

## Prairie Creek Subbasin

The Prairie Creek Subbasin includes the May Creek and Lost Man Creek planning watersheds and a large portion of the Skunk Cabbage Creek Planning Watershed. Prairie Creek drains approximately 40 square miles of the northwestern portion of the Redwood Creek basin and joins Redwood Creek near river mile 3.5. (Figure IV- 10). Most of the Prairie Creek watershed (98%) is in public lands managed by the Redwood National and State Parks (RNSP) (Table IV- 12). The RNSP is a World Heritage Site and is part of the California Coast Range Biosphere Reserve, designations that reflect worldwide recognition of the parks' natural resources as irreplaceable.

Prairie Creek and its eight major tributary streams support populations of Chinook salmon, coho salmon, steelhead, and coastal cutthroat trout. Much of the upper watershed of Prairie Creek and Little Lost Man Creek watersheds are relatively undisturbed areas. These areas retain old growth forest characteristics and provide some of the highest quality fisheries habitat within the Redwood Creek basin.

*Table IV- 12. Prairie Creek Subbasin summary.*

|                             |                |
|-----------------------------|----------------|
| Square Miles                | 39.59          |
| Total Acreage               | 25,339         |
| Private Acres               | 463            |
| Federal Acres               | 18,247         |
| State Acres                 | 6,629          |
| Predominant Land Use        | Park Land      |
| Predominant Vegetation Type | Redwood Forest |
| Miles of Anadromous Stream  | 24             |
| Low Elevation (feet)        | 26             |
| High Elevation (feet)       | 2,270          |

### Geology

This Prairie Creek Subbasin appears domed and uplifted across a broad zone extending from Orick northward to the town of Klamath. Major drainages trend northwest (e.g., Skunk Cabbage Creek, Squashan Creek, etc.); subsidiary drainages are nearly perpendicular to the trend of the major drainages and are oriented to southwest and west-southwest. The stream orientations may be controlled by a set of fractures in the underlying bedrock.

The Grogan fault zone trends southwest of and parallel to Squashan Creek and the fault may control the location of the creek. However, the fault zone is covered in this area by deposits of the Prairie Creek Formation. The Pliocene-Pleistocene Prairie Creek Formation dominates the bedrock exposures west of Highway 101. The Prairie Creek Formation is moderately cemented sand and gravel deposited at the ancestral mouth of the Klamath River. Other sub parallel structural features (faults or lineaments) may influence the locations and orientations of Fern Canyon, Little Lost Man Creek, and Prairie Creek.

The major drainages on west side of Prairie Creek generally have gentle gradients at their heads and flat-floored valleys. Stream profiles steepen towards the modern Redwood Creek channel rather than flattening downstream as is more typical of drainage profiles. This pattern appears to be in response to the regional deformation.

Hanging valleys visible along Gold Bluffs provide geomorphic evidence of headward erosion and stream capture. Some of the drainages along the coastal bluffs west of Highway 101 have seasonal waterfalls. Main drainages do not appear to be actively moving sediment at this time because there is little incision except around the periphery as the system starts to adjust to lower base level.

Drainages east of Highway 101 are steeper and underlain by the Coherent unit of Lacks Creek. Outcrops at higher elevation have been uplifted along a normal fault (Kelsey 1989, unpublished mapping), and Franciscan Complex rocks are exposed below the Prairie Creek Formation in the eroded fault scarp.

