Chapter 3

Gualala Watershed Profile

A summary of the Characteristics of the Gualala River Watershed

The Gualala River watershed drains 298 square miles along the coast of southern Mendocino and northern Sonoma counties. The river enters the Pacific Ocean near the town of Gualala, 114 miles north of San Francisco and 17 miles south of Point Arena. The Gualala River Watershed is elongated, running over 32 miles long north-south, with an average width of 14 miles. Elevations vary from sea level to 2,602 feet at Gube Mountain, and terrain is most mountainous in the northern and eastern parts of the watershed (Figure 3-1). A long history of movement along the San Andreas Fault and the Tombs Creek Fault has been a dominant force in shaping the watershed. The climate is influenced by fog near the coast with seasonal temperatures ranging from 40 to 60 F, with the interior areas of the watershed ranging from below freezing to over 90 F seasonally. Rainfall also varies by location within the watershed with 33 inches falling on average near the town of Gualala and totals reaching over 63 inches in some areas within the interior.

The complexity of large watersheds makes it difficult to speak about them concerning watershed assessment and recommendation issues in other than general terms. In order to be more specific and useful to planners, managers, and landowners, it is useful to subdivide the larger watershed units into smaller subbasin units whose size is determined by the commonality of many of the distinguishing traits. Natural variation in subbasins is at least partially a product of natural and human disturbances. Other variables that can distinguish areas, or subbasins, in larger watersheds include differences in elevation, geology, soil types, aspect orientation, climate, vegetation, fauna, human population, land use and other social-economic considerations.

The Gualala River Watershed was divided into five principal subbasins for this assessment: Wheatfield Fork (37 percent of drainage), Gualala Mainstem/South Fork (21 percent), North Fork (16 percent), Buckeye 14 percent), and Rockpile (12 percent) (Figure 3-1, Table 3-1). The five subbasins conform with Calwater 2.2 Planning Watershed boundaries as explained in the Hydrology Hierarchy section at the end of this chapter. The mainstem Gualala extends only from the convergence of the North Fork and South Fork to the ocean, with much of this reach comprising the estuary. Coastal conifer forests of redwood and Douglas fir occupy the northwestern, southwestern, and central portions of the watershed, while oak-woodland and grassland cover many slopes in the interior. Coho salmon naturally inhabited the streams flowing from coniferous forest, but likely were sub-dominant to steelhead trout in interior areas due to the more open nature of the channels, less suitable habitat, and naturally warmer stream temperatures. The interior is largely grassland with scattered oaks. Surface waters in this area generally lack shade and are warmed with abundant sunshine and warmer air temperatures.

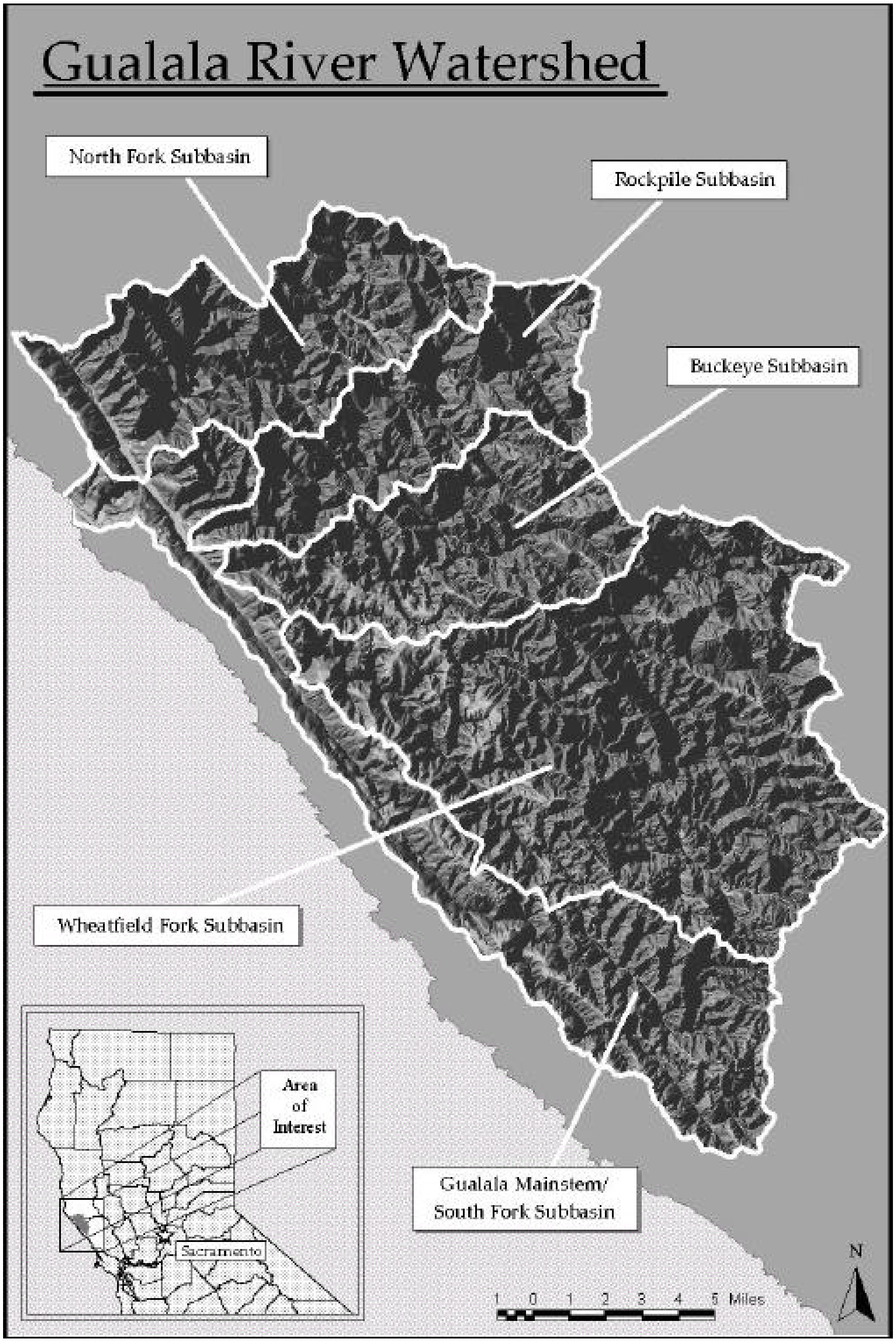

Figure 3-1
NCWAP Subbasins in the Gualala River Watershed, California

Table 3-1
Characteristics and Land Ownership of the Five Gualala River Subbasins for the NCWAP Assessment

Subbasin	North Fork	Rockpile	Buckeye	Wheatfield Fork	Mainstem South Fork	Total
Square Miles	47.9	35.0	39.9	111.6	63.7	298
Acreage, Total	30,635	22,389	25,767	71,445	40,756	190,992
Private Acres	30,635	22,389	25,767	71,279	40,703	190,773
Federal Acres	0	0	0	166	15	181
State Acres	0	0	0	0	38	38
Principal Communities	Gualala	Gualala	Gualala	Annapolis	Cazadero	
Predominant Land Use	Timber Grazing Subdivision	Timber Grazing	Timber Grazing Agriculture	Timber Grazing Agriculture	Timber Grazing Agriculture	
Predominant Vegetation Type	Coniferous Deciduous	Coniferous Deciduous	Coniferous Deciduous	Coniferous Deciduous	Coniferous Deciduous	
Miles of Blue Line Stream	127	88	90	246	134	685

The Wheatfield Fork Hydrologic Subarea is further subdivided by:				
	Super Planning Watershed			
	Hedgepeth Lake	**Lower Wheatfield Fork**	**Walters Ridge**	**Total**
Square Miles	28.5	44.8	38.3	111.6
Acreage, Total	18,230	28,703	24,511	71,445
Private Acres	18,229	28,538	24,511	71,279
Federal Acres	1	165	0	166
Principal Communities	None	Annapolis	None	
Predominant Land Use	Grazing/Vineyards	Grazing Vineyards/limited timber Grazing/vineyards		
Predominant Vegetation Type	Fir/Oak/Grasslands	Mixed young conifer/hardwood	Fir/Oak/Grassland	
State Acres	0	0	0	0
Miles of Blue Line Stream	66.1	90.8	89.0	246

3.1 Hydrology

A rainfall/runoff hydrology predominates in the Gualala River Watershed, with minimal snow accumulation. Detention time and time of concentration of rainfall are reduced by steep slopes and high rainfall amounts, causing stream levels to rise quickly in response to rainfall. Alterations of the landscape can change the hydrologic curves, flood frequencies and peaks within the subbasins of the Gualala watershed.

The mainstem of the Gualala River flows from the confluence of the South Fork and North Fork to the Pacific Ocean. This reach is influenced by seasonal closures of the river mouth, which typically occur in early summer and last until the first heavy rains of October or November, although it may also close briefly during the winter months (California Department of Fish and Game [CDFG] 1968 and EIP 1994).

Precipitation in the Gualala River Watershed is highly seasonal, most precipitation occurring October through April. Average annual precipitation ranges from 33 inches at the lower elevations near the Pacific Ocean to 63 inches at the higher elevations in the southeastern upper watershed. A list of long-term precipitation gages within or near the Gualala River Watershed and a location map are included in Appendix 1.

Two long-term precipitation stations are still operating near the watershed at lower elevations:

- The Fort Ross gage is located in the town of Fort Ross along the coast near the southern portion of the watershed, and has the longest period of record (1876 – present). It lies approximately two miles outside of the watershed boundary.
- The Cloverdale gage is located in the town of Cloverdale northeast of the central eastern portion of the watershed, approximately 11 miles outside of the watershed boundary, and has a period of record from 1894-1896 and 1903–2000.

Similar to other watersheds within the North Coast, only a few streamflow gaging stations have historically operated within the Gualala River Watershed. Streamflow data had not been collected by any agency since 1994. To gain additional streamflow data, three streamflow gaging stations were installed by North Coast Watershed Assessment Program (NCWAP) during the fall of 2000 (one on the North Fork, one on the Wheatfield Fork, and one on the South Fork above the Wheatfield Fork). Zero flow occurred at the new Wheatfield and South Fork gages during the late summer months of 2001, but the North Fork maintained a minimum base flow and was the major if not the only contributor of surface water flow to the estuary during low-flow periods. A list of existing and discontinued streamflow gaging stations, their locations, and period of record along with a location map are provided in Appendix 1.

Only one streamflow gage, South Fork Gualala River near Annapolis, U.S. Geological Survey (USGS) Station #11467500, operated within the watershed for a significant period (October 1950 - September 1971 and June 1991 - June 1994). This station was located below the confluence with the Wheatfield Fork and measured the runoff from a drainage area of 161 of the 298-square-mile Gualala River Watershed (54 percent). During the period of 1991-1994, the gage was operated to record low flows only. A summary and statistical analysis of the flow data for this station is included in Appendix 1.

The two highest flood events during the 21-year operation of the gage occurred in December 1955 at 55,000 cubic feet per second (cfs) and January 1966 at 47,800 cfs. Seven other annual peak events during the operation of the gage exceeded 30,000 cfs. While other north coast rivers experienced near record flood flows in December 1964, the South Fork Gualala gage recorded only 21,000 cfs. An examination of other streamflow gages in the area indicates recent flood events at the South Fork Gualala gage site of 30,000 cfs or greater probably occurred in 1974, 1983, 1986, 1993, 1995, and 1997.

Long-term trends in precipitation or streamflow are difficult to assess due to the general lack of spatial and temporal data. However, based on available long-term records, Maury Roos, the Chief Hydrologist for DWR, does not believe a significant trend in annual precipitation or runoff has occurred statewide or the North Coast during the last century. Affects on unit discharge hydrographs due to changes in land use or geomorphology within the watershed can not be directly assessed with existing data. Changes in rainfall/runoff characteristics can currently only be assessed by the use of computer models. The operation of the new streamflow gaging stations installed within the Gualala River Watershed for NCWAP and other existing streamflow and precipitation gages within the North Coast region should be continued. These data are crucial to modeling as well as watershed restoration activities such as determination of stream sediment and chemical transport total loads; floodplain management; design of bridge and road crossing, water diversion, fish ladder and screen, and streambank stabilization projects; and the California State Water Resources Control Board (SWRCB) water right application and license reviews and judicial water supply allocations.

A search of the SWRCB's Water Right Information System (WRIMS) was performed to determine the number and types of water rights within the Gualala River Watershed. The WRIMS database is under development and may not contain all post-1914 appropriative water right applications that are on file with the SWRCB at this time. Some pre-1914 and riparian water rights are also contained in the WRIMS database for those water rights whose users have filed a "Statement of Water Diversion and Use." SWRCB appropriative water rights and statements of use exist for a total of about 4,500 acre-feet per year (ac-ft/yr) of water from the Gualala River Watershed, at a maximum diversion rate of about 8 cfs for domestic, fire protection, irrigation, municipal, recreation, and stock watering. A list of water rights and associated information contained within WRIMS for the Gualala River Watershed along with a location map are presented in Appendix 1.

Estimated water uses for the Gualala River Watershed are presented in Table 3-2. Detailed explanations of the estimates are provided in Appendix 1.

Table 3-2
Estimated Water Uses in the Gualala River Watershed

Water Use	Estimated Maximum Withdrawal Rate (cfs)
SWRCB appropriative rights	8
Vineyards—dry and frost	27-100
Rural Residential	2.5
North Gualala Water Company	2
Sea Ranch	2.8
Potential total diversion amount	42.3 – 115.3

Any water extraction from surface or groundwater supplies, depending on the amount, location, and season, can affect streamflow, water quality, and consequently, fish habitat. The method of diversion of surface flows, such as dams and pumps without properly designed fish ladders or screens, can also impede and adversely affect all species of fish. Based on existing water rights, land use data, and observations by CDFG staff during their stream field surveys conducted from June – November 2001, current water diversions within the watershed do not appear to significantly affect streamflows, but most actual diversions or resulting streamflow reductions have not been recorded.

Current low-flow constraints in the Gualala River will most likely prohibit future additional SWRCB appropriative water allocations. However, higher use of the rights allocated to the Sea Ranch and North Gualala Water Company is expected in the future. Unregulated water rights or illegal extraction of water may, at times, have an adverse impact on fish habitat and should be monitored.

3.2 Geology

The Gualala River watershed is transected by the San Andreas Fault and the Tombs Creek Fault zones along northwest-oriented lines. The latter separates highly unstable mélange on the east from relatively more stable terrain on the west. The South Fork and the Little North Fork of the Gualala River flow within a linear valley presumably formed by the San Andreas Fault near the coast. (Plate 1, *Geologic and Geomorphic Features Related to Landsliding, Gualala River Watershed, Sonoma and Mendocino Counties, California*).

The Gualala River system and surrounding topography evolved in response to rapid geologic changes along the west coast of North America over the past 30 million years, and especially in the last five million years. The drainage networks evolved along with the changing landscape. The drainage network of the Gualala River is bedrock controlled and records the major geologic changes that took place. The landscape continues to change most notably by mass wasting. Mass wasting and erosion affect fluvial geomorphic conditions, which in turn affect aquatic habitat conditions.

In the Gualala River Watershed, the distribution of landslides, channel types, and sediment yield is controlled by the distribution and physical properties of the various geologic formations that form the foundation of the watershed. Understanding those background relationships can aid in the identification of operative processes, such as changes in the stream channel.

Over the past 5-20 million years ago, much of the region was uplifted. As it was raised and tilted, the rivers incised into bedrock in many places. Large portions of the Gualala River system are incised into heterogeneous bedrock. The bedrock is composed of several rock formations of very different properties that have been juxtaposed in a complicated pattern through multiple generations of folding, faulting, uplift, and subsidence, many of which remain evident in the topography. The resistance of the bedrock to erosion is extremely variable and depends in many ways on the rock composition and the degree of deformation. As the bedrock was uplifted, crushed, and redistributed along active faults, the Gualala River system concurrently evolved. The network of watercourses followed paths of least resistance across the landscape as determined by the distribution of hard, durable rock versus soft, easily erodible rock. Many watercourses lengthened along the weakened rock within fault zones. Many of the streams in the Gualala River Watershed and surrounding area are clearly fault controlled. All of the faults, with the exception of the San Andreas Fault, are now considered inactive. The Tombs Creek Fault System was probably active during the Pleistocene (10,000- 1.1 million years ago).

