C.W.D. COLLECTION SYSTEM PROVIDES SERVICE TO ALPINE MEADOWS ESTATES, BEAR CREEK ASSOCIATION, ALPINE CENTER, ALPINE MANOR, RIVER RUN, ALPINE PLACE AND ALPINE MEADOWS SKI LODGE.

Collection: THE EXISTING COLLECTION SYSTEM IS STRICTLY GRAVITY FLOW. NO FORCE MAINS OR PUMP STATIONS ARE USED. TOTAL COLLECTION SYSTEM LINE LENGTH IS ABOUT 12 MILES.

Treatment: WASTEWATER IS TRANSPORTED TO THE TAHOE - TRUCKEE SANITATION AGENCY MARTIS VALLEY WASTEWATER TREATMENT PLANT.

Disposal: ALPINE STRINGS W D WASTEWATER IS TREATED AT THE T-TSA FACILITIES AND T-TSA EFFLUENT IS DISCHARGED TO SUBSURFACE TRENCHES WITH SEASONAL DISPOSAL TO A SPRAY IRRIGATION FIELD.

Capacity Limitations: CURRENTLY PERMITTED DISPOSAL TO THE T-TSA SYSTEM IS 0.05 MGD. A.S.C.W.D. COLLECTION SYSTEM DESIGN CAPACITY IS 0.5 MGD.



Placer County General Plan

Figure ____ **Wastewater Service Area**

N

Date: 1/15/92

Prepared by:
PSOMAS & ASSOCIATES

LEGEND

Alpine Springs Co. Water District

- Streets
- Waterways
- County Line
- District Service Area

NOTE:
Delineated areas do not represent exact boundaries, rather they represent general or approximate boundaries.

NORTHSTAR COMMUNITY SERVICES DISTRICT

General Information: The Northstar Community Services District was formerly operated by the Placer County Department of Public Works as Placer County Service Area No. 21. Recently the Northstar CSD was formed and formally took command over the wastewater collection system.

Wastewater Generation/Sources: Wastewater is generated by the Northstar subdivision which houses a permanent population of 1,135 and a seasonal population which approaches 9,000. There are 1,136 residential and 17 commercial connections in the system. Wastewater is considered domestic in nature.

Collection System Description: Most of the existing collection system was constructed in 1972 using 6-inch to 8-inch PBVC and ABS sewer lines. The system uses gravity collection with typical manhole and two lift stations.

Deficiencies: Currently there are no identified deficiencies with the existing collection system.

Proposed Improvements: There are currently no planned, proposed or required collection system improvements.

Wastewater Treatment and Disposal System: Wastewater from Northstar CSD is conveyed to the Tahoe-Truckee Sanitation Agency Regional Wastewater Treatment Plant in Martis Valley and tot he Tahoe Sanitary District facilities for treatment.

Financing: Improvement, operations and maintenance costs for the sewage collection, treatment and disposal system are funded through user fees and connection fees.

The current fee schedule for the system is outlined in the following table.

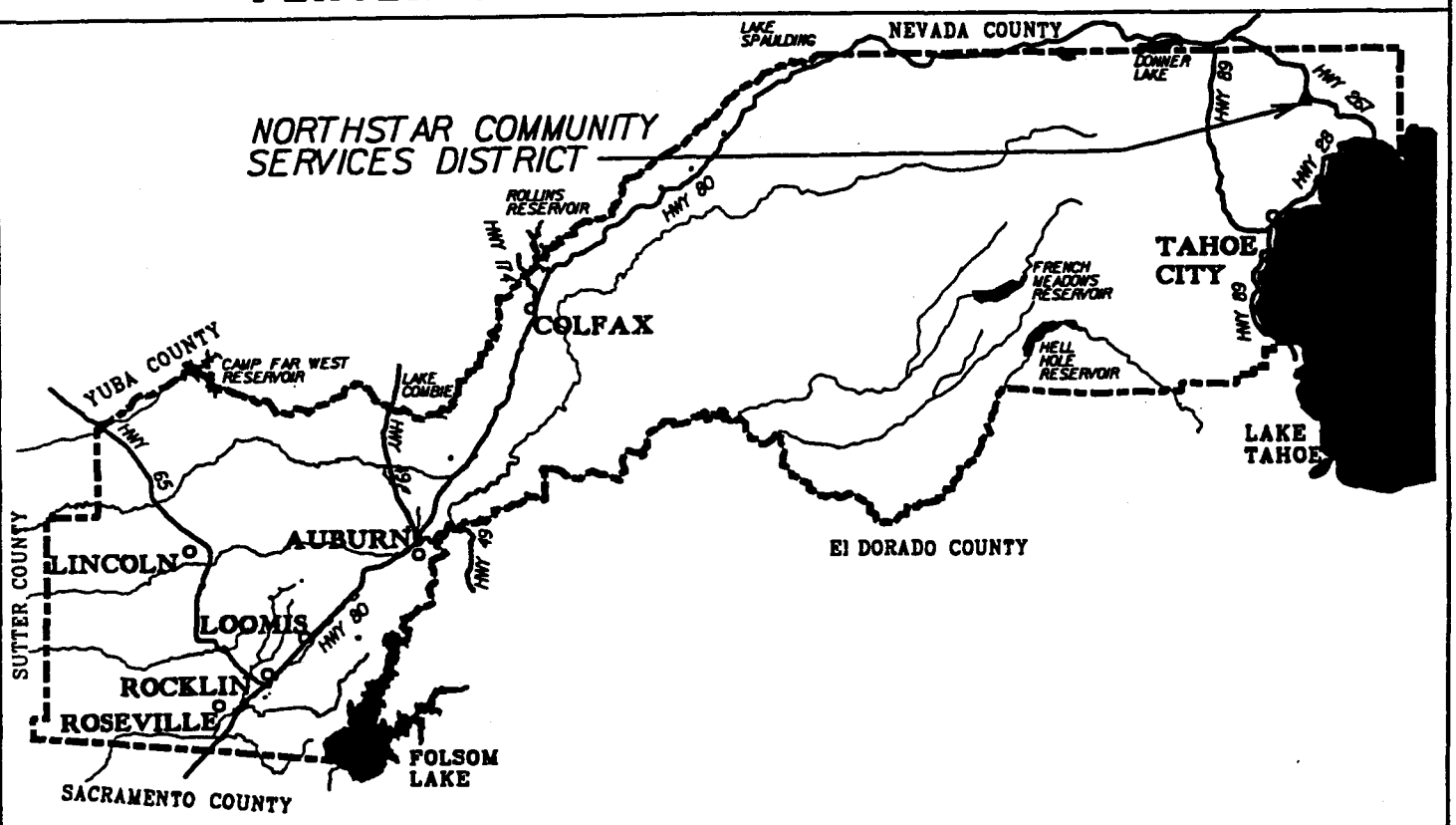
NORTHSTAR CSD SYSTEM FEE SCHEDULE

Connection Type User Fees	Fee
Residential (condos and houses)	$328.80/year
Commercial	
Type B (other businesses)	$3.03/fixture unit
Type F (restaurants)	$2.20/seat
Type Z (theaters)	$0.79/seat
Connection Fee	$250.00 (minimum)

System Appraisal: Northstar CSD provides water supply and wastewater collection services. Wastewater is transported to the Tahoe-Truckee Sanitation Agency Regional Wastewater Treatment Plant.

In general the Northstar CSD wastewater collection and conveyance system is considered in good overall condition. Collection system design capacity is 2.2 mgd.

PLACER COUNTY WASTEWATER SYSTEMS



System Name: NORTHSTAR COMMUNITY SERVICES DISTRICT

Address: 51 TRIMONT LANE, TRUCKEE CA 96161

Contact Name: JAMES H. LOCHRIDGE, UTILITIES MANAGER Phone: (916)-562-0669

Service Area Size: _____ No. Connect.: 1153 Population Served: 3K-9K

Services Provided: WASTEWATER COLLECTION AND EXPORT

Summary System Description

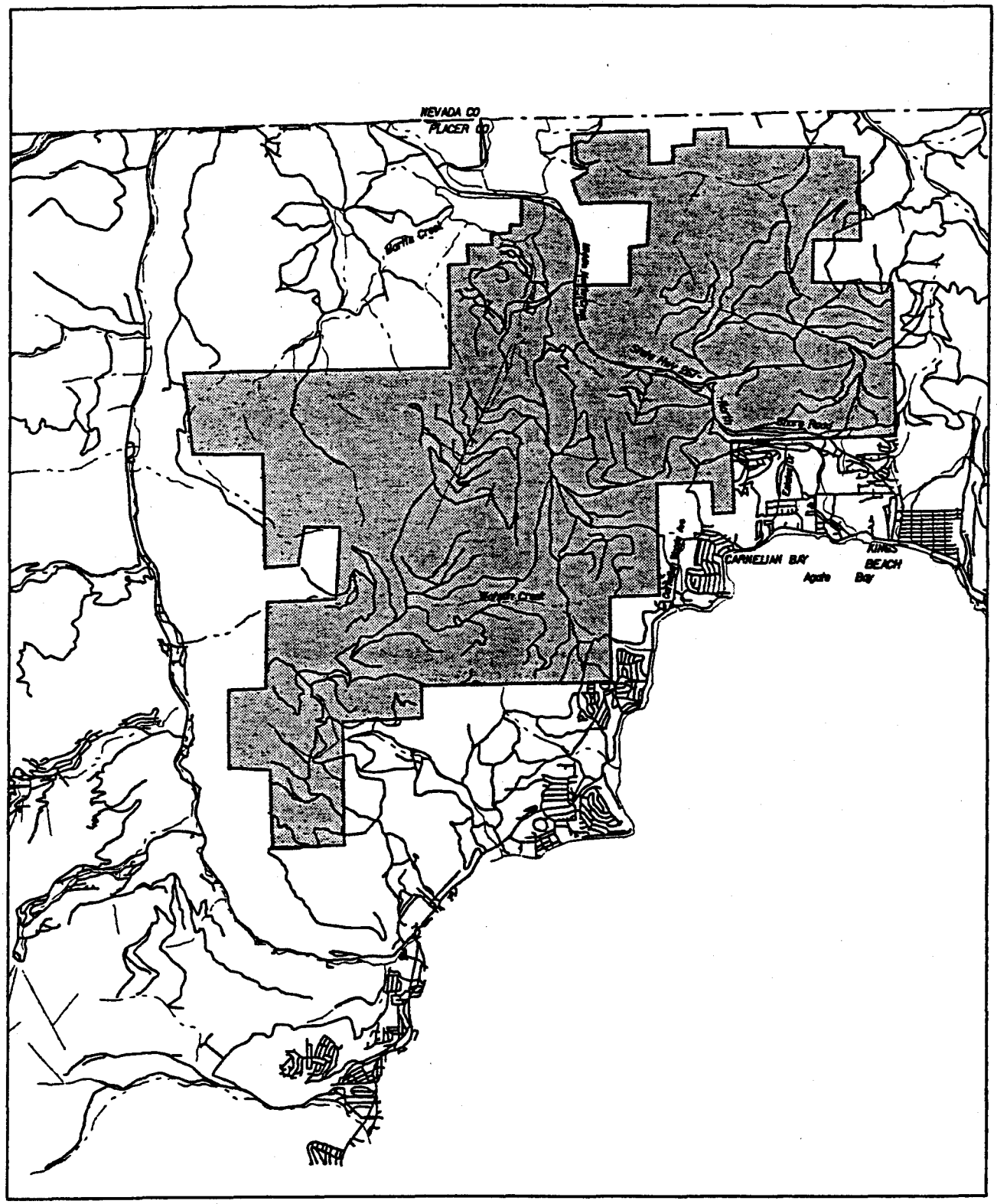
Service Area Characteristics: SIERRA NEVADA MOUNTAIN LOCATION, WELL FORESTED. WASTEWATER IS COLLECTED FROM THE NORTHSTAR SUBDIVISION.

Collection: THE SYSTEM USES 6 & 8 INCH GRAVITY LINE. THERE ARE 2 LIFT STATIONS.

Treatment: WASTEWATER IS TRANSPORTED MAINLY TO THE TAHOE - TRUCKEE SANITATION AGENCY MARTIS VALLEY WASTEWATER TREATMENT PLANT WITH SOME FLOWS ALSO CONVEYED TO TAHOE SANITARY DISTRICT.

Disposal: T-TSA EFFLUENT IS DISCHARGED TO SUBSURFACE TRENCHES WITH SEASONAL DISPOSAL TO A SPRAY IRRIGATION FIELD.

Capacity Limitations: CURRENT MAXIMUM FLOWS ARE LIMITED BY LINE SIZES AND ARE BETWEEN 1.75 AND 2.2 MGD WITH 335,000 GPD OF THE FLOW GOING TO TAHOE SANITARY DISTRICT AND THE REMAINDER TO T-TSA.



Placer County General Plan

Figure ____

Wastewater Service Area

N

Scale: 1" = 10000'

Date: 1/15/92

Prepared by:
PSOMAS & ASSOCIATES

LEGEND

Placer Co. Service Dist. No. 21 - Northstar

- Streets
- Waterways
- County Line
- District Service Area

NOTE:
Delineated areas do not represent exact boundaries, rather they represent general or approximate boundaries.

TRUCKEE SANITARY DISTRICT

General Information: The Truckee Sanitary District (Truckee SD) owns and operates a wastewater collection system responsible for collecting wastewaters from the community of Truckee, Tahoe Donner area, Glenshire/Devonshire Subdivision and the areas surrounding this general region. The Truckee SD was formed in 1906 and began operations in 1908.

Wastewater from the Truckee SD is not regulated by permit from the RWQCB since the system is exporting sewage to the Tahoe-Truckee Sanitation Agency wastewater treatment plant. Maintenance projects for the Truckee Sanitary District are however regulated by Waste Discharge Requirements Order No. 6-85-130 adopted November 14, 1985 and Monitoring and Reporting Program No. 85-130 adopted November 19, 1985.

Wastewater Generation/Sources: Wastewater collected by the Truckee SD system is generated by 6,462 residential and 371 commercial connections. The service area is about 35 square miles and the resident population is 10,000 with a seasonal peak population of approximately 21,000 persons. The wastestream is considered municipal in nature.

Collection System Description: Most of the existing collection system was constructed in 1970 using 6 inch to 21 inch AC, PVC and clay sewer liens. The system uses 1,500,000 feet of gravity lines with a typical manhole spacing of 400 feet and has 31 lift stations.

Deficiencies: Currently there are no identified deficiencies with the existing collection system.

Proposed Improvements: There are no currently planned, proposed or required collection system improvements.

Wastewater Treatment & Disposal System: Wastewater from Truckee SD is conveyed to the Tahoe-Truckee Sanitation Agency Regional Wastewater Treatment Plant in Martis Valley through the T-TSA interceptor main.

Financing: Improvement costs are funded through connection fees whereas operations and maintenance costs are funded through user fees. The annual operations budget for the system is currently $2,230,000 with an administration budget of $760,000. There are 25 staff members.

The current fee schedule for the system is outlined in the following table.

TRUCKEE SD SYSTEM FEE SCHEDULE

Connection Type	Connection Code	Units	Monthly User Fee Per Unit	Monthly User Charge Per Unit
Residential	R	Living Units	$750.00	$14.50
Residential (non-taxed)*	D	Living Units	$750.00	$19.00
Motel Without Kitchen	M	Living Units	$202.00	$3.92
Motel With Kitchen	N	Living Units	$262.0	$5.08
Campsite With Sewer	K	# of Sites	$187.00	$3.63
Campsite Without Sewer	Q	# of Sites	$142.00	$2.76
Other Businesses	B	# of PFU's	$60.00	$.87
Other Businesses (non-taxed)*	E	# of PFU's	$60.00	$1.14
Markets	G	# of PFU's	$60.00	$0.87
Laundries	L	# of 10# Mach.	$240.00	$7.69
Restaurants & Bars	F	# of Seats	$60.00	$1.45
Restaurants & Bars (non-taxed)*	J	# of Seats	$60.00	$1.90
Outside Restaurant Seats	Z	# of Seats	$30.00	$0.72
Theaters	T	# of Seats	$10.00	$0.29
Churches	C	# of Seats	$10.00	$0.29
Barber Shops	H	# of Chairs	$210.00	$4.06
Beauty Shops	A	# of Chairs	$405.00	$7.83
Service Stations	P	# of Serv. Bays	$1,072.50	$20.74
Car Wash	CW	# of Bays	$750.00	$14.50
Car Wash (non-recycle)	NR	# of Bays	$ 2,250.00	$43.50
Other	S			Detetermined by Gen. Manager

Additional deposits, inspection charges, inspection fees and charges may be assessed (see appendix A-1 of TSD Ordinance). Minimum Connection fee is $250.00

Refer to Appendix A-3 of the TSD Ordinance for Fixture Unit Equivalents.

* Refers to customers from whom the TSD recieves no property tax monies. (Federal, State, local governments and districts).

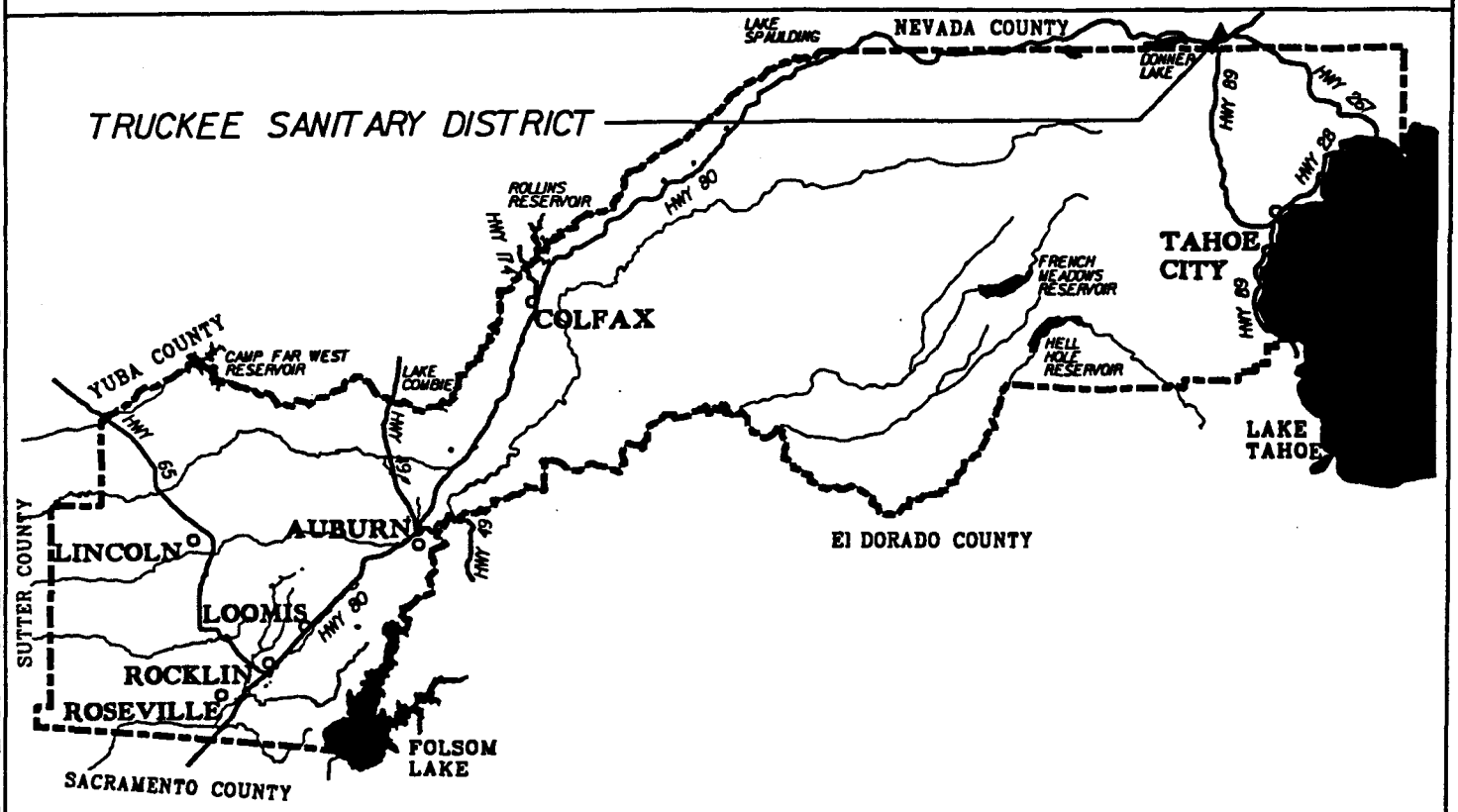
PFU's = Plumbing Fixture Units (see Ordinance for listings).

Source: Truckee Sanitary District Ordinance 2-91, effective July 1, 1991.

System Appraisal: Truckee SD provides a wastewater collection service for the community of Truckee, Tahoe Donner area, Glenshire/Devonshire Subdivision and the areas surrounding this general region. Wastewater is conveyed to the Tahoe-Truckee Sanitation Agency Regional Wastewater Treatment Plant.

In general the Truckee SD wastewater collection and conveyance system is considered in good overall condition. Collection system design capacity is 10.1 mgd with a current flow of nearly 1.5 mgd. Anticipated flow in the year 1992 is 1.5 mgd. Near-term planning does include the connection of additional service areas.

PLACER COUNTY WASTEWATER SYSTEMS



System Name: TRUCKEE SANITARY DISTRICT

Address: P.O. BOX 2628, TRUCKEE, CA 96160

Contact Name: OSSIAN BUTTERFIELD Phone: (916)-587-3804

Service Area Size: 35 sq.mi. No. Connect.: 6833 Population Served: 10,000

Services Provided: WASTEWATER COLLECTION AND EXPORT

Summary System Description

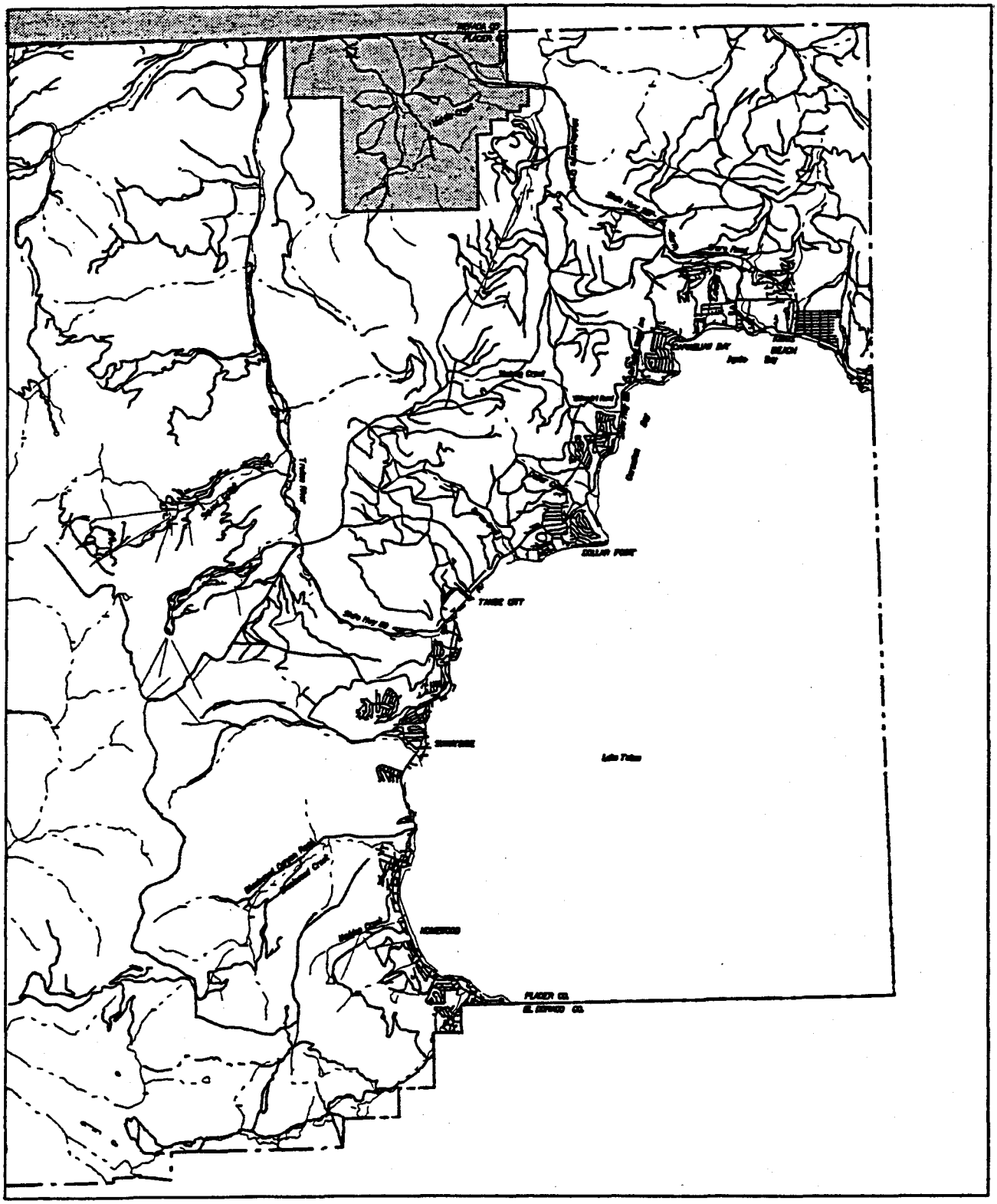
Service Area Characteristics: SIERRA NEVADA MOUNTAIN RANGE, WELL FORESTED. WASTEWATER COLLECTED FROM THE COMMUNITY OF TRUCKEE, TAHOE DONNER AREA, GLENSHIRE/DEVONSHIRE SUBDIVISION AND OTHER SURROUNDING AREAS.

Collection: THE COLLECTION SYSTEM CONSISTS OF 275 MILES OF GRAVITY LINE AND 8.2 MILES OF PRESSURE LINE, 2,284 MANHOLES AND 31 LIFTSTATIONS. THE COLLECTION SYSTEM DESIGN CAPACITY IS 10.1 MGD. (ACTUAL MAX FLOW CAPACITY)

Treatment: WASTEWATER IS TRANSPORTED TO THE TAHOE - TRUCKEE SANITATION AGENCY (T-TSA) MARTIS VALLEY WASTEWATER TREATMENT PLANT.

Disposal: DISPOSAL OF THE TRUCKEE SANITARY DISTRICT WASTEWATER FOLLOWS TREATMENT AT T-TSA. T-TSA EFFLUENT IS DISCHARGED TO SUBSURFACE TRENCHES WITH SEASONAL DISPOSAL TO A SPRAY IRRIGATION FIELD.

Capacity Limitations: CURRENTLY THERE IS NO LIMIT ON PERMITTED DISCHARGE. DESIGN CAPACITY IS 10.1 MGD.



Placer County General Plan

Figure:

Wastewater Service Area

N

Date: 1/15/92

Prepared by:
PSOMAS & ASSOCIATES

LEGEND

Truckee Sanitary District

- Streets
- Waterways
- County Line
- District Service Area

NOTE:
Delineated areas do not represent exact boundaries, rather they represent general or approximate boundaries.

TAHOE-TRUCKEE SANITATION AGENCY

General Information: The Tahoe-Truckee Sanitation Agency (T-TSA) is located at 13720 Joerger Drive, and the mailing address is P.O. Drawer B, Truckee, CA 96160.

Wastewater from T-TSA Martis Valley Wastewater Treatment Plant is regulated by Updated RWQCB Waste Discharge Requirements Order No. 6-90-27 and Monitoring and Reporting Program No. 90-27, effective April 11, 1990.

Wastewater Generation/Sources: The Tahoe-Truckee Sanitation Agency (TTSA) is designated as the regional entity to provide management of wastewater from North Tahoe PUD, Tahoe City PUD, Alpine Springs County Water District, Squaw Valley County Water District, Truckee Sanitary District, and Northstar Community Services District. The wastestream is considered municipal in nature.

In August 1978 average flows to the T-TSA wastewater treatment plant were nearly 3.8 mgd. During February 1986 total wastewater flow reached an estimated 18.5 mgd. TTSA currently handles an average wastewater flow of 3.64 mgd.

Before serving new sewer connection permits in the Tahoe Basin, the property must comply with the regulations of the TRPA, which will determine if the proposed development is consistent with the Lake Tahoe Basin Water Quality Plan. The TRPA is a compact formed by California and Nevada to perpetuate Lake Tahoe water quality.

Collection System Description: The Truckee River Interceptor conveys wastewater from Lake Tahoe Basin Public Utility District to Truckee. The interceptor conveyance system is constructed of CRP and DIP with line sizes varying from 20 inch to 36 inch diameter and a total length of 17 miles.

Deficiencies: TTSA does not have the authority to implore rules or regulations on member entities.

Proposed Improvements: Planned, proposed or required collection system improvements include continued inflow and infiltration monitoring of the existing collection system.

Wastewater Treatment System Description: The T-TSA Regional Wastewater Treatment Plant, located in the Martis Valley near Truckee, Nevada County, provides tertiary level treatment. Treatment processes include comminution, grit removal, primary sedimentation, pure oxygen activated sludge, chemical addition, mixed-media filtration, phosphorus and ammonia removal, and final chlorination. Organic sludge is anaerobically digested and dewatered. The T-TSA Regional Wastewater Treatment Plant was constructed in 1976-77 and began operation in 1978.

The seven day average capacity of the T-TSA treatment facility and its associated collection and disposal systems is 7.4 mgd during the summer period. The instantaneous wastewater flow is not permitted to exceed 13.0 mgd.

TTSA is equipped with 39 million gallons of emergency storage capability, including a 15 million gallon retention basin. A small portion of the 15 MG basin is used to equalize flows.

Deficiencies: Currently there are no identified deficiencies with the existing treatment plant.

Proposed Improvements: TTSA has a sewage overflow preventive maintenance and spill response

program pursuant to RWQCB Waste Discharge Requirements.

Additional planned improvement to the treatment system include increasing wastewater treatment capacity and associated upgrades as outlined in the January 1981 Final EIR and subsequent documents.

Disposal System Description: TTSA effluent is discharged to subsurface leach fields with seasonal disposal to a 10.5 acre spray irrigation field (pilot project status only). Treated and dewatered sludge is transported to the Eastern Regional Sanitary Landfill in Placer County.