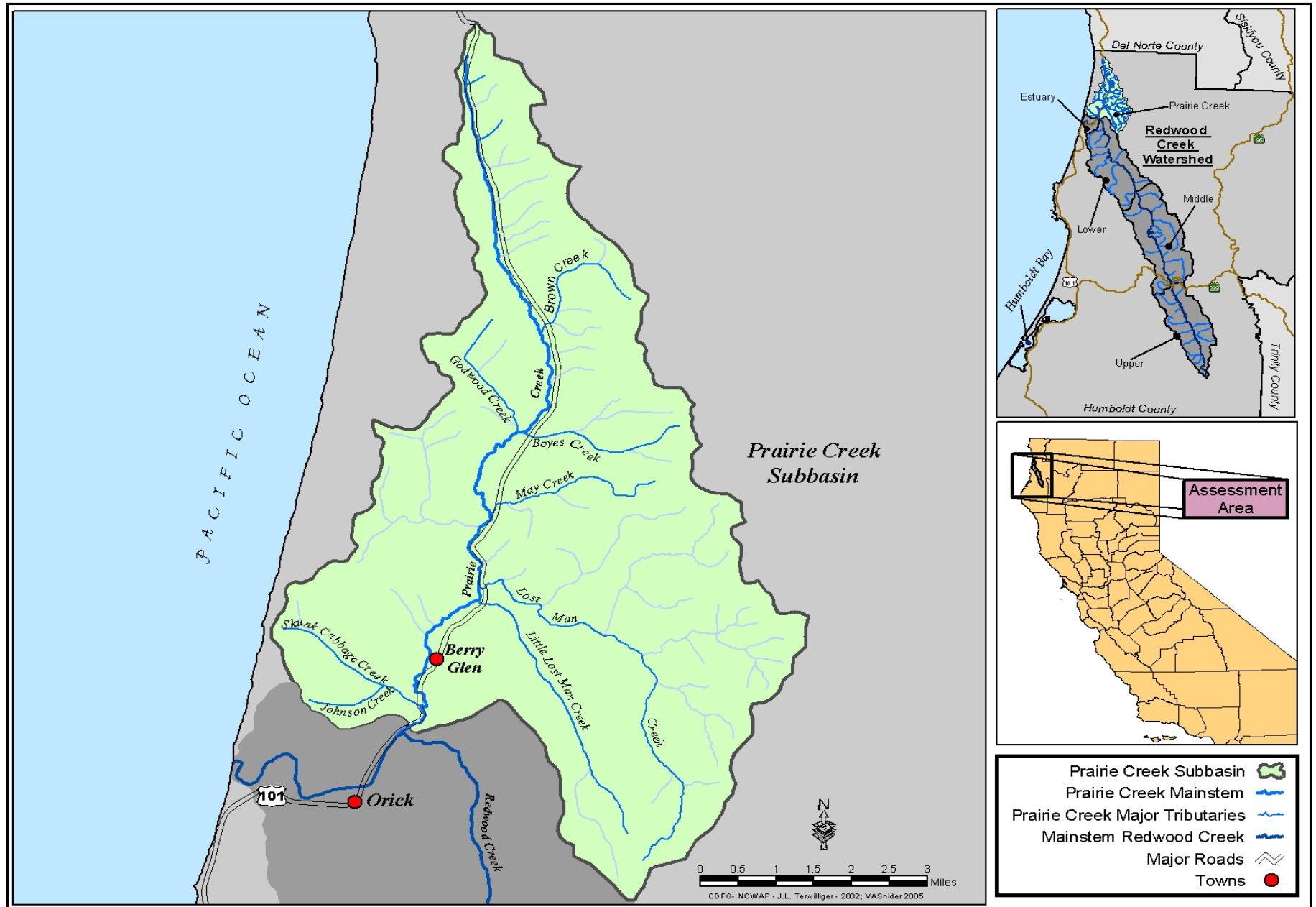


Figure IV- 10. Prairie Creek Subbasin and its tributaries.

Mass wasting features, particularly debris slides, are common in the Prairie Creek Formation (QTpc). Steeper terrain & debris slide slopes are present in the southern half of the subbasin. This difference may be caused by a change in the underlying bedrock. Occasional inner gorges are present near the lower portions of the slopes east of Highway 101.

The southeast portion of the drainage contains numerous rotational landslides and earth flows and is largely underlain by the Coherent unit of Lacks Creek (KJfl). An excessive amount of sediment made its way into the system as a result of the Highway 101 bypass construction. Exposed sandy fills were highly susceptible to erosion, and roadway sanding during icy conditions in the winter continues to pose a major sedimentation problem. Channel bottoms are naturally fine grained because of the sandy parent material and the low channel gradients. The highway activities probably have exacerbated this situation.

While over half of the Prairie Creek Subbasin falls within the high- to very high mass wasting potential category, historically active features account for less than 1.5% of the subbasin area (Table IV- 13). This information is also presented in map form in Plates 1 and 2 in the CGS geology appendix. Debris slides and debris flows are the primary modes of failure, and this is usually in steep areas underlain by the Prairie Creek Formation. Large dormant landslides and earthflows occupy only 8% of the area and most of these are in the portion of the subbasin underlain by the north facies of the incoherent unit of Lacks Creek (Plate A, Sheet 1, CGS appendix).

Table IV- 13. *Prairie Creek Subbasin summary of relative landslide potential and landslide features.*

| Factors                                      | Prairie Creek Subbasin |            | Planning Watersheds |             |               |             | Skunk Cabbage Creek Drainage |              |
|----------------------------------------------|------------------------|------------|---------------------|-------------|---------------|-------------|------------------------------|--------------|
|                                              |                        |            | Area (acres)        | % of Area   | Area (acres)  | % of Area   |                              |              |
| Relative Landslide Potential                 | Acres                  | % Area     | Acres               | % Area      | Acres         | % Area      | Acres                        | % Area       |
| Very Low                                     | 3,492                  | 13.8       | 1,627               | 12.8        | 1,664         | 14.8        | 201                          | 14.2         |
| Low                                          | 3,017                  | 11.9       | 1,672               | 13.2        | 1,214         | 10.8        | 131                          | 9.2          |
| Moderate                                     | 4,565                  | 18.0       | 2,106               | 16.6        | 2,167         | 19.3        | 292                          | 20.6         |
| High                                         | 9,480                  | 37.5       | 4,288               | 33.8        | 4,538         | 40.5        | 654                          | 46.1         |
| Very High                                    | 4,750                  | 18.8       | 2,980               | 23.5        | 1,628         | 14.5        | 142                          | 10.0         |
| High/Very High Subtotal                      | 14,230                 | 56         | 7,268               | 57          | 6,166         | 55          | 796                          | 56.1         |
| <b>Grand Total</b>                           | <b>25,304</b>          | <b>100</b> | <b>12,673</b>       | <b>100</b>  | <b>11,211</b> | <b>100</b>  | <b>1,420</b>                 | <b>100.0</b> |
| Landslide and Selected Geomorphic Features   | Acres                  | % Area     | Acres               | % Area      | Acres         | % Area      | Acres                        | % Area       |
| Historically Active Landslide Features Total | 348                    | 1.4        | 279                 | 2.2         | 69            | 0.6         | 0                            | 0.0          |
| Earthflow                                    | 13                     | 0.1        | 12                  | 0.1         | 1             | 0.0         | 0                            | 0.0          |
| Rock Slide                                   | 25                     | 0.1        | 16                  | 0.1         | 9             | 0.1         | 0                            | 0.0          |
| Debris Slide                                 | 161                    | 0.6        | 157                 | 1.2         | 4             | 0.0         | 0                            | 0.0          |
| Debris Flow                                  | 148                    | 0.6        | 94                  | 0.7         | 55            | 0.5         | 0                            | 0.0          |
| Selected Geomorphic Features Total           | 2,493                  | 10         | 1,454               | 11.5        | 1,040         | 9.3         |                              |              |
| Disrupted Ground                             | 355                    | 1          | 355                 | 2.8         | 0             | 0.0         |                              |              |
| Debris Slide Slope                           | 2,067                  | 8          | 1,083               | 8.5         | 985           | 8.8         |                              |              |
| Inner Gorge (area)                           | 71                     | 0          | 16                  | 0.1         | 55            | 0.5         |                              |              |
| <b>Dormant Landslide Features Total</b>      | <b>2,022</b>           | <b>8</b>   | <b>1,758</b>        | <b>13.9</b> | <b>169</b>    | <b>1.5</b>  | <b>95</b>                    | <b>6.7</b>   |
| <b>Total of all above features</b>           | <b>4,863</b>           | <b>19</b>  | <b>3,490</b>        | <b>27.5</b> | <b>1,278</b>  | <b>11.4</b> | <b>95</b>                    | <b>6.7</b>   |

### Streamside Landslides

Table IV- 14 presents information on the number of streamside landslides for the Prairie Creek Subbasin, which decreased 82% between 1984 and 2000. The decrease mostly reflects improvement in the Lost Man Creek planning watershed, which has the bulk of the streamside landslides found in the subbasin. The May Creek planning watershed also had fewer active streamside landslides in 2000 as compared to 1984.