The present landscape in the Gualala River Watershed continues to change through the processes of erosion and mass wasting in ways that force the streams channels to continually adjust. The timescale over which these changes occur vary from years to millennia. The forces of erosion work against the weaker rock moving them down into the stream channels in the form of landslides. Streams erode into bedrock forming canyons. The local strength of the bedrock determines the steepness of the canyons. Over the long term, the canyon slopes steepen to a threshold at which there is quasi-equilibrium between continued steepening and mass wasting. For example, steep canyons form where bedrock is harder and resistant. Where uplift and incision outpace mass wasting, the slopes are oversteepened. Sediment yield in the watershed is likely between 1,000 to 4,000 tons per square mile per year. Earthflows contribute about 80 percent of this amount. Shallow landsliding is common in many of the steep canyons in the watershed as equilibrium is gradually established. In many areas, large landslides are obstacles that cause the streams to change course and grade. Even in areas where faulting and landsliding are dormant, the resultant distribution of varying rock types still determines stream channel processes.

Historically active landslides (movement within the last 150 years) comprise approximately 10 percent of the watershed, while dormant landslides constitute approximately 25 percent. Large earthflows (approximately one-third of which are historically active) and gullies occur dominantly east of the Tombs Creek Fault zone and in the southern portion of the watershed. Gullies typically erode the surface of the earthflows. Rock slides, debris slides, and debris flows occur dominantly in the rocks of the Coastal Terrane where slopes are steep, as in the North Fork Subbasin and the Fuller Creek watershed in the Wheatfield Fork Subbasin. Large dormant rock slides (no movement within the last 150 years and in some cases movement thousands of years ago) occur along the San Andreas Fault zone and the Tombs Creek Fault zone (Plate 1, *Geologic and Geomorphic Features Related to Landsliding, Gualala River Watershed, Sonoma and Mendocino Counties, California*).

3.2.1 Fluvial Geomorphology

In 1984, roughly 300 of 750 miles of stream channel appeared in a disturbed condition as a result of excess sediment. By 2000, this improved by almost 50 percent with only 156 miles of the channels appearing disturbed. The distribution of the excess sediment within the stream channels is controlled by the location of sediment input and by the effectiveness of the streams to transport the sediment. Higher gradient reaches are more effective in sediment transport. The distribution of channel gradients in the Gualala River Watershed is depicted in Figure 3-2. The distribution of the excess sediment observed in 2000 aerial photos was mainly in low gradient reaches (Figure 3-3).

Low-gradient reaches tended to accumulate excess sediment over long periods. For example, rising sea levels at the end of the Ice Ages (10,000 years ago) drowned the lower reaches of the major tributaries resulting in substantial sediment deposition that formed a near level wedge of sediment. The wedge of sediment comprises the flood plains of the Little North, North, Wheatfield, and South Forks of the Gualala River. Those streams are very low gradient.

Landslides are the main source of sediment delivered to the streams. The distribution of instream sediment reflects the distribution of landslides indicating a strong relationship (Figure 3-4). Sixty-six percent of the excess sediment occurred within 50 meters of landslides. Even landslides classified as dormant seem to play a continuing role on the distribution of instream sediment.

Comparison of the distribution of instream sediment between 1984 and 1999/2000 shows a general watershed-wide reduction in excess instream sediment. This indicates that sediment transport exceeded sediment input over this period and may indicate progressive recovery from past disturbances. The amount of this change is tabulated in Table 3-3.

Table 3-3
Gualala River Watershed - Stream Characteristics Representing Sediment Sources or Storage

Subbasin	Year 2000		Year 1984		1984 to 2000	1:24K Streams
	Disturbed Channel Length (miles)	Percent Total Stream for Entire Watershed or Subbasin	Disturbed Channel Length (miles)	Percent Total Stream for Entire Watershed or Subbasin	Percent Length Change	Total Stream Length (miles)
Gualala River Watershed	***156.8***	***21.0***	***297.8***	***39.9***	***-47.3***	***745.8***
North Fork Subbasin	29.2	23.0	48.3	38.1	-39.5	126.7
Rockpile Creek Subbasin	19.8	22.4	32.0	36.3	-38.3	88.2
Buckeye Creek Subbasin	17.9	19.8	41.6	46.0	-56.9	90.4
Wheatfield Fork Subbasin	56.7	18.9	118.9	39.6	-52.3	300.6
Gualala Subbasin	33.2	23.7	57.0	40.8	-41.8	140.0

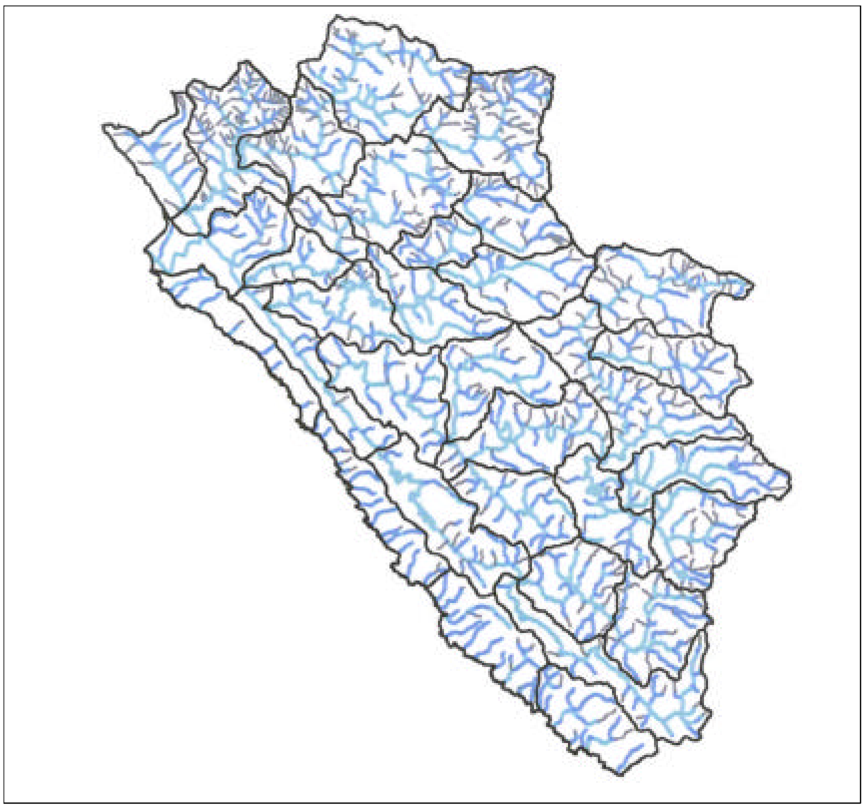

Figure 3-2
Distribution of Channel Gradients in the Gualala River Watershed

Gualala River watershed showing channel type as response (light blue), transport (violet) or source (gray). Response reaches are approximately 459 km (39 percent) of the total 1188 km USGS 1:24,000 blue line streams. Transport reaches are approximately 439 km (37 percent) of the USGS channels. Source reaches are the remaining 290 km (24 percent). Response reaches are those with a blue line channel gradient of less than 4 percent. Transport reaches have gradients of between 4 and 20 percent. Source reaches have gradient above 20 percent. Channel gradients are calculated from USGS 10 meter grid DEMs. Green grid is USGS topographic 7.5-minute boundaries. Black dashed lines are CalWater2.2 planning watershed boundaries.

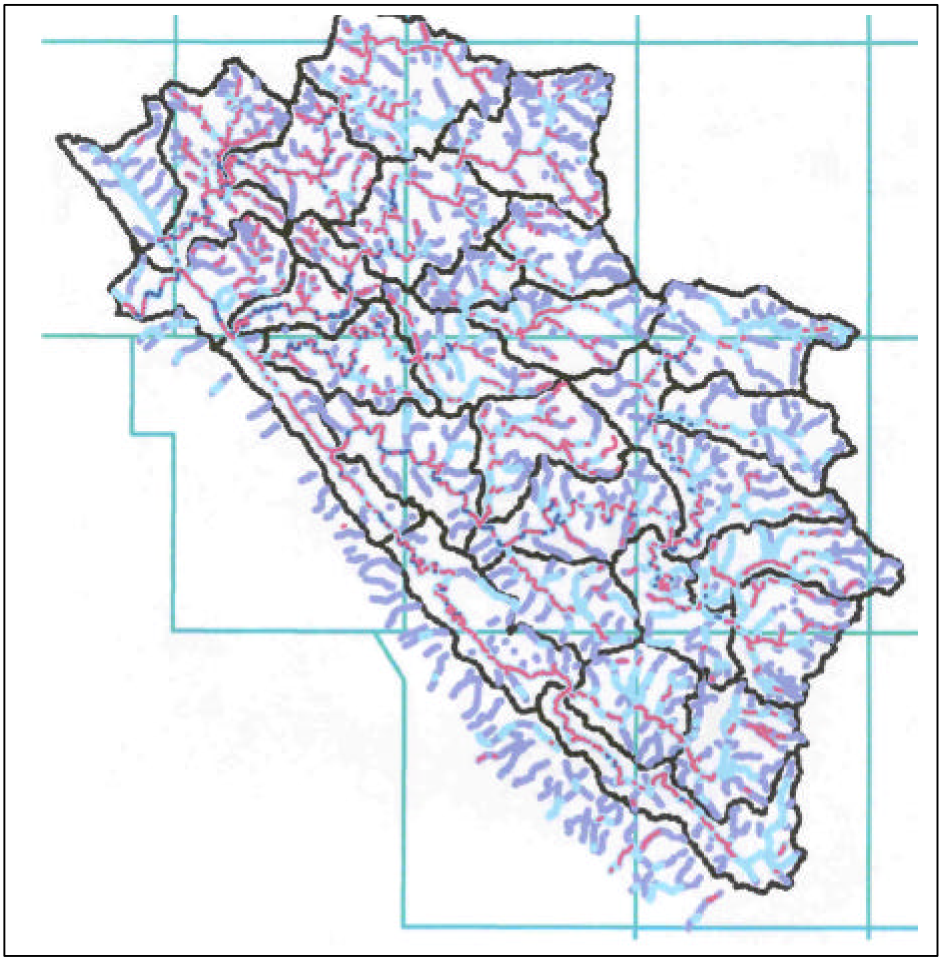

Figure 3-3
Distribution of the Excess Sediment in the Gualala River Watershed in 2000, Mainly in Low-Gradient Reaches

Mapped channel characteristics for 1999 and 2000 that suggest excess deposition or sediment delivery are shown in red, and other mapped channel sediment deposits in blue. Light blue lines are response reaches, slope less than 4 percent, and violet lines are transport reaches, slopes between 4 and 20 percent. Green grid is USGS topographic 7.5-minute boundaries. Black dashed lines are CalWater2.2 planning watershed boundaries.

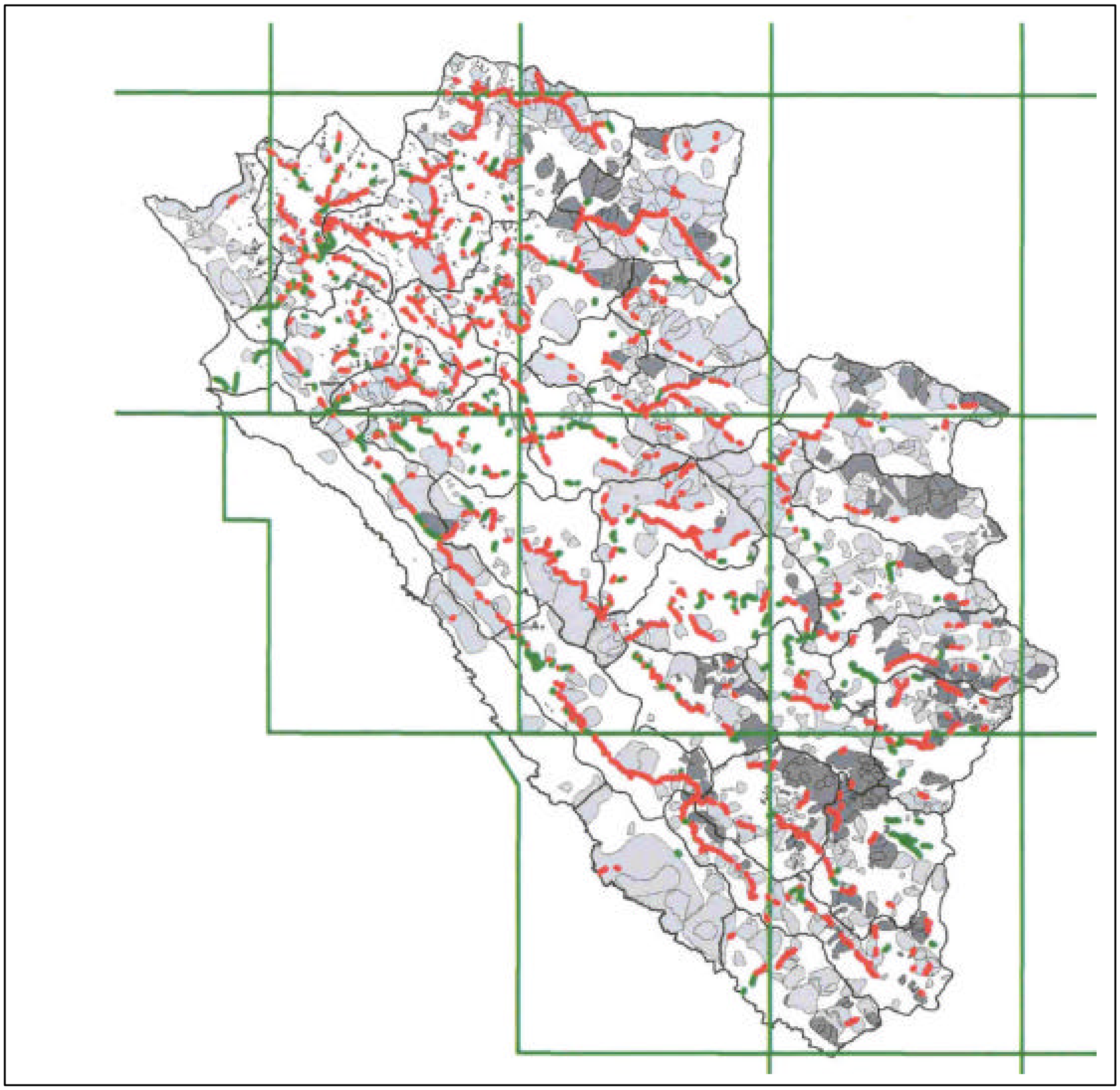

Figure 3-4
Distribution of Landslides in the Gualala River Watershed

Those reached shown in red represent the 70 percent of 1,355 mapped reaches with sediment deposition and erosion stream characteristics within 50 meters of an active or dormant deep seated landslide. Other mapped stream reaches are shown in green. Light gray polygons are dormant and dark gray are historically active deep-seated landslides. Green grid is USGS topographic 7.5-minute boundaries.

3.3 Vegetation

Prior to European settlement, coniferous forest extended throughout approximately two thirds of the Gualala River Watershed. Dense old growth redwood forests occupied the northwestern portion of the Gualala River Watershed, particularly the alluvial North Fork Subbasin. Old growth redwood also lined the long and narrow South Fork valley. Douglas fir predominated in central and mid-slope locations more distant from the coast.

Further inland in the eastern portion of the Gualala River Watershed, the natural distribution of Douglas fir becomes increasingly fragmented. Here, the long summer drought limits Douglas fir to north facing slopes. The oak-woodland predominates as a more continuous distribution on higher, inland terrain the more distant from the coastal marine influence. Large areas of prairie grassland occupy the driest sites along ridge and upslope locations. These occupy larger continuous areas on the highest and easternmost areas of the Gualala River Watershed. Quantitative details are provided in Appendix 3, pages 30–32.