Deficiencies: The TTSA disposal site is located within the Truckee River Hydrological Unit. Several investigations, including a study completed in October 1991 by the TTSA, indicate that TTSA effluent discharged to the subsurface disposal system flows toward the Truckee River and Martis Creek, a tributary of the Truckee River.
The TTSA effluent contains elevated phosphorous concentrations. The TTSA report revealed that 42,000 kilograms of phosphorous was applied to the effluent disposal field since 1978 and between 80 to 90 percent of the phosphorous was estimated to reside in the soil through 1990. Nevertheless, it was found that projected phosphorous concentrations will not exceed the 0.3 mg/l groundwater regulatory limit for 37 years while maintaining the current degree of treatment.

Proposed Improvements: Effluent disposal by spray irrigation is considered an experimental project at this time. Evaluation of the results after November 1991 will determine if this method of disposal is discontinued or expanded in the future.

Financing: Tahoe-Truckee Sanitation Agency semi-annual service charges are $54 per residential living unit. The connection fee is $2,750 for new residences. These fees vary according to the level of service, typically measured by the number of plumbing fixture units (PFU's). Regulations pertaining to the use, rates and charges for the T-TSA system are outlined in the 1990 T-TSA Ordnance and its addenda. The following table provides an outline of the current connection and use fee schedule.

TAHOE-TRUCKEE S.A. FEE SCHEDULE

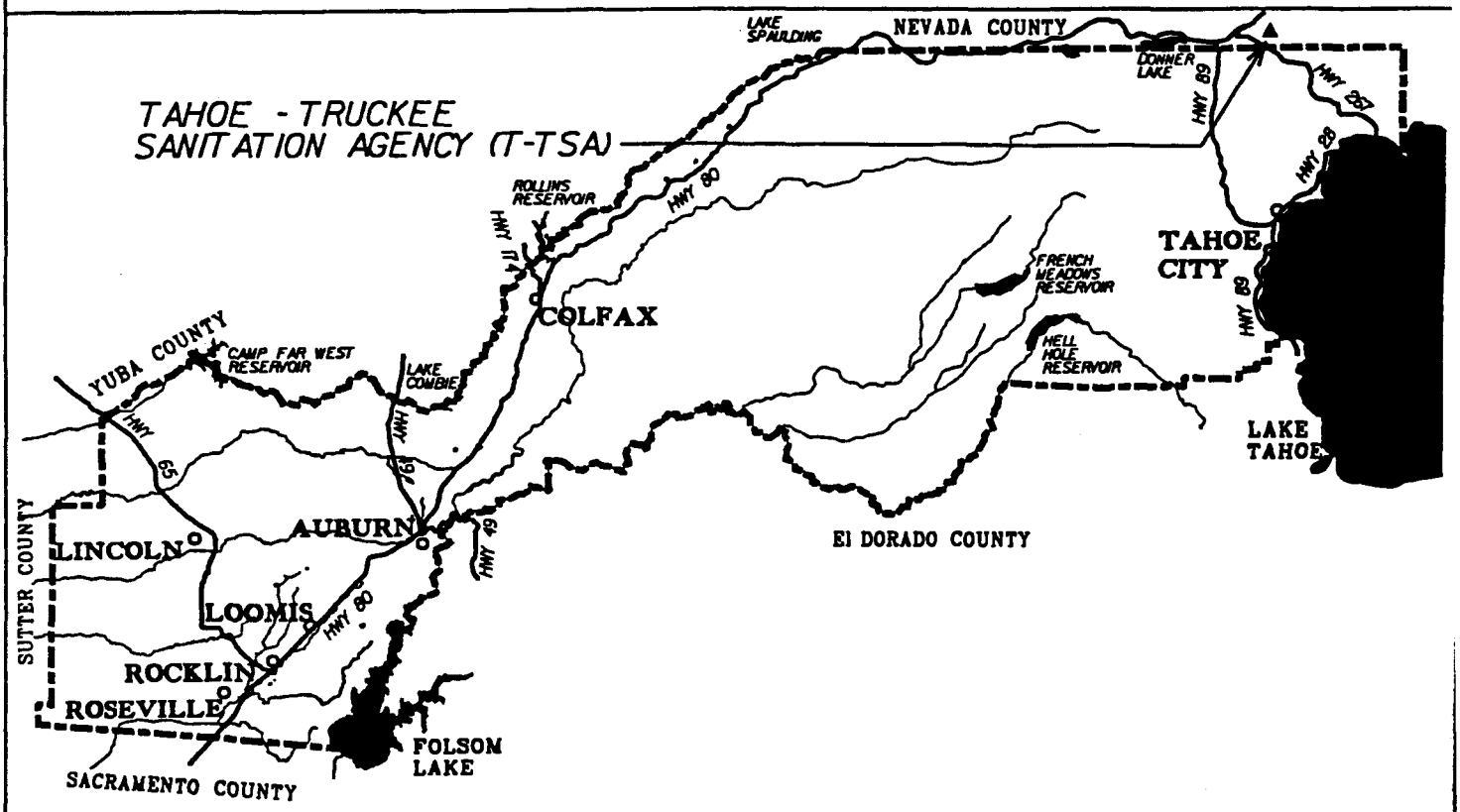
Connection Type	Connection Code	Units	Fee Per Unit	Semi-annual User Charge Per Unit
Residential	R	Living Units	$2,750	$54.00
Residential (non-taxed)	D	Living Units	$2,750	$55.80
Guest House	M	Living Units	$825	$14.70
Motel Without Kitchen	M	Living Units	$825	$14.70
Motel With Kitchen	M	Living Units	$1,965	$18.96
Campsite With Sewer	K	# of Sites	$1.375	$28.92
Campsite Without Sewer	Q	# of Sites	$1,022	$24.42
Restaurants & Bars	F	# of Seats	$275	$5.22
Outside Restaurant Seats	Z	# of Seats	$100	$1.86
Ski Clubs	B	# of PFU's	$275	$6.90
Snack Bars	B	# of PFU's	$275	$6.90
Laundries	L	# of 10# Machines	$1,375	$28.74
		20# to 50# Machines	$2,750	$57.42
Theaters	T	# of Seats	$28	$0.36
Service Stations	P	# of Service Bays	$2,800	$76.02
Barber Shops	H	# of Service Chairs	$825	$14.70
Markets	G	# of PFU's	$415	$10.62
Churches	C	# of Seats	$28	$0.36
Beauty Shops	A	# of Service Chairs	$1,375	$24.42
Other Businesses	B	# of PFU's	$275	$6.90
Other Business (non-taxed)	E	# of PFU's	$275	$7.14
Septage	I	As May Be Determined		$1.02
Other	S	As May Be Determined		$1.02

Source: T-TSA Ordinance 2-91
Notes: PFU's = Plumbing Fixture Units (See Ordinance for listings)

System Appraisal: The Tahoe-Truckee Sanitation Agency is designated as a regional entity to provide wastewater management. TTSA operates a tertiary level wastewater treatment facility discharging to subsurface leach fields and a spray irrigation field, both of which are in hydrologic continuity with the Truckee River and Martis Creek.

In general the T-TSA Martis Valley Wastewater Treatment Plant facilities is considered in excellent overall condition. Treatment/Disposal system design capacity is 7.4 mgd with a current flow of 3.5 mgd. Anticipated flow in the year 2008 is 7.4 mgd with a potential maximum to expand to 10.0 mgd. Near-term planning does not include the connection of additional service areas.

PLACER COUNTY WASTEWATER SYSTEMS



System Name: TAHOE - TRUCKEE SANITATION AGENCY (T-TSA)

Address: 13720 JOERGER DRIVE, TRUCKEE, CA 96160

Contact Name: CRAIG WOODS, GENERAL MANAGER Phone: (916)-587-2525

Service Area Size: _____ No. Connect.: 17,400 Population Served: _____

Services Provided: DESIGNATED AS REGIONAL ENTITY TO PROVIDE WASTEWATER MANAGEMENT.

Summary System Description

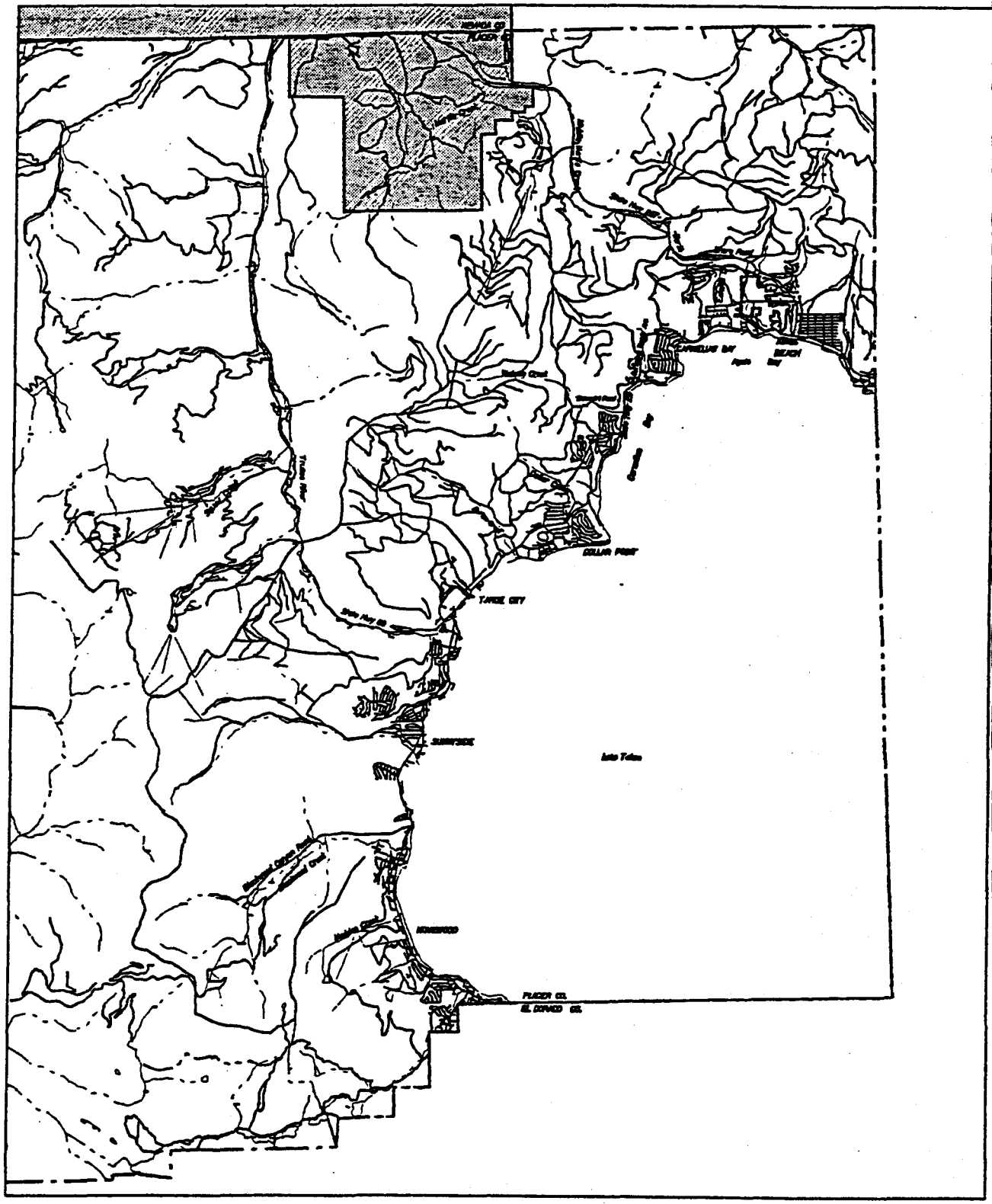
Service Area Characteristics: MANAGES WASTEWATER FROM NORTH TAHOE P.U.D., TAHOE CITY P.U.D., ALPINE SPRINGS C.W.D., SQUAW VALLEY C.W.D., TRUCKEE S.D., AND NORTHSTAR C.S.D.

Collection: TRUCKEE RIVER INTERCEPTOR CONVEYS WASTEWATER FROM LAKE TAHOE DEVELOPMENTS TO TRUCKEE.

Treatment: TERTIARY LEVEL TREATMENT INCLUDES SEDIMENTATION, PURE OXYGEN ACTIVATED SLUDGE, AND PHOSPHOROUS AND AMMONIA REMOVAL. 39 MILLION GALLONS STORAGE CAPABILITY. MAXIMUM FLOW OF 13.0 MGD.

Disposal: EFFLUENT DISCHARGED TO SUBSURFACE LEACHFIELD WITH SEASONAL DISPOSAL TO SPRAY IRRIGATION FIELD.

Capacity Limitations: 7.4 MGD SEVEN DAY AVERAGE DURING SUMMER PERIOD. NEW CONNECTIONS MUST MEET FEDERAL, STATE, AND LOCAL REGULATIONS.



Placer County General Plan

Figure ___

Waste Water Service Area

N

Date: 1/10/92

Prepared by:
PSOMAS & ASSOCIATES

LEGEND

Tahoe Truckee Sanitation Agency

- Streets
- Waterways
- County Line
- District Service Area

NOTE:
Delineated areas do not represent exact boundaries, rather they represent general or approximate boundaries.

Appendix C
Wildlife Habitat Relationships
Community Descriptions

APPENDIX C

WILDLIFE HABITAT RELATIONSHIPS COMMUNITY DESCRIPTIONS

Chapter 9 of the *Draft General Plan Background Report* provides an overview of the vegetation and wildlife resources in Placer County. The summary descriptions of biological communities presented in Chapter 9 are based on the Wildlife Habitat Relationships (WHR) descriptions contained in *A Guide to Wildlife Habitats of California*, which was published by the California Department of Forestry and Fire Protection in October of 1988. This appendix contains reproductions of the detailed WHR community descriptions contained in the original report.

WHR COMMUNITIES DESCRIBED

Perennial Grassland

John G. Kie

Vegetation

Structure.—Perennial Grassland habitats, as defined here, occur in two forms in California: coastal prairie, found in areas of northern California under maritime influence, and relics in the valley grasslands now dominated by annual grasses and forbs. The coastal prairie form is described here. Relic perennial grasslands are discussed in the chapter on Annual Grassland habitats (AGS). Species of perennial grasses are also common in Wet Meadow (WTM) and other habitats.

Structure in Perennial Grassland habitat is dependent upon the mix of plant species at any particular site. For example, sites with western bracken fern exhibit a taller (to 1.5 m (5 ft)), more vertically diverse structure than those dominated by shorter grasses such as silver hairgrass (10-30 cm (0.3-1.0 ft)). Grazing by domestic livestock or wild herbivores such as Roosevelt elk can substantially alter habitat structure through reduction in plant height and removal of biomass. Average herbaceous production on nine soil series in Humboldt County was estimated to be 1700-13,000 kg/ha (1500-11,600 lb/ac) (Cooper and Heady 1964).

Composition.—Perennial Grassland habitats are dominated by perennial grass species such as California oatgrass, Pacific hairgrass, and sweet vernalgrass. On northern sites near the ocean in Del Norte and Humboldt Counties, common species include California oatgrass, American dunegrass, goldfields, Kentucky bluegrass, and western bracken fern (Heady et al. 1977). Further inland, common species include redtop, silver hairgrass, sweet vernalgrass, English daisy, soft chess, coast carex, orchardgrass, California oatgrass, Idaho fescue, red fescue, Douglas iris, western bracken fern and red clover (Heady et al. 1977). To the south, at Point Lobos State Reserve in Monterey County, dominant species include silver hairgrass, coronaria brodiaea, soft chess, California oatgrass, Pacific hairgrass, snakeroot, gumweed, toad rush, poverty rush, common wood-rush, squawroot, and fiddle dock (Heady et al. 1977).

Other Classifications.—Other classifications of Perennial Grassland are Coastal Prairie (Munz and Keck 1959, Cheatham and Haller 1975), Coastal Prairie-Scrub Mosaic (Küchler 1977), and *Festuca-Danthonia* grassland (Heady et al. 1977). Further, CALVEG (Parker and Matyas 1981) describes perennial grass in the North Interior, South Sierran and Southern Interior Ecological provinces. Perennial grass in each of these regions are more associated with the Wet Meadow (WTM) and Fresh Emergent Wetland (FEW) habitats in the North Interior; WTM, FEW, Lodgepole Pine (LPN), Eastside Pine (EPN), and Jeffrey Pine (JPN) in the South Sierran, and Joshua Tree (JST) and Desert Scrub (DSC) in the South Interior. If perennial grass is encountered in any of these regions of the State, refer to the appropriate habitat description.

Habitat Stages

Vegetation Changes 1-2-5-D.—Historically, factors that have affected Perennial Grassland habitats on the north coast include the introduction of non-native annual plant species, increased grazing pressure, elimination of frequent fires, and cultivation (Heady et al. 1977). Vegetation changes influenced by increased grazing, such as the spread of introduced annuals, were slower to occur on the north coast than in the central valley. Spanish missions did not extend north of Sonoma County, and the Russian settlements at Fort Ross and elsewhere on the north coast maintained few cattle and sheep. However, heavy grazing by Roosevelt elk and frequent use of fire by local Indian tribes may have influenced the successional stages of many Perennial Grassland habitats (Heady et al. 1977).

Duration of Stages.—Heavily grazed Perennial Grassland habitat dominated by annual plant species returns to perennial species under reduction in grazing pressure. Heady et al. (1977) suggest a successional sequence of annual forbs, followed by annual grasses and perennial forbs, then by perennial grasses such as hairy oatgrass and common velvetgrass, and ending in a climax community dominated by sweet vernalgrass and Pacific oatgrass. On some sites, Perennial Grassland habitat may give way to Coastal Scrub habitat (CSC) dominated by coyotebush and lupine (Heady et al. 1977).

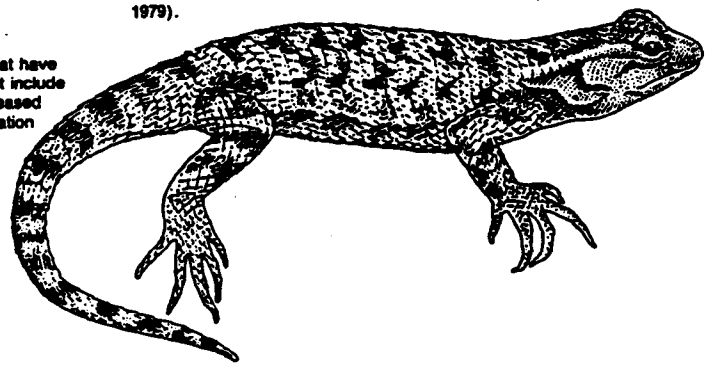
Where Perennial Grassland habitat occurs on sites formerly supporting Douglas-fir (DFR), the establishment of perennial grasses may in some cases prevent succession back to the original forest cover (Gordon Huntington, pers. comm.).

Biological Setting

Habitat.—Perennial Grassland habitat in the coastal prairie can be found adjacent to Douglas-fir (DFR), Redwood (RDW), Coastal Oak Woodland (COW), Closed Cone-Pine Cypress (CPC), Coastal Scrub (CSC), Saline Emergent Wildland (SEW), Estuarine (EST), Marine (MAR), Fresh Emergent Wetland (FEW), Valley-Foothill Riparian (VRI), Cropland (CRP), Pasture (PAS), and Orchard-Vineyard (OVN) habitats.

Wildlife Considerations.—Perennial Grassland provides optimum habitat for many species, including the common garter snake, western terrestrial garter snake (Houck 1979), northern harrier, barn owl, burrowing owl, western kingbird, Say's phoebe, barn swallow, western meadowlark, savannah sparrow, grasshopper sparrow (Harris and Harris 1979), Townsend mole, coast mole, Botta's pocket gopher, western harvest mouse, California vole, long-tailed vole, and Oregon vole (Mossman 1979).

In addition, Perennial Grassland often serves as feeding habitat for the turkey vulture, red-tailed hawk, American kestrel, peregrine falcon, western bluebird (Harris and Harris 1979), fringe-tailed bat, big brown bat, striped skunk, coyote, black-tailed jackrabbit, brush rabbit, Roosevelt elk, and black-tailed deer (Mossman 1979).



Western Fence Lizard *(Sceloporus occidentalis)*

PGS
Perennial Grassland habitat, Solano County, California (photo by Jim Barry)

Perennial Grassland

Physical Setting

Perennial Grassland habitat typically occurs on ridges and south-facing slopes, alternating with forest and scrub in the valleys and on north-facing slopes (Heady et al. 1977). Perennial Grassland habitats are most often found on Mollisols. These soils may grade into Inceptisols to the north, with higher precipitation allowing for leaching of the mollic horizon, and into Alfisols to the south, under drier conditions. On the north coast, Perennial Grassland habitat may occasionally be found on Ultisols which formerly supported Douglas-fir (DFR) habitats, but which have been cleared by man (Gordon Huntington, pers. comm.).

Climatic conditions are under strong maritime influence. Crescent City in Del Norte County has one of the wettest, coolest, most vegetatively productive climates in California (Major 1977). On the north coast, the length of the frost-free season in adjacent Douglas-fir (DFR) habitat is about 200 days (14 fortnights) (Garrison et al. 1977). Annual precipitation is highest in the north (Crescent City 1777 mm (70 in)), and lower to the south (Point Reyes, 497 mm (20 in); Monterey, 465 mm (18 in)) and inland (Davis, 418 mm (16 in)) (Major 1977). Fog, which is common, reduces evapotranspiration, and greatly influences potential natural vegetation.

Distribution

Perennial Grassland habitat occurs along the California coast from Monterey County northward (Küchler 1977). It is found below 1000 m (3280 ft) in elevation and seldom more than 100 km (62 mi) from the coast (Heady et al. 1977).

The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Annual Grassland

John G. Kie

Vegetation

Structure.—Annual Grassland habitats are open grasslands composed primarily of annual plant species. Many of these species also occur as understory plants in Valley Oak Woodland (VOW) and other habitats. Structure in Annual Grassland depends largely on weather patterns and livestock grazing. Dramatic differences in physiognomy, both between seasons and between years, are characteristic of this habitat. Fall rains cause germination of annual plant seeds. Plants grow slowly during the cool winter months, remaining low in stature until spring, when temperatures increase and stimulate more rapid growth. Large amounts of standing dead plant material can be found during summer in years of abundant rainfall and light to moderate grazing pressure. Heavy spring grazing favors the growth of summer-annual forbs, such as tarweed and turkey mullein, and reduces the amount of standing dead material. On good sites, herbage yield may be as high as 4900 kg/ha (4400 lb/ac) (Garrison et al. 1977).

Composition.—Introduced annual grasses are the dominant plant species in this habitat. These include wild oats, soft chess, ripgut brome, red brome, wild barley, and foxtail fescue. Common forbs include broadleaf filaree, redstem filaree, turkey mullein, true clovers, bur clover, popcorn flower, and many others. California poppy, the State flower, is found in this habitat. Perennial grasses, found in moist, lightly grazed, or relic prairie areas, include purple needlegrass and Idaho fescue. Vernal pools, found in small depressions with a hardpan soil layer, support downingia, meadowfoam, and other species (Parker and Matyas 1981).

Species composition is also related to precipitation (Bartolome et al. 1980). Perennial grasses are more common on northern sites with mean annual rainfall greater than 150 cm (60 in). Soft chess and broadleaf filaree are common in areas with 65-100 cm (25-40 in) of rainfall, and red brome and redstem filaree are common on southern sites with less than 25 cm (10 in) of precipitation (Bartolome et al. 1980).

Other Classifications.—Annual Grassland habitat has been described as Valley Grassland (Munz and Keck 1959, Heady 1977), Valley and Foothill Grassland (Cheatham and Haller 1975), California Prairie (Küchler 1977), Annual Grasslands Ecosystem (Garrison et al. 1977), Bromegrass, Fescue, Needlegrass, and Wild Oats series (Paysen et al. 1980), and Annual Grass-Forb series (Parker and Matyas 1981).

Habitat Stages

Vegetation Changes 1-2-S-D.—Annual Grassland habitats occupy what was once a pristine native grassland. The native grassland likely consisted of climax stands of perennial bunchgrasses, such as purple needlegrass, on wetter sites (Bartolome 1981, Bartolome and Gemmill 1981), with annual species existing as climax communities on drier alluvial plains (Webster 1981). Today, plant succession in the classical sense does not occur in Annual Grassland habitats. However, species composition is greatly influenced by seasonal and annual fluctuations in weather patterns. Annual plants germinate with the first fall rains that exceed about 15 mm (0.6 in), growing slowly during winter and more rapidly in spring (Heady 1977). Botanical composition changes throughout the growing season because of differences in plant phenology (Heady 1958). Most annuals mature between April and June (Heady 1977), although some species, such as tarweed and turkey mullein, continue to grow into summer. Fall rains that encourage germination, followed by an extended dry period, favor the growth of deep-rooted forbs (Duncan and Woodmansee 1975), but continuing rainfall favors rapidly growing grasses (Pitt and Heady 1978). Livestock grazing favors the growth of low-stature, spring-maturing forbs, such as filaree (Freckman et al. 1979), and summer annuals, such as turkey mullein (Duncan 1976). Because these are important food plants for many wildlife species, proper levels of livestock grazing are generally beneficial in this habitat. In the absence of livestock, Annual Grassland habitats are often dominated by tall, dense stands of grasses such as ripgut brome (Freckman et al. 1979) and wild oats.

Duration of Stages.—Although Annual Grassland habitats consist largely of non-native annuals, these effectively prevent the reestablishment of native perennials over large areas and now comprise climax communities (Heady 1977). Introduced annuals should be considered naturalized plant species and so managed, rather than as invading species characteristic of poor range sites.

Biological Setting

Habitat.—Annual Grassland habitat is found just above or surrounding Valley Foothill Riparian (VRI), Alkali Scrub (ASC), Fresh Emegent Wetland (FEW), Cropland (CRP), Orchard-Vineyard (OVN), and Pasture (PAS) habitat types, and below Valley Oak Woodland (VOW), Blue Oak Woodland (BOW), Blue Oak-Digger Pine (BOP), Chamise-Redshank (CRC), and Mixed Chaparral (MCH) habitats. Annual Grassland habitat also borders Coast Oak Woodland (COW), Closed Cone-Pine-Cypress (CPC), Coastal Scrub (CSC), and Eucalyptus (EUC) habitats.

Wildlife Considerations.—Many wildlife species use Annual Grasslands for foraging, but some require special habitat features such as cliffs, caves, ponds, or habitats with woody plants for breeding, resting, and escape cover. Characteristic reptiles that breed in Annual Grassland habitats include the western fence lizard, common garter snake, and western rattlesnake (Basey and Sinclear 1980). Mammals typically found in this habitat include the black-tailed jackrabbit, California ground squirrel, Botta's pocket gopher, western harvest mouse, California vole, badger, and coyote (White et al. 1980). The endangered San Joaquin kit fox is also found in and adjacent to this habitat (U.S. Fish and Wildlife Service 1983). Common birds known to breed in Annual Grasslands include the burrowing owl, short-eared owl, horned lark, and western meadowlark (Verner et al. 1980). This habitat also provides important foraging habitat for the turkey vulture, northern harrier, American kestrel, black-shouldered kite, and prairie falcon.

Physical Setting

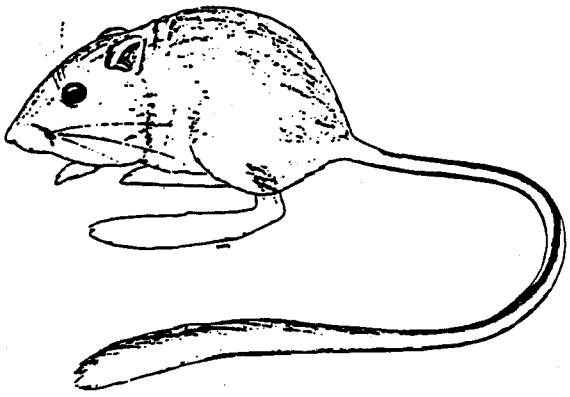
Annual Grassland habitat occurs mostly on flat plains to gently rolling foothills. Common soil orders include Entisols and Alfisols (Garrison et al. 1977). Entisols are often found at lower elevations on flood plains and swales that receive periodic deposits of alluvium (U.S. Soil Conservation Service 1975), and are characterized by little or no pedogenic horizon development. Alfisols occur at higher elevations above the valley floor (Garrison et al. 1977). Some Annual Grassland habitats can be found in the drier portion of the southern San Joaquin Valley on Aridisols (Garrison et al. 1977). Climatic conditions are typically Mediterranean, with cool, wet winters and dry, hot summers. The length of the frost-free season averages 250 to 300 days (18 to 21 fortnights) (Garrison et al. 1977). Annual precipitation is highest in the north (Redding, 960 mm (38 in)) and north coast (Ukiah, 909 mm (36 in)), decreasing to the south (Sacramento, 430 mm (17 in); Stockton, 339 mm (13 in); Fresno, 259 mm (10 in)), and reaching a minimum in the southern San Joaquin Valley (Bakersfield, 150 mm (6 in)) (Major 1977).

Distribution

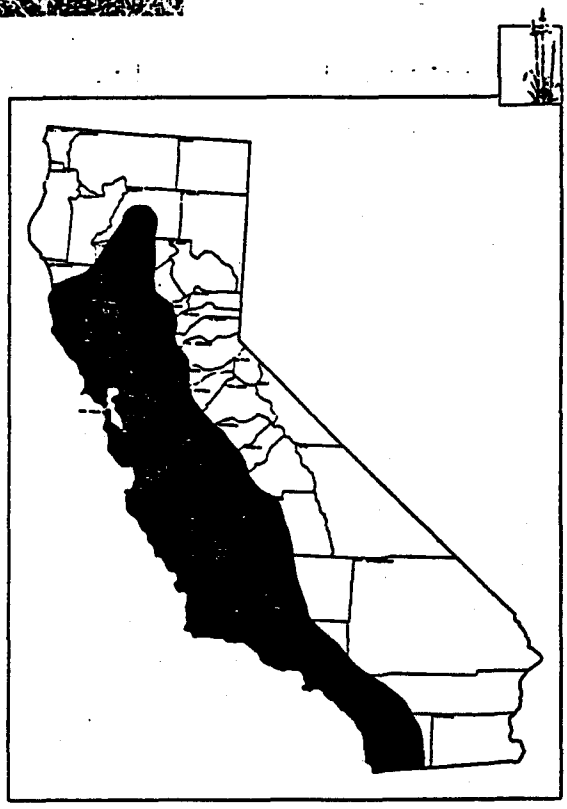
Annual Grassland habitat occurs throughout the central valley of California, in the coastal mountain ranges as far north as Men-

AGS
Annual Grassland habitat, Chino Hills, San Bernardino County, California (photo by Gary O. Fregien)

docino County, and in scattered locations in southern California. It occurs from sea level to about 1200 m (3900 ft) in elevation (Heady 1977). Relics of the pristine California prairie can be found throughout this habitat, including sites at Jepson Prairie (Solano County), and at the University of California's Hopland Field Station (Mendocino County) and Hasting's Natural History Reservation (Monterey County). However, these relics are limited in size and may not constitute a separate habitat.