Table IV- 14. *Prairie Creek Subbasin number and indices of streamside slides by subbasins and planning watersheds in 1984 and 2000.*

| Subbasin or Planning Watershed<br>Unit of Analysis | Analysis<br>Unit Area<br>(sq. km.) | 1984 # of<br>Active*<br>Slides<br>Along<br>Streams | 2000 # of<br>Active*<br>Slides<br>Along<br>Streams | 1984<br>Indexed**<br>Active<br>Slides | 2000<br>Indexed**<br>Active<br>Slides | % Change<br>1984-2000 |
|----------------------------------------------------|------------------------------------|----------------------------------------------------|----------------------------------------------------|---------------------------------------|---------------------------------------|-----------------------|
| Prairie Creek Subbasin                             | 96.9                               | 92                                                 | 17                                                 | 95                                    | 18                                    | -82                   |
| Lost Man Creek                                     | 51.4                               | 86                                                 | 12                                                 | 167                                   | 23                                    | -86                   |
| May Creek                                          | 45.5                               | 6                                                  | 5                                                  | 13                                    | 11                                    | -17                   |

\*\*Index = (# slides/analysis unit area) X 100

## Vegetation

Vegetation within the Prairie Creek Subbasin consists almost entirely of conifers (Table IV- 15 and Figure IV- 11). These conifer stands are, for the most part, two different types. Areas of old growth redwood and Douglas-fir occupy most of the northern portion of the subbasin. Healthy, well-stocked second growth redwood forests are growing on the previously harvested lands in the subbasin. However, some of these second growth stands appear to be overstocked and may be losing vigor due to competition.

Table IV- 15. *Generalized cover type by subbasin and planning watershed.*

| Subbasin or Planning<br>Watershed | Cover Type  |        |         |               |                |       |           |       | Total  |
|-----------------------------------|-------------|--------|---------|---------------|----------------|-------|-----------|-------|--------|
|                                   | Agriculture | Barren | Conifer | Hard-<br>wood | Grass-<br>land | Shrub | Developed | Water |        |
| Prairie Creek Subbasin            | 0           | 132    | 24,173  | 604           | 387            | 36    | 27        | 0     | 25,359 |
| May Creek                         | 0           | 127    | 10,899  | 72            | 140            | 0     | 0         | 0     | 11,238 |
| Lost Man Creek                    | 0           | 5      | 13274   | 532           | 247            | 36    | 27        | 0     | 14,121 |

Redwood and redwood-Douglas-fir forest (21,999 acres in total) and Sitka Spruce-redwood forest (1,579 acres) comprise about 93% of the Prairie Creek subbasin. Douglas-fir forest covers just 51 acres, or less than 1% of the subbasin. One area (132 acres) classified as barren follows the newer section of Highway 101, commonly referred to as the “bypass.”

## Land Use

The great majority of lands within Prairie Creek Subbasin are managed by the RNSP. The RNSP land management strategies include: 1) perpetuation of the redwood forest and associated ecosystems as prime resources; 2) perpetuate ongoing natural influences on the basis of natural values and visitor use; and 3) protect threatened and endangered species and species of special concern (USDOI 1999). The private lands within the basin (approximately 460 acres) are in part used for livestock grazing

## Timber Harvest

Timber harvests and other land use in the Prairie Creek Subbasin began soon after the local gold rush of the 1850s. The size of the huge redwood trees made them prized timber. Large-scale logging was soon underway and the once immense stands of redwoods began to disappear by the close of the 19<sup>th</sup> century.

In the early 1920s, the Save-the-Redwoods League purchased approximately 14,000 acres, creating a sanctuary of old growth coast redwood in the upper Prairie Creek watershed. Logging continued in those parts of the forests that were privately owned, accelerated by increased demand for timber during WW II, and the economic boom of the 1950s. It wasn't until 1968 that Redwood National Park was established, which secured some of the few remaining stands of uncut redwoods. In 1978, Congress added more land that included logged-over portions of Redwood Creek. Today, these lands are undergoing large-scale restoration by the Park resource managers.