3.4 Land Use

The Gualala River Watershed has one of the longest spans of historical use compared to other north coast watersheds. Logging of the virgin old growth redwood forest began during the mid 1800s. The first documented account dates to 1862 in lower portions of the watershed near coastal ramp and port facilities. This includes the lower reaches of the Little North Fork, North Fork, Pepperwood creeks, and the lowest reaches of Rockpile and Buckeye creeks at the confluence with the South Fork. There was concentrated demand for the resource after the 1906 earthquake and rebuilding of San Francisco. The first logging methods used oxen teams to move large old growth redwood logs to terminal points of lateral connecting rail lines. The original rail line ran along the South Fork. Watercourses were frequently used as skid paths to move logs downslope including the use of splash dams. Main rivers were used to float logs downstream. Fire was used extensively to reduce slash during logging and in attempts to convert redwood forest to grazing land after the logging.

Early logging activities left a legacy of impacts, some of which persist to the present. Splash dams and log drives tended to flatten and simplify stream channels. Rail line construction included massive cut and fill excavation along roadbeds which followed streams. Although wood trestles were built over larger watercourses, smaller watercourses were crossed by wood and earth fill which later failed. The introduction of the steam donkey by the turn of the century reduced ground impacts by cable pulling large logs from fixed locations, but allowed much more widespread forest harvest. These operations did not disturb the ground to the extent of more recent tractor operations characterized by large-scale sideslope excavations and skid trail networks. The gasoline powered crawler tractors made their appearance in the North Coast in the late 1920s, but logging in the Gualala was inactive during the Great Depression.

Increased demand for lumber products during the 1950s coincided with the widespread deployment of heavy tractors that were greatly improved by technology advanced during World War II. Early versions of the D-8 and D-10 tractors, using refined track mounts and suspension systems, and powered by diesel engines, were ideally suited for moving large diameter logs over difficult terrain. This equipment was readily maneuverable, enabling large areas to be worked over in short time periods. Rail line networks were quickly abandoned and diesel powered log trucks transported logs along seasonal roads. Between 1952 and 1960, tractor method harvesting extended in a broad sweep from the upper reaches of the North Fork, east through the central and upper reaches of Rockpile and Buckeye creeks, and throughout lower and middle reaches of Wheatfield Fork. Harvest operations followed straight parcel lines regardless of watercourse condition or difficult terrain. Roads often followed the stream channel to enable downslope skidding. Many roads had steep gradients designed to access all positions of the sideslope. Skid trails frequently followed or crossed ephemeral stream channels. Landings were often located in, or adjacent to, watercourses. These were built by pushing woody debris into the channel, and overtopping by dirt fill. Across steep terrain, skid trials cut deep into the sideslopes, creating a terraced effect. By 1964, tractor harvesting had continued at an active pace to comprise a majority, and in some areas, most of the timbered areas in the west and central reaches of the watershed Figures 3-5.

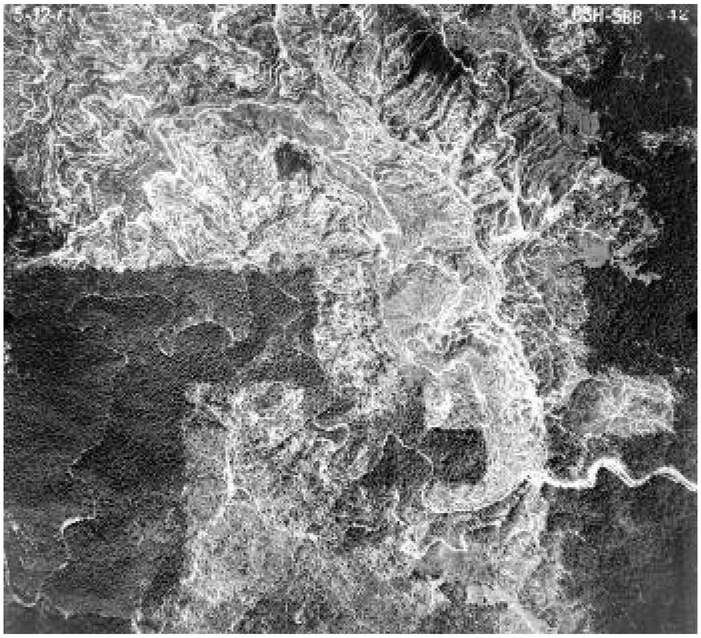

Figure 3-5
1961 Aerial photo, Post World War II Pre-Forest Practice Rules Logging in the Buckeye Subbasin
(Franchini Creek and a new Streamside Road are in upper right)

The lack of any erosion control facilities installed throughout large areas of the watershed, coupled with the uncontrolled installation of fills and the failure to remove fills adjacent to watercourses, left the entire watershed particularly vulnerable to large storm events. Intense prolonged runoff during large storm events in 1962, 1964, and 1966 caused large scale erosion from downcutting, slides, and washing of soil and debris into watercourses. The residual effects are still observed in some areas today. The California Department of Transportation (Caltrans) aerial photos taken in June 1965 at 1:1,200 scale show stream channels meandering through wide, flat areas of buried stream pools, indicating channel aggradation. Roads following the stream channel repeatedly failed as fill sidecast washed out during peak flows. Debris slides above and below roads were frequent. Deep blowouts through landings built over the channels are numerous throughout the 1965 photos. In addition, there were numerous watercourse diversions onto roads and skid trails.

After 1964, harvest operations resumed at an active rate in the lower and middle reaches of the North Fork and entire Little North Fork to remove most of the available timber base in these areas by 1973. Other areas of mature Douglas fir in (1) higher elevation areas and (2) eastern reaches of the watershed were harvested during this time. Only pocket stands and scattered larger timbered blocks remained. Roads and landings continued to be located low on the sideslope, frequently following the stream channel. Subsequent landing blowouts and road failures have been documented along the Little North Fork and central North Fork. There were large storm events in 1972 and 1974. With ranching being the dominant use in mixed conifer, oak and woodland areas, logging of Douglas fir was frequently followed by prolonged cattle grazing. This reduced, and in many locations prevented, conifer reestablishment altogether. Grassland became permanently established throughout the more compacted ground. In addition, removal of Douglas fir in mixed conifer-hardwood forests converted these stands to tan oak and madrone. Prolonged cattle grazing in riparian areas after harvest prevented timely reestablishment of canopy cover over fish bearing watercourses, elevating stream temperatures.

After 1973, logging operations had slowed. Smaller selection method harvests were predominant. By this time, tractor-yarding methods changed to maintain equipment exclusion zones and minimum vegetation retention standards adjacent to watercourses per 1973 Forest Practice Rules. New road locations were moved upslope, but the practice of using existing roads located near streams continued. The new forest practice rules limited the cutblock size, creating smaller logged areas.

In the 1990s, harvest activity increased. Smaller but numerous clearcut blocks appear in the redwood lowland areas of the Gualala Redwoods, Inc. ownership. Throughout the watershed, cable method yarding appears with new road construction now moved to upslope and ridgeline locations. Many sections of the older seasonal roads following the stream channel either are abandoned or removed. Numerous seasonal roads still exist in close proximity to streams, and are used as needed during timber harvest activities. During the mid 1990s, Coastal Forestlands (formerly R&J Timber Co., and purchased by Pioneer Resources in 1998) submitted numerous seed tree overstory removal/dispersed timber harvest plans (THPs), covering large areas but removing scattered single trees and remnant stands left from 1960s era entries. Agency review of these THPs clarified road upgrade work requirements to repair the erosion conditions of pre-1973 operations. There has been little harvesting in these areas since 1998. Residential development near the coast, and vineyard development inland, become more active by the1990s. Ninety-five percent of the Gualala watershed is privately owned.

Table 3-4

Timber Harvest History - Gualala Watershed

Time Period	Acres Under Operation	Type of Operation	Mean Annual Increment (acres/percent by year)
1932– 1942	1,010	Stand Replacement	101 (.05)
1942 – 1952	4,260	Stand Replacement	426 (0.2)
1952 – 1960	54,200	Stand Replacement	6,775 (3.5)
1960 – 1964	20,400	Stand Replacement	5,100 (2.7)
1964 – 1973	10,950	Stand Replacement	1,950 (1.0)
1974 – 1990	9,900	Stand Replacement	619 (.3)
1991 – 2001	45,070	Timber Harvest Plans (THPs)	4,507 (2.4)

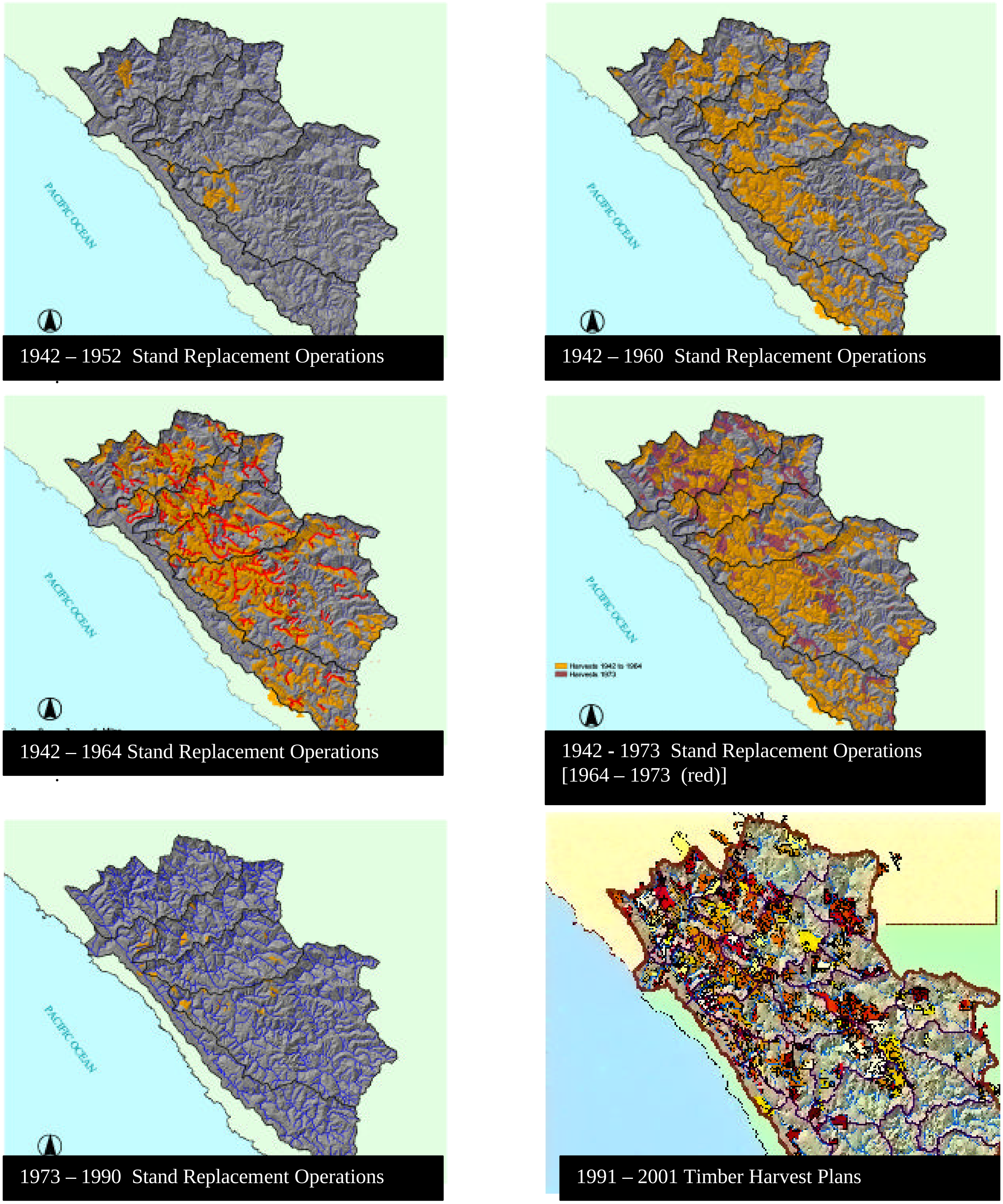

Figure 3-6
Cumulative Stand Replacement Operations 1942 – 1973, and Post 1973 Operations and THPs

Changes in canopy conditions in the Gualala River Watershed were observed from summertime aerial photo sets for 1942, 1968, and 1999. Those photos provide a good perspective on conditions through the period to the present. Bank-to-bank canopy coverage was determined from aerial photos and mapped as "canopy" where canopy was fully covering stream banks. Canopy that covered only one bank or fully exposed channel were mapped as "exposed." This method maps those reaches of blue line streams exposed bank to bank along the immediate stream channel, not the streambank vegetational transition line, or flood line.

Canopy cover was complete in most tributaries in 1942 indicating advanced regeneration from the original old growth logging along the South Fork and lower to mid reaches of the North Fork. The remainder of this subbasin in 1942 consisted of undisturbed old growth conifer timberland in the central reaches, and natural grassland oak woodlands in upland areas. Most stream reaches at this time had nearly full canopy cover. The larger order, downstream stream reaches were naturally aggraded and wide and thereby exposed (Figure 3-7).

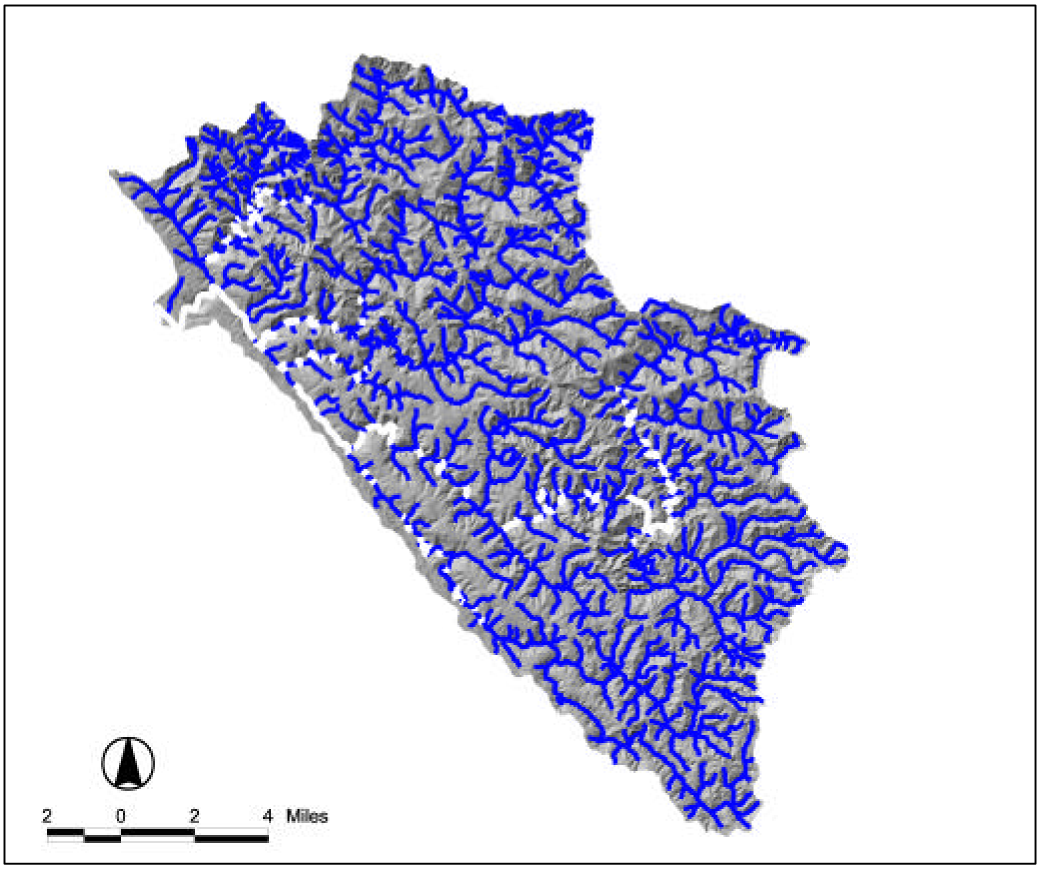

Figure 3-7
1942 Bank-to-Bank Stream Exposure (white) in Generally Undisturbed Old Growth Watershed Conditions
Turn of the century logging was limited to the South Fork valley watershed, and the lower to middle reaches of the North Fork. Dark blue represents partial to entire canopy cover over blue line streams.