Giant Kangaroo Rat *(Dipodomys ingens)*



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Chamise-Redshank Chaparral

Vegetation

Structure.—Fire occurs regularly in Chamise-Redshank Chaparral and influences habitat structure. Mature Chamise-Redshank Chaparral is single layered, generally lacking well-developed herbaceous ground cover and overstory trees. Shrub canopies frequently overlap, producing a nearly impenetrable canopy of interwoven branches. Chamise-dominated stands average 1 to 2 m (3.3 to 6.6 ft) in height, but can reach 3 m (9.8 ft) (Horton 1960, Cheatham and Haller 1975, Hanes 1977). Total shrub cover frequently exceeds 80 percent, but may be considerably lower on extremely xeric sites with poor soils (Minnich 1976, Vogl 1976, Hanes 1977). Redshank stands are slightly taller, averaging 2 to 4 m (6.6 to 13.1 ft) but occasionally reaching 6 m (19.7 ft) (Hanes 1965, 1977, Cheatham and Haller 1975). Mature redshank frequently is more open than chamise and can have sparse herbaceous cover between shrubs (Hanes 1965, 1977, Paysen et al. 1980).

Composition.—Chamise-Redshank Chaparral may consist of nearly pure stands of chamise or redshank, a mixture of both, or with other shrubs. The purest stands of chamise occur on xeric, south-facing slopes (Hanes 1976). Toyon, sugar sumac, poison-oak, redberry, and California buckthorn are commonly found in drainage channels and on other relatively mesic sites (Vogl 1976). At upper elevations or on more mesic exposures, chamise mixes with ceanothus, manzanita, scrub oak, and laurel sumac (Horton 1960, Hanes 1976, Parker and Matyas 1981). Ceanothus and sugar sumac are common associates of redshank (Hanes 1965, 1977). In southern California, white sage, black sage, and California buckwheat are common at lower elevations and on recently disturbed sites (Hanes 1965, 1977).

Distinguishing Chamise-Redshank Chaparral from Mixed Chaparral (MCH) and Coastal Scrub (CSC) is a subjective interpretation based on percent cover by chamise and redshank and time since last burn. Paysen et al. (1980) classify chaparral as chamise or redshank if either species is "dominant". Hanes (1977) considers a stand to be chamise if it comprises 50 to 100 percent of total cover and redshank if it comprises 20 to 50 percent of total cover. For purposes of this description and the WHR model (Salwasser and Laudenslayer 1982), a more complex definition is needed which reflects changes in species composition that occur during post-fire recovery and aging. A stand of brush is classified as Chamise-Redshank Chaparral, as opposed to Mixed Chaparral, if any of the following criteria are fulfilled.

1. Any stand with greater than 60 percent relative shrub cover by chamise and redshank.
2. Young stands recovering from fire with greater than 20 percent absolute shrub cover by chamise and redshank, and greater than 75 percent relative shrub cover by these species and relatively short-lived subshrubs such as yerba-santa.
3. Any stand with at least 50 percent relative shrub cover by chamise and redshank and greater than 75 percent relative shrub cover by these species and shrubs of intermediate lifespan such as several species of ceanothus.

Other Classifications.—Most plant ecologists treat stands dominated by chamise and redshank as distinct types (Cheatham and Haller 1975, Thorne 1976, Hanes 1977, Paysen et al. 1980, Parker and Matyas 1981). Horton (1960) further divides chamise into "pure chamise" and "chamise-ceanothus" to reflect the frequent occurrence of mixtures of these shrubs. The Californian mixed chaparral of Cheatham and Haller (1975) includes many stands of Chamise-Redshank Chaparral that also support a significant component of ceanothus and other shrubs.

Habitat Stages

Vegetation Changes 1;2-4;5-D.—Fire is the primary disturbance initiating secondary succession in Chamise-Redshank Chaparral. Annuals, perennial herbs, and subshrubs are abundant for several years after a fire. Shrubs begin to appear either as seedlings or root-crown sprouts beginning the first growing season after burning (Hanes 1971). As the habitat matures, shrub cover and height increase and herbaceous cover declines (Hanes 1971). Relatively short-lived shrubs and subshrubs, such as California buckwheat, common deerweed, and most species of ceanothus, may be absent or rare in older stands (Horton and Kraebel 1955, Hanes 1977). After each fire, populations of these species and post-fire herbs regenerate quickly from the seed bank in the soil (Sweeney 1956). In old unburned stands, species diversity is low, growth rates are slow, long-lived shrubs accumulate dead material, and some shrubs may die (Hanes 1971, Rundel and Parsons 1979).

Duration of Stages.—The general schedule of post-fire recovery in chaparral is described by Menke and Villaseñor (1977) and Zedler (1977). Herbaceous cover is dominant for 1 to 3 years. Long- and short-lived shrubs increase in height and cover but canopies generally do not overlap for 3 to 15 years after fire. From 10 to 30+ years, short-lived shrubs die, shrub cover increases, the canopy closes, and dead material begins to accumulate. Rundel and Parsons (1979) found that, in the Sierra Nevada, chamise growth rates declined and accumulation of dead material began after 16 years. Time to senescence is dependent on local site characteristics. In southern California, Hanes (1977) considers chamise older than 60 years to be senescent, but this may occur in 20 to 25 years in northern California (Sampson 1944). Horton (1960) states that pure chamise in the San Bernardino Mountains reaches 25 percent cover in 10 years, 50 percent in 40 years, and 70 percent in 55 years. However, recovery rates and peak cover vary with soil type, climatic regime, and slope. For example, most mesic sites supporting chamise and ceanothus reach 50 percent cover in 10 years and 90 percent cover in 25 years. Some sites may reach 90 percent cover in 10 years (T. E. Paysen, pers. comm.). At 50 years, shrub cover in mixed stands of chamise and ceanothus may decline to 80 percent total shrub cover as ceanothus dies (Hanes 1977).

Biological Setting

Habitat.—Chamise-Redshank Chaparral generally occurs below and grades into Mixed Chaparral (MCH). On some sites, Chamise-Redshank Chaparral may form an ecotone with Ponderosa Pine (PPN), Coastal Oak Woodland (COW), or mixed conifer types. In northern California, the lower boundary is with Annual Grassland (AGS) and Blue Oak-Digger Pine (BOP). In southern California, Coastal Scrub (CSC) may form a broad mosaic with Chamise-Redshank Chaparral. Location of the boundary can depend on fire frequency (Hanes 1971). On desert exposures, redshank stands may occur above either Mixed Chaparral (MPC) or Desert Succulent Scrub (DSC) and either above or below Pinyon-Juniper (PJN).

Wildlife Considerations.—Wildlife species found in this habitat type also are found in either Mixed Chaparral (MCH), Montane Chaparral (MCP), Coastal Scrub (CSC) or Sagebrush (SGB) and in shrubs beneath several woodland and forest types. The primary land management consideration is selection of alternative fire management treatments. Long-term fire suppression can lead to stand senescence (Vogl 1977) and declines in deer (Biswell et al. 1952), small mammals (Quinn 1979), birds (Wirtz 1979), and reptiles (Simovich 1979). Most animal populations reach peak densities in the first two or three decades, frequently 1 to 15 years, after a fire. Repeated fires at short intervals could favor crown-sprouting shrubs over obligate seed sprouters (Vogl 1977). Either management extreme could have long-term impacts on wildlife through changes in nutrient availability, soil quality or vegetation composition, structure, and recovery time. Prescribed burning can be an effective management tool, but the effects vary with season of burn (Rundel 1982). Post-fire herbs may be important in immobilizing nitrogen within the chaparral system (Rundel and Parsons 1980). Protecting these herbs from grazing

A. Sidney England

CRC
Chamise-Redshank Chaparral habitat, Grindstone Project, Glenn County, California (photo by A. Sidney England)

may be important for effective long-term habitat maintenance (Rundel 1982). Populations of most small vertebrates decline sharply or are eliminated when chaparral is converted to grassland (Lillywhite 1977). Active and passive chaparral management programs must tailor management prescriptions to specific site characteristics and project goals.

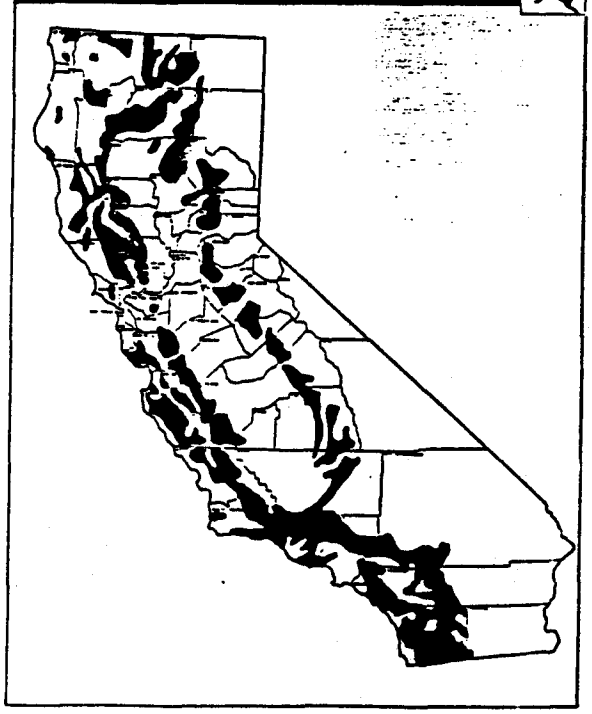
Physical Setting

Chamise-dominated stands are most common on south- and west-facing slopes; redshank is found on all aspects (Hanes 1965, 1977, Cheatham and Haller 1975). Soils usually are thin with little accumulation of organic material (Cheatham and Haller 1975). Chamise may be a dominant shrub on some serpentine sites (Parker and Matyas 1981). Chamise-Redshank Chaparral is found in a mediterranean climate; rainfall is 38 to 63 cm (15 to 25 in), less than 20 percent of total precipitation falls in summer, and winters are mild (Ornduff 1974). The predominant land forms are steep slopes and ridges (Thorne 1976).

Distribution

Hanes (1977) provides a good description of "chamise" and "redshank" chaparral distributions in California. This habitat is usually found below 1200 m (4000 ft) on mountain ranges outside the deserts (Cheatham and Haller 1975, Vogl 1976, Minnich 1976, Hanes 1977, Parker and Matyas 1981). Large nearly pure areas of redshank-dominated chaparral occur in the interior valleys of the peninsular mountain ranges of Riverside and San Diego counties; isolated stands are found in the Santa Monica Mountains and in northern Santa Barbara and San Luis Obispo counties (Cheatham and Haller 1975, Hanes 1977). Chamise is the dominant shrub of this habitat type throughout the rest of the state. Nearly pure stands of chamise cover large areas in the peninsular and transverse ranges and Tehachapi Mountains of southern California. To the north, chamise more frequently mixes with other shrubs, especially several species of ceanothus. This type of vegetation covers large areas in the central coast ranges and on the eastern exposures of the north coast ranges; as isolated stands in the Cascade and Klamath ranges and the Siskiyou Mountains; and in a broken band on the western slope of the Sierra Nevada (Hanes 1977, Parker and Matyas 1981).

Chamise-Redshank Chaparral



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Mixed Chaparral

A. Sidney England

Vegetation

Structure.—Mixed Chaparral (MCH) is a structurally homogeneous brushland type dominated by shrubs with thick, stiff, heavily cutinized evergreen leaves. Shrub height and crown cover vary considerably with age since last burn, precipitation regime (cismontane vs. transmontane), aspect, and soil type (Hanes 1977). At maturity, cismontane Mixed Chaparral typically is a dense, nearly impenetrable thicket with greater than 80 percent absolute shrub cover. Canopy height ranges from 1 to 4 m (3.3 to 13.1 ft), occasionally to 6 m (19.6 ft) (Horton 1960, Cheatham and Haller 1975, Hanes 1977). On poor sites, serpentine soils or transmontane slopes, shrub cover may be only 30 to 60 percent and shrubs may be shorter, 0.5 to 3.0 m (1.6 to 9.8 ft) (Cheatham and Haller 1975, Hanes 1976, 1977). Considerable leaf litter and standing dead material may accumulate in stands that have not burned for several decades.

Composition.—Mixed Chaparral is a floristically rich type that supports approximately 240 species of woody plants (Ornduff 1974). Composition changes between northern and southern California and with precipitation regime, aspect, and soil type. Dominant species in cismontane Mixed Chaparral include scrub oak, chaparral oak, and several species of ceanothus and manzanita. Individual sites may support pure stands of these shrubs or diverse mixtures of several species. Commonly associated shrubs include chamise, birchleaf mountain mahogany, silk-tassel, toyon, yerba-santa, California buckeye, poison-oak, sumac, California buckthorn, hollyleaf cherry, Montana chaparral-pea, and California fremontia. Some of these species may be locally dominant.

Leather oak and interior silktassel are widely distributed on cismontane serpentine soils, and chamise and toyon may be abundant on these soils. Shrubs such as Jepson, coyote, and dwarf ceanothus and serpentine manzanita are local serpentine endemics (Cheatham and Haller 1975, Thorne 1976, Hanes 1977). Incense-cedar, knobcone pine, Coulter pine, and Digger pine frequently are found in Mixed Chaparral on serpentine soils (Thorne 1976).

Shrub live oak, desert ceanothus, and desert bitterbrush are examples of shrubs found in Mixed Chaparral only on transmontane slopes (Cheatham and Haller 1975, Thorne 1976, Hanes 1977, and Zabriskie 1979). However, many species found in cismontane stands are also common on desert-facing slopes. Examples include bigberry manzanita, chamise, birchleaf mountain mahogany, California fremontia, and several species of ceanothus.

Other Classifications.—Most authors divide Mixed Chaparral into several types based on the dominant floristic component, soil type or location. Cheatham and Haller (1975) recognize Californian mixed, south coastal, semi-desert, and serpentine chaparrals. Thorne (1976) identifies mixed chaparral but separates serpentine and desert transition chaparral as distinct types. Paysen et al. (1980) subdivide this type into 7 series (ceanothus, mountain mahogany, scrub oak, prunus, sumac, manzanita, and toyon) based on the dominant or codominant shrub components. Hanes (1977) gives a good review and description of 6 Mixed Chaparral types (ceanothus, scrub oak, manzanita, serpentine, desert, and woodland).

Habitat Stages

Vegetation Changes 1;2-4:S-D.—Post-fire recovery of Mixed Chaparral begins with a cover of subshrubs, annuals, and perennial herbs. However, shrubs that will be dominant in mature chaparral are present as seedlings and root-crown sprouts. As shrub cover and height increase with age, harbaceous cover declines. Long-lived seeds remaining in the soil produce the herbceous cover following the next fire (Sweeney 1956). Shrub species composition also may change as the stand ages. Yerba-santa, common deerweed, and many ceanothus are examples of relatively short-lived (<40 years) shrubs and subshrubs that disappear from stands that have not been burned for decades (Horton and Kraebel 1955, Hanes 1971, 1977). Long-lived shrubs in very old stands become senescent, accumulating standing dead material, and some individual may die.

Some authors (e.g., Thorne 1976) have suggested that Mixed Chaparral might succeed to an oak woodland if protected from fire for extremely long periods. Others (e.g., Minnich 1976) have failed to find evidence to support this notion. Hanes (1977) suggests that confusion may result from inadequate distinction among vegetation types with different species compositions, soil qualities, slopes, aspects, and precipitation regimes.

Duration of Stages.—Menke and Villaseñor (1977) and Zedler (1977) give good descriptions of the chaparral post-fire recovery schedule. For the first 1 to 3 years, cover is dominated by short-lived herbs and subshrubs; shrubs are present as seedlings and root-crown sprouts. From 3 to 15 years, herbaceous species disappear as shrubs and subshrubs enlarge, but shrub canopies generally do not touch. From approximately 10 to 30+ years after a burn, shrub cover increases, canopies begin to overlap, relatively short-lived shrubs begin to die, and dead material accumulates. Stands more than 25 to 35 years old eventually can become senescent. The post-fire recovery schedule varies with species composition, slope, aspect, elevation, and soil type. Shrub regeneration is quicker on more mesic sites. In southern California, stands dominated by manzanita, ceanothus, and scrub oak reach 50 to 60 percent cover in 10 years and 80+ percent cover in 25 to 30 years (Horton 1960, Vogl 1976, Pase 1982b). Recovery time usually is shorter in northern California. Stands of Chamise-Redshank Chaparral (CRC) can become extremely senescent in 60 to 90 years; some Mixed Chaparral types may take 2 to 3 times longer (Hanes 1982).

Biological Setting

Habitat.—Mixed and Chamise-Redshank Chaparral (CRC) occur as a mosaic on low to middle elevation slopes below several woodland and forest types. Compared to Chamise-Redshanke Chaparral, Mixed Chaparral generally occupies more mesic sites at higher elevations or on north-facing slopes. In southern California, Coastal Scrub (CSC) may form the lower chaparral boundary (Hanes 1977). In northern California, Mixed Chaparral merges with Annual Grassland (AGS) and Blue Oak-Digger Pine (BOP) at lower elevations. Chaparral shrubs form the understory of many Blue Oak-Digger Pine stands. At upper elevations, Mixed Chaparral grades into Coastal Oak Woodland (COW), Ponderosa Pine (PPN) or mixed conifer types and frequently forms the understory of these habitats. On desert exposures, Desert Scrub (DSC), Desert Succulent Scrub (DSS) or Joshua Tree (JST) may be found below Mixed Chaparral. Jeffrey Pine (JPN), Pinyon-Juniper (PJN) or Juniper (JUN) habitats occur above Mixed Chaparral.

Wildlife Considerations.—No wildlife species are restricted to Mixed Chaparral. Most species are found in other shrub-dominated types including Chamise-Redshank Chaparral (CRC), Montane Chaparral (MCP), Coastal Scrub (CSC), and Sagebrush (SGB), or the shrubs beneath several woodland and forest types. Wildlife management considerations usually focus on selecting alternative fire management treatments. Potential impacts of management actions in Mixed Chaparral generally are similar to Chamise-Redshank Chaparral.

Physical Setting

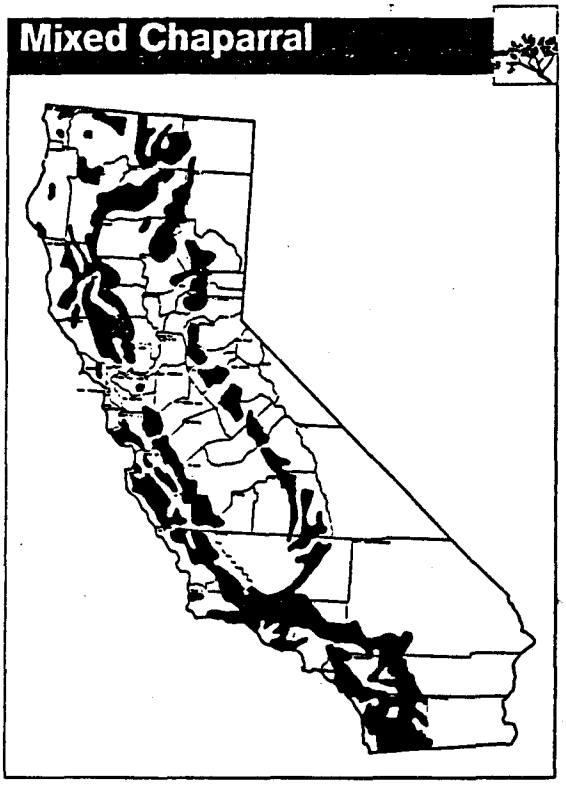
Mixed Chaparral occurs on all aspects, but at lower elevations, it generally is found on north-facing slopes. This pattern is espe-

MCH
Mixed Chaparral habitat, Fouts Spring, Colusa County, California (photo by A. Sidney England)

cially true in southern California. Generally, it occurs on steep slopes and ridges with relatively thin, well-drained soils (Ornduff 1974, Cheatham and Haller 1975). Soils can be rocky, sandy, gravelly or heavy (Cheatham and Haller 1975, Thorne 1976). Mixed Chaparral occurs on sites with deeper and more mesic soils than Chamise-Redshank Chaparral (Cheatham and Haller 1975). Serpentine soils are high in several potentially toxic substances, such as iron and magnesium, and low in required nutrients, including calcium (Whittaker 1975). The mediterranean climate is characterized by cool, wet winters and hot, dry summers. Total rainfall is 38 to 63 cm (15 to 25 in) with less than 20 percent falling during the summer (Ornduff 1974).

Distribution

Mixed Chaparral generally occurs below 1520 m (5000 ft) on mountain ranges throughout California except in the deserts (Cheatham and Haller 1975, Parker and Matyas 1981). Upper and lower elevational limits vary considerably with precipitation regime, aspect, and soil type. Mixed Chaparral occurs throughout the transverse, peninsular, and central coast ranges and the Tehachapi Mountains. In the Sierra Nevada, this type is a broken band along middle and lower elevations of the western slope. It also occupies large areas in the north coast ranges, especially on interior slopes, and is found as large discontinuous patches in the Siskiyou Mountains and Cascade and Klamath Ranges (Cheatham and Haller 1975, Hanes 1977).



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Montane Chaparral

Roland J. Risser and Michael E. Fry

Vegetation

Structure.—The growth form of montane chaparral species can vary from treelike (up to 3 meters) to prostrate. When mature, it is often impenetrable to large mammals. Its structure is affected by site quality, history of disturbance (e.g., fire, erosion, logging) and the influence of browsing animals. For example, on shallow granitic soils in the Sierra Nevada, low dense growths of pinemat manzanita and huckleberry oak characterize an edaphic climax community, associated with scattered conifers and much exposed granite. Following fire in the mixed conifer forest habitat type, whitethorn ceanothus-dominated chaparral may persist as a subclimax community for many years.

Montane chaparral is characterized by evergreen species; however, deciduous or partially deciduous species may also be present. Understory vegetation in the mature chaparral is largely absent. Conifer and oak trees may occur in sparse stands or as scattered individuals within the chaparral type.

Composition.—Montane chaparral varies markedly throughout California. Species composition changes with elevational and geographical range, soil type, and aspect. One or more of the following species usually characterize montane chaparral communities: whitethorn ceanothus, snowbrush ceanothus, greenleaf manzanita, pinemat manzanita, hoary manzanita, bitter cherry, huckleberry oak, sierra chinkapin, juneberry, fremont silktassel, Greene goldenweed, mountain mahogany, toyon, sumac and California buckthorn. As one or more of these species become dominant under various environmental regimes, further subclassification of the montane chaparral series is possible (Krebs 1972, McNaughton 1968).

Other Classifications.—Montane chaparral has been broadly described as chaparral (Munz and Keck 1973, (Küchler 1977) or mountain shrub (USDA 1977). Subclassifications based upon predominant species composition have also also been described as montane mixed shrub series, huckleberry oak/pinemat manzanita series, bush chinquapin series, greenleaf manzanita series, tobacco brush series, mountain whitethorn series (Parker and Matayas 1981); upper montane chaparral, lower montane chaparral (Cheatham and Haller 1975).

Habitat Stages

Vegetation Changes 1;2-4;5-D.— Montane chaparral in California occurs in gradations between two characteristic successional sequences:

The first sequence is associated with poorer, typically shallow soils (in early stages of development), often overlying fractured bedrock. Here, chaparral species may predominate to form an edaphic climax community

In the second sequence, chaparral is a secondary succession following disturbance on deeper forest soils. After disturbance (logging, fire, erosion) chaparral proliferates and may exclude conifers and other vegetation for many years. However, chaparral may facilitate the germination of red fir seedlings (Barbour 1984) and other shade tolerant conifers by providing a protective cover, moderating microclimate, and improving soil conditions. Chaparral shrubs may be an essential link in forest succession by building up soil nutrient levels, especially nitrogen, to the point where trees can survive (Zavitovski and Newton 1968). In mature timber stands, chaparral species may senesce due to insufficient light through the canopy and are only present as a sparse understory. Thus, silvicultural practices have a strong influence on the structure of montane chaparral.

Most montane chaparral species are fire adapted. Mature plants sprout back from the root crown. Some species require scarification of the seed for germination and may produce numerous seedlings after a fire (Gratkowski 1961). However, if fires are too frequent, these species may be eliminated (Biswell 1969) changing the subsequent structure of the community. Deer and livestock foraging on sprouting chaparral may also have a significant effect on its rate of development, structure, and ultimate species composition (Biswell and Gilman 1961, Davis 1967). The forage yields of most sprouting shrubs are reduced for the first few years after a fire, but rapidly regain their original status. Burned areas commonly produce new shrub growth high in protein and are a preferred food source for herbivores (Einarsen 1946, Swank 1956).

Duration of Stages.—Following fire, herbaceous plants may dominate for up to 5 years. Usually within 7 to 9 years the brush overstory is fully developed (Sweeney 1956, Sampson 1944). Chaparral may persist for up to 50 years or longer before conifer development begins to significantly reduce the shrub growth through shading (Lyon 1969, Sweeney 1968). Where chaparral types occur as an edaphic climax (i.e., on poor, rocky soils, fractured bedrock or lava caps), growth rates may be rather slow, growth form is usually small and stunted, and individuals may be quite old.

Development of montane chaparral at high elevations is often slowed by cold temperatures, snow cover and a short growing season (Barbour and Major 1977). However, at lower elevations, burned or logged areas may sprout new growth by the next growing season.

Biological Setting

Habitat.—Montane chaparral adjoins a variety of other wildlife habitats, including montane riparian (MRI), mixed chaparral (MCH), and perennial grassland (PGS). It becomes established in disturbed coniferous habits such as ponderosa pine (PPN), mixed conifer (SMC), Jeffrey pine (JPN), red fir (RFR) and lodgepole pine (LPN). At high elevations in the southern Sierra, it may occur with a sparse juniper overstory. At the lower extent of its elevational range, montane chaparral may intergrade with mixed chaparral, a very similar habitat type.

Wildlife Considerations.—Montane chaparral provides habitat for a wide variety of wildlife. Numerous rodents inhabit chaparral (Wirtz 1974). Deer and other herbivores often make extensive use of chaparral. Throughout the west slope of the Sierra and south through the Transverse Range, deer are strongly associated with chaparral communities. Montane chaparral provides critical summer range foraging areas, escape cover and fawning habitat. In the Sierra, fawning areas are frequently found where the chaparral lies adjacent to or contains an interspersion of perennial grass or meadow-riparian habitat (Ashcraft 1975, Dasmann, 1971, Ashcraft 1976, Pacific Gas and Electric 1961). Some small herbivores use chaparral species in fall and winter when grasses are not in abundance. Rabbits and hares eat twigs, evergreen leaves and bark from chaparral. Shrubs are important to many mammals as shade during hot weather, and moderate temperature and wind velocity in the winter (Loveless 1967).

Many birds find a variety of habitat needs in the montane chaparral. It provides seeds, fruits, insects, protection from predators and climate, as well as singing, roosting and nesting sites (Verner and Boss 1980), Storer and Usinger 1970).

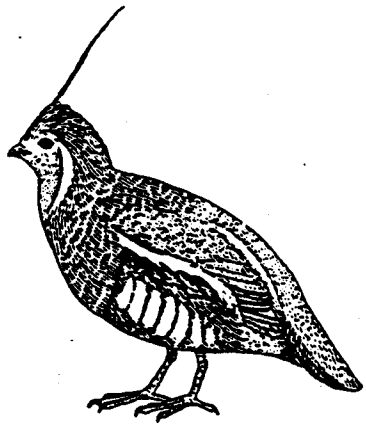
Physical Setting

Montane chaparral can be found on shallow to deep soils, on all exposures, and from gentle to relatively steep slopes. It may dominate on more xeric sites, but occurs locally throughout the coniferous forest zone. Generally, climate is like that associated with the coniferous forest zone—cold winter temperatures with substantial precipitation. Summers are typically hot and dry (Bar-

bour and Major 1977). In the northern portion of the state, montane chaparral is found between 914 to 2743 m (3000-9000 ft). In southern California this type occurs above 2134 m (7000 ft).

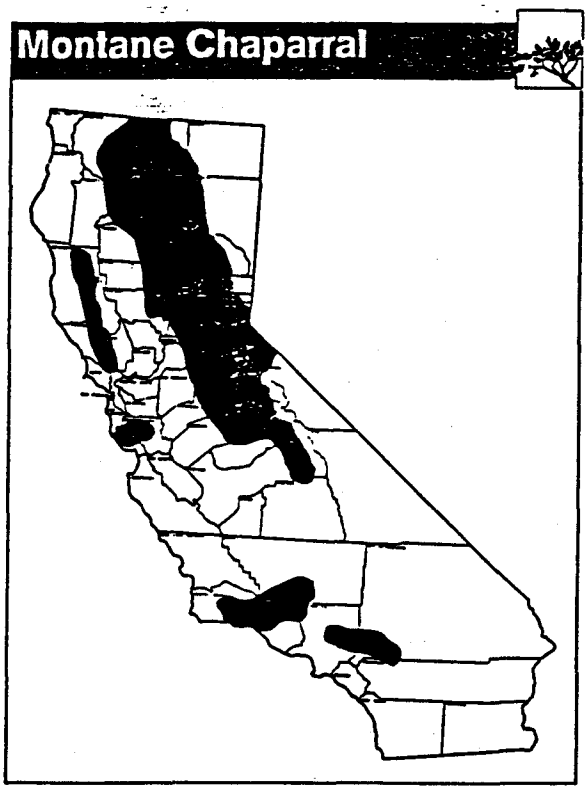
Distribution

Montane chaparral is associated with mountainous terrain from mid to high elevation at 914 to 3047 m (3000-10,000 ft). It occurs in southern California above 2134 m (7000 ft) in the Transverse Range of Los Angeles, and in San Bernardino, Riverside and San Diego counties; from Siskiyou to Kern counties in the Cascade and Sierra Nevada mountains; as a minor type from Tehama to Lake counties; and in Del Norte, Siskiyou, Trinity, and Shasta counties in the North Coast Ranges and Klamath mountains (Barbour and Major 1977). As a successional stage following disturbance, its distribution coincides with the ponderosa pine and mixed coniferous forest habitat types (Barbour and Major 1977).