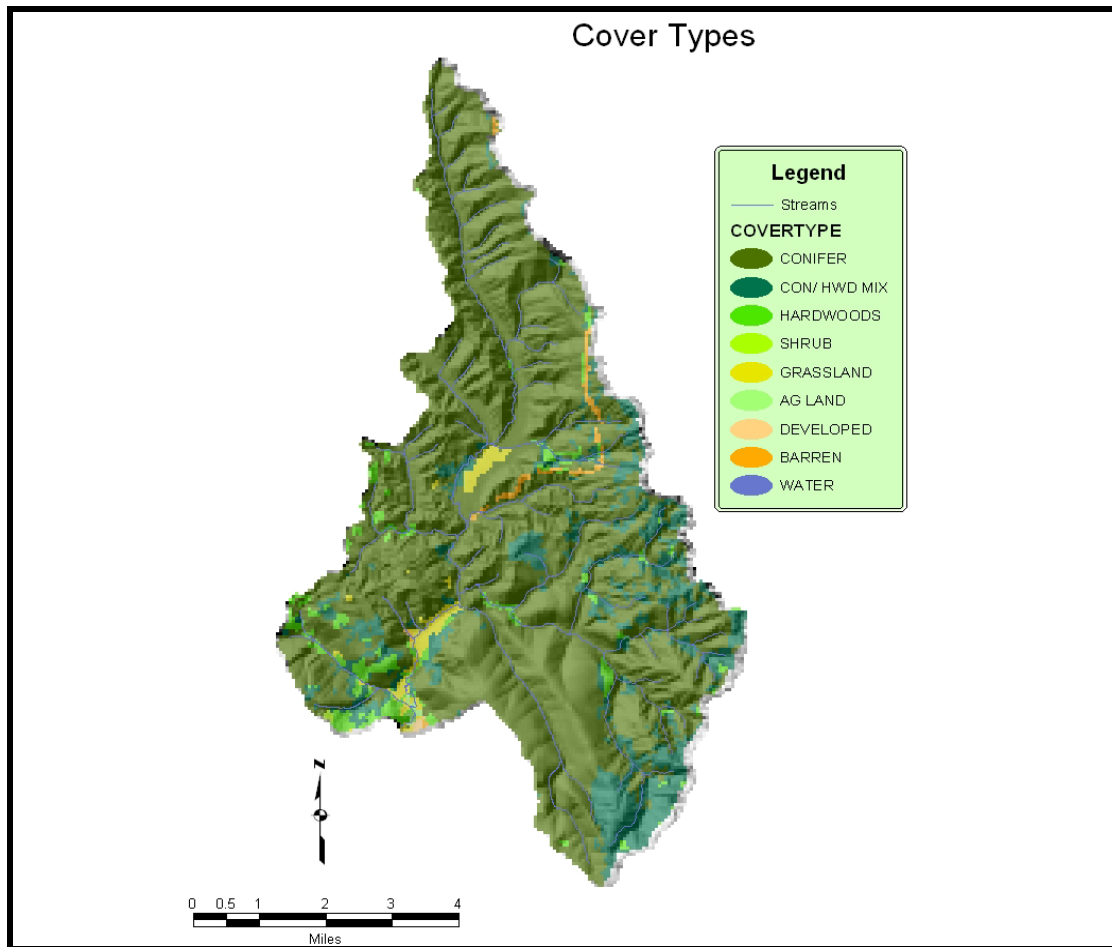


Figure IV- 11. Prairie Creek vegetation map showing cover types.

Before the expansion of Redwood National and State Park, over half of the watershed was logged. Timber harvests and associated road construction occurred in the May Creek, Boyes Creek, Lost Man Creek, and Skunk Cabbage Creek watersheds. Some early tractor logging started in the Prairie Creek Subbasin in the late 1930s, but did not become highly utilized until after World War II. By 1948 the use of tractors had become the primary mover during yarding operations.

A total of 13,542 acres were harvested within the private lands of Prairie Creek Subbasin from 1950 to 1978 (Table IV- 16, Figure IV- 12). Most the major harvest operations occurred between 1950 and 1964. These harvested areas now support stands of well-stocked young-growth forests. Approximately half of this area was partially logged. These areas now contain a mixed stand component of both old growth and second-growth trees.

With the Prairie Creek Subbasin now largely in state and national park ownership, there has been no timber harvest there since 1978. Approximately 460 acres in the subbasin, or about 1.8% of the area, is in private lands today. Any land use on these private lands should protect site-specific values of RNSP lands and consider potential cumulative effects to the subbasin.

Table IV- 16. Prairie Creek Subbasin timber harvest history, 1950-2000.

| Subbasin or Planning Watershed | Harvest Acres by Period |           |           |           |           |                 | Total Acres | Percent Harvested |
|--------------------------------|-------------------------|-----------|-----------|-----------|-----------|-----------------|-------------|-------------------|
|                                | 1950-1964               | 1965-1974 | 1975-1983 | 1984-1992 | 1992-2000 | Total Harvested |             |                   |
| Prairie Creek Subbasin         | 11,236                  | 1,387     | 919       | 0         | 0         | 13,542          | 25,305      | 53.5              |
| May Creek                      | 4,216                   | 59        | 378       | 0         | 0         | 4,653           | 11,243      | 41.4              |
| Lost Man Creek                 | 6,426                   | 1,288     | 475       | 0         | 0         | 8,189           | 12,704      | 64.4              |
| Skunk Cabbage Creek Drainage   | 594                     | 40        | 66        | 0         | 0         | 700             | 1,420       | 49.3              |