Large-scale block clearance timber harvest projects in the mid-20th-century entirely eliminated overstory shade canopy over most salmonid spawning ground by 1968 (Figure 3-8).

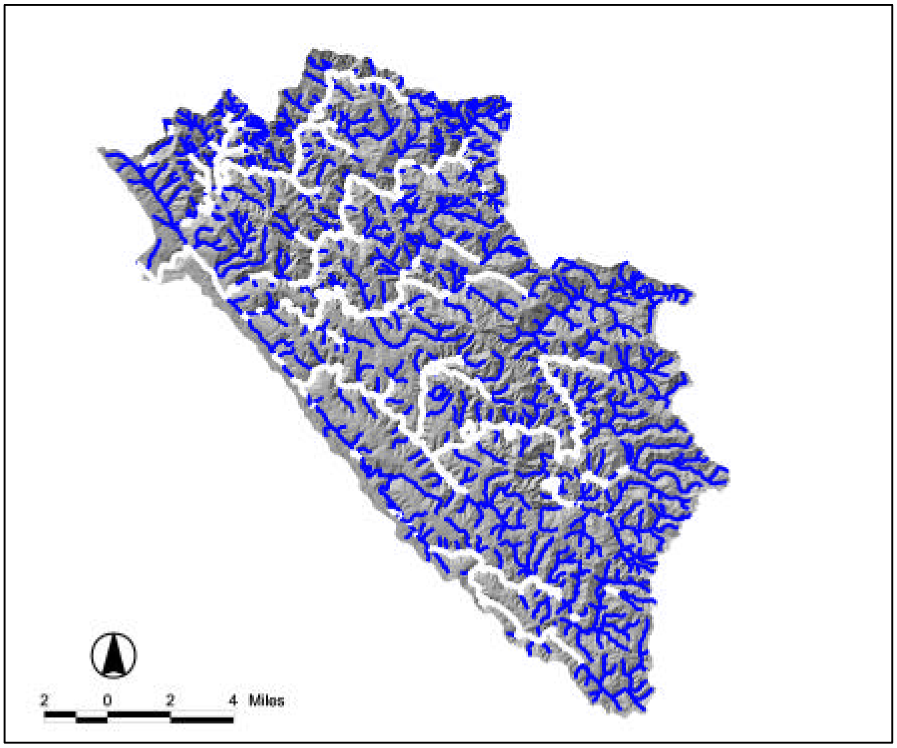

Figure 3-8
1968 Bank-to-Bank Stream Exposure (white)
Pre-1973 tractor harvesting was mostly complete. Partial to entire stream cover is shown in dark blue.

The end of the tractor logging era and infrequent timber harvesting until the late 1980s allowed canopy cover in-growth in most areas. These improvements in canopy coverage are evident in comparing the 1968 map to the 1999 map, with the amount of exposed stream length reduced from a range of 40-70 percent to approximately 25 percent averaged throughout the watershed (Figure 3-9). Streamside canopy now consists primarily of 40-year-old pole- to mid-sized conifers and mixed conifer/hardwood stands in the middle to upper subbasin reaches.

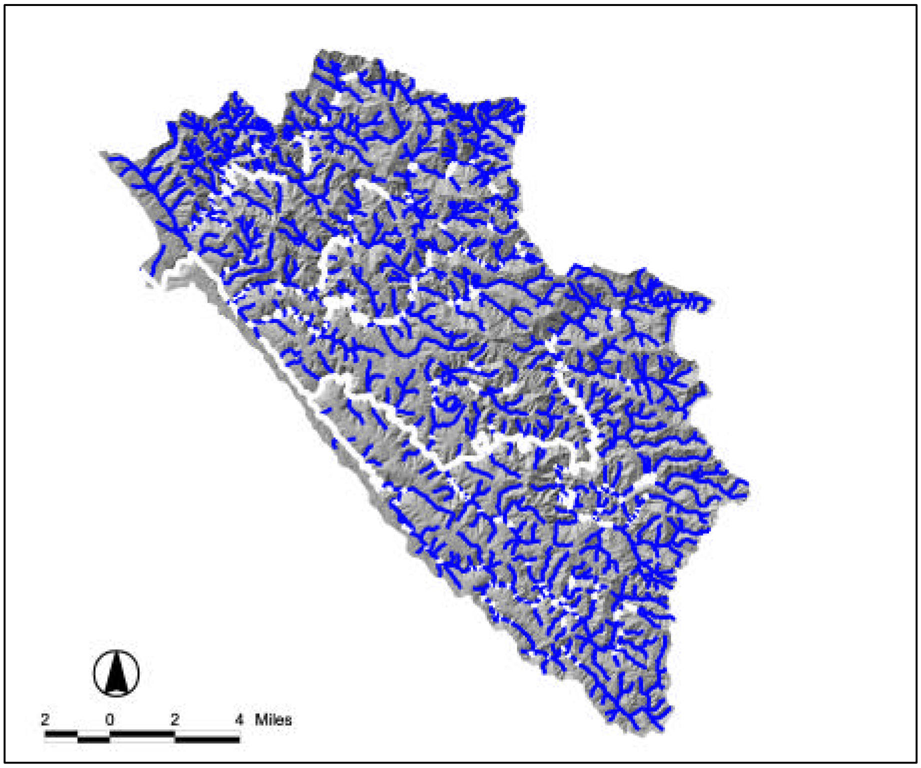

Figure 3-9
1999/2000 Bank-to-Bank Stream Exposure (White), Reflecting Vegetational Ingrowth Since 1968

3.5 Water Quality

The U. S. Environmental Protection Agency (USEPA) data from April of 1974 to June of 1988 at the South Fork near Valley Crossing, the Wheatfield Fork near Valley Crossing, and the mainstem Gualala downstream of the North Fork indicate a moderately hard water stream with pH slightly above neutral, high dissolved oxygen, low dissolved solids, and low nutrients (nitrogen and phosphorus). Sampling by the NCRWQCB during 2001 at those and two additional sites (South Fork at Hauser Bridge, and House Creek near the mouth) were not substantially different from the StoRet data. While these parameters may vary to some degree with season and local conditions, all values were within the NCRWQCB's Basin Plan limits and comparable to data in the NCRWQCB files for other north coast streams. There were no large differences among the stations, though it appears that House Creek may be higher in hardness, alkalinity, and conductance than the mainstem stations. However, the small amount of data available are not sufficient to make a conclusive statement. Appendix 4 contains the raw data and graphs.

Water temperature data were available from the Gualala River Watershed Council and Gualala Redwoods, Inc and NCRWQCB file copies of Coast Forest Lands, Ltd activities. Water temperatures expressed as the highest of the floating weekly average for the summer (maximum weekly average temperature [MWAT]) and seasonal maximum were in the range of suitability for salmonids in the North Fork mainstem and other tributaries where measured. MWAT values exceeded suitable conditions in most of the mainstem areas where measured in the Rockpile, Buckeye, Wheatfield Fork, and South Fork/Main Gualala. Seasonal maxima followed the same pattern, approaching lethal or above lethal in mainstem areas mentioned and not in the North Fork mainstem and other tributaries.

Linear regression of canopy and water temperature metrics (MWAT and seasonal maximum) for 11 sites in the Gualala River Watershed showed a relationship of higher water temperatures with lower canopy values (Appendix 4). Shade is one factor in water temperatures, with flow, air temperature, and humidity being other major controlling factors. As such, the correlation of lower canopy values with higher water temperatures is expected.

Generally, as watershed size increases, so does water temperature. As water moves downstream the length of exposure to air temperature and sunlight increase and an increase in temperature is expected. Additionally, streams tend to widen as they flow downstream, and wider channels are less apt to have full shade cover and will be influenced by cooler riparian air temperatures to a lesser degree due to the volume of water. A linear regression of watershed size to MWAT using data from north coast streams showed a relationship of warming downstream as watershed size increased (Appendix 4). However, the opposite is true when one looks at water temperatures in the North Fork mainstem. Temperatures actually cool as the stream moves downstream (larger watershed) most likely due to cooling from tributary flows, increased canopy, and coastal influences.

While the regressions are easily explained in a general sense, neither of those analyses included the factors of stream flow, stream aspect, thermal reach length, air temperature, relative location in the watershed, contributions from tributaries and groundwater inflow, and differences among years. However, in order to provide a better perspective on the spatial distribution of water temperatures in the watershed, further analysis by the Gualala River Watershed Council (GRWC) using the spot temperatures from the CDFG habitat inventory survey for 2001 is planned, as is a search for data from the upper areas of the watersheds. GRWC also is actively seeking access for temperature monitoring locations in the upper watershed areas for the coming years to develop more information and explore the temperature relationships on a broader scale in the watershed. Water temperature modeling would also help in explaining these relationships.

On December 20, 2001, the USEPA established a sediment Total Maximum Daily Load (TMDL) for the Gualala River based on the information contained in the Gualala Technical Support Document (TSD) prepared by Regional Board staff and their consultants. The purpose of the TSD was to estimate current discharges of sediments to the surface waters of the Gualala River Watershed, and to identify the reduction in discharges necessary for achieving water quality standards contained in the North Coast Region Water Quality Control Plan. The Gualala TSD (NCRWQCB 2001b) listed eight sediment sources: road mass wasting, bank erosion, natural mass wasting, surficial road erosion, road gullies, road-stream crossing failures, skid trails, and features associated with other timber harvest activities. Rates of sediment delivery were estimated based on feature area, average depth of failure of 56 measured features, proximity to watercourses, and a conversion factor of 1.48 tons/yd^3. Estimates of sediment delivery were presented by geographic association with management activity. For TMDL purposes, the NCRWQCB contractor only mapped a subset of the total small landslide population, with smaller features accounted for through field surveys.

The purpose of the TSD mass wasting inventory was to identify recently active (1978-2000) mass wasting features (defined as those features that exhibit signs of movement discernible from sequential sets of aerial photos at a 1:24,000 scale) for purposes of developing estimates of current sediment delivery associated with both natural and anthropogenic sources.

The TSD mass wasting inventory focused only on recent (1978-2000) features. Relict mass wasting features that were re-vegetated in the 1988 photos were not mapped by the NCRWQCB contractor.

The Regional Board aerial photo analysis mass wasting inventory included only features > 10,000 feet^2 in plan area. NCRWQCB developed estimates of delivery from mass wasting features < 10,000 feet^2 from on-the-ground measurements to account for the contribution of smaller features difficult to identify due to photo scale, aspect, and shading. Features were mapped on 1988 (entire watershed), 1999 (Sonoma County), and 2000 (Mendocino County) aerial photos.

The NCRWQCB classified features by management association based on (1) geographic intersection of mass wasting features with management features and (2) professional judgment. NCRWQCB assumed that features with no apparent association with management activities were natural.

The NCRWQCB contractor identified only the recently active portions of large, deep features, usually the toe or side scarps. Similarly, large, complex earthflows were not identified in their entirety for the TSD mass wasting inventory. Instead, recently actively eroding surfaces larger than 10,000 ft^2 were individually identified within complex earthflow features. NCRWQCB estimated delivery associated with earthflow creep separately.

In the course of geologic mapping completed by CGS, partial estimates of sediment loads were developed (see Section 2.1.2 and Appendix 2 for complete description of mapping). CGS documented all observable landslides regardless of their potential for sediment delivery to streams and included both small landslides as well as other sediment sources including large earthflows, rockslides, debris slide slopes and inner gorges. CGS also categorized landslides as historically active (movement within the last 150 years) and dormant (movement older than 150 years) based on geomorphic characteristics that suggest recent movement as observed either in the field or on aerial photos. Mapped deep-seated landslides include both earthflows and rockslides that are of sufficient size that their estimated depth of lower failure surface is greater than 10 feet.

CGS found a substantially larger number of small landslides depicted as points on the geologic map than previously mapped by the NCRWQCB (2001b), 618 versus 2128, possibly because NCRWQCB mapped only features greater than 10,000 $feet^2$ in plan area judged to have occurred within the timeframe of their analysis (1978-2000). NCRWQCB estimated the contribution of features smaller than 10,000 $feet^2$ from field data. CGS found that approximately 34 percent of the 298 square mile Gualala River Watershed is underlain by deep-seated landslides, e.g., earthflows or rock slides. Approximately 9 percent of the entire watershed contains historically active earthflows (8.3 percent) and rock slides (0.5 percent). The remaining deep-seated landslides are either dormant earthflows (8 percent of watershed area) or dormant rockslides (16.8 percent of watershed area).

CGS did not examine whether human activity contributed to deep-seated landslides, however**,** CGS considers both dormant and historically active landslides capable of generating background sediment loads. Many historically active landslides are found within larger areas of older dormant landslides, suggesting that some recent landslides are the result of reactivation of portions of dormant landslides. In addition, CGS found that most (58 percent) of the CGS smaller landslides mapped as points lie within larger deep-seated landslides or geomorphic terrains created by landsliding. This suggests preferential development of smaller landslides on existing unstable slopes. Additional study is needed in order to assign the actual cause of small landslides to either background or anthropogenic activities or some combination of both. It should be noted that the activity rating of a landslide (historically active or dormant) is based on geomorphic characteristics that suggest recent movement as observed either in the field or on aerial photos.

The overall rate of movement of historically active landslides is higher than for dormant landslides and stable ground. Historically active landslides result in greater disruption to the terrain (disruptions include sharper topography, angular blocks and scraps, and hummocky undrained depressions) and this provides greater opportunity of infiltration of rainfall that maintains the instability and accelerated surface erosion. In comparison, the rate of movement of dormant landslides is sufficiently low to allow surface geomorphic processes to erode and smooth the landscape reducing topographic irregularities and allowing the development of internal drainage networks. In the Gualala River watershed, the average area of historically active deep-seated landslides mapped as a polygon is approximately 40 acres, equating to at least 1,000,000 tons. The Monitoring Study Group Report (1999, and references therein) found that a majority of very small landslides (significantly less than one acre) that occur after timber harvesting activities was directly related to roads; field experience shows that most road-caused failures are significantly less than an acre in size. This size disparity (40 acres for the average historically active deep-seated landslide versus road-related failures after timber harvesting of less than one acre) indicates that deep-seated landslides result dominantly from larger scale conditions different than the likely anthropogenic landslides caused by road construction.

Using this assumption, CGS estimated a background sediment load in the Gualala River Watershed based on the large, deep-seated landslides and from creep of soils on the other more stable terrains. This estimate was made using information on the landslide type, landslide area, stream density, stream length and stream order developed by CGS as part of their geologic and geomorphic mapping (see Appendix 2). The rates for landslide movement used in background sediment load estimates were taken from literature and varied by landslide type. The range of rates of movement included both high and low rates; high rates included historically active earthflows (300 mm/year), historically active rockslides (50 mm/year), dormant earthflows (20 mm/year), dormant rockslides (10 mm/year), and other areas (1.6 mm/year). Low rates of movement included historically active earthflows (130 mm/year), historically active rockslides (25 mm/year), dormant earthflows (10 mm/year), dormant rockslides (5 mm/year), and other areas (1.6 mm/year). (Harden and others, 1978; Kelsey, 1977, 1978, 1987; Nolan and Janda, 1995; Swanston and others, 1995). The difference in lower and higher estimates of background sediment load reflects the variability of movement rates and soil thickness. All other model parameters were held constant (e.g., number of stream banks delivering sediment and the lengths of stream banks delivering sediment). For the purposes of estimating background sediment, terrains other than the deep-seated landslides were combined with other unmapped more stable areas even though CGS mapped much of the area as geomorphically unstable terrains (i.e., debris slide slopes or disrupted ground). Both a low and high estimate of background sediment load was developed in order to evaluate the importance of the variations in rate of landslide movement.

The results of CGS's estimate found a watershed wide annual average background sediment load of approximately 1,000 to 3,100 tons/mi^2/yr from large, deep-seated landslides, both earthflows and rockslides, combined with slower soil creep on more stable terrain. Sediment delivery from these sources was considered background for the purpose of this investigation. Most of the sediment delivered from large, deep-seated landslides (85 to 90 percent) was derived from deep-seated landslides mapped as historically active, of which 94 percent are earthflows. The remaining mass of background sediment was primarily delivered from the larger area of dormant deep-seated landslides. This range of background sediment load is consistent with those found in other sediment load studies on the north coast of California including a sediment transport study later used for reservoir design (see CGS report in Appendix 2). In addition, a three-fold variability in sediment load rate is consistent with field studies that measured sediment delivery over time (Kelsey, 1977, 1987; Nolan and Janda, 1995).