Mountain Quail *(Oreortyx pictus)*

MCP
Montane Chaparral habitat, Sierra Nevada, California (photo by Roland J. Risser)



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Alpine Dwarf-Shrub

Gary L. Benson

Vegetation

Structure.—Alpine Dwarf-Shrub habitats typically are low graminoid and forb communities with an admixture of dwarf-shrubs (often cushion plants) (Küchler 1977). The perennial herbs or dwarf shrubs comprising these communities are usually less than 0.5 m (18 in) tall (Cheatham and Haller 1975). Coverage may reach 100 percent at lower elevations but becomes increasingly open as elevation increases. On mesic sites, a continuous turf contrasts with patches of bunchgrasses and cushion plants on drier sites (Küchler 1977).

Composition.—Species composition varies considerably throughout California. The most common shrubs occurring are creambush oceanspray, Greene goldenweed and mountain white heather. These shrubs occur primarily in northern California and the Sierra Nevada. Creambush oceanspray also occurs commonly in the southern California mountains. The most common alpine shrub in the White Mountains is timberline sagebrush (Parker and Matyas 1981, Cheatham and Haller 1975).

Nonshrub species that commonly occur in the alpine areas of northern California and the Sierra Nevada include Eschscholtz buttercup, primrose, prostrate sibbaldia, sedge, bluegrass, buckwheat, squirreltail, rock-cress, mountain sorrel, pussypaws, Indian paintbrush, Payson's draba, and Sitka romanzoffia (Parker and Matyas 1981, Cheatham and Haller 1975).

The following nonshrub species dominate the high Sierra: columbine, heart willowweed, Davidson's penstemon, Jacobs-ladder, and Coville's phlox (Parker and Matyas 1981, Cheatham and Haller 1975).

The scattered alpine areas of the San Bernardino, San Gabriel and San Jacinto mountains are dominated by draba, Parish's alumroot, creambush oceanspray, silver raillardella, alpine Eschscholtz buttercup, wild onion, rock-cress, mariposa lily, and several species of buckwheat (Parker and Matyas 1981, Cheatham and Haller 1975).

The dominant nonshrub species in alpine areas of the White Mountains include timberline sagebrush, Scribner's wheatgrass, several species of phlox, and Jacobs-ladder (Cheatham and Haller 1975).

Other Classifications.—Other names for Alpine Dwarf-Shrub habitat include Dwarf Scrub (Alpine) Series (Parker and Matyas 1981), Alpine Community (Küchler 1977), Alpine fell-field (Munz and Keck 1959) and Alpine fell-field cushion type (Thorne 1976). This habitat is included in Cheatham and Haller's Alpine Fell-fields major subdivision under their Alpine Boulder and Rock Field habitat type. Cheatham and Haller (1975) further subdivide Alpine Fell-fields into 1) Klamath-Cascade, 2) Sierra Nevada, 3) Southern California, and 4) White Mountains Fell-fields.

Habitat Stages

Vegetation Changes 1:2-4,S-M.—Following disturbance, Alpine Dwarf-Shrub habitats follow a slow successional process to any of the structural classes 1:2-4;S-M. There is limited information about the changes that occur in the plant communities comprising this habitat. Only limited autecological studies have been conducted (Mooney 1966, Billings and Mooney 1968, Billings 1975, Chabot and Billings 1972, Schultze et al. 1967, Johnson and Caldwell 1975, Ehleringer and Miller 1975), but insufficient comprehensive synecological work has been conducted to effectively describe the various successional stages and associated species in this habitat. Major and Taylor (1977) present an excellent review of the work on floristics and autecology of alpine communities.

Duration of Stages.—Development of communities in this habitat proceeds quite slowly and does not attain great stature or complicated structure due to the harsh environmental conditions. The time required to proceed through the few successional stages is not known, but is dependent on the severity of the local environmental and soil conditions. Presumably, the structure and composition of the *climax* communities do not change substantially over time. Severe changes in weather patterns — extended drought, for example — or other environmental conditions — landslide, mass-wasting, and destructive activities of animals or man — usually result in the communities of this habitat reverting to earlier successional stages.

Biological Setting

Habitat.—The Alpine Dwarf-Shrub habitat is restricted to the highest elevations generally above timberline. At the lower elevational extent of this habitat, it normally interfaces with 1) Subalpine Conifer (SCN) and closed cone pine/cypress (CPC) habitats, 2) Subalpine Forest or Foxtail Pine Forest in the north, 3) Sierran Mixed Subalpine Forest in the Sierra Nevada, 4) Southern California Subalpine Forest and 5) Bristlecone Pine Forest in the White Mountains. The Alpine Dwarf-Shrub habitat vegetation may sometimes constitute part of the Bristlecone Pine Forest where they intergrade. The Alpine Dwarf-Shrub habitat often intergrades with Alpine Talus and Scree Slopes in the summit regions of southern California mountains. This habitat also intergrades quite broadly with Subalpine Sagebrush in the White Mountains (Cheatham and Haller 1975).

Wildlife Considerations.—Birds common in this habitat (or adjacent alpine meadows) include blue grouse, rufous hummingbird, mountain bluebird and gray-crowned rosy finch. Mammals in this habitat include the Mount Lyell shrew, broad-footed mole, pika, white-tailed jackrabbit, yellow-bellied marmot, Belding's ground squirrel, northern pocket gopher or mountain pocket gopher, and mountain sheep (Storer and Usinger 1963).

Physical Setting

Generally, the Alpine Dwarf-Shrub habitat is found above timberline on all aspects, slopes, and ridgelines, so the physical environment tends to be cold, dry, and windy. In the northern portion of California, this habitat is cold with a brief summer growing season. This habitat is subject to intense solar radiation and freezing nights in summer. It is subject to severe winds and very low temperatures in winter on windward slopes, which are often blown clear of snow. Protected slopes often have persistent snowdrifts until midsummer or later. The substrate is quite rocky with little soil formation and excellent drainage. Plants in this habitat are subject to dessication by midsummer after meltwater disappears.

In northern California, this habitat is cold with a brief summer growing season and is somewhat drier and cooler in the Sierra Nevada. In southern California, the habitat is less cold and accumulates less snow than the Sierra Nevada so it tends to be drier. It is also subject to severe winds from fall through spring. In the White Mountains, this habitat has much less snow, so it is significantly drier and colder than in the Sierra Nevada (Cheatham and Haller 1975).

The growing season occurs July and August in northern California and along the Sierra Nevada. Here, the growing season is often delayed until the beginning of August because of heavy snow accumulation. The growing season can also be limited by drought. The growing season in southern California normally begins in June (Cheatham and Haller 1975).

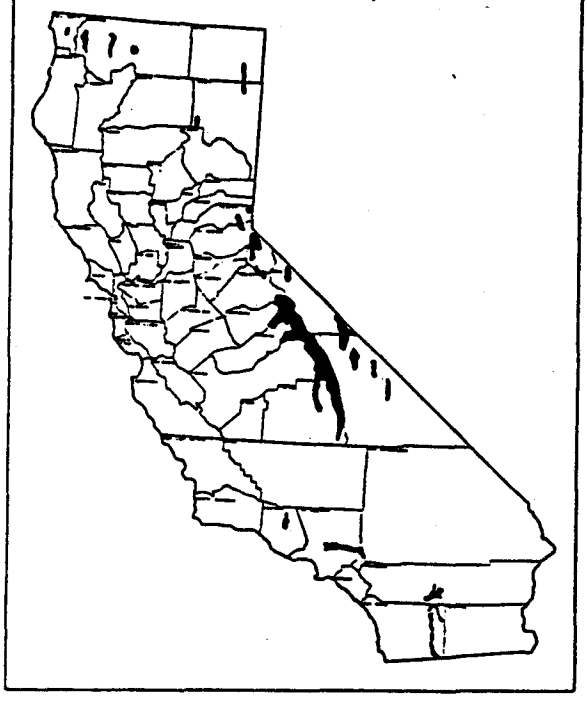
This habitat is found only in the highest elevations in California (see map). Toward the north, it is found on the highest peaks of the Klamath Range, usually above 2270 m (7500 ft). It is also

ADS
Alpine Dwarf-Shrub habitat, Lake Tahoe Basin, California (photo by Gary Benson)

found on Mt. Shasta and Mt. Lassen from 2580 to 3180 m (8500 to 10,500 ft) and occasionally higher (Cheatham and Haller 1975). In the Sierra Nevada, it is confined to the highest peaks, from Lake Tahoe to Yosemite, usually above 2575 m (8500 ft). From that point southward, it is almost continuous along the Sierra Nevada crest to Olancha Peak (Tulare-Inyo county line). Toward the southerly extent along the Sierra Nevada, this habitat is found above 3480 m (11,500 ft). In southern California, it is confined to the summit region and adjoining ridgelines above 3030 m (10,000 ft) in the San Bernardino, San Gabriel, and San Jacinto mountains. Alpine Dwarf-Shrub is almost continuous along the main ridge of the White Mountains above 3480 m (11,500 ft) (Cheatham and Haller 1975).

Pika *(Ochotona princeps)*

Alpine Dwarf-Shrub



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Valley Oak Woodland

Lyman V. Ritter

Vegetation

Structure.—This habitat varies from savanna-like to forest-like stands with partially closed canopies, comprised mostly of winter-deciduous, broad-leaved species. Denser stands typically grow in valley soils along natural drainages. Tree density decreases with the transition from lowlands to the less fertile soils of drier uplands. Exceptions to this pattern are known, especially in the central coastal counties (N. H. Pillsbury, pers. comm.). Similarly, the shrub layer is best developed along natural drainages, becoming insignificant in the uplands with more open stands of oaks. Valley oak stands with little or no grazing tend to develop a partial shrub layer of bird-disseminated species, such as poison-oak, toyon, and coffeeberry (J. R. Griffin, pers. comm.). Ground cover consists of a well-developed carpet of annual grasses and forbs. Mature valley oaks with well-developed crowns range in height from 15 to 35 m (49 to 115 ft) (Cheatham and Haller 1975, Conard et al. 1977).

Composition.—Canopies of these woodlands are dominated almost exclusively by valley oaks (Conard et al. 1977). Tree associates in the Central Valley include California sycamore, Hinds black walnut, interior live oak, boxelder, and blue oak. The shrub understory consists of poison-oak, blue elder, California wild grape, toyon, California coffeeberry, and California blackberry. Various sorts of wild oats, brome, barley, ryegrass, and needlegrass dominate the ground cover.

Digger pine and coast live oak are associated with VOWs along the Coast Range (Parker and Matyas 1979). Griffin (1976) reported that Coulter pine and canyon live oak are found in a montane savanna of valley oak in the Santa Lucia Range, Monterey County.

Other Classifications.—This type is referred to as the Foothill Woodland by Munz and Keck (1959), Valley Oak Savanna (33) by Küchler (1977), the Valley Oak Phase of the Foothill Woodland by Griffin (1977), Valley Oak Series by Paysen et al. (1980), and Valley Oak Community by Parker and Matyas (1979). Conard et al. (1977) and others include VOWs in the Central Valley riparian zone, a vegetative division in the physiographic gradient extending from river edges to higher terraces. Cheatham and Haller (1975) included part of the VOW habitat in their Central Valley Bottomland Woodland (6.11), and Küchler (1977) included parts in his Riparian Forest (28) designation.

Habitat Stages

Vegetation Change 1;2-5:S-D.—In most remaining VOW, little recruitment of young oaks occurs to replace the veteran oaks dying of natural causes or being destroyed by urban and agricultural development (White 1966, Griffin 1973, 1976, 1977). The lack of oak recruitment seems to be related to animal damage of acorns and seedlings (Griffin 1980a, b). The successful combination of circumstances for valley oak establishment is speculative. The future of this habitat in valley locations seems to be fewer valley oaks and more open grassland (Griffin 1976). However, Griffin (1976) found that the current absence of ground fire encourages the invasion of evergreen oaks, Coulter pine, or both, in upland sites in the Santa Lucia Mountains.

Presently, most valley oak stands are in mature stages 5:S-D, but structural classes 1-5:S-D are presumably possible. Canopy development and plant density are variable. Only a few localized studies give quantitative data on the structure of VOW (see Griffin 1976, Conard et al. 1977).

Duration of Stages.—Secondary succession of VOWs under natural conditions has not been studied and little opportunity exists for its study. Most surviving stands appear to be between 100 and 300 years old, and individual valley oaks may live as long as 400 years (Stern 1977). Valley oaks seem to be tolerant of flooding (Harris et al. 1980), and young trees will sprout when fire damaged (Griffin 1976). Given natural perturbations such as fire and flooding, and assuming successful regeneration of valley oaks, VOW would probably remain the climax community.

Biological Setting

Habitat.—VOWs in the Great Valley usually merge with Annual Grasslands or border agricultural land. Where these woodlands extend to the foothills surrounding the valley, they intergrade with Blue Oak Woodlands or Blue Oak-Digger Pine habitats. Near major stream courses this community intergrades with Valley-Foothill Riparian vegetation. West of the Coast Range, VOWs sometimes associate with Coastal Oak Woodlands and, to a limited extent, Montane Hardwood and Coastal Scrub.

Wildlife Considerations.—These woodlands provide food and cover for many species of wildlife. Oaks have long been considered important to some birds and mammals as a food resource (i.e., acorns and browse). Verner (1980) reported that 30 bird species known to use oak habitats in California include acorns in their diet. An average of 24 species of breeding birds were recorded on a study plot at Ancil Hoffman Park, near Carmichael, in Sacramento County from 1971 to 1973 (Gaines 1977). The study plot was dominated by valley oaks but included some cottonwood in the canopy. Probably the most significant breeding bird species recorded was red-shouldered hawk. In decreasing order, the most common species were European starling, California quail, plain titmouse, scrub jay, rufous-sided towhee, Bewick's wren, bushtit, and acorn woodpecker. Barrett (1980) indicates that the ranges of about 80 species of mammals in California show substantial overlap with the distribution of valley oaks, and several, such as fox and western gray squirrels and mule deer, have been documented using valley oaks for food and shelter.

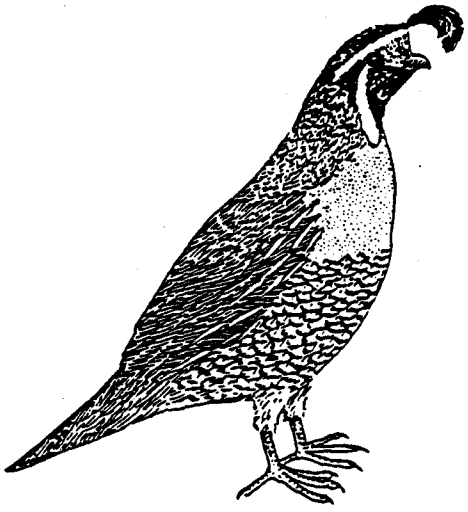
Physical Setting

This habitat occurs in a wide range of physiographic settings but is best developed on deep, well-drained alluvial soils, usually in valley bottoms. Most large, healthy valley oaks are probably rooted down to permanent water supplies (Griffin 1973). Stands of valley oaks are found in deep sills on broad ridgetops in the southern Coast Range. Where this type occurs near the coast, it is usually found away from the main fog zone (Griffin 1976). The climate is Mediterranean, with mild, wet winters and hot, dry summers.

Distribution

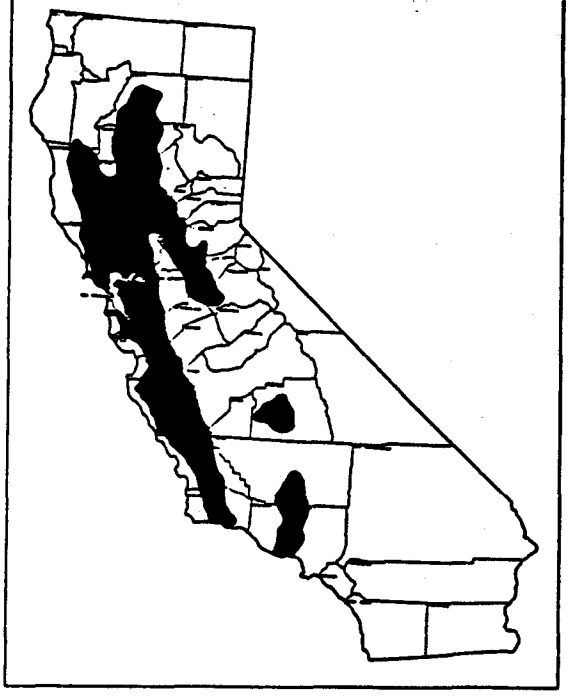
Remnant patches of this habitat are found in the Sacramento Valley from Redding south, in the San Joaquin Valley to the Sierra Nevada foothills, in the Tehachapi Mountains, and in valleys of the Coast Range from Lake County to western Los Angeles County. Usually it occurs below 610 m (2000 ft), although Griffin (1976) reported a ridgetop stand at 1525 m (5000 ft) in the Santa Lucia Mountains.

VOW
Valley Oak Woodland habitat, San Joaquin Valley, California (photo by Stan W. Elems)



California Quail *(Callipepla californica)*

Valley Oak Woodland



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Blue Oak Woodland

Lyman V. Ritter

Vegetation

Structure.—Generally these woodlands have an overstory of scattered trees, although the canopy can be nearly closed on better quality sites (Pillsbury and De Lasaux 1983). The density of blue oaks on slopes with shallow soils is directly related to water stress (Griffin 1973). The canopy is dominated by broad-leaved trees 5 to 15 m (16 to 50 ft) tall, commonly forming open savanna-like stands on dry ridges and gentle slopes. Blue oaks may reach 25 m (82 ft) in height (McDonald 1985); the tallest tree, found in Alameda County, measured 28.7 m (94 ft) high and had a crown spread of 14.6 m (48 ft) (Pardo 1978). Shrubs are often present but rarely extensive, often occurring on rock outcrops. Typical understory is composed of an extension of Annual Grassland vegetation.

Composition.—Blue oak is the dominant species, comprising 85 to 100 percent of the trees present. Common associates in the canopy are coast live oak in the Coast Range, interior live oak in the Sierra Nevada, valley oak where deep soil has formed, and western juniper in the Cascade Range. In the Tehachapi and Paiute Ranges in Kern County, this habitat mixes with species from east of the mountains—California juniper and single-leaf pinyon. In interior sections of the southern Coast Range, as in San Luis Obispo County, it mixes with California juniper (V. L. Holland, pers. comm.). Associated shrub species include poison-oak, California coffeeberry, buckbrush, redberry, California buckeye, and manzanita spp. The ground cover is comprised mainly of annuals, such as bromegrass, wild oats, foxtail, needlegrass, filaree, filaree, fiddleneck, and others. Comprehensive descriptions of different BOW's can be found in White (1966), Griffin (1977), Baker et al. (1981), and Pillsbury and De Lasaux (1983).

Other Classifications.—The habitat is referred to as Foothill Woodland by Munz and Keck (1959), Blue Oak Phase of the Foothill Woodlands by Griffin (1977), Blue Oak Series by Paysen et al. (1980), Blue Oak Savanna by Verner and Boss (1980), and Blue Oak Community by Parker and Matyas (1981). BOW's and Blue Oak-Digger Pine Woodlands are considered a single habitat in Küchler's (1977) Blue Oak-Digger Pine Forest (25) and in the Blue Oak-Digger Pine (250) type of the Society of American Foresters (Eyre 1980).

Habitat Stages

Vegetation Changes 1;2-1:S-D.—Details of successional trends in this habitat type are poorly known. Succession presumably proceeds directly from annual grasslands to tree stages. Most stands of BOW exist as medium or large tree stages with few or no young blue oaks present (White 1966, Holland 1976, Griffin 1977, Baker et al. 1981). Therefore, only structural classes 3-5:S-D are likely to be found. Few areas can be found in California where successful recruitment of blue oaks has occurred since the turn of the century (Holland 1976). This may be due to changes in land use; increased consumption or damage of acorns and seedlings by insects, livestock, and native animals; competition between seedlings and introduced annuals for available soil nutrients and moisture; and the absence of appropriate climatic conditions. Where germination of acorns occurs, survival and growth of the seedlings typically fail. Probably in the drier savanna-like stands, the grassland openings will simply become larger as older trees die. Griffin (1977) suggests that live oaks may replace decidious oaks in some areas, because their seedlings are more browse resistant. Many authorities question whether conditions will ever again support the recruitment of blue oaks needed to maintain these important woodlands.

Duration of Stages.—Valid generalizations about the duration of various successional stages leading to mature stands of BOW are not possible, because adequate quantitative studies have never been done. The successional sequence probably takes at least 50 years, even on good sites. Age studies in the Coast Range (White 1966, Pillsbury and De Lasaux 1983) and the southern Sierra Nevada (Brooks 1969) indicate that most blue oak stands are currently 80 to 120 years in age. Blue oaks are relatively slow-growing, long-lived trees. Large blue oaks range in age from 153 to 390 years (White 1966). Estimation of tree age based on dbh measurements is risky, however, because the dbh relationship varies tremendously depending on site quality. Moreover, height growth is extremely slow or even ceases after trees reach 65 cm (26 in) in dbh (McDonald 1985).

Biological Setting

Habitat.—This type usually intergrades with Annual Grasslands or Valley Oak Woodlands at lower elevations and Blue Oak-Digger Pine woodlands at higher elevations.

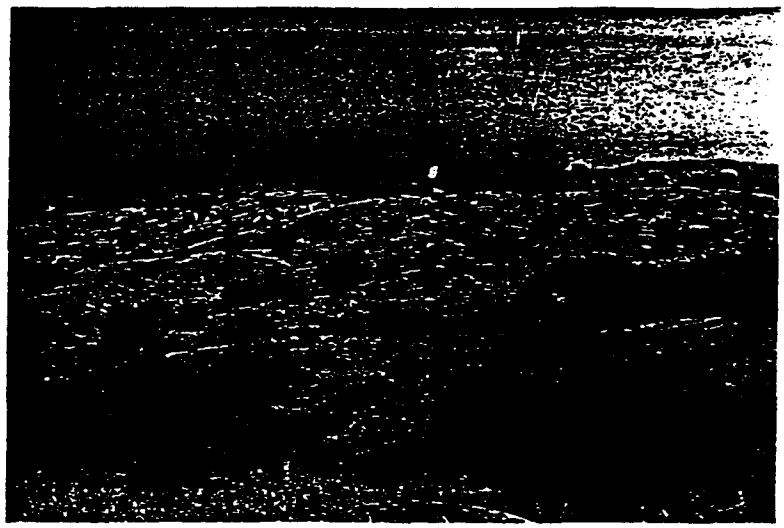
Wildlife Considerations.—The importance of oak habitats to wildlife in California has recently been reviewed by Barrett (1980) and Verner (1980), but they give few details relevant specifically to BOW's. Verner and Boss (1980) give data on wildlife use in blue oak savannahs of the western Sierra Nevada. They indicate that 29 species of amphibians and reptiles, 57 species of birds, and 10 species of mammals find mature stages of this type suitable or optimum for breeding, assuming that other special habitat requirements are met. Griffin (1971) concluded that acorns buried by scrub jays, yellow-billed magpies, western gray squirrels and California ground squirrels are more likely to germinate because they root better and are less likely to be eaten. Although many wildlife species benefit from the use of oaks and even enhance oak germination, additional information is needed on many aspects of oak-wildlife relationships before this habitat can be properly managed.

Physical Setting

BOW's are usually associated with shallow, rocky, infertile, well-drained soils from a variety of parent materials (McDonald 1985). Blue oaks are well adapted to dry, hilly terrain where the water table is usually unavailable (Griffin 1973). The climate is Mediterranean, with mild wet winters and hot dry summers. Climatic extremes are relatively great in these woodlands, because they have a considerable geographic and elevational range. Average annual precipitation varies from 51 to 102 cm (20 to 40 in) over most of the blue oak's range, although extremes are noted from 25 cm (10 in) in Kern County to 152 cm (60 in) in Shasta County (McDonald 1985). Blue oaks have an unusual tolerance of severe drought, even shedding their leaves during periods of extreme moisture stress. This survival trait contributes to its pattern of distribution, as it competes most successfully with other tree species on drier sites (McDonald 1985). Mean maximum temperatures are from 24 to 36°C (75 to 96°F) in summer, and minima are from −2 to 6°C (29 to 42°F) in winter. The growing season ranges from 6 months in the north to the entire year in the south, with 175 to 365 frost-free days (Burcham 1975).

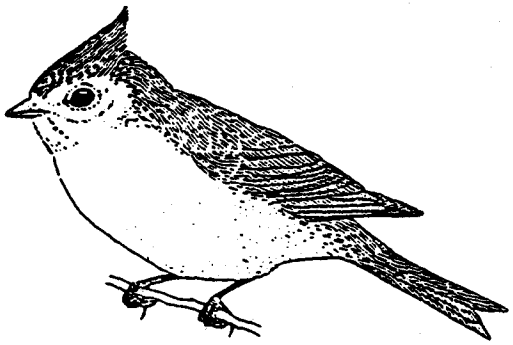
Distribution

BOW's occur along the western foothills of the Sierra Nevada-Cascade Ranges, the Tehachapi Mountains, and in the eastern foothills of the Coast Range, forming a nearly continuous ring around the Central Valley. The habitat is discontinuous in the valleys and on lower slopes of the interior and western foothills of the Coast Range from Mendocino County to Ventura County. It is generally found at elevations from 152 to 610 m (500 to 2000 ft) at the northern end of its range and on the western slopes of the Sierra Nevada, from 76 to 915 m (250 to 3000 ft) in the central Coast Range, and from 168 to 1370 m (550 to 4500 ft) in the Transverse and Peninsular Ranges (Sudworth 1908).



BOW
Blue Oak Woodland habitat, San Joaquin Experimental Range, California (photo by Jared Verner)

Blue Oak Woodland



Plain Titmouse *(Parus inornatus)*

The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Blue Oak—Digger Pine

Jared Verner

Vegetation

Structure.—This habitat is typically diverse in structure both vertically and horizontally, with a mix of hardwoods, conifers, and shrubs. The shrub component is typically composed of several species that tend to be clumped, with interspersed patches of Annual Grassland. Woodlands of this type generally have small accumulations of dead and downed woody material and relatively few snags, compared with other tree habitats in California. Most existing stands of this type are in mature stages, with canopy cover ranging from 10 to 59 percent, and dbh ranging from 2.5 to 30 cm (1 to 12 in). Size class 6 depends on a sparse overstory of digger pine above a lower canopy of oaks, as canopies of blue oak seldom exceed 15 m (50 ft) in height. Individual trees seldom exceed 125 cm (49 in) dbh, and exceptionally may reach 30 m (100 ft) in height.

Composition.—Blue oak and digger pine typically comprise the overstory of this habitat, with blue oak usually most abundant. Stands dominated by digger pine tend to lose their blue oak, which is intolerant of shade (P. M. McDonald, pers. comm.). In the foothills of the Sierra Nevada, tree species typically associated with this habitat are interior live oak and California buckeye. In the Coast Range, associated species are the coast live oak, valley oak, and California buckeye (Griffin 1977). Interior live oak sometimes dominates the overstory, especially in rocky areas and on north-facing slopes at higher elevations (Neal 1980).

At lower elevations, where blue oaks make up most of the canopy, the understory tends to be primarily annual grasses and forbs. At higher elevations where digger pines and even interior live oaks sometimes comprise the canopy, the understory usually includes patches of shrubs in addition to the annual grasses and forbs. Shrub species include Ceanothus spp., mariposa manzanita, whiteleaf manzanita, Parry manzanita, redberry, California coffeeberry, poison-oak, silver lupine, blue elder, California yerba-santa, rock gooseberry, and California redbud.

Other Classifications.—This type is referred to as Blue Oak-Digger Pine by the Society of American Foresters (Eyre 1980) and Parker and Matyas (1981), and as Blue Oak-Digger Pine Forest by Küchler (1977). Neal (1980) gives an excellent, short description of the type, and a more complete description can be gleaned from Griffin (1977) in his discussion of California's oak woodlands.

Habitat Stages

Vegetation Changes 1;2-5;S-D;6.—Succession presumably proceeds from annual grasslands directly to tree stages at lower elevations, where a shrub layer is usually sparse or absent. At higher elevations, shrubs and trees regenerate together.

Duration of Stages.—Secondary succession beginning with disturbed soil is rapid during early stages, with annual grasslands giving way to shrubs within 2 to 5 years. However, stands of mature shrubs adequate to provide habitat for those wildlife species requiring them take longer to develop—approximately 10 to 15 years. The conifers grow more rapidly than the hardwoods, maturing into relatively large trees even within 30 to 40 years, judging from the photo series taken at the San Joaquin Experimental Range in Madera County (Woolfolk and Reppert 1963). Most of the meager information on growth rates of blue oaks comes from sites in northern and central California. They generally grow slowly at all ages. Blue oaks in Nevada, Shasta, and Placer Counties showed little or no growth in height after they reached 65 cm (26 in) dbh (McDonald 1985). The age at which they normally begin producing acorn crops is unknown (M. McClaran, pers. comm.), but it likely takes several decades.

Concern has been expressed for the long-term existence of this habitat (Holland 1976), because "little regeneration has occurred since the late 1800s, as livestock, deer, birds, insects, and rodents consume nearly the entire acorn crop each year. Of the few seedlings that become established a large proportion are eaten by deer" (Neal 1980:126). Furthermore, the absence of grazing livestock does not generally result in regeneration (White 1966), because many other animals eat acorns and seedling oaks. Moreover, introduced grasses are subject to burning, may compete directly with seedling oaks for light and nutrients, and may be allelopathic to the oaks.

The general absence of secondary successional stages of these woodlands has precluded detailed study of their composition or rates of change.

Biological Setting

Habitat.—As Griffin (1977:386) points out, "oak woodland seldom forms a continuous cover over large areas. It is a major item in a mosaic including valley grassland...and chaparral...with strips of riparian forest." This mosaic is reflected in the character of the understory in stands of BOP woodlands. At lower elevations, these woodlands merge with Annual Grasslands, Blue Oak Woodlands, and Valley Oak Woodlands. The Annual Grasslands actually extend into the woodlands as a ground cover where not shaded by shrubs. The Blue Oak Woodlands differ from the BOP type in lacking a conifer component and usually in lacking a shrub component.