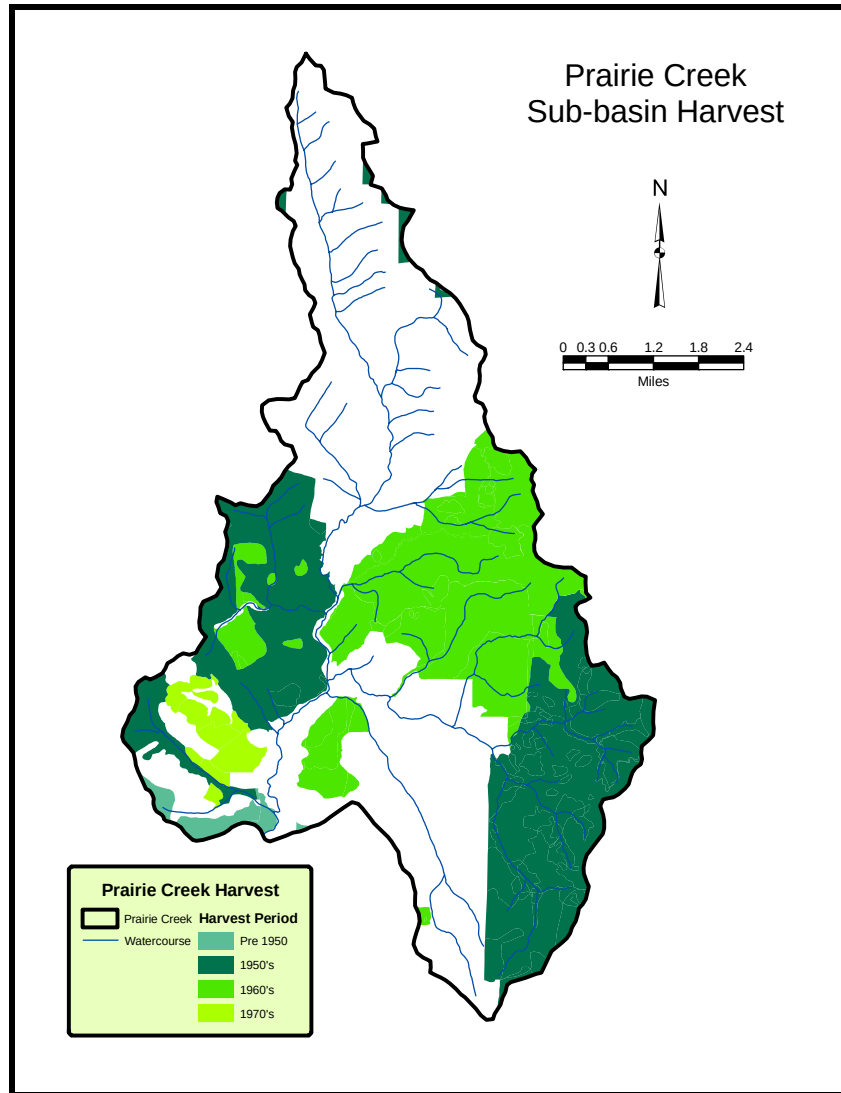


Figure IV- 12. *Prairie Creek Subbasin timber harvest.*

### Roads

The Prairie Creek Subbasin has an estimated 108 miles of roads, or a road density of 2.7 road miles per square mile. An estimated 42% of the road miles are on areas of high or very high relative landslide potential. The bulk of the roads (66 of 108 miles) are in the Lost Man Creek planning watershed, which gives the planning watershed a road density of 5.5 road miles per square mile. The Skunk Cabbage Creek drainage has the lowest road density of 0.8 road miles per square mile.

The majority of the roads in the May Creek, Prairie Creek, Skunk Cabbage, and Lost Man Creek watersheds were constructed before 1950. After 1950 haul road systems, for the most part, followed the drainages themselves. Landings, some quite extensive, were also built in or along the watercourse channel. Roads and landings built in or adjacent to streams create major sediment sources that can result in significant sediment in stream systems and result in significant adverse impacts to fish habitat. The Redwood National and State Parks have removed streamside roads in these areas.

Additional adverse impacts during the construction of the Highway 101 bypass in 1989 from roads occurred. Winter rains eroded exposed soils and delivered large amounts of fine sediments to the headwaters of Prairie Creek tributaries. Salmonid spawning and rearing habitat of Brown, Boyes, and May Creeks were affected by the event. The reach of Prairie Creek downstream of Boyes Creek to the confluence with Redwood Creek was also impacted by the sediment transported downstream from the tributaries.

## Fire and Fuels

Fuel ranks were developed for the Prairie Creek Subbasin (Table IV- 17 and Figure IV- 13). These rankings are based on vegetation and slope characteristics and rank potential fire behavior under an assumed constant set of weather conditions (see [http://www.frap.cdf.ca.gov/data/fire\\_data/fuels/fuelsfr.html](http://www.frap.cdf.ca.gov/data/fire_data/fuels/fuelsfr.html)). Given the relatively cool, damp, marine-influenced weather of the Prairie Creek Subbasin, the fuel rankings alone likely overstate the actual fire risk.

The subbasin is dominated by areas in the high fuel rank, with 80% of the area falling into that class. An additional 4% of the subbasin is modeled as having a very high fuel rank. Small pockets of very high rank exist throughout the subbasin, with the largest area in the southern corner of the Lost Man Creek Planning Watershed. The Skunk Cabbage Creek drainage has relatively lower fuel ranks compared to the Lost Man and May Creek planning watersheds. Only under rare, severe fire weather conditions would the fuel conditions in the Prairie Creek Subbasin pose as high a risk as their rankings imply.

Table IV- 17. Fuel ranks summary for Prairie Creek Subbasin and planning watersheds.

| Area of Analysis                  | Fuel Rank |    |        |    |           |   |            |    | Total Acres |
|-----------------------------------|-----------|----|--------|----|-----------|---|------------|----|-------------|
|                                   | Moderate  |    | High   |    | Very High |   | Not Mapped |    |             |
|                                   | acres     | %  | acres  | %  | acres     | % | acres      | %  |             |
| Prairie Creek Subbasin            | 3,869     | 15 | 20,267 | 80 | 955       | 4 | 277        | 1  | 25,368      |
| Lost Man Creek Planning Watershed | 2,290     | 18 | 9,708  | 76 | 648       | 5 | 59         | <1 | 12,705      |
| May Creek Planning Watershed      | 951       | 8  | 9,838  | 88 | 239       | 2 | 215        | 2  | 11,243      |
| Skunk Cabbage Creek Drainage      | 629       | 44 | 721    | 51 | 67        | 5 | 3          | <1 | 1,420       |

## Fluvial Geomorphology

Prairie Creek is the largest tributary to Redwood Creek. It occupies a narrow channel that is separated from a wide upper floodplain by clearly defined banks (Janda and others 1975). Streambed material is sandy-fine pebble gravel and accumulations of coarse organic debris have been described as sparse (Janda and others 1975). It flows southward along U.S. Highway 101 and drains approximately 40 square miles of redwood forest within RNSP and about 450 acres of privately owned land. Prairie Creek enters the mainstem Redwood Creek about a mile north of Orick.

The subbasin contains low-gradient streams having equal proportions of response and transport reaches. About 41% of the streams are response reaches and 43% transport reaches, 15% of the total reaches have channel gradients less than 1%, and 16% are source reaches steeper than 20% (Table IV- 18). Much of the subbasin, with its low-gradient streams, provides anadromous salmonid habitat.