3.5.1 MACROINVERTEBRATES

Freshwater benthic macroinvertebrates live primarily on instream boulder, cobble or gravel substrate, and include worms, snails, clams, crustaceans, aquatic beetles, the nymph forms of mayflies, stoneflies, dragonflies and damselflies and larval forms of caddisflies and true flies. They are most easily categorized into feeding guilds, species that obtain a common food source in a similar manner: shredders, filter-collectors, collect-gatherers, scrapers-grazers, and predators.

The complex of benthic macro invertebrates is influenced by location in the watershed. The Gualala River mainstem is a fourth order stream, all other tributaries within the watershed are of smaller order. The predominant feeding guilds in fourth order streams are scrapers, which consume the algal growth associated with a more open canopy cover and collectors utilizing the high amount of fine particulate organic matter which has drifted downstream. First and second order streams are usually dominated by shredders, which process leaf litter and other forest debris, and collectors, which further process shredder excrement.

Species richness, species composition, and tolerance/intolerance metrics can be used as indicators of biotic conditions in a stream. Species richness and composition tend to decrease in response to habitat disturbance. Tolerance measures reflect the sensitivity of the community to aquatic sensitivity. Harrington (2000) developed the Russian River Index of Biological Integrity, which includes six metrics: taxa richness, percent dominant taxa, EPT taxa, modified EPT taxa, Shannon diversity and tolerance value. EPT refers to the taxa of Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly) insect orders. The Shannon diversity index is a quantitative measure of habitat diversity. These six metrics were integrated into a single score for biotic condition categories: excellent (30-24), good (23-18), fair (17-12), and poor (11-6).

Gualala Redwoods, Inc. provided benthic macroinvertebrate data from three replicate samples collected at four sites: two sites in Dry Creek, and one site each in the Little North Fork and mainstem Gualala. The biological metrics from these sites were averaged, then compared to modified biotic condition categories. The Shannon Diversity metric was unavailable and not included in the score, thus biotic condition categories were decreased by five points to arrive at the "Visual Distribution Score": excellent (25-19), good (18-13), fair (12-7), and poor (<7) (pers comm. A. Rehn). The sites sampled on Dry Creek, Little North Fork and the mainstem Gualala indicated a "good biotic condition" (Figure 3-10).

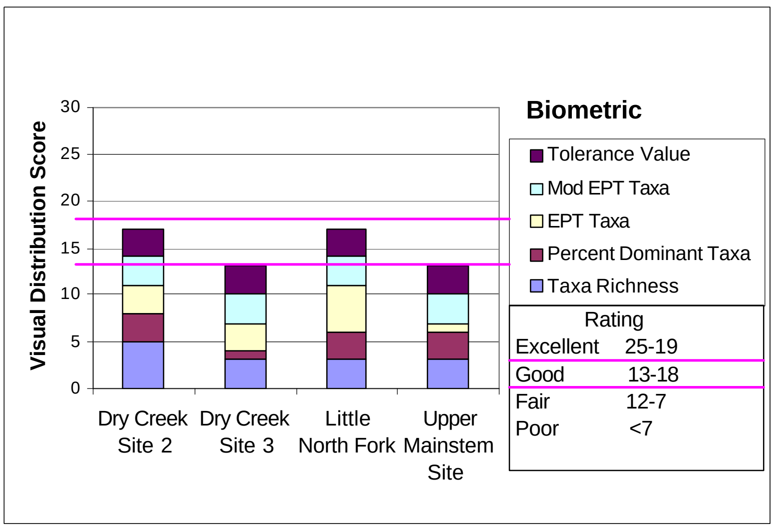

Figure 3-10
North Fork Gualala Macroinvertebrate Data, 2001

3.6 Fish/Habitat Relationships

3.6.1 Historic Fish Habitat Relationship

In 1964, 1970, 1977 and 1981, CDFG conducted stream surveys on various tributaries in the five subbasins of the Gualala River. The stream surveys conducted in 1964 and 1970 coincided with the end of an extensive period of logging in the Gualala River Watershed. The results of the historic stream surveys were not quantitative and cannot be used in comparative analyses with current habitat inventories. The data from these stream surveys provide a snapshot of the conditions at the time of the survey (Table 3-5). Terms such as excellent, good, fair and poor were based on the judgment of the biologist or scientific aid conducting the survey.

Table 3-5
Summary of Historic (1964-1981) Stream Surveys Conducted in the Gualala River Watershed, California

Tributary	Date Surveyed	Habitat Comments	Barrier Comments	Management Recommendations
North Fork Subbasin North Fork	9/17 and 18/1964	Excellent steelhead trout, coho salmon spawning and nursery stream. Spawning areas poor in the upper ½ of the stream and excellent in the lower ½ of the stream; Pool: Riffle ratio 50:50; Good shelter provided by logs, boulders, algae, and roots.	None	Should be managed as a steelhead trout, coho salmon stream; The future planting of coho salmon is recommended to increase the population; The removal of log jams is not recommended.
Little North Fork	9/10/1964	Fair spawning area with loose gravel available, approximately 60 percent of the stream available for spawning, spawning area suitable for steelhead trout and coho salmon; Pool: Riffle ratio 80:20; Good shelter available as undercut banks, overhanging vegetation, logs, and rocks.	30 partial barriers	Continue to manage as a steelhead trout, coho salmon spawning and nursery stream; Habitat improvement, consisting of removal of slash and debris and log jams to improve fish passage and stream condition is suggested; Possible planting of coho salmon to establish a better run is recommended.
Buckeye Subbasin Buckeye Creek	8/27/1964 8/19/1970	Good spawning and rearing area; 50 percent pools; Steelhead present. Silt and sand dominated substrate indicating poor spawning; 25 percent pools;	Some partial barriers	Replant riparian vegetation; remove log jams
North Fork Buckeye Creek	8/5/1964 8/5/1982	25 percent pools; Sluggish water with algal bloom. 40 percent pools	Slash; Log jams	Plant riparian; Improve poor logging practice. Plant riparian to reduce water temperature.
Wheatfield Subbasin Wheatfield Fork	9/28/1964	Good spawning beds; Pool: Riffle ratio 75:25; Shelter provided by boulders, logs, overhanging water grasses, and undercut banks.	Waterfall ¼ mile below the upper limit of anadromy; No complete fish passage barriers,	Clearing of the log jam and clearing of the falls

Table 3-5
Summary of Historic (1964-1981) Stream Surveys Conducted in the Gualala River Watershed, California

Tributary	Date Surveyed	Habitat Comments	Barrier Comments	Management Recommendations
Fuller Creek	8/18 - 19, 1964	Spawning area fair, with less than 50 percent of the streambed containing suitable spawning area and gravel; Pool: Riffle ratio 70:30; Logs, rocks, and undercut banks provided good shelter.	9 partial barriers consisting of log jams.	Removal of log jams to improve passage; Possible planting of coho salmon to re-establish a self-supporting run.
Haupt Creek	8/25/1964 6/24/1970	With a general clean-up and proper management, could become a first class steelhead trout, coho-salmon producing stream. A large amount of good spawning area available, consisting of loose gravel deposits, some places 60 feet wide; Pool: Riffle ratio 80:20; Good shelter provided by algae, boulders, undercut banks, and logs. Spawning area from mouth to upper fish limit; About 60 percent pools; About 25 percent of shelter in the first 100 feet of stream.	17 partial barriers, consisting of log jams; 1 fish passage barrier20 log jams; no fish passage barriers,	Removal of barriers; Removal of slash from streambed to improve nursery area; Careful management of a coho salmon program to re-establish a run in a stream which has a tremendous amount of suitable coho salmon spawning areaRemove log jams from mouth to upper fish limit 6 miles upstream.
House Creek	9/17/1965- 9/18/1965	Pools: 60-80 percent in summer; Shelter is inadequate; Conditions favor rough fish over salmonids.	Concrete dam Numerous small log jams in headwaters and tributaries	Manage as steelhead spawning and nursery.
Patchett Creek	8/20/1964	40 percent of the streambed below the upper anadromy limit good; Shelter provided by logs, undercut banks, overhanging grass – scarce in some areas	15 log jams between mouth and upper limit of anadromy; 3 waterfalls.	Removal of 15 log jams from mouth to bedrock falls 150 feet below the first fork

Table 3-5
Summary of Historic (1964-1981) Stream Surveys Conducted in the Gualala River Watershed, California

Tributary	Date Surveyed	Habitat Comments	Barrier Comments	Management Recommendations
South Fork Main Stem Subbasin South Fork	9/23 and 9/24 1964	Plentiful spawning areas throughout the stream. Pool:Riffle 95:5 Generally poor shelter consisting of overhanging banks, boulders, logs, aquatic plants and overhanging aquatic plants.	Old Log JamsNone Complete.	Continue to manage for production of juvenile steelhead trout and coho salmon.
	5/17 and 18/1977	Summer flows are limited ; Pool: Riffle ratio 7:3; The majority of pools had little to no shelter; Shelter consisted of boulders, aquatic plants, logs, undercut banks, and overhead canopy	No barriers observed; Each summer a dam is constructed approximately ½ mile below the Wheatfield Fork.	
Marshall Creek	9/28/1964	Deposits of good spawning gravel exist throughout the stream from the mouth to the upper fisheries value; Pool: Riffle ratio 50:50; Good shelter provided by logs, boulders, undercut banks, roots, and trees.	No complete barriers	Should be managed as a steelhead trout and coho salmon spawning and nursery stream
Marshall Creek Tributary #3	9/28/1964	Very limited fisheries value; Watershed severely burned 10 years ago Lower half mile has spawning gravel available, but summer flow is very low.	Total barrier to fish a half mile above the mouth.	None
Marshall Creek Tributary #5	9/29/1964	Summer flows are limited. Some suitable spawning gravel directly above large log jams.	Over 40 log jams in a 1 mile stretch of stream; A number form complete fish passage barriers.	Remove log jams
McKenzie Creek	9/23 and 24/1964	Spawning areas fair to good in the lower 1/3 of stream, excellent in the middle section of stream, and fair in the upper 1/3 of stream; Pool: Riffle ratio 60:40; Good shelter provided by rocks and undercut banks.	7 partial barriers; Large 7 feet high 40 feet dam present 1/6 mile upstream from mouth; Large bedrock falls 1-1/4	Continue to manage as a coho salmon, steelhead trout spawning and nursery area; After removal of falls, possible planting of coho salmon to re-establish a self-supporting run.

Table 3-5
Summary of Historic (1964-1981) Stream Surveys Conducted in the Gualala River Watershed, California

Tributary	Date Surveyed	Habitat Comments	Barrier Comments	Management Recommendations
			miles upstream	
McKenzie Creek Tributary #6	10/1/1964	Streambed unsuitable for spawning except for the lower ½ mile of stream which is dry in the summer.	Impassable 10 feet falls ½ mile upstream from the mouth.	None
Palmer Canyon Creek	7/31/1981	Could become a good spawning area and nursery habitat for rainbow trout/steelhead trout if improved Occasional small isolated spawning areas separated by areas of boulders or heavily silted areas; Adequate vegetative cover, undercut banks and logs are present in the lower and mid sections of stream.	9 partial fish passage barriers; 2 complete fish passage barriers.	Needs removal of log jams, healing of eroded areas and stream bank cover in upper sections.

In response to the 1964 management recommendations, logging debris, log jams, and other woody materials were cleaned (cleared) from the streams by CDFG and the California Conservation Corps throughout the Gualala River Watershed in the 1970s and 1980s.

3.6.2 TARGET VALUES FROM HABITAT INVENTORY SURVEYS

Target Values from the Habitat Inventory Surveys (Flosi et al 1998)

Beginning in 1991, habitat inventory surveys were used as a standard method to determine the quality of the stream environment in relation to conditions necessary for salmonid health and production. Target values are provided in the *California Salmonid Stream Habitat Restoration Manual* for each of the individual habitat elements measured (Flosi et al. 1998) (Table 3-6). When habitat conditions fall below the target values, restoration projects may be required to meet critical habitat needs for salmonids.

Table 3-6
Habitat Inventory Target Values Taken from the *California Salmonid Stream Habitat Restoration Manual* (Flosi et al 1998)

Habitat Element	Canopy Density	Embeddedness	Primary Pool Depth/Frequency	Shelter/Cover
Range of Values	0-100%	0-100%	0-40%	Ratings range from 0-300
Target Values	>80%	>50% or greater of the pool tailed surveyed provides good spawning conditions	Depth - 1st and 2nd order streams >2 feet 3rd and 4th order streams >3 feet Frequency->40% of stream	>80

Canopy Density- 80 Percent or More of the Stream is Covered by Canopy

Near-stream forest density and composition contribute to microclimate conditions. These conditions help regulate air temperature and humidity, which are important factors in determining stream water temperature. Along with the insulating capacity of the stream and riparian areas during winter and summer, canopy levels provide an indication of the potential present and future recruitment of large woody debris to the stream channel. Revegetation projects should be considered when canopy density is less than the target value of 80 percent.

Good Spawning Substrate- 50 Percent or More of the Pool Tails Sampled are 50 Percent or Less Embedded

Cobble embeddedness is the percentage of an average sized cobble piece, embedded in fine substrate at the pool tail. The best coho salmon and steelhead trout spawning substrate are 0-50 percent embedded. Category 1 is defined by the substrate being 0-25 percent embedded. Category 2 is defined by the substrate being 26-50 percent embedded. Cobble embedded deeper than 51 percent is not within the range for successful spawning. The target value is 50 percent or greater of the pool tails sampled are 50 percent or less embedded, thus provides good spawning substrate conditions. Streams with less than 50 percent of their length greater than 51 percent embedded do not meet the target value or provide adequate spawning substrate conditions.

Pool Depth/Frequency- 40 Percent or More of the Stream Provides Pool Habitat

During their life history, salmonids require access to pools, flatwater, and riffles. Pool enhancement projects are considered when pools comprise less than 40 percent of the length of total stream habitat.

The target values for pool depth are related to the stream order. First and second order streams are required to have 40 percent or more of the pools over 2 feet to meet the target values. Third and fourth order streams are required to have 40 percent or more of the pools over 3 feet to meet the target values. A frequency of less than 40 percent or inadequate depths indicates that the stream provides insufficient pool habitat.

Shelter/Cover- Scores of 80 or Better Means that the Stream Provides Sufficient Shelter/Cover

Pool shelter/cover provides protection from predation and rest areas from high velocity flows for salmonids. Shelter/cover elements include undercut bank, small woody debris, large woody debris, root mass, terrestrial vegetation, aquatic vegetation, bubble curtain (whitewater), boulders and bedrock ledges. All elements present are measured and scored. Shelter/cover values of 80 or less indicates that shelter/cover enhancement should be considered.

3.6.3 CURRENT FISH HABITAT RELATIONSHIP

Habitat inventory surveys were conducted on a total of 26 streams. In 2001, CDFG conducted over 100 miles of habitat inventory surveys on 18 streams. These surveys were completed under the direction of NCWAP. Prior to NCWAP, approximately 15 miles of current habitat inventory data existed. This included four streams by Sotyome Resource Conservation District in 1995 and four streams inventoried by CDFG in 1999. Canopy density, embeddedness, primary pool depth/frequency and shelter cover are summarized in Table 3-7.

In the North Fork Subbasin, the Flosi, et al (1998) canopy cover target value was reached on Log Cabin Creek. All of the other streams surveyed in the North Fork Subbasin were close to the target value except Dry and Robinson creeks. Embeddedness target values were attained or exceeded on all tributaries except Doty and McGann creeks. The target values for Pool Frequency/Depth and Pool Shelter/Cover were not met on any of the streams surveyed.

In the Rockpile Subbasin, the canopy cover target value was not met on Rockpile Creek, the only stream surveyed in the Rockpile Subbasin. Embeddedness target values were reached on Rockpile Creek in the 8.5 miles surveyed. The target values for Pool Frequency/Depth and Pool Shelter/Cover were not met.