At upper elevations, BOP habitats merge with extensive stands of Mixed Chaparral in most localities, although in some places the Ponderosa Pine type grows at an elevation low enough to form a mixed ecotone with Mixed Chaparral and BOP.

Wildlife Considerations—BOP woodlands provide breeding habitats for a large variety of wildlife species, although no species is totally dependent on them for breeding, feeding, or cover. In the western Sierra Nevada, for example, 29 species of amphibians and reptiles, 79 species of birds, and 22 species of mammals find mature stages of this type suitable or optimum for breeding, assuming that other special habitat requirements are met (Verner and Boss 1980).

Most species breed during late winter and early spring—a factor to consider when planning management activities. Snags are less common, and hence less critical to wildlife, in this than in other forest types. Most species of cavity-nesting birds, for example, use living oaks. The cavities are often in scars where limbs have broken from the trunk or a main branch and have developed a level of decay that makes them more easily excavated by primary cavity nesters.

According to Olson (1974), blue oaks produce an abundant seed crop every 2 to 3 years and bumper crops every 5 to 8 years; however, McClaran (pers. comm.) questions that such a clear cycle of acorn production has been confirmed. In any case, acorns are an important food resource for many species of birds (Verner 1980) and mammals (Barrett 1980).

Physical Setting

The habitat occurs in a typically Mediterranean climate—hot, dry summers and cool, wet winters. Most precipitation falls as rain from November through April, averaging from 51 to 102 cm (20 to 40 in) within the primary range of blue oak (McDonald 1985). The frost-free growing season ranges from 150 to 300 days, with January minima averaging −1°C (30°F) and July maxima averaging 32°C (90°F) (McDonald 1985).

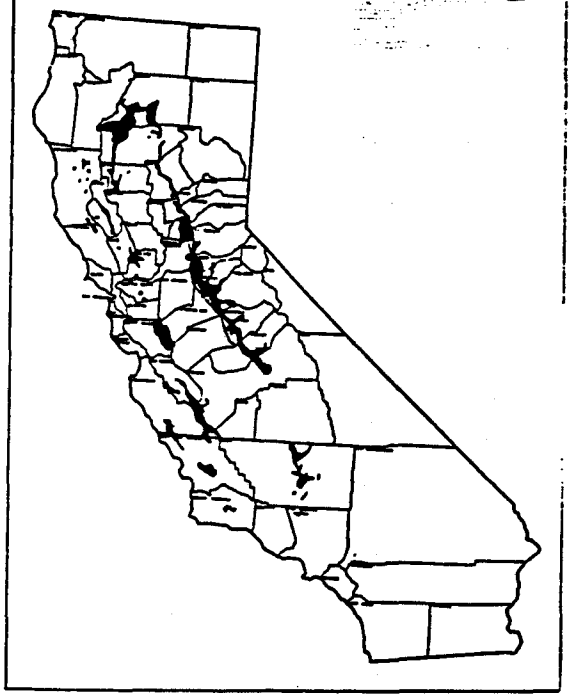
Soils are from a variety of generally well-drained parent materials, ranging from gravelly loam through stony clay loam. Soils rich in rock fragments are typical (McDonald 1985).

BOP
Blue Oak-Digger Pine habitat, western slope Sierra Nevada, California (photo by Jared Verner)

Blue Oak—Digger Pine

Distribution

The range of this habitat (well described by Neal, 1980) generally rings the foothills of the Central Valley, between 150 and 915 m (500 and 3000 ft) in elevation. The Pit River drainage in the Cascade Range and the foothills of the Klamath Mountains mark the approximate northern limit. The habitat is nearly continuous in the western foothills of the Sierra Nevada, except for a gap of 96 km (60 mi) between the Kings and Kern Rivers, where digger pine is missing. The distribution extends south into the Liebre Montains of northern Los Angeles County and the drainages of Piru Creek and Santa Clara River in Ventura County. It is discontinuous in the Coast Range west of the Central Valley from Ventura to Mendocino Counties. And it extends westward to within 16 km (10 mi) of the coast in a few places (Griffin 1977, Neal 1980).



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Acorn Woodpecker *(Melanerpes formicivorous)*

Montane Hardwood

Philip M. McDonald

Vegetation

Structure.—A typical montane hardwood habitat is composed of a pronounced hardwood tree layer, with an infrequent and poorly developed shrub stratum, and a sparse herbaceous layer. On better sites, individual trees or clumps of trees may be only 3 to 4 m (10 to 13 ft) apart. On poorer sites, spacing increases to 8 to 10 m (26 to 33 ft). Where trees are closely spaced, crowns may close but seldom overlap. Living crowns on mature canyon live oaks occupy about 60 percent of the bole on typical sites and up to 80 percent on poor sites. Tree heights tend to be uniform at most ages in mature stands where hardwoods occur, but subordinate to conifers. Mature oaks on better sites and in canyons range between 17 and 30 m (56 and 98 ft) tall and up to 150 cm (59) in) dbh. On poorer sites, mature trees typically are 10 to 15 m (33 to 49 ft) tall with boles up to 65 cm (26 in) in dbh, with dome-shaped crowns almost as wide as the trees are tall. On rocky summits, canyon live oak is a shrub of small diameter, usually less than 4 m (13 ft) in height. Snags and downed woody material generally are sparse throughout the montane hardwood habitat.

Composition.—In the Coast Range and Klamath Mountains, canyon live oak often forms pure stands on steep canyon slopes and rocky ridgetops. It is replaced at higher elevations by huckleberry oak (Parker and Matyas 1980). At higher elevations, it is scattered in the overstory among ponderosa pine, Coulter pine, California white fir, and Jeffrey pine, the latter on serpentine and peridotite outcrops. Middle elevation associates are Douglas-fir, tanoak, Pacific madrone, California-laurel, California black oak, and bristlecone fir. Knobcone pine, Digger pine, Oregon white oak, and coast live oak are abundant at lower elevations. Understory vegetation is mostly scattered woody shrubs (manzanita, mountain-mahogany, poison-oak) and a few forbs.

In the Transverse and Peninsular ranges of southern California, overstory associates at middle and higher elevations are Jeffrey pine, ponderosa pine, sugar pine, incense-cedar, California white fir, bigcone Douglas-fir, California black oak, and Coulter pine. At lower elevations, associates are white alder, coast live oak, bigleaf maple, California-laurel, bigcone Douglas-fir, and occasionally valley oak, Digger pine, and blue oak (Cheatham and Haller 1975, McDonald and Littrell 1976). Understory shrub species are manzanita, poison-oak, coffeeberry, currant, and ceanothus.

In the southern Cascade and Sierra Nevada ranges, steep, rocky south slopes of major river canyons often are clothed extensively by canyon live oak and scattered old-growth Douglas-fir. Elsewhere, higher elevation overstory associates are typical mixed conifer and California black oak; lower elevation associates are Digger pine, knobcone pine, tanoak, Pacific madrone, and scrubby California-laurel. Associated understory vegetation includes Oregon-grape, currant, wood rose, snowberry, manzanita, poison-oak, and a few forbs and grasses.

Other Classifications.—In southwest Oregon, the species is part of the mixed evergreen (Pseudotsuga-sclerophyll) zone and to a lesser extent the conifer forest zone on drier areas (Franklin and Dryness 1969). These classifications are pertinent to California as well. In California, canyon live oak occurs in 12 of the 17 forest communities described by Munz and Keck (1968), in 8 dominance types in the Sierra Nevada (Myatt 1980), and in 6 ecological provinces (Parker and Matyas 1980). Cheatham and Haller (1975) place canyon live oak in 8 minor subdivisions of 2 habitat types. Canyon live oak is recognized as a forest cover type by the Society of American Foresters and is an associate species in eight other types (Eyre 1980).

Habitat Stages

Vegetation Changes 1;2-5;S-D.—Initial establishment of canyon live oak is by acorns, most of which do not move far from beneath tree crowns. Wider dissemination of acorns and seeds of associate species is by birds and mammals. After establishment, canyon live oak sprouts vigorously from the root crown. Most hardwood associates also sprout prolifically. Rapid sprout growth enables the hardwoods to capture most of the favorable microsites, forcing the conifers to invade harsher sites, or those made harsh by hardwood roots below ground and hardwood shade above. Delayed establishment, slow growth, and sparse or clumpy distribution of conifers often results.

In most instances, succession is slow. Seldom is canyon live oak a pioneer species, but occasionally it invades and becomes established on alluvial soils (Heady and Zinke 1978). Canyon live oak has loose, dead, flaky bark that catches fire readily and burns intensely (Plumb 1980). Occasional fire often changes a stand of canyon live oak to live oak chaparral, but without fire for sufficient time, trees again develop. Where fire is frequent, this oak becomes scarce or even drops out of the montane hardwood community.

Duration of Stages.—A type more stable than Montane Hardwood is difficult to envision. The large number of species in the type, both conifer and hardwood, allow it to occupy and persist in a wide range of environments. Good soils and poor, steep slopes and slight, frequently disturbed and pristine—all are at least adequate habitats for one or more species. Longevity (at least 300 years for some species), and large size help to ensure dominance. Seed and sprout reproductive modes assure both widespread and stationary reproduction, and consequently several age and size classes usually are present in most areas. Growth of most hardwoods, especially canyon live oak, generally is slow and depends on depth and rockiness of soil, slope, and possibly length of time for roots to reach groundwater (Myatt 1980).

Biological Setting

Habitat.—At lower elevations, neighboring habitats are Valley-foothill Hardwood-conifer (VHC) and, to a lesser extent, Closed-cone Pine Cypress (CPC). At low and middle elevations, Mixed Chaparral (MCH) interfaces with Montane Hardwood. Wildlife habitats at middle elevations, often overlapping above and below, are Montane Hardwood-conifer (MHC), Mixed Conifer (MCN), Douglas-fir (DFR) and, to a lesser degree, Pine-juniper (PJN). At higher elevations, Montane Hardwood is neighbor to Eastside Pine (EPN), Jeffrey Pine (JPN), and Montane Chaparral (MCP).

Wildlife Considerations.—Bird and animal species characteristic of the Montane Hardwood habitat include disseminators of acorns (scrub and Steller's jays, acorn woodpecker, and western gray squirrel) plus those that utilize acorns as a major food source—wild turkey, mountain quail, band-tailed pigeon, California ground squirrel, dusky-footed woodrat, black bear, and mule deer. Deer also use the foliage of several hardwoods to a moderate extent. Many amphibians and reptiles are found on the forest floor in the Montane Hardwood habitat. Among them are Mount Lyell salamander, ensatina, relictual slender salamander, western fence lizard, and sagebrush lizard. Snakes include rubber boa, western rattlesnake, California mountain kingsnake, and sharp-tailed snake.

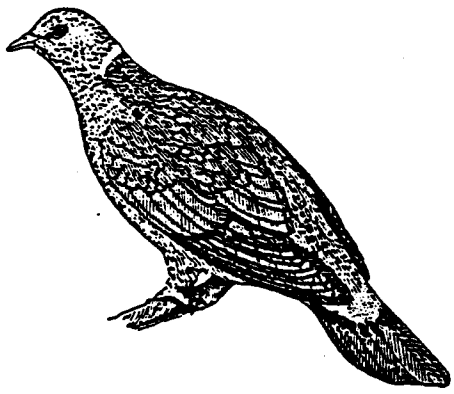
Physical Setting

Canyon live oak and associates are found on a wide range of slopes, especially those that are moderate to steep. Soils are for the most part rocky, alluvial, coarse textured, poorly developed, and well drained. Soil depth classes range from shallow to deep. Canyon live oak, incense-cedar, and a few other associates are also found on ultrabasic soils. Mean summer temperatures in the Montane Hardwood habitat vary between 20° and 25°C (68° and 77°F) and mean winter temperatures between 3° and 7°C (37° and 45°F). Frost-free days range from 160 to 230 (Thornburgh 1986).

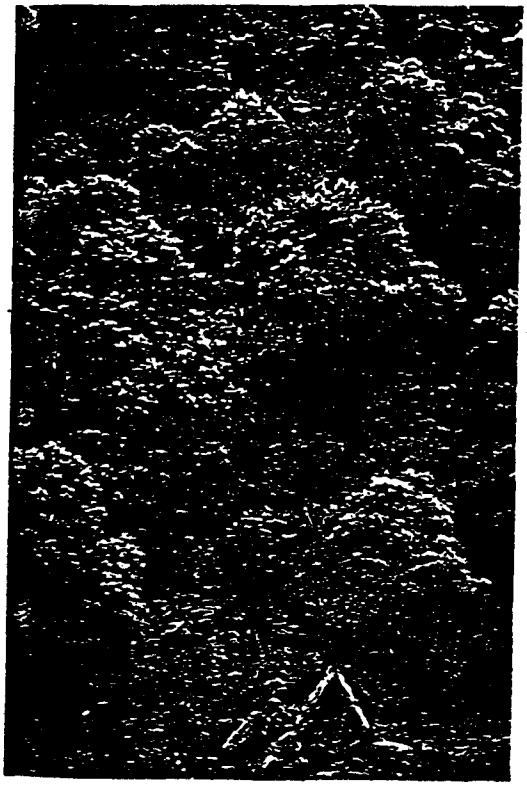
Annual precipitation varies from 2794 mm (110 in) in the northern Coast Range to 914 mm (36 in) in the mountains of southern California.

Distribution

The Montane Hardwood habitat ranges throughout California mostly west of the Cascade-Sierra Nevada crest. East of the crest, it is found in localized areas of Placer, El Dorado, Alpine, and San Bernardino Counties. Elevations range from 100 m (300 ft) near the Pacific Ocean to 2745 m (9000 ft) in southern California.

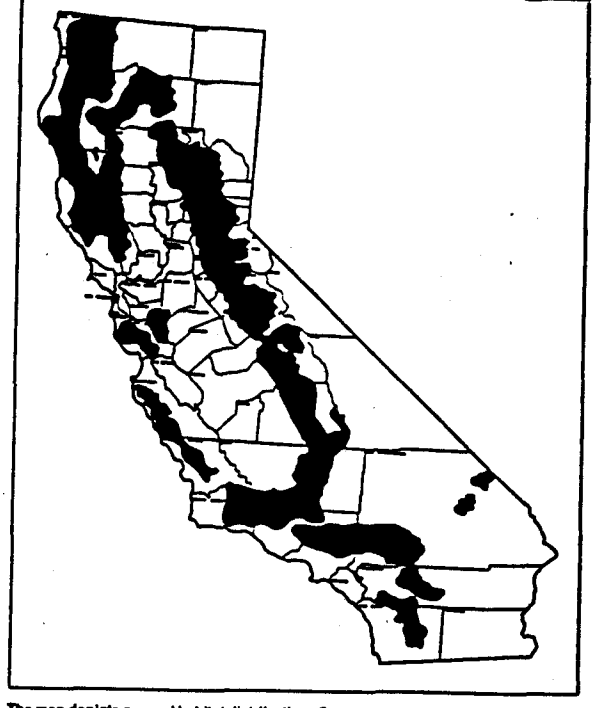


Band-tailed Pigeon *(Columba fasciata)*



MHW
Montane Hardwood habitat, Trinity County, California (photo by Phillip McDonald)

Montane Hardwood



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Montane Hardwood-Conifer

Vegetation

Structure.—Montane Hardwood-Conifer (MHC) habitat includes both conifers and hardwoods (Anderson et al. 1976), often as a closed forest. To be considered MHC, at least one-third of the trees must be conifer and at least one-third must be broadleaf (Anderson et al. 1976). The habitat often occurs in a mosaic-like pattern with small pure stands of conifers interspersed with small stands of broad-leaved trees (Sawyer 1980). This diverse habitat consists of a broad spectrum of mixed, vigorously growing conifer and hardwood species. Typically, conifers to 65 m (200 ft) in height form the upper canopy and broad-leaved trees 10 to 30 m (30 to 100 ft) in height comprise the lower canopy (Proctor et al. 1980, Sawyer 1980). Most of the broad-leaved trees are sclerophyllous evergreen, but winter-deciduous species also occur (Cheatham and Haller 1975).

Relatively little understory occurs under the dense, bilayered canopy of MHC. However, considerable ground and shrub cover can occur in ecotones or following disturbance such as fire or logging. Steeper slopes are normally devoid of litter; however, gentle slopes often contain considerable accumulations of leaf and branch litter (Cheatham and Haller 1975).

Composition.—Common associates in MHC are ponderosa pine, Douglas-fir, incense-cedar, California black oak, tanoak, Pacific madrone, Oregon white oak, and other localized species. Species compostion varies substantially among different geographic areas.

In the north coast, California black oak, Oregon white oak, golden chinquapin, and canyon live oak are commonly found with white fir, Douglas-fir, and ponderosa pine (Parker and Matyas 1981). In the Klamath Mountains and north coast from the Oregon border to Marin County, Oregon white oak, tanoak, Pacific madrone, red alder, Douglas-fir, western red cedar, western hemlock, ponderosa pine, sugar pine, and knobcone pine are common (Küchler 1977, McDonald 1980, Parker and Matyas 1981). In the northern interior, California black oak, bigleaf maple, Pacific madrone, and tanoak are common with ponderosa pine, white fir, incense-cedar, Douglas-fir, and sugar pine forming the overstory. In the northern Sierra Nevada, common associates include California black oak, bigleaf maple, white alder, dogwood, Douglas-fir, incense-cedar and ponderosa pine. In the southern Sierra Nevada, common associates include California black oak, black cottonwood, canyon live oak, Jeffrey pine, Douglas-fir, ponderosa pine, sugar pine, incense-cedar, and localized areas of giant sequoia (Küchler 1977, Parker and Matyas 1981). In the central coast, common associates include coast live oak, big leaf maple, Pacific madrone, tanoak, canyon live oak, Coulter pine, coastal redwood and, to a lesser extent, California black oak and ponderosa pine. In the northern central coast, Douglas-fir is found; while in the southern areas, bigcone Douglas-fir occurs. In the Tehachapi, transverse and peninsular ranges of Southern California, common associates include canyon live oak, Pacific madrone, coast live oak and, to a lesser extent, California black oak, ponderosa pine, sugar pine, and incense-cedar (Thorne 1976, Küchler 1977, Parker and Matyas 1981).

Other Classifications.—Montane Hardwood-Conifer is very diverse and has been given a variety of names in the literature including: Mixed Evergreen Forest (Munz and Keck 1973); Mixed Evergreen Zone - Second Growth Forest (Broadleaf 1.1.1H) (Mixed 1.2.31) (Proctor et al. 1980); Mixed Evergreen Forest with Chinquapin, Mixed Hardwood Forest, Mixed Hardwood and Redwood Forest, Oregon Oak Forest, Coulter Pine Forest (Küchler 1977); Mixed Evergreen Forest, Coast Range Mixed Conifer Forest, Santa Lucia Fir Forest, Coast Range Ponderosa Pine Forest, Coulter Pine Forest (Cheatham and Haller 1975); Santa Lucia Fir Series, Bigcone Douglas-fir Series, Madrone Series and Black Oak Series (Paysen 1980); Oregon White Oak (Stein 1980); California Black Oak (McDonald 1980); Douglas-fir-Tanoak-Pacific Madrone (Sawyer, 1980); Black Oak Series, Maple-Alder-Dogwood Series, Mixed Conifer-Pine Series, Madrone-Tanoak Series (Parker and Matyas 1981).

Habitat Stages

Vegetation Changes 1;2-5;5-D;6.—This habitat is climax in most cases; however, it can occur as a seral stage of mixed conifer forests. Vegetation response following disturbance, such as fire or logging, begins with a dense shrubby stage dominated by taller broad-leaved species. The stand gradually increases in height, simultaneously developing into two canopy strata with faster growing conifers above and broad-leaved species below. On mesic sites the conifer component overtakes the hardwood component more rapidly than on xeric sites, where the hardwood component is dominant longer (McDonald 1980).

Duration of Stages.—Secondary succession following disturbance is vigorous, with shrubs and trees regenerating together. The conifer component develops into relatively large, mature trees within 30 to 50 years. The broad-leaved component normally requires 60-90 years. Eventually the conifer component overtakes the broad-leaved component. Successional sequence and timing varies geographically and differs depending on species and environmental factors such as climate, water, and soil.

Biological Setting

Habitat.—Geographically and biologically, Montane Hardwood-Conifer is transitional between dense coniferous forests and montane hardwood, mixed chaparral, or open woodlands and savannahs. MHC merges with many other habitats at its upper and lower ecotones. These habitats include Valley-Foothill Hardwood (VFH), Valley-Foothill Hardwood-Conifer (VHC), Valley-Foothill Riparian (VRI), Closed-Cone Pine-Cypress (CPC), Montane Hardwood (MHW), Mixed Conifer (MCN), Douglas-fir (DFR), Redwood (RDW), Montane Riparian (MRI), Montane Chaparral (MCP), and Mixed Chaparral (MCH). The habitat is an area of vegetational and floristic diversity with large numbers of endemic species (Proctor et al. 1980).

Wildlife Considerations.—Montane Hardwood-Conifer provides habitat for a variety of wildlife species. Mature forests are valuable to cavity nesting birds. Moreover, mast crops are an important food source for many birds as well as mammals. Canopy cover and understory vegetation are variable which makes the habitat suitable for numerous species. In mesic areas, many amphibians are found in the detrital layer. Due to geographic variation in components of Montane Hardwood-Conifer, caution must be exercised when predicting wildlife species use.

Physical Setting

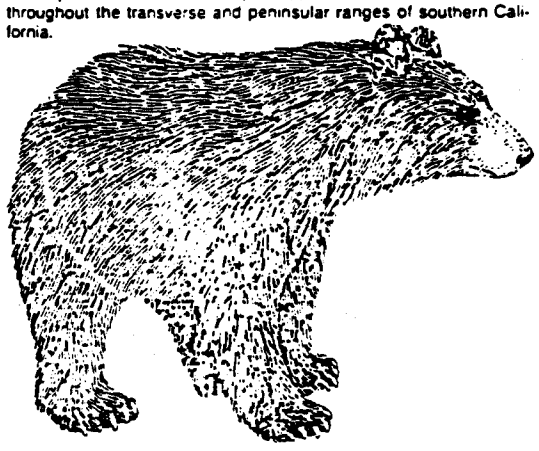
Montane Hardwood-Conifer generally occurs on coarse, well-drained mesic soils, in mountainous terrain with narrow valleys. Slopes average approximately 57 percent with all aspects encountered. Winters are cool and wet; summers are hot and dry. Northern California Montane Hardwood-Conifer sites have less rainfall and fog than Redwood (RDW) or Mixed Conifer (MCN) habitats. In southern California, this habitat is found at higher elevations, and in moist canyons. Average rainfall is 60 to 170 mm (25 to 65 in), with some fog. The growing season is 7 to 11 months, with 200 to 300 frost-free days. Mean summer maximum temperatures are 25 to 36°C (75 to 95°F). Mean winter minima are −2 to 4°C (29 to 30°F) (Munz and Keck 1970).

Richard Anderson

MHC
Montane Hardwood-Conifer habitat, Sierra Nevada, California (photo by Richard L. Anderson)

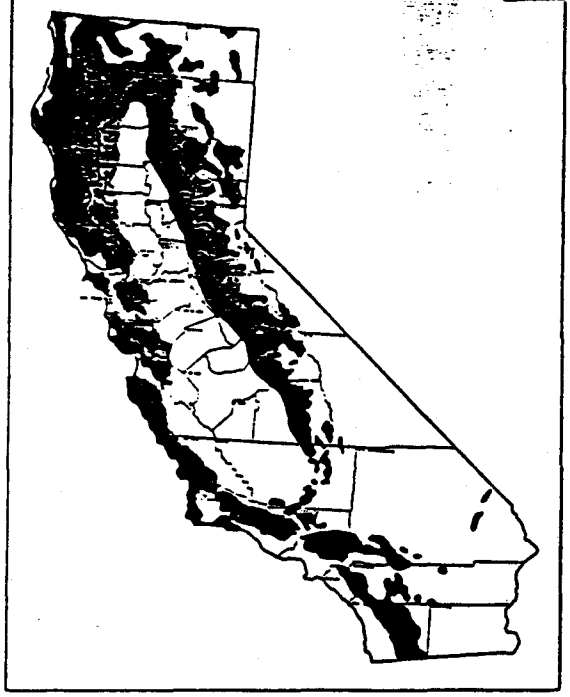
Distribution

Montane Hardwood-Conifer occurs throughout California and is somewhat continuous from Santa Cruz County northward through the outer coast range into Oregon, usually some distance inland from the coast (Cheatham and Haller 1975). The habitat typically follows the upper and/or inland margins of the coastal redwood (RDW) or Douglas fir (DFR) habitats. It can also be found on northfacing slopes of the inner north coast ranges, the Santa Lucia Mountains, as well as small patches extending to Santa Barbara County (Cheatham and Haller 1975). Montane Hardwood-Conifer also occurs somewhat continuously down the Sierra Nevada to the transverse ranges. Elevations range from 300 to 1210 m (1000 to 4000 ft) in the north to 605 to 1760 m (2000 to 5800 ft) in the south. Isolated patches of MHC can be found throughout the transverse and peninsular ranges of southern California.



Black Bear *(Ursus americanus)*

Montane Hardwood-Conifer



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Aspen

Jared Verner

Vegetation

Structure.—Mature stands of quaking aspen usually have relatively open canopies, often shared with other deciduous trees and a few conifer species, typically pines. Average canopy closures of stands in eastern California range from 60 to 100 percent in young and intermediate-aged stands and from 25 to 60 percent in mature stands (E. L. McGraw, pers. comm.). Quaking aspens often attain a height of 18 m (60 ft) and a diameter of 0.6 m (2 ft) (Brockman et al. 1968). Extraordinary trees may reach a height of 30 m (100 ft) and a diameter of about 1 m (3 ft) (Strothmann and Zasada 1957). The open nature of the stands results in substantial light penetration to the ground. Therefore all stands have an herbaceous understory with about half maintaining a tall shrub layer (DeByle and Zasada 1980).

Composition.—Aspen stands are typically composed of clones representing one or more genetic lines. They vary from a few stems on less than 1 ha (2.5 acres) to thousands of stems on 20 ha (50 acres) or more (Barnes 1975). Associated subdominant tree species may include willows, alders, black cottonwood, lodgepole pine, Jeffrey pine, ponderosa pine, red fir, white fir, Douglas-fir, and Engelmann spruce (Thorne 1977, DeByle and Zasada 1980, Parker and Matyas 1981). In communities near climax, however, quaking aspen is conspicuously the dominant species in the canopy.

Important understory shrubs include sagebrush, roses, snowberry, western chokecherry, and western serviceberry. Forbs are usually more abundant than grasses and sedges, and the herbaceous component is typically so rich and diverse as to defy description (DeByle and Zasada 1980).

Other Classifications.—This cover type is referred to as Aspen Woodland by Thorne (1977), Quaking Aspen by Parker and Matyas (1981), and the Aspen Series by Paysen et al. (1980). DeByle and Zasada (1980) describe the type over its entire distribution in the United States and Canada.

Habitat Stages

Vegetation Changes 1;2-5;S-D;6.—Following disturbance, succession proceeds rapidly from an herbaceous layer to shrubs and trees, which invade together. The successional status of aspen stands is unsettled. Most authorities regard it as an early seral stage that invades after fire or other distrubances (Strothmann and Zasada 1957). Consequently, successful, long-term suppression of fires or excessive grazing and browsing by ungulates may result in the eventual disappearance of quaking aspen from an area (Gruell and Loope 1974).

All stands spread by root suckering, resulting in stands comprised of a mosaic of clones of different ages, ranging in size from less than 1 ha (2.5 acres) to more than 20 ha (50 acres) (DeByle and Zasada 1980). Quaking aspens, intolerant of shade, are gradually replaced by more shade-tolerant conifers. "Owing sometimes to the paucity of coniferous seed trees and perhaps also to increasing aridity, the rate of coniferous invasion is so slow that a virtually permanent (climax) type has developed on some sites. On these, aspen vegetatively reproduces repeatedly and develops into all-aged stands" (DeByle and Zasada 1980:96).

Duration of Stages.—The rate of succession in aspen stands varies considerably, even within the same physiographic province (Bartos 1973). Therefore, it is difficult to generalize about the rates. Typically, however, early successional stages are of short duration. The herbaceous stage gives way to a shrub-seedling stage within 5 years. The shrub-seedling stage develops into a pole-sized stand usually within 10 to 15 years, with trees maturing within 30 years. Although quaking aspens are relatively short-lived trees, and subject to significant heart rot, DeByle and Zasada (1980) report intact stands 200 years of age.

Biological Setting

Habitat.—Aspen stands in California occur primarily at higher elevations near seeps, streams, and meadows on the eastern slopes of the Sierra Nevada and Cascade Ranges. Zonally they are found within the Red Fir, Mixed-conifer, and Lodgepole Pine habitats (Thorne 1977, Parker and Matyas 1981). Aspens commonly occur adjacent to Sagebrush habitats and other montane shrub types, where they are often the only tree species present. They are also found along streams adjoining Jeffrey Pine habitats. At higher elevations they occur with whitebark pine, where they grow in a shrubby, wind-pruned form (Parker and Matyas 1981).

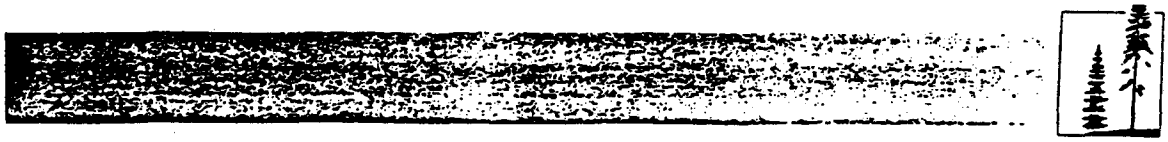
Wildlife Considerations.—Although no wildlife species is totally dependent on habitats dominated by aspen, this cover type adds significantly to the richness of the wildlife in areas where it occurs. The habitat typically has a shrubby ecotone with adjacent meadows. This and the shrub understory within stands provide nesting cover for several species that might otherwise be scarce or absent. The mesic sites that permit aspen to establish also result in higher insect production compared to adjacent forests or shrublands. Such insect production, together with a high rate of fungal infection of trees, is thought to account for the greater variety and abundance of birds in ASP habitats than in adjacent forests and shrublands (Winternitz 1980). Aspen stands are habitats favored by a variety of cavity-nesting birds, such as bluebirds, sapsuckers, downy woodpeckers, and chickadees. Snags are important to cavity nesters in these stands, but live aspens are easily and therefore commonly drilled by excavating species. On the eastern slopes of the Sierra Nevada, aspen stands adjoining sagebrush and other shrub habitats apart from forested sites often provide nesting cover for northern goshawks. (E. L. McGraw pers. comm.).