Table IV- 18. Percent of stream length by stream gradient classes.

| % Stream by Gradient    | Prairie Creek Subbasin | Planning Watersheds |                 | Skunk Cabbage Creek Drainage |
|-------------------------|------------------------|---------------------|-----------------|------------------------------|
|                         |                        | Lost Man Creek      | May Creek       |                              |
|                         | % stream length        | % stream length     | % stream length | % stream length              |
| < 1% (Response Reach)   | 14.7                   | 17.2                | 12.2            | 77.4                         |
| 1-4% (Response Reach)   | 25.5                   | 13.4                | 37.6            | 6.8                          |
| 4-20% (Transport Reach) | 43.8                   | 54.2                | 33.3            | 11.6                         |
| >20% (Source Reach)     | 16.0                   | 15.2                | 16.9            | 4.3                          |

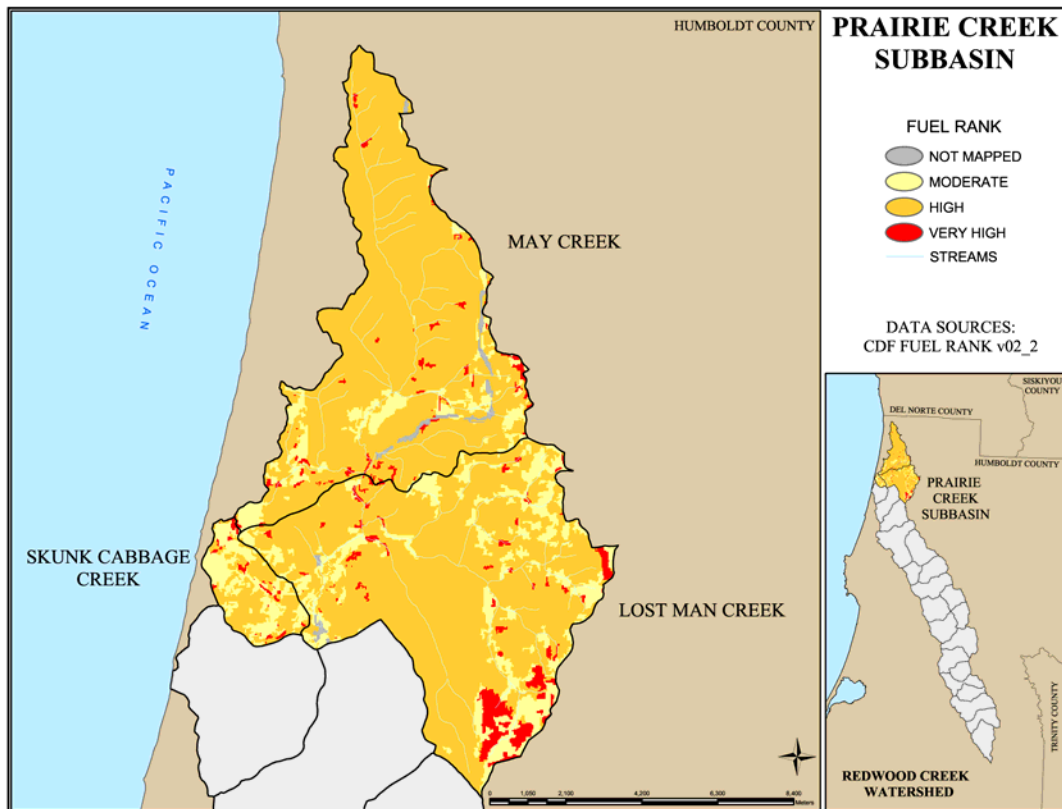


Figure IV- 13. Fuel ranking map of the Prairie Creek Subbasin.

### Stream Disturbance

CGS mapped what appeared to be a thousand-foot reach of widened channel in Prairie Creek, just above its confluence with May Creek from air photos taken in 2000. This feature may be an accumulation of sediment that was contributed at least in part by the 1989 storm and consequent erosion of fine sediment from construction activities along the Highway 101 bypass.

However, between 1984 and 2000, negative stream features such as lateral bars, wide channels, and eroding banks decreased 88% from (3.13 mi to 0.37) miles by length in this subbasin (Table IV- 19). This is probably due to a lack of large storms and related erosion and a reduction of sediment inputs during the time interval, as well as to downstream transport of elevated sediment from previous storms. Overall the subbasin showed improvement in the 16-year period.

Table IV- 19. Length of negative stream features, negative stream feature index, and percent change for 1984 to 2000.

| Subbasin or Planning Watershed Unit of Analysis | Analysis Unit Area (sq. km.) | Negative Features 1984 (m) | Negative Features 2000 (m) | Indexed Negative Features 1984* | Indexed Negative Features 2000* | % Change 1984-2000 |
|-------------------------------------------------|------------------------------|----------------------------|----------------------------|---------------------------------|---------------------------------|--------------------|
| Prairie Creek Subbasin                          | 96.9                         | 5,035                      | 603                        | 52                              | 6                               | -88                |
| Lost Man Creek                                  | 51.4                         | 4,565                      | 279                        | 89                              | 5                               | -94                |
| May Creek                                       | 45.5                         | 470                        | 324                        | 10                              | 7                               | -31                |

\* Index = (length of negative features in meters/area of unit of analysis in square kilometers)

## Water Quality

### Temperature

This subbasin contains optimal channel shade and climate conditions creating fully suitable water temperatures for salmonids. Existing data show maximum MWATs of 57°F at two locations on mainstem Prairie Creek from 1997-2001. Three tributaries to Prairie Creek had MWATs between 56 and 58°F with one recording of 64°F in

1974. The Prairie Creek subbasin is influenced by coastal fog and dense canopy cover provided by the redwood forest. Both the coastal climate and forest function to moderate air and water temperatures in the basin.

Maximum daily water temperatures recorded during the summers of 1997 through 2001 for the site in the Prairie Creek Subbasin ranged from 58 to 63°F (Table IV- 20). These readings did not approach the lethal limit of 75°F.

Table IV- 20. Prairie Creek Subbasin MWATs recorded between 1997 and 2001.

| Site ID             | Site                            | Subbasin | Period of Record | Max MWAT (°F) | Seasonal Maximum (°F) |
|---------------------|---------------------------------|----------|------------------|---------------|-----------------------|
| 10, Little Lost Man | Little Lost Man                 | Prairie  | 1974             | 57            |                       |
| 20, Lost Man        | Lost Man                        | Prairie  | 1974             | 64            |                       |
| 20, Lmc             | Lost Man                        | Prairie  | 2001             | 58            | 61                    |
| 30, Ldc             | Larry Dam Creek                 | Prairie  | 2000, 01         | 57            | 58                    |
| 3015                | Prairie Creek at Streelow Creek | Prairie  | 1997, 1999       | 59            | 61                    |
| 3016, prw           | Prairie Creek at Wolf Bridge    | Prairie  | 1997-98, 01      | 60            | 63                    |

### Water Column Chemistry

Eight tributary stations in the Prairie Creek subbasin were monitored by USGS between 1973 and 1977. Data for dissolved oxygen ranged from 8-13mg/L (water quality objective >8mg/L), pH ranged from 6 to 8.3 (water quality objective 6.5-8.5), and conductivity ranged from 20-130umhos (water quality objective <220umhos). Water quality samples taken in Prairie Creek and its tributaries indicate compliance with Basin Plan objectives and no noticeable trends were observed. An assessment of current water chemistry conditions in the Prairie Creek Subbasin is lacking due to the absence of data post 1977. See Appendix C for water chemistry data from Prairie Creek.