In the Buckeye Subbasin, the canopy cover target value was not met on Buckeye Creek, the only stream surveyed in the Buckeye Subbasin. Embeddedness target values were reached on Buckeye Creek. The target values for Pool Frequency/Depth and Pool Shelter/Cover were not met.

In the Wheatfield Subbasin, the canopy cover target value was met on Sullivan Creek. None of the other nine streams surveyed met the target value. House, Pepperwood, Sullivan, and Tombs creeks, and the Wheatfield Fork met the target values for embeddedness. The target values for Pool Frequency/Depth or Pool Shelter/Cover were not met in any of the streams surveyed.

In the Mainstem/South Fork Subbasin, the canopy cover target value was met on Palmer Canyon, Carson, and Camper creeks, and on surveyed reaches of the upper South Fork. The target values for Pool Frequency/Depth or Pool Shelter/Cover were not met in any of the streams surveyed.

Table 3-7
Summary of Current (1995, 1997, and 2001) Conditions Based Upon Habitat Inventory Surveys from the Gualala River Watershed, California
Condensed Tributary Reports are located in Appendix 6

Habitat Element Stream Name	Surveyed Length (feet).	Canopy Density Cover	Embeddedness	Primary Pool Depth/ Frequency	Shelter Cover Ratings
Target Values (Flosi et al 1998)		***>80%r***	***>50%***	***>40%***	***>80***
North Fork Subbasin	***111,758***				
Doty Creek	6,237	74%	25%	4%	36
Dry Creek	11,161	58%	70%	6%	32
Dry Creek Tributary #1	2,695	59%	51%	22%	30
Little North Fork	20,806	76%	83%	16%	54
Log Cabin Creek	1,698	83%	90%	1%	43
McGann Creek	1,980	76%	0%	3%	5
North Fork *(partial survey)*	59,362	78%	82%	29%	28
Robinson Creek	7,819	66%	65%	3%	70
Rockpile Subbasin	**44,500**				
Rockpile Creek	44,500	55%	52%	22%	41
Buckeye Subbasin	**51,085**				
Buckeye Creek	51,085	61%	68%	11%	44
Wheatfield Fork Subbasin	**289,627**				
Danfield Creek	2,103	49%	28%	5%	26
Fuller Creek (1995)	17,952	66%	3%	5%	25
North Fork Fuller Creek (1995)	14,275	68%	20%	13%	58
South Fork Fuller Creek (1995)	23,198	59%	28%	13%	37
House Creek	54,916	21%	70%	8%	15
Pepperwood Creek	17,931	19%	70%	16%	12
Sullivan Creek (1995)	5,015	89%	63%	7%	36
Tombs Creek	37,359	65%	55%	9%	51
Wheatfield Fork	116,878	45%	50%	25%	17
Mainstem/South Fork Subbasin	**57,218**				
Camper Creek (1999)	3,546	86%	70%	3%	25
Carson Creek (1999)	6,834	83%	50%	14%	19
Marshall Creek *(partial survey)*	21,698	55%	90%	13%	13
McKenzie Creek (1999)	3,801	69%	60%	18%	23
Palmer Canyon Creek	95	82%	65%	3%	12
Upper South Fork *(partial survey)*	8,451	96%	73%	5%	22
Wild Hog Creek	2,493	73%	52%	2%	8

3.6.4 CHANGES IN HABITAT CONDITIONS FROM 1964 TO 2001

Streams surveyed in 1964 and habitat inventory surveyed in 1995, 1999, and 2001 were compared to indicate changes between historic and current conditions. Data from the 1964 stream surveys provide a snapshot of the conditions at the time of the survey. Terms such as excellent, good, fair, and poor were based on the judgment of the biologist or scientific aid conducting the survey. The results of the historic stream surveys were qualitative and cannot be used in comparative analyses with the more quantitative data provided by the habitat inventory surveys, with any degree of accuracy. However, the two data sets may be compared to show general trends (Table 3-8). Data were not available to indicate habitat conditions prior to 1964, thus it is unknown if the conditions observed in 1964 showed a decline or improvement in habitat conditions.

According to aerial photographs, the canopy density of the 1960s was substantially reduced from the conditions observed in the 1940s. The canopy appeared to be low or absent in the 1960s in many parts of the watershed. Mid-20th-century timber operations and ranchland conversions removed riparian canopy cover, changing streambank exposure from about five percent in 1942 to a range of 40 to 70 percent bank exposure in the Gualala River Watershed by 1968. Bank exposure was lower in 1999, reduced to approximately 25 percent averaged throughout the watershed.

The Little North Fork and the North Fork mainstem (North Fork Subbasin) were both surveyed in 1964 and 2001. The canopy cover increased substantially, indicating improved conditions over those observed in the 1960s aerial photographs. The 2001 spawning substrate conditions may have improved on the Little North Fork and remained or returned to the same conditions observed in 1964. The 2001 spawning substrate improved on the upper reach and remained the same on the lower reach of the North Fork compared to conditions observed in 1964. The 2001 primary pool frequency and shelter/cover appear to have decreased since 1964.

Historic data were unavailable for the Rockpile Subbasin because surveys were not conducted.

Buckeye Creek was surveyed in 1964 and 2001. The canopy cover appeared to have increased somewhat, but remained below target values, indicating some improvement toward a recovered condition since the 1960s aerial photographs. The 2001 spawning substrate conditions continued to provide the same acceptable conditions observed in 1964. The 2001 primary pool frequency and shelter/cover appear to have decreased since 1964.

House Creek and the Wheatfield Fork mainstem (Wheatfield Fork Subbasin) were surveyed in 1964 and 2001. Fuller Creek was surveyed in 1964 and 1995. The canopy cover on House Creek and the Wheatfield Fork appeared to have decreased or remained the same and remains below target values, indicating little or no improvement toward a recovered condition over those observed in the 1960s aerial photographs. Fuller Creek's canopy cover appears to have increased somewhat, but still does not meet target values, indicating some improvement toward a recovered condition. The spawning substrate on House Creek appears to have improved somewhat, while the Wheatfield Fork has remained or returned to the same conditions observed in 1964. Spawning substrate conditions appear to have decreased on Fuller Creek indicating a worsening of embeddedness possibly from upstream or upslope fine sediment. The 2001 primary pool frequency and shelter/cover decreased substantially since 1964 on Fuller Creek and the Wheatfield Fork. On House Creek, the primary pool frequency appear to have decreased while the shelter/cover values have remained inadequate.

Table 3-8

Comparison Between Historic Habitat Conditions Observed in 1964 with Current Habitat Inventory Surveys Based Upon Quantitative Measurements in 1995, 1999 and 2001 from the Gualala River Watershed, CA

Target Values (Flosi et al 1998): Canopy 80 Percent; Spawning Substrate Embeddedness <50 Percent; Primary Pool/Frequency 40 Percent; Shelter/Cover Value 100

Habitat Element Stream Names	1960s Canopy Cover Photos	2001 Canopy Density	1964 Spawning Substrate	2001 Spawning Substrate Embedded-ness	1964 Pool Depth/ Frequency	2001 Primary Pool/ Frequency	1964 Shelter Cover	2001 Shelter/ Cover Value	Change in Conditions from 1964 to 2001
North Fork Subbasin									
Little North Fork	Low or Absent	76%	Good	83%	50%	16%	Good	54	Increase in spawning substrate conditions. Decrease in pool habitat and shelter/cover.
North Fork	Low or Absent	78%	Excellent	82%	80%	29%	Good	28	No change in spawning substrate conditions. Decrease in pool habitat and shelter/cover.
Buckeye Subbasin									
Buckeye Creek	Low or Absent Replant	61%	Good	68%	50%	11%	N/A	44	Increase in spawning substrate conditions. No change in canopy conditions. Decrease in pool habitat and shelter/cover.
Wheatfield Fork Subbasin									
Fuller Creek (1995)	Low or Absent	66%	Fair	3%	70%	5%	Good	25	Decrease in spawning substrate and pool habitat and shelter/cover.
House Creek	Low or Absent	21%	Good	70%	70%	8%	Inadequate	15	Increase in spawning substrate. Decrease in pool habitat and shelter/cover.

Table 3-8

Comparison Between Historic Habitat Conditions Observed in 1964 with Current Habitat Inventory Surveys Based Upon Quantitative Measurements in 1995, 1999 and 2001 from the Gualala River Watershed, CA

Target Values (Flosi et al 1998): Canopy 80 Percent; Spawning Substrate Embeddedness <50 Percent; Primary Pool/Frequency 40 Percent; Shelter/Cover Value 100

Habitat Element Stream Names	1960s Canopy Cover Photos	2001 Canopy Density	1964 Spawning Substrate	2001 Spawning Substrate Embedded-ness	1964 Pool Depth/ Frequency	2001 Primary Pool/ Frequency	1964 Shelter Cover	2001 Shelter/ Cover Value	Change in Conditions from 1964 to 2001
Wheatfield Fork	Low or Absent	45%	Good	50%	75%	25%	Good	17	No change in spawning substrate. Decrease in pool habitat and shelter/cover.
Main stem /South Fork Subbasin									
Marshall Creek (*partial survey*)	Low or Absent	55%	Good	90%	50%	13%	Good	13	Increase in spawning substrate. Decrease in pool habitat and shelter/cover.
McKenzie Creek (1999)	Low or Absent	69%	Good	60%	60%	18%	Good	23	Increase in spawning substrate. Decrease in pool habitat and shelter/cover.
Upper South Fork (*partial survey*)	Low or Absent	96%	Good	73%	95%	5%	Poor	22	

Marshall Creek and the South Fork mainstem (Gualala Mainstem/South Fork Subbasin) were surveyed in 1964 and partial surveys were conducted in 2001. McKenzie Creek was surveyed in 1964 and 1995. The canopy cover increased substantially in the headwaters area of the South Fork, indicating improved conditions over those observed in the 1960s aerial photographs. On Marshall and McKenzie creeks, the canopy cover appears to have increased somewhat, but still does not meet target values, indicating some improvement toward a recovered condition. The 2001 primary pool frequency and shelter/cover have decreased substantially since 1964 on Marshall and McKenzie creeks. The headwaters area of the South Fork appears to have decreased in primary pool frequency since 1964, while the poor shelter/cover conditions have remained the same.

3.7 Fish History and Status

Current fish species of the Gualala River Watershed include coho salmon (silver) (H. Alden, pers comm. 2002; CDFG unpub 2002), steelhead trout, pacific lamprey, roach, coastrange sculpin, prickly sculpin, riffle sculpin (R. Kaye, pers comm. 2002) and three-spine stickleback. Above impassable barriers, resident populations of rainbow trout exist (Cox 1989). Species inhabiting the coastal lagoon/estuary include starry flounder, staghorn sculpin (Brown 1986) and Pacific herring (R. Kaye, pers comm. 2002) (Table 3-9).

Historic anecdotal accounts cite eulachon in the estuary and Sacramento sucker in the main stems of both Buckeye Creek and Wheatfield Fork (Higgins 1997). Snyder (1907) did not observe Sacramento suckers on the Wheatfield Fork. Juvenile Chinook (king) salmon specimens were caught prior to 1945 indicating that they were present at that time (D. Fong pers. comm.). It is unknown if eulachon, Sacramento sucker or Chinook salmon inhabit the watershed today.

Table 3-9
Current Fish Species in the Gualala River Watershed, California

Common Name	Scientific Name
Anadromous	
Coho salmon	*Oncorhynchus kisutch*
Steelhead trout	*Oncorhynchus mykiss*
Pacific lamprey	*Lampetra tridentata*
Freshwater	
Gualala Roach	*Lavinia symmetricus parvipinnis*
Coast range sculpin	*Cottus aleuticus*
Prickly sculpin	*Cottus asper*
Riffle sculpin	*Cottus gulosus*
Threespine stickleback	*Gasterosteus aculeatus*
Marine or Estuarine	
Surf smelt	*Hypomesus pretiosus*
Pacific herring	*Clupea pallasii*
Staghorn sculpin	*Leptocottus armatus*
Starry flounder	*Platicthys stellatus*

3.7.1 Salmonid Population

In assessing salmonid populations, data are collected through various methods: mark and recapture, creel census, juvenile trapping and electrofishing. The data are then analyzed to arrive at a population estimate backed by statistical confidence intervals. Accurate population estimates include some enumeration of the whole or selected portion of the population. Population estimates made without data or by relating one watershed's precipitation, latitude and longitude, and comparing it with better-studied streams of similar size are not credible and cannot be used to establish trends. The National Marine Fisheries Service (NMFS 2001) cites using at least two complete life cycles to indicate a trend.

Salmonid population data is limited for the Gualala River Watershed. Anecdotal evidence suggests that coho salmon and steelhead trout populations on the Gualala River were large and experienced a decline prior to the 1960s. After World War II ended in 1945, the Gualala River became a popular place to fish for coho salmon, steelhead trout, and possibly chinook salmon, based on the 200-300 percent increase in fishing pressure (Taft 1946). The increased fishing pressure indicated that the coho salmon and steelhead trout populations were large in the 1940s. In 1952, electrofishing below the confluence of the North Fork showed healthy population conditions based on the length frequencies of the fish captured (Kimsey 1952). Bruer (1953) wrote that there were millions of young steelhead trout and coho salmon in the Gualala River Watershed.

Although accurate coho salmon population estimates were never conducted, stream surveys indicated that the coho salmon population began to decline prior to the 1960s. Stream surveys from 1964 recommended stocking coho salmon to reestablish viable self-supporting runs in streams with pre-existing populations. This stocking indicated a shift from the large, fishable, population of the 1940s toward the need to reestablish a viable population in the 1960s, further establishing that the coho salmon population declined during the 1950s. In 1956, adverse logging conditions and past improper practices had done considerable damage to the headwaters (Fisher 1957). This was primarily in the form of old logjams, debris and siltation. Coho salmon stocking began in 1969. By 1970, 120,000 coho salmon fingerlings had been stocked; 30,000 of these close to the time when stream surveys were conducted throughout the watershed. Coho salmon were observed in most of the tributaries surveyed, however it is not known whether they were native or hatchery stock. Over the next 30 years, another 347,780 hatchery coho salmon were stocked in the Gualala River Watershed. From the 1995-1998 brood years, 45,000 were planted in the Little North Fork (Figure 3-11). Even with the extensive planting coho salmon had not been regularly observed in the Gualala River Watershed, except in the North Fork Subbasin. Coho salmon were not detected in electrofishing in 2001, and possibly are extirpated from the Gualala River Watershed (Coho Salmon Status Review 2001). In September 2002, young-of-the-year coho salmon were observed in the North Fork Subbasin during snorkel surveys on Dry Creek, a tributary to the North Fork, and in two sites on the Little North Fork and Doty Creek during electrofishing surveys (Table 3-10).

Starting in the 1940s and continuing today, steelhead trout have been actively fished on the Gualala River. In 1945, a summer juvenile steelhead trout closure was ordered to protect juvenile salmonids. This closure remained in effect until 1982. Bruer (1953) stated that the Gualala River was a prime steelhead trout and coho salmon stream and should be used to provide recreation for hundreds of anglers. By 1956, the Gualala River continued to sustain a good steelhead trout population despite the damage to the headwaters. Fishing pressure continued to increase through the early 1970s. In spite of the increased pressure, the steelhead trout catch was less than in the 1950s, probably due to smaller steelhead trout populations. During the 1970s, CDFG efforts focused on a program to enhance sport fishing on the Gualala River. CDFG began planting steelhead trout in 1970, and by 1976, 83,220 were planted. Using mark and recapture techniques on the mainstem of the Gualala River, two credible steelhead trout population estimates were made in 1975-76 and 1976-77. The populations were estimated at 7,608 in 1975-76 and 4,324 in 1976-77 with 95 percent confidence intervals. From 1983 to 1989, 301,770 steelhead trout were planted in the Gualala River. In 1989, a population estimate of 69.5 juvenile steelhead trout per 1000 square feet was calculated for one location on Fuller Creek, a tributary to the Wheatfield Fork. In 1990, 41,300 steelhead trout were planted in the Gualala River. From 1993-1997 and 1999-2000, the Gualala River Steelhead Project rescued 37,030 steelhead trout, of which 20,328 were released. Steelhead trout young-of-the-year and older were observed in all ten of the tributaries electro fished in September 2001. During the 2001 fishing season, local angler and long time Gualala CDFG Warden Ken Hofer reported that the steelhead trout run was the largest seen in over seven years.