Physical Setting

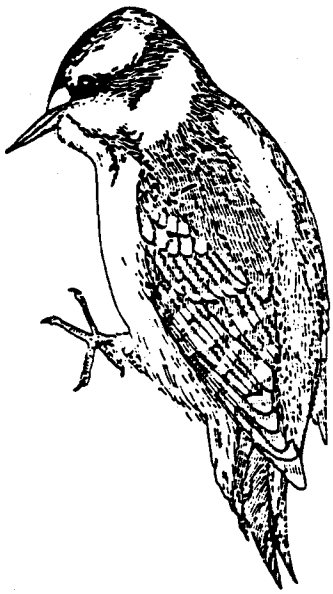
Aspen stands occur at high elevations on a variety of sites and soils. A high water table during the early part of the growing season is required. Therefore, these stands are good indicators of moist conditions (Parker and Matyas 1981). Sites with permanent high water tables are occupied by willows (Thorne 1977), with which aspens may form ecotones. Soils range "from shallow stony soils and loamy sands to heavy clays. Best development occurs on well-drained sandy to silt loam soils" (DeByle and Zasada 1980). The climate is rigorous—long winters with heavy snows and very cold temperatures, hence a short growing season.

Distribution

Most ASP habitats in California are found within 80 km (50 mi) of the Nevada border from Mono County to Plumas County. Small stands are scattered generally north and westward from there into northern Trinity and western Siskiyou Counties (Griffin and Critchfield 1972). Disjunct populations occur in the White and San Bernardino Mountains (Lloyd and Mitchell 1966, Paysen et al. 1980). Elevational limits generally range from 2000 to 3000 m (6550 to 9850 ft), although quaking aspen occurs as low as 915 m (3000 ft) at McArthur-Burney Falls State Park, Shasta County (Griffin and Critchfield 1982). Aspen stands do not extend to the upper tree line in any locality (DeByle and Zasada 1980).

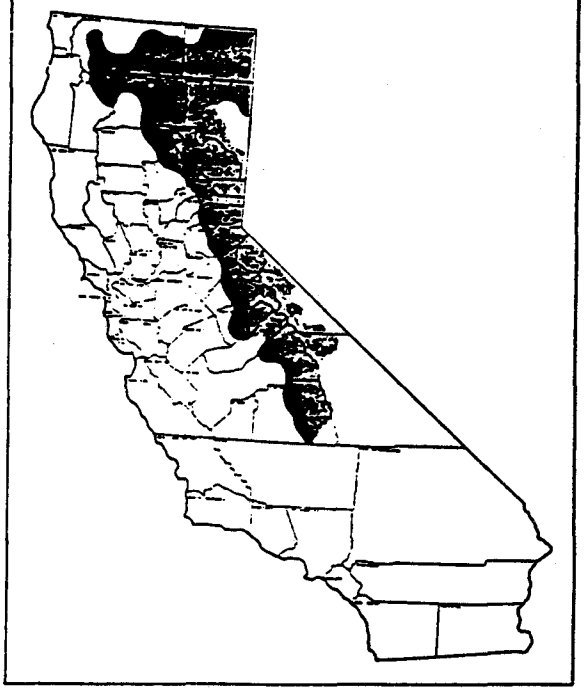


ASP
Aspen habitat, Tuolumne County, California (photo by William F. Laudenslayer, Jr.)



Downy Woodpecker *(Picoides pubescens)*

Aspen



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Ponderosa Pine

E. Lee Fitzhugh

Vegetation

Structure.—Tree spacing in ponderosa pine stands varies from open patchy to extremely close. On high quality sites, virgin stands may be 46-55 m (150-180 ft) high, with diameters from 0.9-1.2 m (3-4 ft) (Harlow and Harrar 1950). Typical overstory coverage of all layers may exceed 100% (Vankat 1970). Other conifers, when present, provide denser crowns than do the pine, thus creating habitat diversity. Grasses, shrubs, and deciduous trees may be present or absent. Typical coverage of shrubs is 10-30% and of grasses and forbs is 5-10% (Barbour 1986).

Composition.—The ponderosa pine habitat includes pure stands of ponderosa pine as well as stands of mixed species in which at least 50% of the canopy area is ponderosa pine. Associated species vary depending on location in the state and site conditions. Typical tree associates include white fir, incense-cedar, Coulter pine, Jeffrey pine, sugar pine, Douglas-fir, bigcone Douglas-fir, canyon live oak, California black oak, Oregon white oak, Pacific madrone and tanoak.

Associated shrubs include manzanita, ceanothus, mountain-misery, Pacific dogwood, hairy yerba-santa, yellowleaf silktassel, bitter cherry, California buckthorn, poison-oak, Sierra gooseberry.

Grasses and forbs include slimleaf brome, Orcutt brome, carex, smallflower melicgrass, bluegrass, bottlebrush squirreltail, bedstraw, brackenfern, bush morning-glory, rhomboid clarkia, Child's blue-eyed mary, shrubby eriastrum, splendid gilia, Sierra iris, whisker-brush, Inyo bush lupine, summer lupine, purple nightshade, streptanthus, gooseroot violet, and wildiris.

Other Classifications.—The ponderosa pine habitat, as defined here, forms a part of the yellow pine forest of Munz and Keck (1959) and Thorne (1977), the montane forest of Griffin and Critchfield (1976), the ponderosa/Jeffrey pine series of Paysen, *et al.* (1980) and the mid-montane conifer forest of Barbour (1986). More restrictive types which include only a part of the ponderosa pine habitat are Pacific ponderosa pine (245) (Eyre 1980), ponderosa pine (Parker and Matyas 1979 and Barbour and Major 1977), western Sierra ponderosa pine forest (Barry unpublished, cited in Cheatham and Haller 1975), ponderosa pine series of the Sierra montane conifer forest (Pase 1962a), Coast Range ponderosa pine forest and "westside" ponderosa pine forest (Cheatham and Haller 1975), and Sierran yellow pine forest (Küchler 1977). In addition, on those sites where ponderosa pine is dominant, portions of other montane forests (Küchler 1977), and Pacific ponderosa pine-Douglas-fir (Barbour 1986), and mixed conifer (244, 243), (Eyre 1980) are included in ponderosa pine habitat.

Habitat Stages

Vegetation Changes 1;2-5;SD.—Most ponderosa pine stands that include other coniferous trees probably are maintained by periodic ground fires. In many of these stands, crown fires result in dense montane chaparral communities (Cheatham and Haller, 1975). Young, dense stands, as in plantations, exclude most undergrowth once trees attain a closed canopy. Prior to that, dense brush is typical, but an herbaceous layer may develop on some sites.

Duration of Stages.—On sites or areas that are dry or of low quality, significant pine regeneration may depend on concurrent disturbance of chaparral and a good pine seed crop with favorable weather. Thus, it may require 50-100 years for significant pine regeneration in the absence of intervention. Clearcuts with minimal brush control develop a dense stand of pole-size trees in 20-30 years, twice the time required when brush is completely removed. Dense brush is typical in young stands and an herbaceous layer may develop on some sites. On drier sites, there is less tendency for succession toward shade-adapted species. Sites disturbed by fire or logging sometimes are converted to dense montane chaparral or mixed chaparral. Moist chaparral areas of higher site quality tend to develop directly into mixed conifer stands.

As young, dense stands age and attain a closed canopy, they exclude most undergrowth. When other adapted conifers occur in moist ponderosa pine stands of medium to high site quality, they may form a significant understory in about 20 years in the absence of fire. If allowed to continue, such succession may change the structure and composition of the stand within 40 years sufficiently to favor wildlife adapted to mixed conifer habitats. Most ponderosa pine stands that include other coniferous trees probably are maintained by periodic ground fires (Cheatham and Haller 1975).

Biological Setting

Habitat.—In Northern California, ponderosa pine stands occur above coastal oak woodland, valley oak woodland, blue oak woodland, blue oak-digger pine and below mixed conifer. Montane hardwood stands may be below or interspersed with ponderosa pine. Jeffrey pine stands often occur above ponderosa pine, but may be found on serpentine soils or on harsh sites at lower elevations in the ponderosa pine zone. Farther south, coastal scrub, chamise-redshank, mixed chaparral, or woodland oaks are typical at the lower boundary of the ponderosa pine habitat, with bigcone Douglas-fir or true firs at the upper edge. Dry, rocky sites within the habitat may support montane chaparral, mixed hardwood-conifer or closed-cone pine-cypress. Isolated, small patches of bigcone Douglas-fir may occur in mesic canyons or on north-facing slopes within ponderosa pine stands.

Wildlife Considerations.—Ponderosa pine sometimes is a transitional or migratory habitat for deer and can be extremely important to deer nutrition in migration holding areas. A mixture of early and late successional stages closely interspersed probably will provide good general wildlife habitat, but riparian zones, deer migratory routes and holding areas require special consideration during management planning. The California condor uses the ponderosa pine habitat from Madera and Santa Clara Counties southward. Moreover, the Sierra Nevada red fox, Siskiyou mountain salamander and Shasta salamander also are found in the habitat.

Physical Setting

The lower elevational limit of the habitat may correspond to a mean annual temperature less than 13°C (55°F) and precipitation greater than 350 mm (33 in) except in southern California (Barbour 1986). Brown (1982) reported a minimum precipitation level of 635 mm (25 in) annually in the Peninsular Ranges. Ponderosa pine is found on all aspects, depending on soils and location within the local elevational range. Less than one-third of the precipitation is snowfall (Barbour 1986).

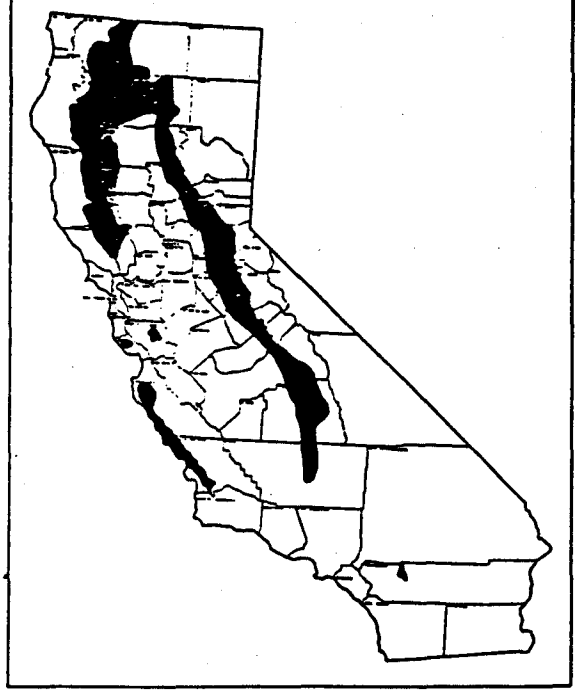
Distribution

Ponderosa pine habitat is found on suitable mountain and foothill sites throughout California except in the immediate area of San Francisco Bay, in the north coast area, south of Kern County in the Sierra Nevada and east of the Sierra Nevada Crest. Elevational ranges include 240-180 m (800-5000 ft) in the northern Sierra Nevada and Cascades, 1200-2100 m (3937-6890 ft) in the central and southern Sierra Nevada and 1300-2140 m (4265-7021 ft) in the Transverse and Peninsular Ranges, although it may be

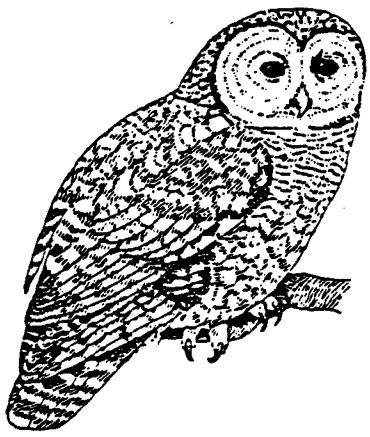
PPN
Ponderosa Pine habitat, Trinity County, California (photo by E. Lee Fitzhugh)

found as low as 105 m (3445 ft) in moist south-coastal sites (Rundel *et al.* 1977, Thorne 1977, Brown 1982 and Cheatham and Haller 1975). The ponderosa pine habitat is replaced by Jeffrey pine on the Mojave Desert slopes of the Transverse Range and often on the eastern side of the Peninsular and Coast Ranges.

Ponderosa Pine



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.



Spotted Owl *(Strix occidentalis)*

Sierran Mixed Conifer

Barbara H. Allen

Vegetation

Structure.—The Sierran mixed conifer habitat is an assemblage of conifer and hardwood species that forms a multilayered forest. Historically, burning and logging have caused wide variability in stand structure, resulting in both even-aged and uneven-aged stands (Rundel et al. 1977). Virgin old-growth stands where fire has been excluded are often two-storied, with the overstory comprised of mixed conifer and the understory white fir and incense-cedar (Tappeiner 1980).

Forested stands form closed, multilayered canopies with nearly 100 percent overlapping cover (Rundel et al. 1977). When openings occur, shrubs are common in the understory (Kosco 1980). Closed canopy stand distribution is both extensive and patchy depending on scale, site, slope, soils, microclimate, and history.

At maturity, the dominant conifers range from 30 to 60 m (100 to 200 ft) tall with a highly variable basal areas of about 17 to 26 sq m (180 - 280 sq ft). Diameter breast height at maturity for pines and Douglas-fir is commonly greater than 1 m (40 in); white fir greater than 0.9 m (35 in) is common (Laake and Fiske 1983b). Fuel loading in stands heavy with pine may reach 27,000 kg/ha (70 to 80 t/ac) in natural stands; whereas fuel loading in stands heavy with fir may reach 16,000 kg/ha (40 to 50 t/ac).

Composition.—Five conifers and one hardwood typify the mixed conifer forest — white fir, Douglas-fir, ponderosa pine, sugar pine, incense-cedar, and California black oak. White fir tends to be the most ubiquitous species (though most often a minor overstory component) because it tolerates shade and has the ability to survive long periods of suppression in brush fields. Douglas-fir dominates the species mix in the north, but is absent south of the Merced River (Tappeiner 1980). Ponderosa pine dominates at lower elevations and on south slopes. Jeffrey pine commonly replaces ponderosa pine at high elevations, on cold sites, or on ultramafic soils (Rundel et al. 1977). Red fir is a minor associate at the highest elevations. Sugar pine is found throughout the mixed conifer type. Black oak is a minor, but widespread, component in mixed conifer stands. Though black oak does best on open sites, it is maintained under adverse conditions such as shade, ridgetops, and south slopes where conifers may regenerate in its shade (Tappeiner 1980). In the central and particularly southern Sierra Nevada, giant sequoia is a striking associate of the mixed conifer type (Rundel et al. 1977). White fir, incense-cedar and sugar pine are associated with the mesic giant sequoia sites (Tappeiner 1980).

Deerbrush, manzanita, chinquapin, tan oak, bitter cherry, squawcarpet, mountain whitethorn, gooseberry, rose, and mountain misery are common shrub species in the mixed conifer understory (Kosco and Bartolome 1983). Grasses and forbs associated with this type include mountain brome, *Carex*, bull thistle, iris, *Juncus*, and needlegrass. In all, over 100 species of grasses, forbs and shrubs contribute to the flora of the mixed conifer habitat (Tappeiner 1980).

Other Classifications.—Other names for the Sierran mixed conifer habitat include yellow pine forest (Munz 1973). Parker and Matyas (1981) divide Sierran mixed conifer into five series: mixed conifer-fir, mixed conifer-pine, ponderosa pine, white fir and Jeffrey pine. Rundel et al. (1977) describes the mixed conifer as part of a White fir-mixed conifer forest and Cheatham and Haller (1975) call this habitat Sierran coniferous forest (8.42), a major subdivision of the lower montane coniferous forest habitat (8.4). Sierran mixed conifer is SAF type 243 (Tappeiner 1980). Where ponderosa pine or Douglas-fir predominates without significant amounts of white fir or incense-cedar, the forest is typed as Pacific ponderosa pine or Pacific ponderosa pine-Douglas-fir (SAF types 245 and 244, respectively) (McDonald 1980).

Habitat Stages

Vegetation Changes 1;2-5;S-D;6.—After logging or burning, succession proceeds from an ephemeral herb to perennial grass-herb, through a shrub-perennial grass stage, to conifers (Burcham 1964). In many areas, however, shrubs appear in the first year after disturbance (Kosco 1980). The habitat stages are stage 1, grass-forb, with bedstraw, plantain, mountain brome, and needlegrass as common early succession species; stage 2, shrub-seedling-sapling, characterized by manzanita, *Ceanothus*, cherry, gooseberry, and mountain misery. In the seedling tree stage through the sapling tree, pole tree, small tree, and medium/large tree stages, the five conifers gain dominance of the site.

Duration of Stages.—Stage duration has been described by Verner (1980). The grass-forb stage, generally is short-lived (less than 2 years). The shrub-seedling-sapling stage is usually evident by yr 2 and lasts 10 to 40 yr; this stage is a mixture of shrubs and saplings up to 6 m (20 ft) tall depending on the site, degree, and type of disturbance. If tall shrubs capture the site, it may take 10 to 15 plus yr for trees to dominate the site. The pole-medium tree stage supports trees up to 15 m (50 ft) tall and may last from 15 to 90 yr on poor sites. The mature and overmature stages include stands greater than about 30 m (100 ft) in height.

Biological Setting

Habitat.—The type adjoins the Pacific ponderosa pine-Douglas-fir type (SAF 244) in the Klamath Mountains and Cascade Range, the Pacific ponderosa pine (SAF 245) and interior ponderosa pine (SAF 237),(PPN) at lower elevations and drier slopes, and the white fir (SAF 211), (WFR) and red fir (SAF 207), (RFR) types at higher elevations. Montane meadows and riparian deciduous woodlands are found within the Sierran mixed conifer type. Digger-pine oak, blue oak savannah and chaparral types may adjoin this type at drier, and lower elevations.

Wildlife Considerations.—The mixed conifer forest supports some 355 species of animals (Verner and Boss 1980). Sensitive species inhabiting mixed conifer include spotted owl, fisher and pine marten. Endangered species include bald eagle and peregrin falcon (Verner and Boss 1980). Variety in plant species composition provides diversity in food and cover. Black oak acorns, berries from a variety of shrubs (e.g., deerbrush), and a great number of grasses and forbs provide the forage resource essential for wildlife (Kosco and Bartolome 1983).

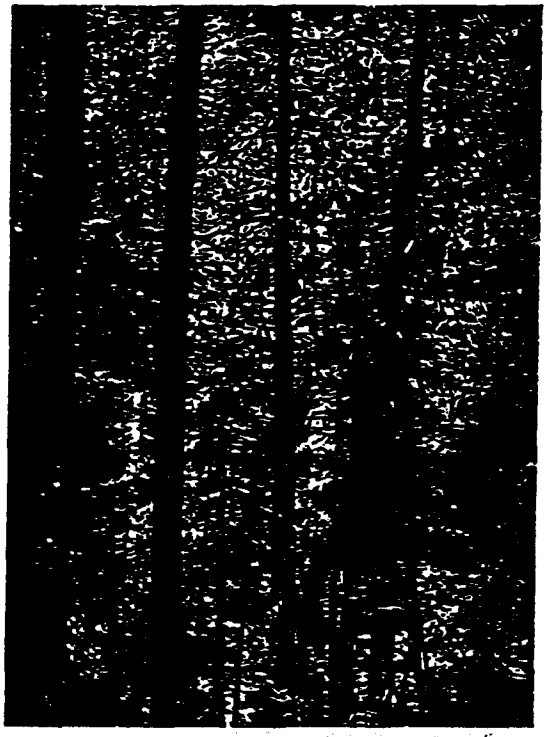
Physical Setting

Soils supporting the Sierran mixed conifer habitat are varied, derived primarily from Mesozoic granitic, Paleozoic sedimentary and volcanic rocks; and Cenozoic volcanic rocks. Serpentine soils, found primarily in the northern mixed conifer zone, support a number of endemic plants. Soils are deep to shallow. Fissures and cracks in granitic parent material often support forest growth, even where soil development is shallow. Temperatures range from 24 to 58°C (40 to 96°F) in summer and 4 to 36°C (−10 to 60°F) in winter and decrease with elevation (Major 1977). The growing season ranges between 90 and 330 days in the north with 40 to 200 frost-free days, and 180 to 365 days in the south with 180 frost-free days. Precipitation ranges from 76 to 229 cm (30 to 90 in) per year, from October to May, with increasing snowfall as elevation increases.

Distribution

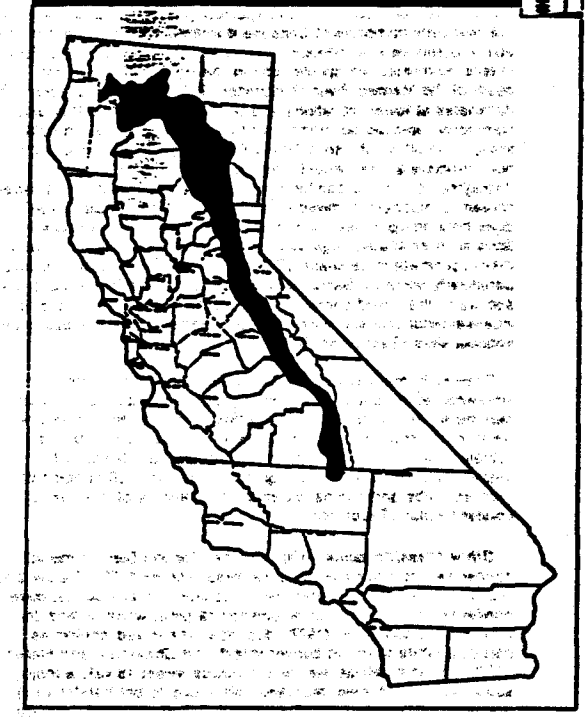
The Sierran mixed conifer habitat generally forms a vegetation band ranging 770 to 1230 m (2500 to 4000 ft) in the north to 1230 to 3076 m (4000 to 10,000 ft) in the southern Sierra Nevada (Griffin and Critchfield 1972). The Sierra Nevada mixed conifer forest occupies between 1.8 to 3.2 million ha (4.5 to 7.8 million ac) in southern Oregon and California, dominating western middle elevation slopes of the Sierra Nevada. Disjunct populations of mixed conifer are found in the Peninsular, Transverse, and Coast ranges of California.

Pileated Woodpecker *(Dryocopus pileatus)*



SMC
Sierran Mixed Conifer habitat, Rubicon River, Placer County, California (photo by Robert F. Holland)

Sierran Mixed Conifer



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

White Fir

Karen Shimamoto

Vegetation

Structure.—The White Fir (WFR) habitat is characterized by nearly monotypic even-aged overstory (Cheatham and Haller 1975, Paysen et al, 1980, Riegel 1982, Rundel et al. 1977). Overlapping crowns that cast deep shade are characteristic, although open stands are common (Cheatham and Haller 1975, Eyre 1980, Riegel 1982). Northern California specimens grow to about 70 m (230 ft) in height. Southern California specimens grow to about 30 m (100 ft) (Cheatham and Haller 1975). The understory may consist of sparsely scattered grasses, forbs, and shrubs, or white fir seedlings and saplings (Cheatham and Haller 1975, Eyre 1980, Paysen et al. 1980). However, on moist swales or drainage bottoms, herbaceous cover may approach 100 percent (Rundel et al. 1977). Downed material usually consists of logs, branches and needle litter (Cheatham and Haller 1975). Fire influences the white fir habitat by causing a mosaic of even-aged stands in different successional stages.

Composition.—Mature white fir stands, normally monotypic, with more than 80 percent occurring as white fir, are found throughout California; from the Klamath Mountains along the north coast to the south coast mountain ranges, and in interior ranges from the Warner Mountains in the Great Basin to the Clark, Kingston, and New York mountain ranges in interior southern California (Rundel et al. 1977, Parker and Matyas 1981).

Shade and downed woody material tend to inhibit understory species (Parker and Matyas 1981). In the Klamath Mountains, for example, canyon live oak and chinkapin are the predominant understory species and open stands usually include squawcarpet and barberry. Dense stands, however, have herbaceous species such as wake robin, vetch, and pipsissewa. Jeffrey pine is an associate in the Cascades and Warner mountain ranges, with greenleaf manzanita and currant as understory shrubs. Tree associates change in the southern Sierra Nevada, where sugar pine, incense-cedar, and red fir are found. Pipsissewa, wintergreen, current, and snowplant are in the understory (Cheatham and Haller 1975). In the south coast range and south interior range, sugar pine and single-leaf pinyon occur as associates of white fir, most commonly on cool, north- and east-facing slopes, respectively. Rundel et al. (1977) describes white fir vegetative composition over elevational and moisture differences in the Sierra Nevada.

Other Classifications.—Historically, the white fir habitat has been described as part of the mixed conifer habitat (white fir phase) (Griffin 1967) or as ecotonal between mixed conifer and red fir. Munz and Keck (1959) simply included it in yellow pine forest. White fir habitat is now named White Fir (Parker and Matyas 1981); White Fir (211) (Eyre 1980); White Fir Series (Paysen et al. 1980); White Fir Zone (Franklin and Dyrness 1973); Sierran White Fir (8.424) and Southern California White Fir (8.532) (Cheatham and Haller 1975); White Fir-Sugar Pine Forest (Thorne 1977).

Habitat Stages

Vegetation Changes 1;2-5;S-D;6.—Following disturbance, white fir proceeds through the seral stages (Gordon 1970, 1973b, Eyre 1980, Conard 1980, Conard and Radosevich 1982, Hopkins 1982, Laacke and Fiske 1983).

In the grass/forb stage, bare mineral soil provides the best seedbed for white fir. If the site has been burned, brush seedlings such as manzanita, snowbrush ceanothus, mountain whitethorn, deerbrush, willow, bittercherry, huckleberry oak, currant, gooseberry and chinkapin also become established.

In the shrub/sapling stage, large brushfields comprise 75 percent of the vegetative cover and persist for 30-50 years. Varying density of white fir seedlings (1000-10,000 stems per ha) establish within 10 to 20 years, growing under and eventually overtopping the brush. In managed situations, brush is removed and white fir growth increases by as much as 200 percent in height.

In the pole/medium tree stage, white fir overtops the shrubs which for the most part are shaded out and die. Sometimes an understory of white fir establishes by the time the overstory reaches pole height. This multilayered condition persists into later stages.

In the large tree stage, a characteristic understory develops including whitevein shinleaf, little prince's pine, brackenfern, striped coralroot, and milk kelloggia—primarily root parasites and semiparasitic species.

Duration of Stages.—The duration of the grass/forb stage is dependent on the availability of a white fir seed source and a good seed crop every 3-9 years (Schopmeyer 1974, Gordon 1978). Reforestation activities would limit the duration of this seral stage to less than 5 years. In the shrub/sapling stage, white fir seedlings and saplings can persist for 30 to 50 years under a brush overstory. The average age in the large tree stage is 250 to 300 years with 70 to 90 cm (28-35 in) dbh (Hopkins 1979a, 1979b).

Biological Setting

Habitat.—In the Klamath Mountains, the Cascades, and the Sierra Nevada, white fir habitat occurs between mixed conifer and red fir habitats (Eyre 1980, Parker and Matryas 1981). In the south coast Transverse and Peninsular ranges, and in the mountain ranges of interior southern California, white fir intergrades at lower elevations with mixed conifer and is replaced at higher elevations by lodgepole pine (Cheatham and Haller 1975, Parker and Matyas 1981).

Wildlife Considerations.—White fir habitat is probably the coolest, moistest, nonriparian habitat within the lower to mid-elevation forests in northern California. In southern California this habitat is colder and drier, probably equivalent to the red fir habitat elsewhere, but with drier conditions (Cheatham and Haller 1975).

As stands mature, a high percentage of defective trees are found, the result of windthrow and heart rot fungus (Gordon 1973, Hopkins 1982). Excellent habitat is provided for snag and cavity dependent wildlife species, particularly when breaks occur between 15-30 m (50-100 ft). The additional benefit of heart rot is the cylindrically stable snag created as a result of the rot moving from the inside of the tree to the outer diameter.

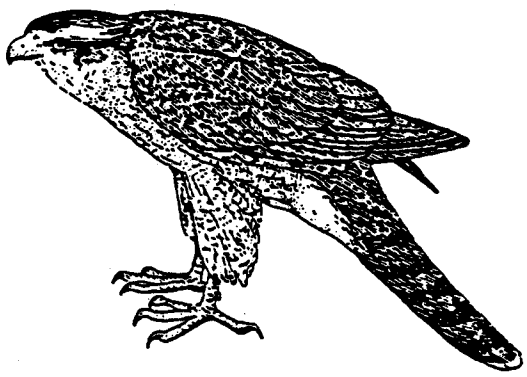
White fir is the preferred tree species for insect-gleaning yellow-rumped warblers and western tanagers, and is also commonly used by other insect-gleaning birds, such as mountain chickadee, chestnut-backed chickadee, golden-crowned kinglet, and black-headed grosbeak (Airola and Barrett 1985).