### In-Channel Sediment

Intensive fine and suspended sediment sampling occurred in Prairie Creek when the California Department of Transportation constructed a highway bypass (1988-90) around and through the watershed and for ten years after construction was completed. A storm in October 1989 eroded fine sediment from exposed areas along the construction site and large amounts of sediment entered Brown, Boyes, and May Creeks. Most of the monitoring from this incident developed from a violated water quality permit and was not a long-term sampling project to monitor and assess the health of Prairie Creek. Data collected under permit requirements showed that impacts to salmonid habitat did occur. Surveys by Welsh and Olliver (1998) in the affected streams found that densities of amphibians were significantly lower in the streams impacted by sediment compared to unaffected eastern tributaries of Prairie Creek of similar attributes. The same factors that may be decreasing stream amphibians could have hindered salmon production in these tributaries of Prairie Creek. The Highway 101 bypass sediment inputs may have also adversely effected salmonid egg survival during the early 90s. Meyer (1994) found that egg survival in the unaffected reach of Prairie Creek (located above Boyes Creek) was higher for both coho and Chinook during the 1991-93 water years compared to reaches that received sediments from the Highway 101 bypass construction. Detailed information about the Prairie Creek Highway 101 bypass project can be found in Rogers (1999), Coey (1998), Klein (1993), Roelofs (1999), Welsh (1999) and many others.

The only D<sub>50</sub> particle size data in the Prairie Creek sub-watershed obtained for this assessment resulted from a study performed from 1989 to 1991 by the RNSP to monitor the recovery of a dam removal on Lost Man Creek. Due to the specifics of the study and lack of exact spatial locations, the data were not assessed in this report. Most of the samples were taken from a disturbed area; thus the data are not representative of the stream itself, nor does it accurately reflect the status of salmonid spawning habitat in that reach. More information about this study can be obtained from the RNSP.

Existing data for subsurface fine sediment in the Prairie Creek watershed was sampled from Lost Man and Little Lost Man Creeks in 1974 and 1987. Woods (1975) took McNeil core samples in Lost Man and Little Lost Man Creeks and analyzed the samples volumetrically. The 1974 results for the size class <0.85mm from Lost Man Creek was less than 26% and less than 18% from Little Lost Man Creek. Samples from both creeks exceeded the TMDL target of less than 14% fines <0.85mm. Little Lost Man Creek was sampled again in 1987 by the

RNSP, however the samples were analyzed after they had been dried. The 1987 sample can not be compared to TMDL targets nor can they be compared to the 1974 sample due to the different methods of analysis.

## Salmonid Habitat Assessment

The Prairie Creek Subbasin supports populations of Chinook salmon, coho salmon, steelhead, coastal cutthroat trout, and other valuable fisheries resources. Streams of the Prairie Creek Subbasin provide approximately half of the tributary habitat (24 miles) available to anadromous salmonids in the Redwood Creek basin (Table IV-21). The Prairie Creek Subbasin is composed of a mix of old growth forest streams (upper Prairie Creek, Godwood Creek, Little Lost Man Creek) and streams impacted by logging, highway construction, and other land use (Lower Prairie Creek, Brown Creek, Boyes Creek, Lost Man Creek, and May Creek).

Table IV- 21. *Prairie Creek Subbasin streams, species present, and number of stream miles accessible to anadromous salmonid.*

| Stream                | Species Observed                                                                                                                             | Stream Length Access (mi.) | References                                                                                                                                                                   |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Prairie Creek         | Chinook salmon<br>Coho salmon<br>coastal cutthroat trout<br>steelhead trout<br>chum salmon (rare)<br>Pacific giant-salamander<br>tailed frog | 11.8                       | CDFG 2001 surveys, Klatte and Roelofs 1999-1997, Neillands 1990, Brown and Anderson 1988                                                                                     |
| Lost Man Creek        | Chinook salmon<br>Coho salmon<br>coastal cutthroat trout<br>Steelhead trout                                                                  | 2.9                        | CDFG 2001 & 1966 Stream Surveys, carcass surveys 1984-1992, RPN/USFS barrier study notes, Neillands 1990, Brown 1988                                                         |
| Little Lost Man Creek | Chinook<br>coho<br>coastal cutthroat<br>steelhead                                                                                            | 2.0                        | Klatte and Roelofs 1997, D.J. Manning, et al. 1996, USFS/RNP barrier study 1995, RNP/USFS-RSL revisit of 1981 thesis sites field notes, Neillands 1990, Brown 1988           |
| Brown Creek           | Chinook<br>coho<br>coastal cutthroat<br>steelhead<br>trout<br>pacific lamprey                                                                | 1.4                        | Klatte and Roelofs 1997, USFS/RNP barrier study 1995, Neillands 1990, Brown 1988, 1988 (referencing CDFG stream surveys)                                                     |
| Boyes Creek           | Chinook<br>coho<br>coastal cutthroat<br>steelhead                                                                                            | 0.9                        | Klatte and Roelofs 1997, Brown 1988, 1988 (referencing CDFG stream surveys and Chuck Warren personal communication)                                                          |
| Streelow Creek        | coho<br>coastal cutthroat<br>steelhead<br>cutthroat/steelhead<br>Pacific lamprey                                                             | 1.3                        | RNP/USFS-RSL revisit of 1981 thesis sites field notes, Neillands 1990, Brown 1988                                                                                            |
| Godwood Creek         | Chinook<br>coho<br>coastal cutthroat                                                                                                         | 2.8                        | CDFG 2002, Klatte and Roelofs 1997, Neillands 1990, Brown 1988,                                                                                                              |
| Skunk Cabbage Creek   | coho<br>steelhead                                                                                                                            | 0.6                        | Brown 1988                                                                                                                                                                   |
| May Creek             | coho<br>coastal cutthroat<br>steelhead<br>Pacific giant-salamander                                                                           | 0.4                        | CDFG, 1980 & 76 stream surveys, Klatte and Roelofs 1997, USFS/ RNP barrier study notes 1995, Neillands 1990, Brown 1988 (ref. CDFG surveys, C Warren personal communication) |