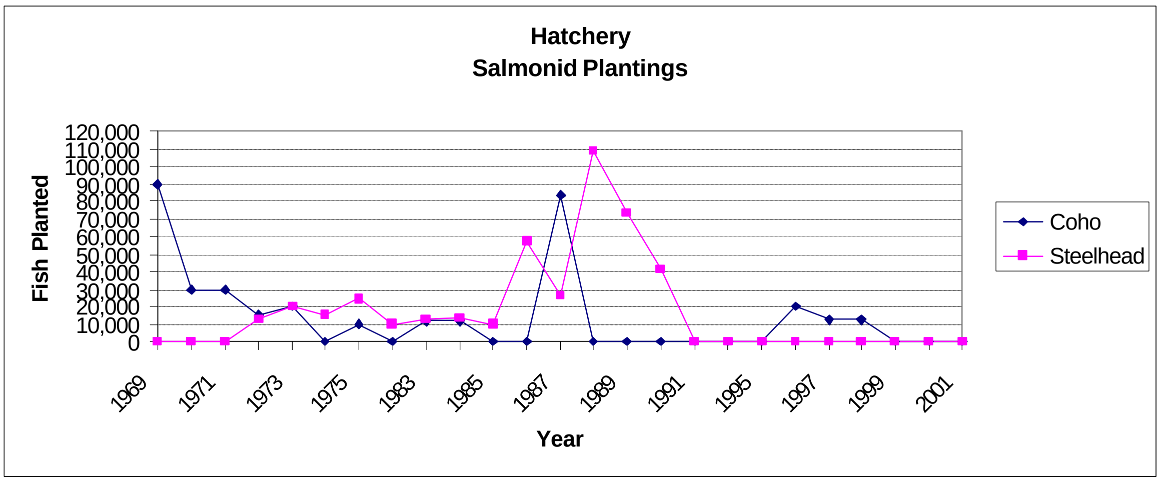

Figure 3-11
Stocking Records from 1969-99 for Coho Salmon and Steelhead Trout in the Gualala River Watershed, California

Table 3-10
Coho Salmon and Steelhead Trout Data Summary by Decade, Gualala River Watershed, California

Decade	Coho Salmon	Steelhead Trout
1940s	A.C. Taft, chief of the Bureau of Fish Conservation, noted that the fishing pressure on the Gualala River increased 200-300% immediately after World War II ended in 1945.	A.C. Taft, chief of the Bureau of Fish Conservation, requested that the entire Gualala River and its tributaries be closed to fishing for small and immature steelhead trout and salmon. Upon his recommendation, the summer closure began in 1945 and remained until 1982.
1950s	In 1952, electrofishing below the confluence of the North Fork revealed that the length frequencies of the fish removed showed a healthy condition (Kimsey 1952). Bruer (1953) wrote that there are millions of young steelhead trout and coho salmon in the Gualala watershed.	During December 1954 through February of 1955, creel surveys were conducted to determine the quality of the steelhead trout fishery on the Gualala River. Five hundred and seven fish were checked. A total catch estimate of 1,352 fish for the season was extrapolated with data from a use count.

Table 3-10

Coho Salmon and Steelhead Trout Data Summary by Decade, Gualala River Watershed, California

Decade	Coho Salmon	Steelhead Trout
	In 1957, Fisher, cited that the adverse logging conditions and past improper practices had done considerable damage to the headwaters. This was primarily in the form of old logjams, debris and siltation. By 1959, the summer opening was not worth while for a person who must travel any distance (Kastner 1959).	In 1956, Fisher, concluded that the Gualala remained one of the better Region III steelhead trout streams. It appeared to sustain a good steelhead trout population despite the poor environmental conditions over a considerable portion of its headwaters. He speculated that unaffected tributary streams must have provided good spawning conditions.
1960s	Stream surveys were conducted in 1964. The species presence and relative abundance of salmonids were estimated from observations recorded while walking upstream along the banks. These surveys had no quantitative basis from which to estimate populations. Where coho salmon were observed during these stream surveys the management recommendations included “possible planting to re-establish a self supporting run” (Table 3-5). Based on CDFG’s management prescriptions of the time, this recommendation likely indicated that the native coho salmon populations were not self-sustaining prior to 1964. CDFG reported population estimates of 4000 coho salmon in 1965. This population estimate was made without any supporting data thus is not reliable. The estimate was ranked “C without data” the lowest quality rating designated by the California Fish and Wildlife Plan, Volume III. In 1969, 90,000 coho salmon were planted.	Steelhead trout were present during stream surveys in 1964. Only one creel census survey was conducted on January 24, 1962. The result of the survey showed 11 steelhead trout caught by 18 anglers. Total angler hours were 56.5 resulting in a catch-per-unit-effort of 0.20 fish/hour. CDFG reported steelhead trout population estimates of 16,000 in 1965. This population estimate was made without any supporting data, thus is not reliable. The estimate was ranked “C without data”, the lowest quality rating designated by the California Fish and Wildlife Plan, Volume III.
1970s	A 1970s U.S. Bureau of Reclamation study of the Gualala River stated that 75 miles of habitat were available to coho salmon in the Gualala Watershed (U.S. BOR 1974). The “available habitat” estimate was made by relating the Gualala watershed with better-studied streams of similar size and characteristics. This estimate was not substantiated through actual observation. Hatchery plants of coho salmon; 1970, *30,000*; 1971, *30,000*; 1972, *15,000*; 1973, *20,000*; 1975, *10,000*. Total number of coho salmon planted in the 70s, *105,000*. Some streams were surveyed in 1970 with methods similar to those conducted in 1964 (Table 3-5). It is not known how many of the coho salmon observed during these stream surveys were from the 120,000 planted in 1969-1970. No mention of marked or unmarked hatchery coho salmon were found in the planting records or stream reports In the mid-1970s, the CDFG’s Coastal Steelhead Project was conducted, in part, on the Gualala River, California. In 1972-73, the creel censuses began in November and resulted in high counts of coho salmon catches with 831 total coho salmon counted. All other years, the creel censuses began in December after the peak of the coho salmon run had passed. In the 1973-74 survey fifty-two coho salmon were counted, in the 1974-75 survey ten coho salmon were counted, in the 1975-76 survey ten coho salmon were counted and in the 1976-77 survey no coho salmon were counted.	A 1970s U.S. Bureau of Reclamation study stated that 178 miles of habitat were available to steelhead trout in the Gualala Watershed (U.S. BOR 1974). Some streams were surveyed in 1970 with methods similar to those conducted in 1964 (Table 3-5). The steelhead trout observed during these stream surveys were assumed native as planting did not occur until 1972. The steelhead trout planted during the 1970s were 12,750 in 1972; 20,300 in 1973; 15,600 in 1974; 24,600 in 1975; and 10,070 in 1976, a total of 83,320. The Mad River Hatchery yearling steelhead trout were marked by a fin-clip. CDFG reports cite origins of brood stocks as Mad River Hatchery, South Fork Eel River and San Lorenzo River. In 1972-73, L.B. Boydstun, CDFG fish biologist, estimated that the fishing effort on the Gualala River had probably increased over 60% since the early 1950s, when the only other creel censuses were conducted. In spite of the increased pressure during the 1972-73 season, the steelhead trout catch was around 25% of what it was during the 1953-54 and 1954-55 seasons. He attributed the poor catch to smaller populations. During the 1972-73 creel census, 288 steelhead trout were caught. No recognizable hatchery fish from the spring planting in 1972 were observed. During 1975-76 and 1976-77, steelhead trout population estimates were made as part of a five-year study. This

Table 3-10

Coho Salmon and Steelhead Trout Data Summary by Decade, Gualala River Watershed, California

Decade	Coho Salmon	Steelhead Trout
	California Drought	study utilized creel census, use counts, adult tagging, and downstream migrant trapping in conjunction with the planting of steelhead trout. The goal of the project was to estimate winter adult steelhead trout populations, estimate angler harvest rates and evaluate the contribution of hatchery steelhead trout to the fishery. This program focused on enhancing the Gualala River as a sport-fishing stream. The steelhead trout population estimate was 7,608 in 1975-76 and 4,324 in 1976-77, 95% confidence intervals. Two years of data is not sufficient to establish a population trend. Adult steelhead trout population data does not exist after 1977. Harvest estimates were made at the end of the fishing seasons for each of the five years studied. In the 1972-73 season, 288 fish were surveyed. In 1973-74, 1682 steelhead trout were marked for possible recapture. In 1974-75, there were 793fish counted and in 1975-76, there were 1418 fish counted. Eleven percent of the fish surveyed in 1975-76 were hatchery fish, and a 20.3 % harvest rate was calculated. In the 1976-77 season, there was a 19.8% harvest rate with no hatchery fish recorded. No creel census results were documented from the 76-77 season. The surveys typically began in December. The 1972-73 survey began in November.
1980s	From 1985-1989, 102,000 coho salmon were planted.	From 1983-89, 301,770 steelhead trout were planted in the Gualala River. The year totals of steelhead trout planted were; 12,500 in 1983; 13,400 in 1984; 9,700 in 1985; 57,450 in 1986; 26,250 in 1987; 108,750 in 1988 and; 73,700 in 1989. Bag seines were employed five times during the years of 1984-1986, to sample the game and non game fishes of the Gualala River estuary. The purpose of this survey was to assess the impact of proposed water diversions on aquatic species, in general, and juvenile salmonids, in particular. On Robinson Creek, one station was three-pass electro fished and showed a steelhead trout density of 0.85 per meter. Since electrofishing data were collected only in 1983 on Robinson Creek, insufficient data exists in which to make comparisons. Three pass electrofishing data were collected on a lower and upper site in the Little North Fork in 1988 and 1989. The surveys resulted in an average steelhead trout density of 0.45 on the Little North Fork. In 1989, juvenile steelhead trout population on Fuller Creek (approx. 6 mile long, 3rd order stream) was estimated at 62 with a standard error of 8.599. Four stations were fished with a two or three pass depletion electro-fish method. These stations were located on South Fork and Mainstem of Fuller Creek. The intent of this survey was to assess the impacts from the upstream logging. Station 4 was upstream of the falls on the South Fork, where resident rainbow trout were observed. Young-of-the-year and one year and older steelhead trout, western roach, and three-spined

Table 3-10

Coho Salmon and Steelhead Trout Data Summary by Decade, Gualala River Watershed, California

Decade	Coho Salmon	Steelhead Trout
		stickleback were found during these surveys.
1990s	Over three years, 45,000 juvenile coho salmon from the 1995-1998 brood years were planted in the Little North Fork. The juveniles were from the Noyo River Egg Collecting Station run by CDFG in Fort Bragg, CA. During snorkel surveys, Gualala Redwoods, Inc. observed coho salmon young-of-the-year on the Little North Fork, Robinson and Dry Creek in 1998 Between July 1, 1999 and June 30, 2000, spawner and electrofishing surveys were conducted on the Little North Fork Gualala River. These surveys were conducted to determine whether the planting of coho salmon during the 1996-98 periods was effective. No coho salmon were found. .	In 1990, a total of 41,300 steelhead trout were planted in the Gualala River. Since1993, the Gualala River Steelhead Project rescued steelhead trout juveniles from streams in danger of drying up during the summer months. Rescued fish are kept in two Doughboy pools at the hatchery on Doty Creek, a tributary to the Little North Fork of the Gualala River. The fish are released in the North Fork Subbasin and main stem Gualala River after the first substantial winter rains increase stream flows. From 1993-1997 and 1999-2000, 37,030 steelhead trout have been rescued and 20,328 have been released. During 1990-93, 95, 98, 99 and 2000 three-pass electrofishing data were collected on a lower and upper site in the Little North Fork. No effort was recorded in 1990-1992. Both sites showed small fluctuations in young-of–the year populations. Both sites showed a slight increase in one year old fish from 1995-2000. Two year and older steelhead trout numbers were identical at the lower site and slightly increased at the upper site from 1998-2000. In 1995, one-pass electrofishing surveys were conducted on Fuller Creek and South Fork Fuller Creek. Young of the year, year plus and two year plus steelhead trout were observed. The results were not comparable to the 1989 survey, due to differences in sampling techniques. Gualala Redwoods, Inc. conducted snorkel surveys in 1997, 1998 and 1999. In 1997-98, one year and older steelhead trout were observed in Buckeye Creek and South Fork. In 1998, one year and older steelhead trout were observed in the Wheatfield Fork. In 1999, one year and older steelhead trout were observed in Little North Fork, Robinson Creek, North Fork and Doty Creek.
2000	Robinson Creek and Dry Creek were surveyed in 1999, 2000, and 2001, no coho salmon were found (CDFG unpubl. data) Historical coho salmon streams listed by Brown and Moyle (1991) were electro-fished in September, 2001. The method used was the modified ten-pool protocol (Attachment D). The streams electro-fished were North Fork, Doty Creek, South Fork, Franchini Creek, Wheatfield Fork, Haupt Creek, Tombs Creek, House Creek, Pepperwood Creek and Marshall Creek. This survey was specifically aimed at establishing coho salmon presence in the streams sampled. Coho salmon were not found in any of the streams surveyed. <u>Coho Salmon Status Review</u> (2001) stated no known	Between July 1, 1999 and June 30, 2000, spawner and electrofishing surveys were conducted on the Little North Fork, a tributary to the North Fork by CDFG. These surveys were conducted to determine whether the planting of coho salmon during the three-year period of 1995/96-1997/98 were effective. In 2000-2001, 7,600 and 5,450 steelhead trout were planted on the North Fork between Elk Prairie and Dry Creek. During snorkel surveys, Gualala Redwoods, Inc. observed one year and older steelhead trout on: Little North Fork, Robinson, North Fork, and Dry Creek in 2000 and 2001; on the mainstem of Buckeye Creek in 2000 and 2001; and on the South Fork in 2000 and 2001.

Table 3-10
Coho Salmon and Steelhead Trout Data Summary by Decade, Gualala River Watershed, California

Decade	Coho Salmon	Steelhead Trout
	remaining viable coho salmon populations in the Gualala River system. In September 2002, coho salmon young-of-the year were present on Dry Creek, a tributary of the North Fork during a snorkel survey and two sites on the Little North Fork and Doty Creek during electrofishing. Coho young-of-the-year were present on McGann Creek, rescued and released (R. Dingman, pers. comm.)	February-April 2001, a volunteer effort steelhead trout spawning surveys observed redds on Wheatfield Fork, Tombs Creek, Britain Creek, House Creek, and South Fork. Redds were observed on Rockpile Creek in 2001 (K. Morgan, pers. comm).

3.7.2 STOCKING OF COHO SALMON AND STEELHEAD TROUT

In the past, stocking of hatchery-raised salmonids was regularly employed to supplement declining stocks and/or to enhance sport-fishing quality. Coho salmon and steelhead trout were stocked on the Gualala River for both of these reasons. Coho salmon stocking began in 1969 and continued until 1999. A total of 342,000 were planted over 30 years. Steelhead trout were stocked as part of sport fishing enhancement projects. Steelhead trout stocking began in 1972 and continued until 1990. Additionally, from 1993 to the present at least 37,030 steelhead trout have been rescued and raised by the Gualala River Steelhead Project, at least 20,328 steelhead trout were released (one year of data is missing). A total of 444,530 steelhead trout were planted over 29 years (Figure 3-13).

3.7.3 SALMONID RANGE OR DISTRIBUTION

Distribution relates to any species' given range at the time the information was collected. Changes in fish distribution result from changes in water and habitat conditions from natural and human-caused impacts, and as a result of over-harvesting, on both a localized and global scale.

The distribution of coho salmon has changed substantially over the past 32 years in the Gualala River Watershed. Coho salmon were known to be distributed in four of the five subbasins, inhabiting 10-15 tributaries (Table 3-11). In 1995, coho salmon were observed in Robinson and Dry creeks (both are tributaries to the North Fork) (Gualala Redwoods, Inc. 2001). Brown and Moyle (1991) did not include Robinson or Dry Creeks as historically containing coho salmon.