Physical Setting

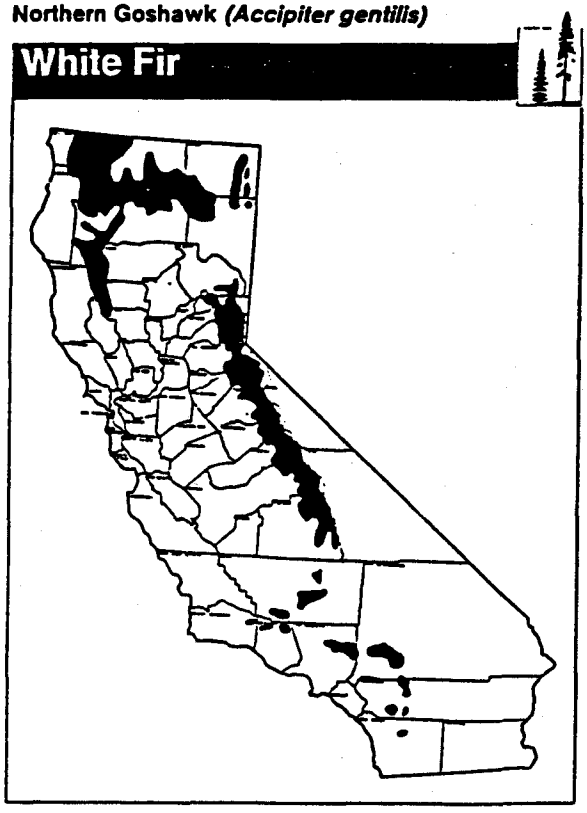
White fir habitats are found on a variety of soils developed from different parent material, including volcanic and igneous rocks, granitics, various metamorphics, and sedimentary material (Franklin and Dyrness 1973, Fowells 1965, Hopkins 1982). Soils are coarse textured, well-drained, have poorly developed profiles, are often rocky, and are cold, with mean annual temperatures from 0 to 10°C (32°-50°F) (Cheatham and Haller 1975, Riegel 1982, Laacke and Fiske 1983). Cooler north- and east-facing slopes are the most common sites throughout the state, however, Riegel (1982) noted the presence of unusually xeric white fir stands in the Warner Mountains. Precipitation is between 76-178 cm (30-70 in) mostly in the form of snow. Almost all precipitation falls between October and May (Laacke and Fiske 1983).

Distribution

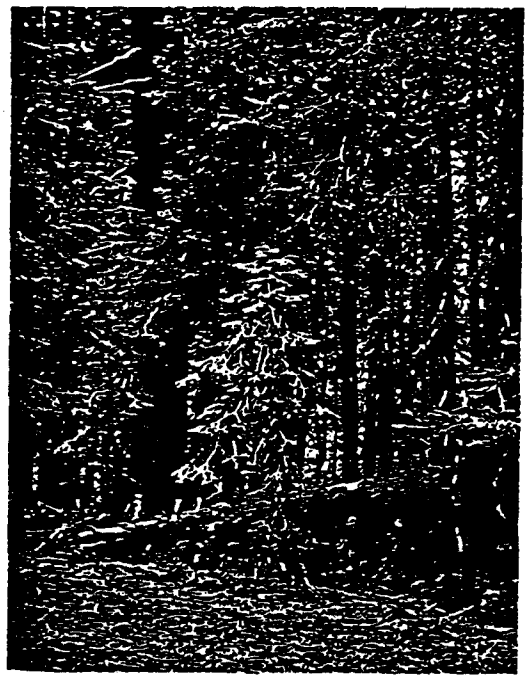
Elevation of white fir habitat varies with latitude. In the Klamath Mountains of Trinity and Siskiyou Counties, white fir is found from 1370 to 1680 m (4500-5500 ft); from 1520 to 1830 m (5000-6000 ft) in the Cascade and Warner Mountains; at about 1675 m (5500 ft) in the Southern Sierra Nevada; above 1800 m (6000 ft) throughout the Trnasverse and Peninsular Ranges; and between 1600 to 2135 m (6000-7000 ft) in the southern interior ranges (Cheatham and Haller 1975, Parker and Matyas 1981). Small relict stands are also found at 2300 to 2880 m (7500-9500 ft) in the Clark, Kingston, and New York Mountains in the Mojave Desert (Thorne 1977, Paysen et al. 1980).



Northern Goshawk *(Accipiter gentilis)*



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.



WFR
White Fir habitat, Lassen Volcanic National Park, California (photo by Mary Ann Showers)

Lodgepole Pine

James W. Bartolome

Vegetation

Structure.—Lodgepole pine typically forms open stands of similarly sized specimens in association with few other species and with a sparse understory (Rundel et al. 1977). On fertile sites, trees can reach a height of 40 m (130 ft), but typically a stand consists of groups averaging 15 to 20 m (40 to 65 ft) in height. Nine stands in Sequoia National Park (Van Kat and Major 1978, cited in Rundel et al. 1977) averaged 56 percent crown cover, 3390 trees per ha (1370 per ac), and 58 sq m (625 sq ft) of basal area per ha (2.5 ac). Mature Sierran stands often contain significant seedlings and saplings, in contrast to the even aged character of stands in the northern Cascades and Rocky Mountains (Critchfield 1980).

Composition.—Lodgepole pine overwhelmingly dominates the habitat. Occasional associates include aspen and mountain hemlock. The amount of understory is weakly correlated with overstory density (Bartolome 1983). The understory may be virtually absent, consisting of scattered shrubs and herbs, or a rich herbaceous layer at meadow margins. Many lodgepole stands are associated with meadow edges and streams, where the understory consists of grasses, forbs, and sedges. In the southern Sierra and mountains of southern California, understory shrubs such as huckleberry and mountain heather may be common (Cheatham and Haller 1975).

Other Classifications.—Lodgepole Pine habitats form an easily distinguishable subdivision of the mixed conifer forest. Other classifications are Lodgepole Pine (U.S. Forest Service 1981) and Lodgepole Forest (Munz and Keck 1949). Classifications based on potential vegetation may not include a lodgepole pine type, considering it successional to other forest types.

Habitat Stages

Vegetation Changes 1;2-5;S-D.—Three major disturbances affect lodgepole pine in California: fire, insects, and logging. These disturbances create openings of various sizes that lodgepole pines rapidly recolonize (Lotan and Perry 1983). The stages of vegetation change are primarily the result of increased tree density, canopy cover, and size.

A short period of herbaceous productivity precedes closure of the tree canopy on productive sites. The prolific seed output, establishment, and seedling growth of lodgepole pine makes the period of herbaceous production short.

Continued recruitment into stands produces overstocking and slow growth of the overcrowded trees. This overcrowding may make them susceptible to insects (Lotan and Perry 1983), although others have argued that the more vigorously growing trees are more likely to be attacked. Beetle infestation creates large quantities of fuel that increase the probability of wildfire.

Many Sierran meadows have been invaded over the last few centuries by lodgepole pine (Benedict 1982); creating new dense stands. Although the understory persists, productivity is lowered (Bartolome 1983). The causes of this invasion remain poorly understood. Repeated episodes of tree invasion and subsequent reestablishment of meadows have occurred since the most recent glaciation.

Duration of Stages.—Young pines establish very rapidly and become reproductive; five year-old lodgepole pines are capable of producing cones (Critchfield 1980). Within 20 years, the canopy closes and understory productivity becomes negligible (Basile 1975). Duration of the type thus depends on subsequent longevity of the trees. Stand persistence appears inversely related to site productivity (Lotan and Perry 1983); highly productive sites in Washington and Idaho were reported to start losing trees at 80 to 100 years. The upper limit of tree age seems about 400 years, although Critchfield (cited in Rundel et al. 1977) estimated one tree in the Sierra to be at least 600 years old.

Biological Setting

Habitat.—Typically the lodgepole pine zone is found above red fir and below the other subalpine conifer habitats (Rundel et al. 1977). Although the boundaries between lodgepole pine and meadow are dynamic, they are easily differentiated in classification of the existing landscape. Lodgepole pine most closely associates with the red fir habitat of lower elevations. Although lodgepole pine is widespread, it is generally a minor forest element in other habitats. At the upper elevation limits of lodgepole pine in southern California, the trees may adjoin alpine habitats.

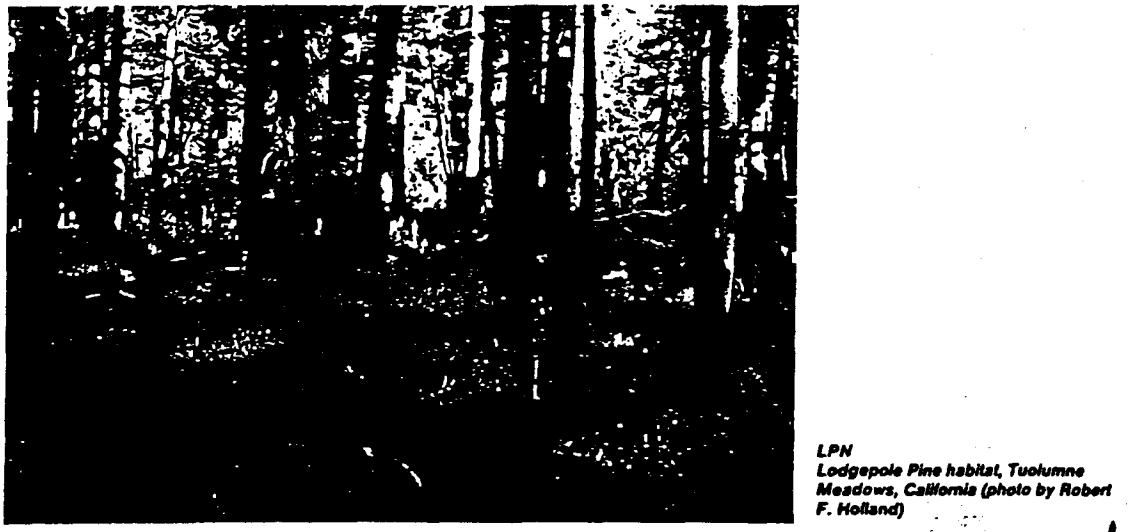
Wildlife Considerations.—Lodgepole pine stands have low structural diversity and are relatively low in animal species. Many species found in lodgepole pine stands are associated with the meadow edge. The Lodgepole habitat provides suitable habitat for 6 reptiles and amphibians, 49 birds, 35 mammals (Verner and Boss 1980). These species include wolverine (rare), goshawk (sensitive), bald eagle (endangered), and prairie falcon (sensitive).

Physical Setting

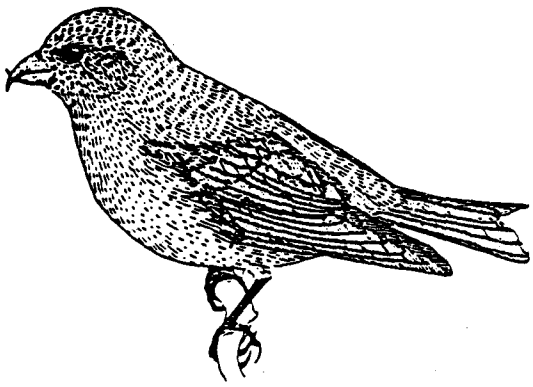
Lodgepole pine occupies an array of landscape units within its zone of adaptation. Areas of lodgepole pine in the red fir habitats are characterized by poor drainage and often a cooler microsite. Lodgepole pine is commonly associated with meadows (Rundel et al. 1977). Although lodgepole pine has well developed water regulation mechanisms, it typically occupies areas with at least seasonally wet soils. Annual precipitation in the lodgepole pine zone averages from 750 to 1000 mm (30 to 40 in) annually, mostly as snow. The growing season is short, averaging 2 to 3 months (Rundel et al. 1977).

Distribution

Lodgepole Pine habitats are scattered throughout the state, but concentrated in the Sierra Nevada and southern Cascades. Significant stands, however, occur in the higher mountains of southern California (Griffin and Critchfield 1972). Well developed lodgepole pine habitats are found above 1800 m (5900 ft) elevation in the northern Sierra and above 2400 (7900 ft) in the south.

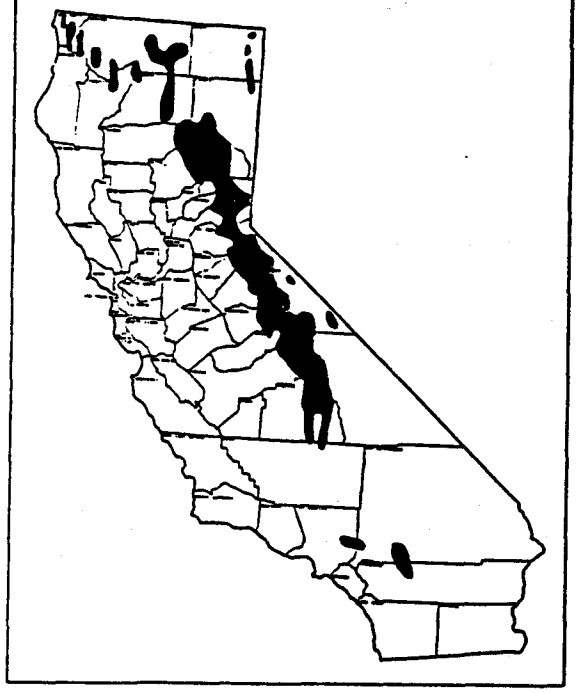


LPN
Lodgepole Pine habitat, Tuolumne Meadows, California (photo by Robert F. Holland)



Red Crossbill *(Loxia curvirostra)*

Lodgepole Pine



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Red Fir

Reginald H. Barrett

Vegetation

Structure.—Stand structure is typified by even-aged (established within 20-year span) groups of trees that cover several to thousands of square meters. The cause of this pattern is probably a history of recurrent lightning fires, windthrows, and insect outbreaks acting to kill groups of trees (Oosting and Billings 1943, Vankat 1970, Kilgore 1971, 1973, Gordon 1973a, Rundel et al. 1977, Pitcher 1981). Natural regeneration occurs on the disturbed site following the next good cone crop. Young seedling stands are thinned by competition for soil moisture during summer (Gordon 1970, Ustin et al. 1984). Logging is becoming a more common source of disturbance, creating larger openings on average than historic disturbances (Chapel et al. 1983).

Composition.—Mature red fir stands normally are monotypic, with very few other plant species in any layer. Heavy shade and a thick layer of duff tends to inhibit understory vegetation, especially in dense stands (Oosting and Billings 1943). To the north, in the Klamath Mountains, red fir gives way to noble fir (Griffin and Critchfield 1972).

Other Classifications.—Because of its distinctiveness, references to the red fir type are unambiguous (Jensen 1947, Storer and Usinger 1963, Munz and Keck 1970, Cheatham and Haller 1975, Küchler 1977, Matyas and Parker 1979, Eyre 1980, Holstein 1980).

Habitat Stages

Vegetation Changes 1;2-5;S-D.—After disturbance — typically logging or fire — red fir vegetation on a site proceeds through 4 seral stages: grass/forb, shrub/sapling, pole/medium tree, and large tree (Oosting and Billings 1943, Vankat 1970, Gordon 1979, Rundel et al. 1977, Zieroth 1978, Pitcher 1981). The grass/forb stage occurs when red fir seedlings become established on mineral soil or shallow litter and require about 5 years to reach a height of 15 cm (6 in). Herbs, are often sparse due to competition for soil moisture on light soils. In the shrub/sapling stage, large brushfields may develop after hot wildfires and are dominated by *Ceanothus* or other shrub species for many years. The pole/medium tree stage produces dense stands of young red fir that grow slowly with little mortality for many years. In the large tree stage, subdominant trees die and add to a growing layer of duff and downed woody material, and dominant trees continue to grow for several hundred years to heights of 40 m (130 ft). Old-growth stands on poor sites in the Sagehen Creek drainage of Nevada County average about 400 years old. The understory of mature stands is limited to less than 5 percent cover of shade tolerant forbs (e.g., *Chimaphila menziesii, Phyrola picta).*

Duration of Stages.—Seral patterns are defined here for both good and poor sites (Schumacher 1928; Dunning and Reineke 1933; Oosting and Billings 1943, Gordon 1970, 1973b, Rundel et al. 1977, Barrett and Salwasser 1982). The seral pattern on good sites includes 10 years in the grass/forb stage, 20 years in the shrub/seedling stage, 80 years in the pole/medium tree stage and 110 years in the large tree stage. The pattern on poor sites includes 20 years in the shrub/seedling stage, 100 years in the pole/medium tree stage and 250 years in the large tree stage. Hence the cumulative year totals are 200 from the good site and 400 from the poor site.

Biological Setting

Habitat.—Red fir habitats occur on frigid soils of the higher mountains of northern California. At lower elevations red fir habitats intergrade with white fir-dominated mixed conifer stands on drier sites and with lodgepole pine-mountain meadow stands on moist sites. Small pockets of lodgepole pine also occur in wet sites scattered throughout large tracts of red fir. Similar inclusions of aspen may be found along riparian zones. Mountain meadows of various sizes, sometimes associated with small lakes, are also typical of red fir habitats. At higher elevations, red fir habitats include increasing numbers of mountain hemlock, western white pine, whitebark pine, and to a lesser extent, foxtail pine and limber pine. Noble fir is associated with red fir in the northwestern region of the State (Rundel et al. 1977).

Wildlife Considerations.—Red fir habitats throughout California provide food or cover for at least one season to a total of 169 wildlife species (8 amphibians, 4 reptiles, 104 birds including 15 waterbirds, and 53 mammals). Red fir habitats can be considered very important for 28 birds and 26 mammals. Of special note are goshawk (sensitive species); blue grouse (game species); great gray owl, red fox, pine marten, and wolverine (rare species). Several rare or endangered raptors use red fir habitats to a minor extent (Grinnell and Storer 1924, Sumner and Dixon 1953, Shelford 1963, Storer and Usinger 1963, Johnston 1970, Verner and Boss 1980).

Physical Setting

Red fir habitats are found on frigid soils over a wide range of topography exclusive of very wet sites. Annual precipitation ranges from 1000 to 3000 mm (40 to 50 in) per year, primarily as snow that forms packs up to 5 m (15 ft) in winter. Summers are dry, limiting tree growth to seasonally available soil moisture (Rundel et al. 1977).

Distribution

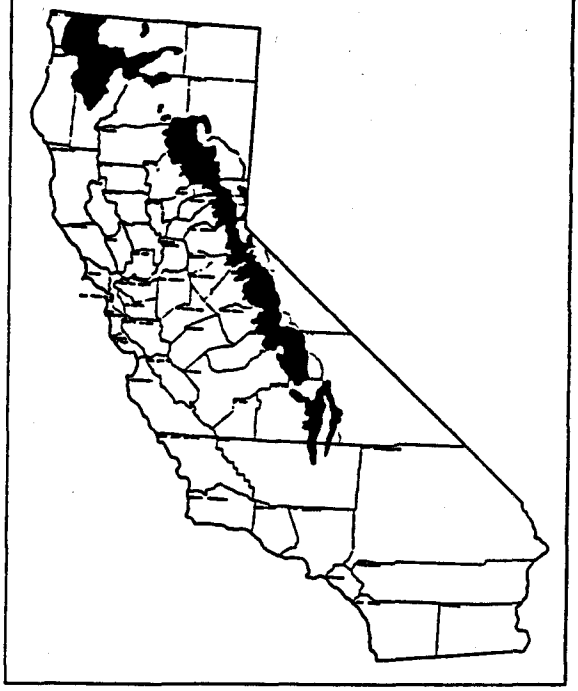
Red fir is distributed in an elevational band from about 1800 to 2750 m (6000 to 9000 ft). It extends from northern Lake County northward through the North Coast Ranges and from Kern County northward through the Sierra Nevada into the Cascade Range of southwestern Oregon (Griffen and Critchfield 1972). Large expanses of nearly monotypic stands of red fir are common throughout its range. Logging of red fir is accelerating, consequently the amount of low seral stages will increase considerably in the future.

Marten *(Martes americana)*

Great Gray Owl *(Strix nebulosa)*

RFR
Red fir habitat, Sierra Nevada, California (photo by Joe R. McBride)

Red Fir



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Subalpine Conifer

Jared Verner and Kathryn L. Purcell

Vegetation

Structure.—Typical SCN habitats are open forests with needle-leaved evergreen trees of low to medium stature. Stand density and tree height are typically greater at lower limits of its elevational range (Küchler 1977). In protected sites at lower elevations, tree height may exceed 30 m (100 ft), but trees on exposed sites and windy ridges near tree line are shaped into krummholz—stunted, mat-like forms often only about 1 m (3 ft) tall. Shrubby vegetation and herbaceous ground cover are generally sparse or lacking. Litter accumulation is typically scanty, but fallen woody material persists for long periods in the cold climate.

Composition.—Several species dominate canopies of this type in different localities, either singly or in mixtures of two or more species (Parsons 1980). These include Engelmann spruce, subalpine fir, mountain hemlock, western white pine, lodgepole pine, whitebark pine, foxtail pine, bristlecone pine, and limber pine.

Although typically of minor importance, a shrub understory may include Parry manzanita, squaw currant, purple mountain heather, oceanspray, and big sagebrush. Willows, western huckleberry, California huckleberry, Sierra bilberry, and alpine laurel occur on moist sites. Western wheatgrass, California brome, several species of lupines, and a variety of flowering annuals are common in the sparse ground cover (Rundel et al. 1977, Parsons 1980).

Other Classifications.—SCN combines several types described by other authors. It includes the Engelmann Spruce-Alpine Fir, Mountain Hemlock, Whitebark Pine, Foxtail Pine, Western White Pine, Limber Pine, and Bristlecone Pine of Parker and Matyas (1979) and the Society of American Foresters (SAF) (Eyre 1980), as well as California Mixed Subalpine (256) of the SAF. Subalpine Coniferous Forests (8.6) of Cheatham and Haller (1975) include approximately the same range of dominants. Bristlecone Pine, Foxtail Pine, and Limber Pine of Paysen et al. (1980) are included, as are the Subalpine Forest (17) and Bristlecone Pine Forest (18) or Munz and Keck (1959). Finally Upper Montane-Subalpine Forest (17), Southern Montane-Subalpine Forest (18), and Great Basin Subalpine Forest (19) of Küchler (1977) overlap with SCN as described here.

Habitat Stages

Vegetation Changes 1;3-5;S-D.—Most high-elevation forests in California have been little disturbed by human influence, but fire, wind, and other natural disturbances offer chances to study successional changes in these forests. Owing to their lack of economic importance, however, few such studies have been carried out in SCN habitat. Parsons (1980:90) observed that the infrequent fire pattern at high elevations in the Sierra Nevada leads to "a specific vegetational mosaic...characteristic of the high country." No details are available. Most of the canopy dominants are pioneers and probably also climax species, at least in harsher environments. For example, whitebark and limber pine, though less shade tolerant than subalpine fir, Engelmann spruce, and mountain hemlock, can regenerate without wildfire or logging due to their longevity and ability to survive extremely cold climates. Furthermore, the short growing seasons, as well as the typically open nature of the stands at higher elevations help ensure regeneration (Pfister et al. 1977).

Duration of Stages.—Little information is available, although Parsons (1980:90) notes that "the slow growth and longevity of most of the subalpine species lead to long timespans between stages." Many tree species that dominate stands of this type are well known for their longevity and slow growth. A whitebark pine 43 cm (17 in) in dbh was 800 years old (Arno 1967), foxtail pine has been aged at nearly 2000 years (Mastroguiseppe 1972), and bristlecone pine has been aged at over 4600 years in the White Mountains of eastern California and over 4900 years on Wheeler Peak in eastern Nevada (Hawksworth and Bailey 1980).

Biological Setting

Habitat.—SCN intergrades with Lodgepole Pine, Jeffrey Pine, and Red Fir habitats at lower elevations. The shrub understory and ground cover are better developed where SCN habitats adjoin moist sites, as along riparian corridors or montane meadows.

Wildlife Considerations.—Coniferous forests at high elevations in California typically support fewer species of amphibians, reptiles, birds, and mammals than any other major forest type in the State. The reasons, though, not clearly established, probably involve some combination of climate, short growing season, lower primary productivity, moisture stress, and lower production of insects and other invertebrates that provide food resources for many vertebrates. Excluding species dependent on ponds, lakes, streams, or cliffs, Laudenslayer (1980) shows no amphibians and only one reptile that find conditions suitable for breeding in these high-elevation forests. He lists only 17 species of birds and 15 of mammals that find conditions optimum, and 14 birds and 22 mammals that find conditions suitable for breeding in such forests. Several species that find optimum or suitable conditions at these high elevations have special significance for land managers. These include the great gray owl, pileated woodpecker, marten, and wolverine.

Burney (1980:99) writes that "birds and small mammals consume so much limber pine seed that little is left for natural regeneration. However, small mammals that transport and bury seed aid dissemination into new areas, and germination of forgotten seed caches undoubtedly accounts for dense groups of stems occasionally found." Such groups of stems are better known to grow from caches left by Clark's nutcrackers, which are probably the primary agents of seed dispersal for limber and perhaps whitebark pines (Tomback and Kramer 1980, Tomback 1982).

Physical Setting

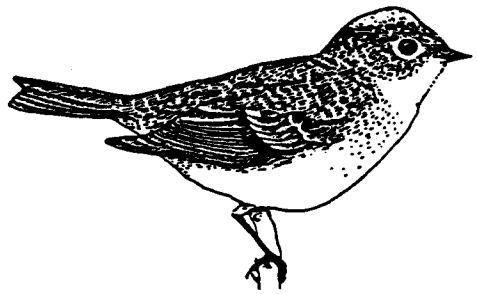
These forests typically occupy extremely harsh environments. Soils are generally thin and of low quality—coarse sand, gravel, volcanic debris, and rocks derived from decomposing parent material. Although subalpine fir and Engelmann spruce occur together on rocky, moist moraines and are considered to be indicators of high soil moisture (Parker and Matyas 1979), most stands of SCN are on dry, well-drained soils. The climate is especially challenging. For example, in the Subalpine Forest type described by Munz and Keck (1959), precipitation averages only 76 to 127 cm (30 to 50 in) and may be as low as 38 cm (15 in) east of the crest of the Sierra Nevada. Heavy snow cover is usual. Mean summer high temperatures probably do not exceed 18°C (65°F), and killing frosts are possible during all months. The growing season lasts only 7 to 9 weeks. Similarly, in bristlecone pine forests, measured precipitation over a 3-year period averaged 38 cm (15 in), much of it as snowfall. Mean summer maximum temperatures ranged from 12 to 19°C (54 to 66°F), and winter minima ranged from −16 to −6°C (3 to 21°F) (Munz and Keck 1959). Intense winds are characteristic of these habitats.

Distribution

SCN is generally distributed at high elevations in all significant mountain ranges of the State. It is well represented in the north, with an elevational range from about 2100 to 2900 m (7000 to 9500 ft); and in the Sierra Nevada, ranging from 2700 to 3350 m (9000 to11,000 ft). "It is poorly represented in southern California" (Parsons 1980:90), typically within an elevational range of 2880 to 3400 m (9500 to 11,200 ft) (Cheatham and Haller 1975). Engelmann spruce-subalpine fir stands are poorly represented in California, occurring together only near Russian Peak in southwestern Siskiyou County (Griffin and Critchfield 1972, Parker and

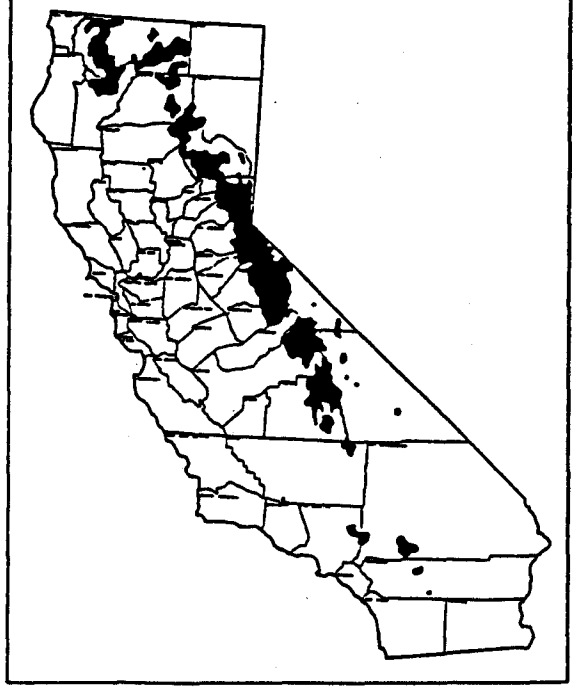
SCN
Subalpine Conifer habitat, Vista Point, Kaiser Pass California (photo by Jared Verner)

Matyas 1979). "Mountain hemlock, lodgepole pine, western white pine, and California red fir are common in mixed stands above the red fir forest in the north" (Parsons 1980:90). Mountain hemlock is the usual dominant in the northern Sierra Nevada, gradually disappearing to the south (Rundel et al. 1977). The southernmost stand occurs in Tulare County (Parsons 1972). In the Warner Mountains and from about Lake Tahoe southward in the Sierra Nevada, whitebark and lodgepole pine dominate stands of SCN to about the headwaters of the Kern River, where foxtail pine becomes the usual dominant species (Cheatham and Haller 1975). Whitebark pine tends to be the dominant conifer near tree line in the central Sierra Nevada (Cheatham and Haller 1975, Rundel et al. 1977). Limber pine occupies similar sites on the east side of the Sierra Nevada in Inyo and Mono Counties (Arno 1967, Griffin and Critchfield 1972), and together with lodgepole pine it comprises the dominant type in stands of SCN in southern California (Cheatham and Haller 1975). Bristlecone pine stands occur from about 2900 to 3500 m (9500 to 11,500 ft) elevation in the White and Inyo Mountains and the Last Chance and Panamint Ranges, east of the southern Sierra Nevada (Parker and Matyas 1979).



Ruby-crowned Kinglet *(Regulus calendula)*

Subalpine Conifer



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Jeffrey Pine

Joe R. McBride

Vegetation

Structure.—The structure of the Jeffrey pine forest varies over its distribution. A single tree layer is characteristic of Jeffrey pine stands on moderately dry sites, giving an impression of openness, limited leaf area, light, and heat. On moist and mesic sites a second tree layer exists which is composed of deciduous hardwood species, whereas on dry sites evergreen hardwood species form the second tree layer. Conifer species provide the second tree layer on xeric sites. The single (or upper) tree layer ranges from 30 to 50 m (98 to 164 ft) in height, but in some stands this layer may exceed 65 m (213 ft) (Fowells 1965). The second tree layer, where it exists, varies from 5 to 10 m (16 to 33 ft) in height. Complete (100 percent) crown cover is seldom encountered in Jeffrey pine habitats. Most stands have typically between 40 and 70 percent crown cover in the uppermost tree layer and usually less than 50 percent crown cover in the second layer, except on moist sites where Aspen cover may approach 100 percent. In southern California a krummholz form, where trees are only a few meters tall, is found at higher elevations near timberline.

A sclerophyllous shrub layer is common to most Jeffrey pine stands except on serpentine soils, extremely xeric sites where the shrub layer is absent (Jenkinson 1980), and where the krummholz form exists. Height and crown cover of the shrub layer varies with site characteristics. For example, taller shrub layers up to 2 m (6 ft) with significant crown (>70 percent) are common on more mesic sites.

Composition.—Jeffrey pine is the dominant species found in the upper tree layer. It usually forms pure stands but may have as its associates ponderosa pine, Coulter pine, sugar pine, lodgepole pine, timber pine, white fir, red fir, incense-cedar, and black cottonwood. Jenkinson (1980) suggests that any stand in which Jeffrey pine makes up the majority of the stocking should be recognized as Jeffrey pine. Dominant species composition of the second tree layer consists of aspen on moist sites, California black oak on mesic sites, and pinyon pine and western juniper on dry sites. Shrub species composition varies between geographical regions. In the Klamath Mountains, huckleberry, scrub oak, manzanita, Fremont silktassel and coffeeberry dominate the shrub layer. Shrubs common to the Jeffrey pine type on the western slope of the Sierra Nevada include huckleberry oak, manzanita, and mountain misery. East of the Sierra-Cascade crest, the dominant shrub layer species include squaw currant, snowbush, and greenleaf manzanita at higher elevations, and antelope bitterbrush, rabbitrush, and sagebrush at lower elevations. The shrub layer of Jeffrey pine stands in southern California is dominated by scrub oak, ceanothus, Sierra chinquapin, manzanita, Parish snowberry, and cherry.

Herbaceous species common to the Jeffrey pine type in southern California include rockcress, birdbeak, buckwheat, fritillary, groundsmoke, ivesia, lupine, rock melic, Bridge's penstemon, penstemon and needlegrass (Thorne 1977). Species common to Jeffrey pine stands along the east slope of the Sierra Nevada include squirreltail, blue wildrye, slender hairgrass, western needlegrass, woolly wyethia, and pennyroyal.

Other Classifications.—Jeffrey pine has been included in the broad yellow pine forest type of Munz and Keck (1949-50); pine-Douglas-fir, pine-fir, and pine-Douglas-fir-fir of Jensen (1947); Jeffrey pine of Parker and Matyas (1981), SAF (Eyre 1980), and Cheatham and Haller (1975); the upper montane mixed conifer forest of Cheatham and Haller (1975); and type 42 - evergreen forest land of Anderson et al. (1976). Jeffrey pine is divided into two classes - northern Jeffrey pine forest and southern Jeffrey pine forest - by Küchler (1977). Paysen et al. (1980) includes Jeffrey pine in the Ponderosa/Jeffrey Pine Series of the Conifer Forest Subformation. Horton (1960) divides it between the pine forest type and the sugar pine-white fir forest type, while Thorne (1975) includes it in the yellow pine forest.

Habitat Stages

Vegetation Changes 1;2-5:S-D.—Old-growth Jeffrey pine stands exhibit an uneven-aged structure. Analysis of fire scars and age structure suggests that prehistoric fires played an important role in regeneration without destoying the overstory (McBride and Laven 1976); however, in southern California fires have recently eliminated large areas of Jeffrey pine forest overstory because of accumulated surface fuels. The successional pattern following these fires involves an initial fireweed stage, followed by a shrub stage dominated by ceanothus and manzanita. Where canyon live oak is present in the second tree layer, an oak stage develops instead of the more common shrub stage (Minnick 1976). In time, Jeffrey pine succeeds the shrub or oak stage to restore the original vegetation.

Duration of Stages.—Jeffrey pine stands are self-perpetuating under a regime of periodic surface fires. Typical old-growth stands in southern California support trees up to 450 years old. The age structure of these stands suggests that regeneration has occurred about every 40 to 60 years (Laven 1982). Where crown fires have created openings, the fireweed stage lasts for 2 to 3 years, followed by the shrub stage which persists for 15 to 20 years. Extensive areas of ceanothus and manzanita (i.e., montane chaparral) and canyon live oak woodland, resulting from large crown fires occurring in the last 70 years in the San Bernardino Mountains, show no evidence of reestablishment of Jeffrey pine, and further succession of these areas to Jeffrey pine is problematical. Forest harvesting using selective cutting and sanitation-salvage methods has converted Jeffrey pine stands to oak woodlands or montane chaparral in the San Bernardino Mountains (Minnick 1976). Where clearcutting or group selection cutting was followed by planting Jeffrey pine, the type has been successfully maintained.

Biological Setting

Habitat.—The Jeffrey pine habitat is associated with Douglas-fir at its lower elevations and subalpine conifer at its higher elevations in the Klamath Mountains. East of the Sierra-Cascade crest it occurs between subalpine conifer at higher elevations and pinyon-juniper or sagebrush at lower elevations. On the west side of the Sierra Nevada, Jeffrey pine is generally found above Sierra Nevada mixed conifer and below the subalpine conifer or alpine dwarf shrub. On ultramafic soils at mid-elevations, Jeffrey pine is surrounded by mixed conifer (Sierra Nevada and Klamath-enriched). In southern California, Jeffrey pine is situated above ponderosa pine or blue oak-digger pine on the southern side of the Transverse and the southwestern side of the Peninsular Ranges. At higher elevations in these mountains it gives way to subalpine conifer. At lower elevations on the northern side of the Transverse Range it adjoins pinyon-juniper. On the northeastern side of the Peninsular Range, it is adjacent to the desert scrub or pinyon-juniper. Areas of Jeffrey pine forest in the Peninsular Range east of San Diego are surrounded by chamise (redshank) or are adjacent to pinyon-juniper type.

Wildlife Considerations.—Jeffrey pine is intermediate in species richness between warmer forests at lower elevations and colder forests at higher elevations in the Klamath Mountains and on the west side of the Sierra Nevada. Its species richness exceeds that of the adjacent upper elevation forests and lower elevation woodland and scrub types in both the Transverse and Peninsular Ranges.

The value of the Jeffrey pine forest type as a habitat for wildlife is due in large part to the food value of the Jeffrey pine seeds. Pine seeds are included in the diet of more wildlife species than any other genus except oak (Light 1973). The bark and foliage also serve as important food sources for squirrels and mule deer. Jeffrey pine provides vital nesting cover for several species such as nuthatch, brown creeper, woodpecker, and northern flying

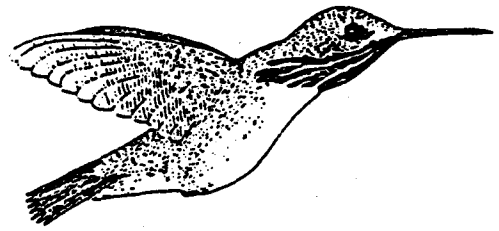
squirrel. The southern rubber boa, a species listed as rare by the State of California and sensitive by the U.S. Forest Service, is reported to occur in the Jeffrey pine forest type in southern California (Cunningham 1966).

Physical Setting

Jeffrey pine occurs in a variety of physical settings throughout its extensive range. The tolerance of its dominant species to low temperatures allows the type to occupy the borders of topographic frost pockets and high cold ridges (Haller 1959). It is commonly found on soils developed from granite and lava flows, but can also develop as a type on ultramafic soils (Walker 1954). Its distribution in northern California west of the Sierra-Cascade crest is limited to such soils (Jenkinson 1980). Jeffrey pine is not restricted by aspect or slope.

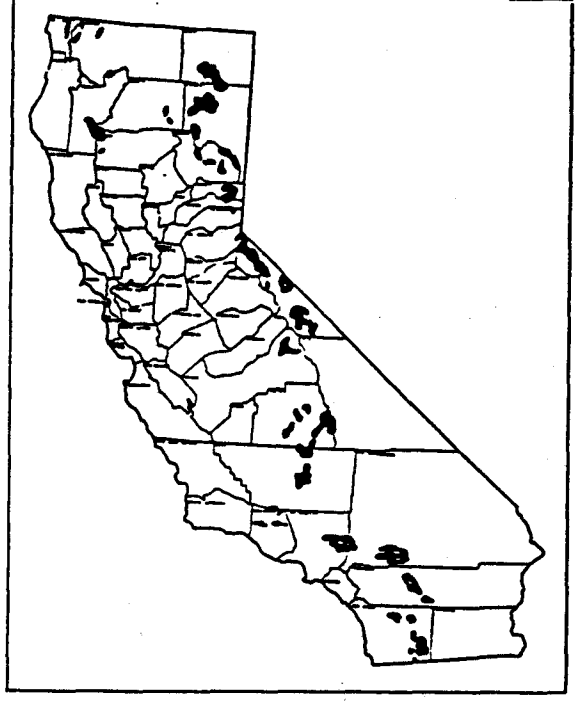
Distribution

Jeffrey pine ranges from 150 to 2900 m (500 to 9500 ft), the actual range depending upon latitude. The habitat covers extensive areas in the Klamath Mountains, North Coast Range, Cascade Range, Modoc Plateau, Sierra Nevada, Transverse Range, and the Peninsular Range in California. It also occurs in Oregon, Nevada, and Baja California.



Calliope Hummingbird *(Stellula calliope)*

Jeffrey Pine



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

JPN
Jeffrey Pine habitat, Sierra Nevada, California (photo by Joe R. McBride)

Eastside Pine

E. Lee Fitzhugh

Vegetation

Structure.—The eastside pine habitat is characterized by short to moderate height, 20-35 m (65-115 ft tall) pine trees at maturity. Without disturbance, except for naturally occurring fire, a mosaic of even-aged patches develops, with open spaces and dense sapling stands. Oaks or junipers may form an understory, but pure stands of pine also are found. An open stand of low shrubs, less than 2 m (6.5 ft) and a grassy herb layer are typical. Crowns of pines are open, allowing light, wind and rain to penetrate, whereas other associated trees provide more dense foliage.

Composition.—Ponderosa pine is the dominant tree with less representation by Jeffrey pine, lodgepole pine, white fir, incense-cedar, Douglas fir, California black oak and western juniper. Stands of Washoe pine mixed with white fir, white pine and lodgepole pine at higher elevations in the Warner Mountains are included in this habitat. Undergrowth varies depending on site conditions, but typically may include one or more of the following shrubs: big sagebrush, antelope bitterbrush, manzanita, ceanothus, rubber rabbitbrush, *mountain mahogany, creambush* ocean-spray and mountain snowberry. Prominent herbaceous plants include mule ears, arrowleaf balsamroot, Idaho fescue, pinegrass, bluebunch wheatgrass and bottlebrush squirreltail.

Other Classifications.—*The eastside pine habitat is equivalent* to interior ponderosa pine (Eyre 1980), the yellow pine-shrub forest *(Pinus-Purshia)* (Küchler 1977) and "eastside" ponderosa pine forest (Cheatham and Haller 1975). It is a subdivision of the ponderosa/Jeffrey pine series (Paysen et al. 1980), ponderosa pine (Rundel et al. 1977, Parker and Matyas 1979) and yellow pine forest (Munz and Keck 1959, Thorne 1977).

Habitat Stages

Vegetation Changes 1;2-5;S-D.—Logging, bark beetles, root diseases and fire are the major disturbances in the eastside pine type. *The understory typical of the specific site increases* following disturbance, depending on the nature of the disturbance, season in which it occurred and weather patterns. In general, disturbance favors brush, particularly manzanita and ceanothus. But some kinds of disturbance may eliminate antelope bitterbrush, a desirable deer forage plant that may not be as robust a competitor with trees as are some other shrubs. Open tree stands generally support more vigorous brush or grass understories which may prevent additional tree regeneration for many years. Fire tends to *maintain pine stands on sites that will support other conifers.* The following understory dominants may be used to identify different eastside pine communities: western juniper, manzanita, several species of ceanothus, big sagebrush, antelope bitterbrush, grass dominance and forb dominance.

Duration of Stages.—Eastside pine is moderately slow growing and long-lived. The time required for succession varies greatly depending on site, competition and seed source. *The more severe sites within the type impose problems of reproduction and* competition, so that stands may not necessarily reproduce themselves after disturbance, being replaced instead by forbs, grasses, brush or junipers.

Biological Setting

Habitat.—Eastside pine is bounded at the lower edge by low and big sagebrush, bitterbrush, perennial grassland or pinyon-juniper woodland habitat which often are found on finer textured soils and at the upper edge by mixed conifer, lodgepole pine, and red fir. Eastside pine occupies an intermediate, less harsh environment than Jeffrey pine, which occurs above and intermingled with eastside pine.

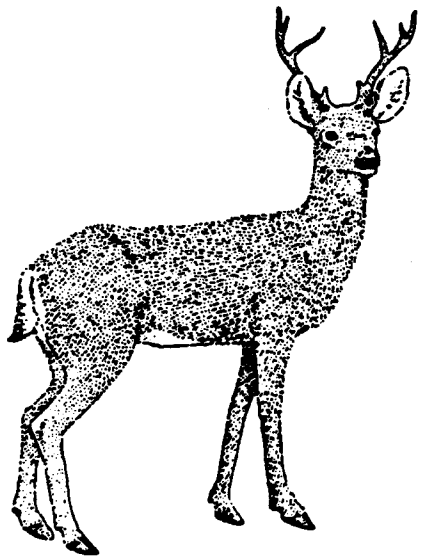
Wildlife Considerations.—Pine types with shrubby understories have a high degree of vertical diversity, expecially when other conifers are present. Large pine branches form good nesting substrates for large raptors. Sites supporting the larger shrub species —manzanita and some ceanothus species—may become so densely vegetated in the absence of fire that livestock and big game cannot use the areas. Eastside pine stands often form important migratory and winter range for deer. Higher elevation stands with grassy understories near water may be extremely important deer fawning areas and migratory holding areas. Important wildlife species in the eastside pine habitat include the bald eagle and American peregrine falcon (both on federal and state endangered species lists) and the Sierra Nevada red fox, and the California bighorn sheep.

Physical Setting

Eastside pine habitat is found on coarse, well-drained basaltic soils, in a drier, colder setting than the Ponderosa pine (PPN) habitat. All exposures are represented depending on elevation. Fine-textured soils favor pinyon-juniper habitats.

Distribution

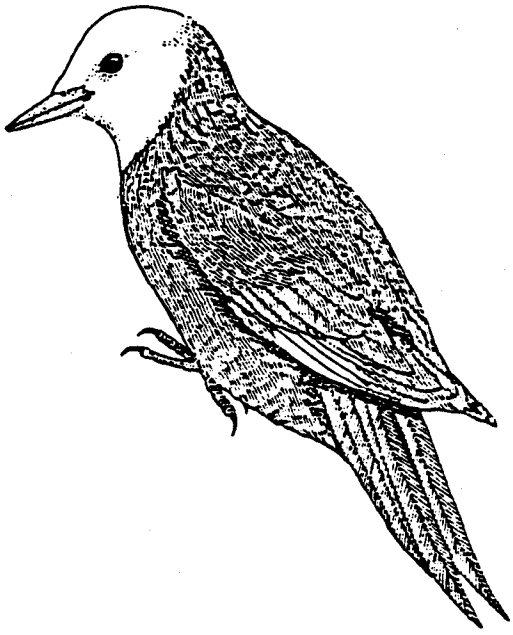
Eastside pine habitat occurs from about 1200-1980 m (400-6500 ft) elevation, approximately east of a line drawn from Lake Tahoe to Hilt, *a small town on Interstate 5 where it crosses the Califor*nia-Oregon border (McDonald 1983). Eastside pine habitat extends into Oregon. Small scattered stands occur south of Lake Tahoe through the northern half of Inyo County.



Mule Deer *(Odocoileus hemionus)*

EPN
Eastside Pine habitat, Black Mountain Experimental Forest, Lassen County, California (photo by Sydney Smith)

Eastside Pine



White-headed Woodpecker
(Picoides albolarvatus)

The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Valley Foothill Riparian

William E. Grenfell Jr.

Vegetation

Structure.—Canopy height is approximately 30 m (98 ft) in a mature riparian forest, with a canopy cover of 20 to 80 percent. Most trees are winter deciduous. There is a subcanopy tree layer and an understory shrub layer. Lianas (usually wild grape) frequently provide 30 to 50 percent of the ground cover and festoon trees to heights of 20 to 30 m (65 to 98 ft). Herbaceous vegetation constitutes about one percent of the cover, except in openings where tall forbs and shade-tolerant grasses occur (Conard et al. 1977). Generally, the understory is impenetrable and includes fallen limbs and other debris.

Composition.—Dominant species in the canopy layer are cottonwood, California sycamore and valley oak. Subcanopy trees are white alder, boxelder and Oregon ash. Typical understory shrub layer plants include wild grape, wild rose, California blackberry, blue elderberry, poison oak, buttonbrush, and willows. The herbaceous layer consists of sedges, rushes, grasses, miner's lettuce, Douglas sagewort, poison-hemlock, and hoary nettle.

Other Classifications.—Other classification schemes that describe VRI habitats are Cottonwood and California Sycamore (Parker and Matyas 1981), Central Valley Bottomland Woodland - 6.11, Southern Alluvial Woodland - 6.31 (Cheatham and Haller 1975), Wild Rose, Alder, Cottonwood, Sycamore, Willow (Paysen et al. 1980), Riparian Forest - 28 (Küchler 1977) and Forested Wetland - 61 (Anderson et al. 1976).

Habitat Stages

Vegetation Changes 1;2-5;S-D.—Cottonwoods grow rapidly and can reach WHR size/age class 5 in about 20 to 25 years. One specimen measuring 92 cm (36 in) (inside the bark) showed an age of 29 years (Sudworth 1908). This secondary succession to climax could occur as rapidly as 25 to 30 years in VRI habitats dominated by cottonwood. One valley oak tree 54 cm (21 in) in diameter (WHR size/age class 4) showed an age of 57 years. Valley oak dominated riparian systems would probably take 75+ years to reach climax/maturity. Some VRI types consisting of only a shrub layer (VRI 1;2: S-D) (willows, wild rose, blackberry) may persist indefinitely.

Duration of Stages.—Shrubby riparian willow thickets may last 15-20 years before being overtopped and shaded out by cottonwoods. Cottonwood or willow tree habitats close to river channels that receive a good silt infusion, without major disruptive flows, tend to be self perpetuating (R. Holland pers. comm.).

Biological Setting

Habitat.—Transition to adjacent nonriparian vegetation is usually abrupt, especially near agriculture (Cheatham and Haller 1975). The Valley-Foothill Riparian habitat is found in association with Riverine (RIV), Grassland (AGS, PGS), Oak Woodland (VFH) and Agriculture (PAS, CRP). It may intergrade upstream with Montane Riparian.

Wildlife Considerations.—Valley-foothill riparian habitats provide food, water, migration and dispersal corridors, and escape, nesting, and thermal cover for an abundance of wildlife. At least 50 amphibians and reptiles occur in lowland riparian systems. Many are permanent residents, others are transient or temporal visitors (Brode and Bury 1985). In one study conducted on the Sacramento River, 147 bird species were recorded as nesters or winter visitants (Laymon 1985). Additionally, 55 species of mammals are known to use California's Central Valley riparian communities (Trapp et al. 1985).

Physical Setting

Valley-foothill riparian habitats are found in valleys bordered by sloping alluvial fans, slightly dissected terraces, lower foothills, and coastal plains. They are generally associated with low velocity flows, flood plains, and gentle topography. Valleys provide deep alluvial soils and a high water table. The substrate is coarse, gravelly or rocky soils more or less permanently moist, but probably well aerated (Cheatham and Haller 1975). Average precipitation ranges from 15 to 76 cm (6-30 in), with little or no snow. The growing season is 7 to 11 months. Frost and short periods of freezing occur in winter (200 to 350 frost-free days). Mean summer maximum temperatures are 24 to 39°C (75 to 102°F), mean winter minima are −2 to 7°C (29 to 44°F) (Munz and Keck 1973). VRI habitats are characterized by hot, dry summers, mild and wet winters. Coastal areas have a more moderate climate than the interior and receive some summer moisture from fog (Bailey 1980). Potential evaporation during the warmest months is often greater than precipitation. Low rainfall and streamflow result in water scarcity in many parts of the area.

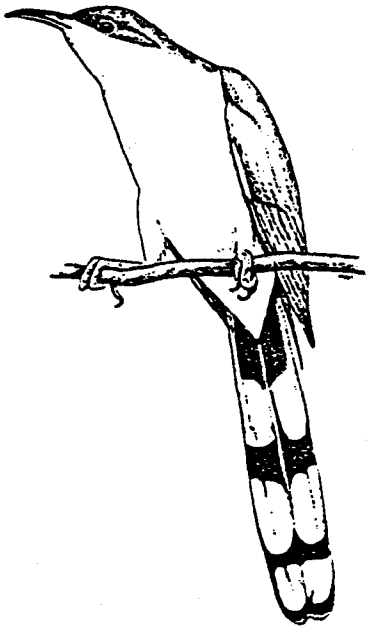
Distribution

Valley-foothill riparian habitats occur in the Central Valley and the lower foothills of the Cascade, Sierra Nevada and Coast ranges. They are also found in lower slopes at the bases of the Peninsular and Transverse ranges. A few lower elevation locations are on the desert side of the southern California mountains. VRI habitats range from sea level to 1000 m (3000 ft), fingering upward to 1550 m (5000 ft) on south-facing slopes.

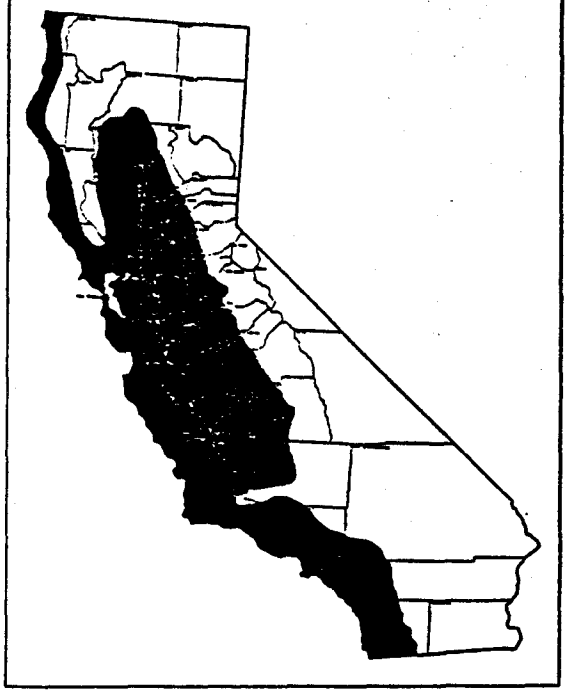
Ringtail *(Bassariscus astutus)*

VRI
Valley Foothill Riparian habitat, Sacramento River, California (photo by Robert F. Holland)

Valley Foothill Riparian



Western Yellow-billed Cuckoo
(Coccyzus americanus)



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.

Montane Riparian

William E. Grenfell Jr.

Vegetation

Structure.—The vegetation of montane riparian (MRI) zones is quite variable and often structurally diverse (Marcot 1979). Usually, the montane riparian zone occurs as a narrow, often dense grove of broadleaved, winter dedicuous trees up to 30 m (98 ft) tall with a sparse understory. At high mountain elevations, MRI is usually less than 15 m (49 ft) high with more shrubs in the understory. At high elevations, MRI may not be well developed or may occur in the shrub stage only.

Composition.—In northwest California along streams west of the Klamath Mountains, black cottonwood is a dominant hardwood. In some areas, it is codominant with bigleaf maple. In either case, black cottonwood can occur in association with dogwood and boxelder. At high elevations, black cottonwood occurs with quaking aspen and white alder (Parker and Matyas 1979).

In northeastern California, black cottonwood, white alder and thinleaf alder dominate the montane riparian zone. Oregon ash, willow and a high diversity of forbs are common associates.

In the Sierra Nevada, characteristic species include thinleaf alder, aspen, black cottonwood, dogwood, wild azalea, willow and water birch (southern Sierra east of the crest), white alder and dogwood (north Sierra).

In the southern Coast Range as well as Transverse and Peninsular ranges, bigleaf maple and California bay are typical dominants of montane riparian habitat. Fremont cottonwood is the most important cottonwood in the Sierra below 1524 m (5000 ft), much of the Coast Ranges and the Transverse and Peninsular ranges.

MRI habitats can occur as alder or willow stringers along streams of seeps. In other situations an overstory of Fremont cottonwood, black cottonwood and/or white alder may be present.

Other Classifications.—Montane riparian habitats are also described as riparian (Laudenslayer 1982), riparian deciduous (Verner and Boss 1980, Marcot 1979), bigleaf maple, alder, maple-alder-dogwood, white alder, willow and alder-willow series (Parker and Matyas 1979), mixed riparian woodland - 6.21, willow thickets - 6.24 and red alder groves - 6.22 (Cheatham and Haller 1975).

Habitat Stages

Vegetation Changes 1;2-5;S-D;6.—Definite successional stages are not described in the literature. Many montane riparian stages may prevail indefinitely, climax or subclimax. Shrub-type stages should be evaluated as size/age class 1 or 2. Overstory trees such as cottonwood, maple and alder may range up to size/age class 6.

Duration of Stages.—Montane riparian habitats within given watersheds tend to maintain the same mosaic of stages. However, the location of these stages may vary as a result of periodic torrential flows. Riparian Systems can be damaged by debris, sedimentation, or uprooting of entire plants which are redeposited further downstream (Campbell and Green 1968).

Biological Setting

Habitat.—The transition between MRI and adjacent nonriparian vegetation is often abrupt, especially where the topography is steep. This habitat intergrades with montane chaparral, montane hardwood, montane hardwood/conifer, lodgepole pine, red fir and wet meadow habitats.

Wildlife Considerations.—All riparian habitats have an exceptionally high value for many wildlife species (Thomas 1979, Marcot 1979, Sands 1977). Such areas provide water, thermal cover, migration corridors and diverse nesting and feeding opportunities. The shape of many riparian zones, particularly the linear nature of streams, maximizes the development of edge which is so highly productive for wildlife (Thomas 1979).

The range of wildlife that uses the MRI habitat for food, cover and reproduction include amphibians, reptiles, birds and mammals.

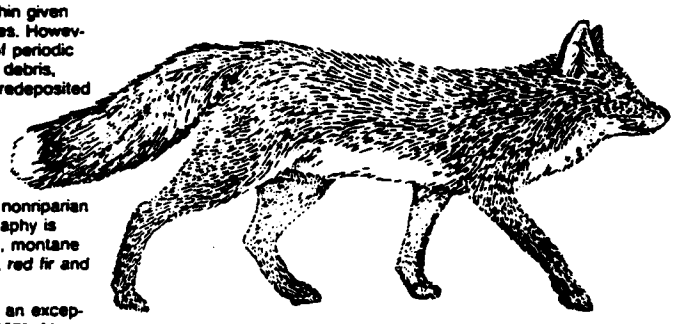
The southern rubber boa and Sierra Nevada red fox are among the rare, threatened or endangered wildlife that use MRI habitats during their life cycles.

Physical Setting

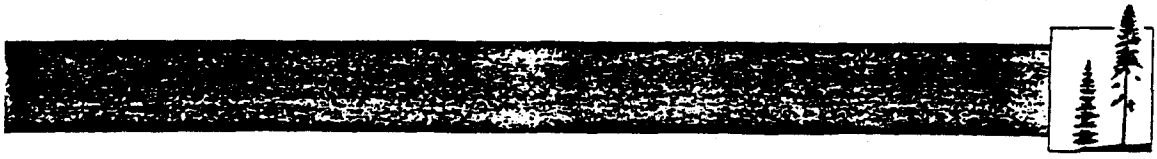
Riparian areas are found associated with montane lakes, ponds, seeps, bogs and meadows as well as rivers, streams and springs. Water may be permanent or ephemeral (Marcot 1979). The growing season extends from spring until late fall, becoming shorter at higher elevations. Most tree species flower in early spring before leafing out.

Distribution

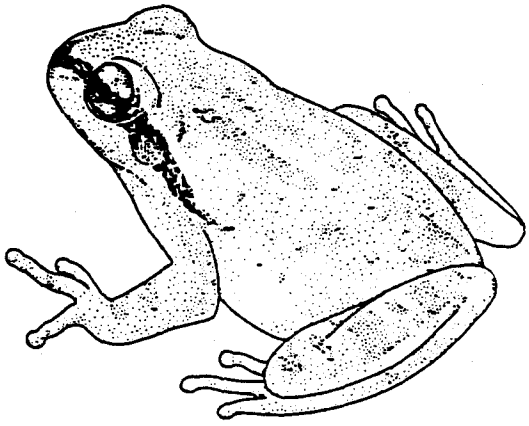
Montane riparian habitats are found in the Klamath, Coast and Cascade ranges and in the Sierra Nevada south to about Kern and northern Santa Barbara Counties, usually below 2440 m (8000 ft). The Peninsular and transverse ranges of southern California from about southern Santa Barbara to San Diego Counties also include MRI habitat. MRI subtype, consisting mostly of red alder, is found from northern San Luis Obispo to Del Norte Counties along the immediate coast (Cheatham and Haller 1975).



Sierra Nevada Red Fox *(Vulpes vulpes necator)*

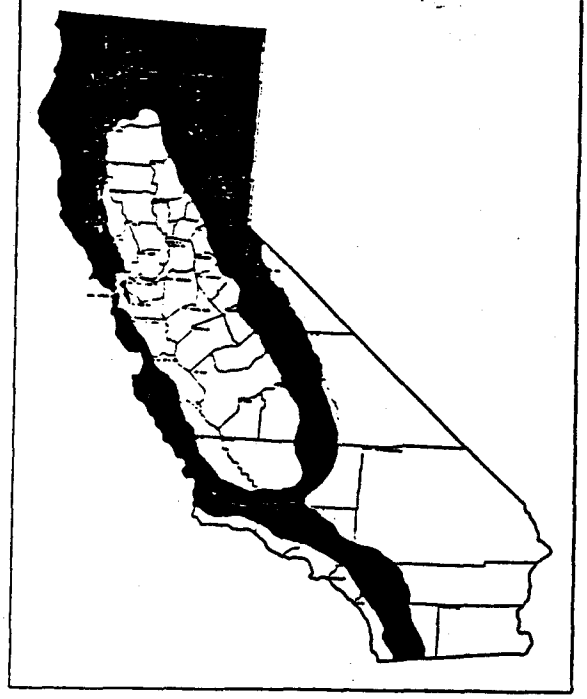


MRI
Montane Riparian habitat, Alder Creek, Sierra County, California (photo by William F. Laudenslayer, Jr.)



Pacific Treefrog *(Hyla regilla)*

Montane Riparian



The map depicts general habitat distribution. Green represents an area of the state that the habitat can be found when the proper environmental conditions exist.