Table 3-11
Historic Coho Distribution (Brown and Moyle 1991)

Subbasin	North Fork	Rockpile	Buckeye	Wheatfield Fork	Main Stem South Fork
Tributaries	North Fork Doty Creek Little North Fork	No data available or not surveyed	Franchini Creek	Wheatfield Fork Fuller Creek North Fork Fuller Creek South Fork Fuller Creek Haupt Creek	South Fork Marshall Creek Sproule Creek McKenzie Creek

During 1998 snorkel surveys, coho salmon young-of-the-year were observed on Robinson Creek, a tributary to the North Fork (Gualala Redwoods, Inc.)

For the NCWAP and the CDFG *Coho Salmon Status Review* (CDFG 2001), the known historic coho salmon streams and additional habitat inventoried streams were electro fished to determine presence using the Ten Pool Protocol in 2001 (Preston et al. 2001). The North Fork, Franchini Creek, Wheatfield Fork, Haupt Creek, House Creek, Pepperwood Creek, Danfield Creek, Tombs Creek, Marshall Creek, and the South Fork were electro fished. Coho were not observed on any of these streams.

In 2002, coho salmon were found on Dry Creek, Doty Creek and on the Little North Fork (Gualala Redwoods, Inc. unpub. 2002; CDFG unpub. 2002). The Gualala River Steelhead Project rescued and relocated 163 young-of-the-year coho salmon from McGann Creek during May, June and July 2002 (R. Dingman, pers. comm). The current distribution of coho salmon appears restricted to the North Fork Subbasin in tributaries of both the North Fork and Little North Fork (Table 3-12).

Table 3-12
Current 2001-2002 Coho Salmon Distribution in the Gualala River Watershed, California
(Gualala Redwoods, Inc. and CDFG unpub data 2002)

Subbasin	North Fork	Rockpile	Buckeye	Wheatfield Fork	Main Stem South Fork
Tributaries	Doty Creek Dry Creek Little North Fork McGann Gulch	Not surveyed	Not surveyed	Not surveyed	Not surveyed

Since 1995, coho salmon have been observed in only Robinson and Dry creeks (both are tributaries to the North Fork) (Gualala Redwoods, Inc. 2001). Brown and Moyle (1991) did not include Robinson or Dry creeks as historically containing coho salmon. As a part of the Gualala NCWAP and Coho Salmon Status Review project (CDFG 2001), the listed historical coho salmon streams were surveyed by electrofishing in 2001. Coho salmon were not observed in any of their historic tributaries during electrofishing surveys in September 2001. In 2002, coho salmon were observed on Dry Creek, Doty Creek and on the Little North Fork (Gualala Redwoods, Inc. unpub. 2002).

The historic distribution of coho salmon based upon bank observations during CDFG stream surveys in 1964 and 1970 (Figure 3-12).

From the mid 1950s to the mid 1960s the most substantial tractor logging occurred. During this period extensive damage was inflicted on the watershed, particularly to the streams and the headwaters of the streams. The resulting debris accumulations and log jams created fish passage barriers, reducing the distribution of steelhead trout in the Gualala River Watershed.

Table 3-13
Historic Steelhead Trout (*Oncorhynchus mykiss*) Distribution Based Upon CDFG Stream Surveys from 1960s and 1970s in the Gualala River Watershed, California

Subbasin	North Fork	Rockpile	Buckeye	Wheatfield Fork	South Fork
Tributary Streams	North Fork Dry Creek Robinson Creek Little North Fork Doty Creek	No surveys conducted	Buckeye Creek Franchini Creek	Wheatfield Fork Fuller Creek North Fork Fuller Creek South Fork Fuller Creek House Creek Britain Creek Danfield Creek Jim Creek Sugarloaf Creek Patchett Creek	South Fork Marshall Creek Sproule Creek McKenzie Creek Palmer Canyon Creek Haupt Creek

No data exist to confirm the steelhead trout distribution prior to the mid 1950s-60s logging era. Slash and log jams located in both tributaries and headwater areas were well documented in the 1964 and 1970 stream surveys. This logging debris created barriers to fish passage, thus reducing steelhead trout distribution from its potential pre-logging range.

Steelhead trout distribution in the Gualala River Watershed does not appear to have changed over the past 37 years. This conclusion is based on comparison of stream surveys from 1964 and 1970 and the habitat inventory and electrofishing surveys of 2001 (Table 3-13). Sugarloaf and Patchett Creeks were not surveyed in 2001. Young-of-the-year, one year old and older steelhead trout were observed in all tributaries surveyed. Young-of-the-year steelhead trout were the most numerous age class observed. The 10 Pool Protocol (Preston et al, 2001) was used during the 2001 electrofishing surveys. Population and age class estimates cannot be determined from the resulting data.

3.7.4 Fish Restrictions, Acts, Protections

Due to declining north coast populations, NMFS listed coho salmon under the federal Endangered Species Act (ESA) in 1996. Steelhead trout are currently listed as threatened under the federal ESA. The “threatened” status restricts river sport fishing for steelhead trout on Gualala River. The winter steelhead trout fishery of the Gualala River is currently managed as a catch and release fishery from November 1 to March 31. Only barbless hooks may be used. One hatchery trout or one hatchery steelhead trout may be taken. The summer fishery currently spans from the fourth Saturday of May to October 31. Only artificial lures may be used and no fish may be taken. The legal fishing limits are on the Main Stem (South Fork) of the Gualala River from the mouth, at the Pacific Ocean, to the confluence of the Wheatfield and South forks. Contact CDFG for current regulations.

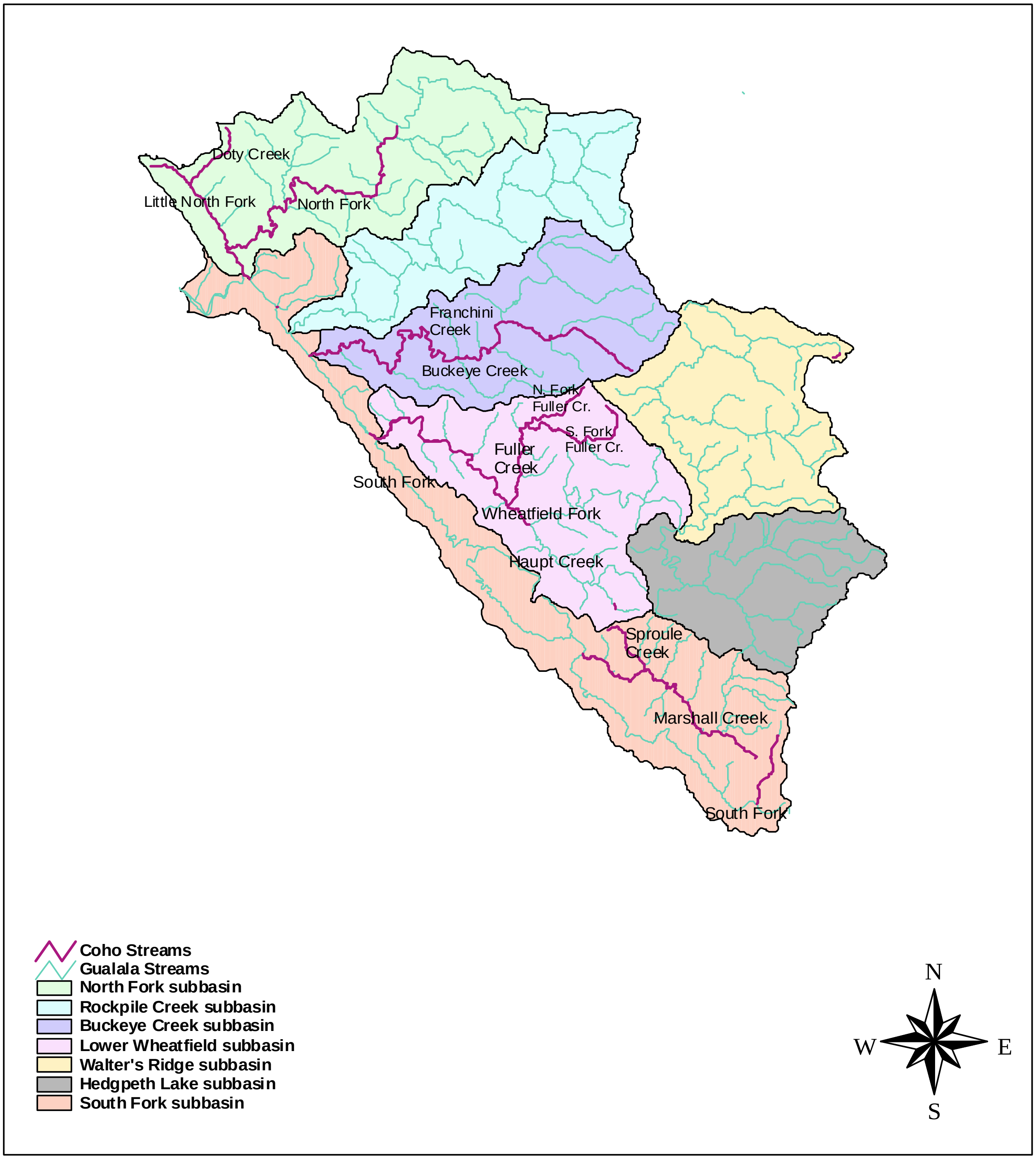

Figure 3-12

Historic coho salmon (*Oncorhynchus kisutch)* distribution based on CDFG stream reports from pre-planting in 1964 and post-planting 1970 in the Gualala River Watershed, California. The coho salmon young-of-the-year observed on Robinson Creek (1998) and Dry Creek (1998 and 2002) were not included on this map.

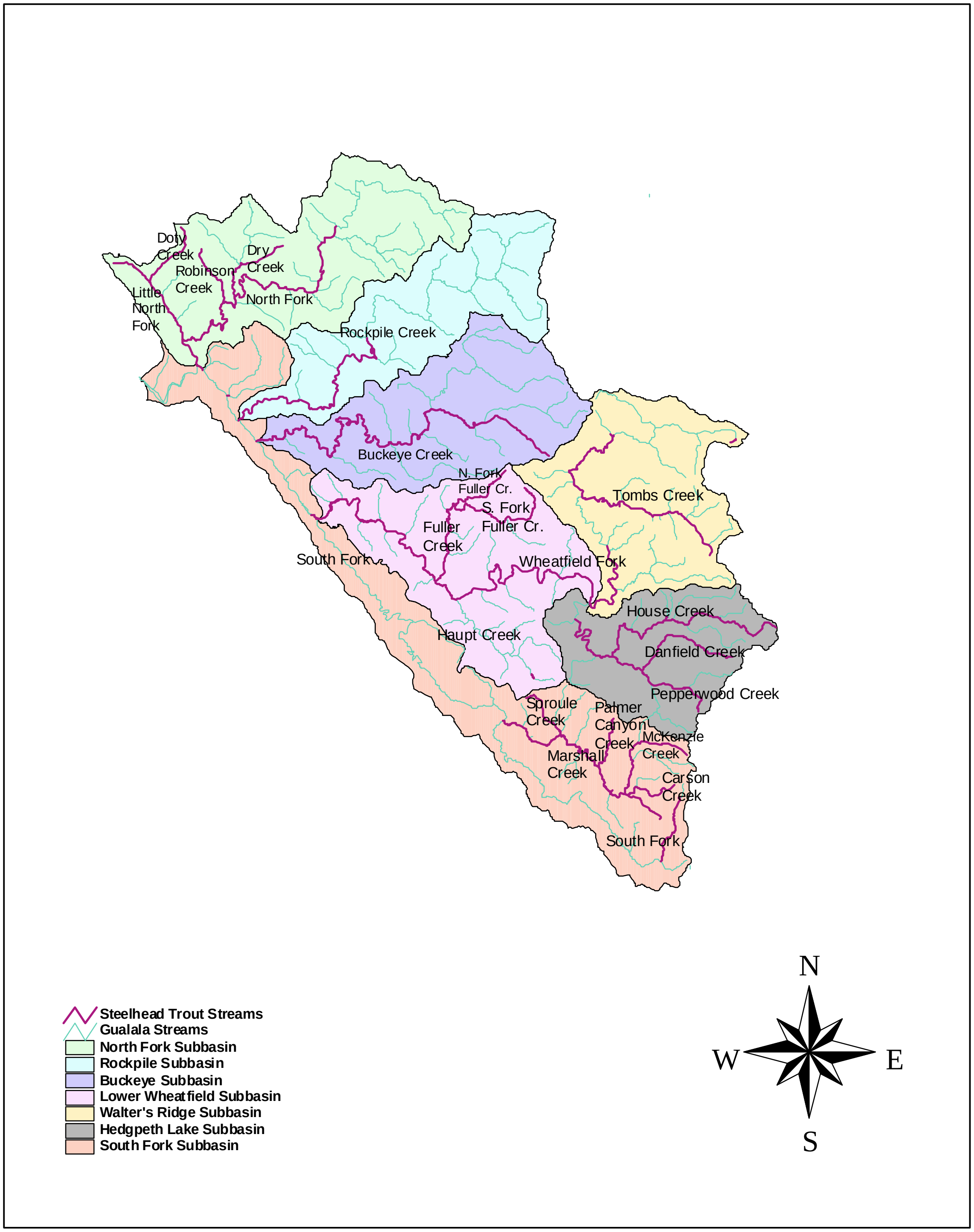

Figure 3-13

Current observed steelhead trout (*Oncorhynchus mykiss*) distribution based on observations (1970-present), and CDFG habitat inventories and electrofishing surveys in 1995, 1999, and 2001 in the Gualala River Watershed, California.

3.7.5 SPECIAL-STATUS SPECIES

The Gualala River is part of the Central California Coast (CCC) coho salmon Evolutionary Significant Unit (ESU). Coho salmon are listed as endangered under both the State and federal Endangered Species Act in the Central California Coast ESU. Most abundance trend indicators for streams in the CCC coho salmon ESU indicate a decline since the late 1980s. However, some streams of the Mendocino County coast show an upward trend in 2000 and 2001. Time-series analysis for these streams showed a declining trend and predicts that this trend will continue, despite the recent increases. However, these populations are more vulnerable to extinction due to their small size, and the spatial isolation of this region due to extirpation of coho salmon populations to the north and south. Coho salmon populations in streams in the northern portion of this ESU seem to be relatively stable or are not declining as rapidly as those to the south. However, the southern portion, where widespread extirpation and near-extinctions have occurred, is a major and significant portion of the range of coho salmon in this ESU. Small population size along with large-scale fragmentation and collapse of range observed in data for this area indicate that metapopulation structure may be severely compromised and remaining populations may face increased threats of extinction because of this. For this reason, the CDFG concludes that CCC coho salmon are in serious danger of extinction throughout all or a significant portion of their range (Coho Salmon Status Review 2001).

3.7.6 OTHER FISH AND AQUATIC ORGANISMS

Historically, the presence of non-game fish species was recorded with varying degrees of accuracy during stream surveys and electrofishing surveys. Observations of these species were made with little attempt to count their numbers or document their presence. Rough-Skinned Newt (*Torch granulose*), Pacific Giant Salamander (*Dicomptodon ensatus*), and Yellow-Legged Frogs (*Rana boyii*) were observed during electrofishing and habitat inventory surveys (Table 3-14).

Table 3-14
Non-salmonid aquatic species documented in the Gualala River Watershed, California.

North Fork Subbasin	Rockpile Creek Subbasin	Buckeye Creek Subbasin	Wheatfield Fork Subbasin	South Fork Subbasin
Gualala Roach		Yellow Legged Frog	Gualala Roach	Gualala Roach
Three-Spine Stickleback		Pacific Giant Salamander	Three-Spine Stickleback	Three-Spine Stickleback
Prickly Sculpin			Prickly Sculpin	Prickly Sculpin
Sculpin			Coast Range Sculpin	Sculpin species
Pacific Lamprey			Pacific Lamprey	Pacific Lamprey
Pacific Giant Salamander			Yellow-Legged Frog	Yellow-Legged Frog
			Rough Skinned Newt	
			Turtles	
			Garter Snakes	