The Prairie Creek watershed has been the study area for several landmark reports, masters' thesis, and other studies of watershed conditions and fishery resources. Some of the earliest reports contain valuable descriptions of past habitat conditions and fishery resources.

## Past Surveys

CDFG stream surveys in May and Lost Man creeks show differences in stream habitat conditions and fish populations before and after logging activity. The surveys share a common theme, both streams declined in stream habitat quality and also declined in fish abundance after “poor logging practices.” Other streams of the Prairie Creek watershed that experienced timber harvests in the 1950s to the mid 1970s likely received similar impacts, as little or no protection was given to riparian and aquatic habitat systems. Changes found after logging included large increase in fine sediments in spawning gravels, numerous log jams, and a general reduction in the numbers of salmonids. Summaries of past stream surveys for May and Lost Man Creek are provided in Appendix D.

### *Present Surveys*

In 2001, CDFG Stream habitat survey protocols were used to collect data describing stream habitat conditions from nine sample reaches located in the Prairie Creek Subbasin. The sites were selected using an equal probability random tessellation stratified survey design to develop a set of spatially balanced sampling reaches for the Prairie Creek and lower subbasins (Olsen 2000) (Figure IV- 14). These data represent site-specific attributes and do not necessarily characterize the entire reach of any stream.

The entire anadromous reach of Godwood Creek was surveyed in 2002 using CDFG survey protocols according to Flosi et al. (1998). Results from select stream habitat components are summarized below. Abbreviated stream reports generated from surveys conducted in the Prairie Creek watershed and summary comparisons between past and present surveys are provided in Appendix D.

### *Stream Reach Characteristics*

#### *Pool:Riffle:Run Relationships*

**Significance:** Productive anadromous streams are composed of a balance of pool, riffle and run habitat. Each plays an important role as salmonid habitat. The number of pools or pool frequency can be measured as a ratio of the number of bank full widths (BFWs) per pool in a stream reach. Using this metric, pool to pool spacing in many redwood forest streams ranges from approximately 2 to 7 BFWs and is often controlled by LWD (Keller and MacDonald 1981). In straight and meandering streams, pools are also often spaced more or less regularly at a repeating distance of 5 to 7 BFWs (Leopold 1994). A potential problem with using this metric is that BFWs may be widened from disturbance associated bank erosion during recent flood events. Since pool spacing is influenced by BFW, pools may be less frequent than pre-disturbance conditions if channels have widened, but appear within desirable ranges relative to present conditions.

The mean bank full width (BFW) to pool ratio for all Prairie Creek Subbasin sample sites combined was 5:1. The mean ratio of pool: riffle: run occurrence was 34% pool, 33% riffle and 31percent run habitat (Table IV- 22). Together, these data suggest that the mean frequency of pool habitat in The Prairie Creek Subbasin is within desirable range for anadromous salmonid habitat. The mean percent length of pool, riffle, and run was 27: 35: 38 respectively, showing that the length of pool habitat is below the desired standard of 40% of stream length for anadromous fish habitat in Flosi et al. (1998). Individual sites listed in Table IV- 23 show the variation in stream reach characteristics among streams. Boyes Creek had the lowest percent of pools.



Figure IV- 14. Prairie Creek Subbasin Instream habitat sampling point.

Table IV- 22. Prairie Creek Subbasin bank full width (BFW) measured from sampling, site.

| Stream Reach                                        | Stream Order | Reach Length (feet) | Unit Count* | Estimated BFW (ft.) | BFW to Pool frequency ratio | Pool:Riffle:Run % occurrence | Pool:Riffle:Run % length | Dry % length |
|-----------------------------------------------------|--------------|---------------------|-------------|---------------------|-----------------------------|------------------------------|--------------------------|--------------|
| Boyce Creek Site 11                                 | 1            | 508                 | 21          | 12.5                | 10 : 1                      | 19 : 38 : 38                 | 17 : 27 : 52             | 4            |
| Brown Creek Site 10                                 | 1            | 512                 | 17          | 15.9                | 6 : 1                       | 29 : 47 : 24                 | 21 : 62 : 17             | 0            |
| May Creek Site 19                                   | 1            | 449                 | 16          | 12                  | 6 : 1                       | 38 : 31 : 31                 | 38 : 19 : 44             | 0            |
| Lost Man Creek Site 15                              | 2            | 634                 | 21          | 31.3                | 3 : 1                       | 32 : 32 : 27                 | 22 : 38 : 38             | 2            |
| Lost Man Creek Site 23                              | 2            | 962                 | 14          | 48                  | 3 : 1                       | 43 : 14 : 43                 | 14 : 5 : 81              | 0            |
| Lost Man Creek Site 5                               | 2            | 844                 | 17          | 45.6                | 2 : 1                       | 47 : 29 : 24                 | 44 : 34 : 23             | 0            |
| Trib to Lost Man Creek Site 13                      | 2            | 474                 | 15          | 19.2                | 5 : 1                       | 33 : 47 : 20                 | 28 : 47 : 25             | 0            |
| Prairie Creek Site 3                                | 3            | 568                 | 10          | 34                  | 4 : 1                       | 40 : 30 : 30                 | 40 : 40 : 20             | 0            |
| Prairie Creek Site 6                                | 3            | 544                 | 12          | 18                  | 10 : 1                      | 25 : 33 : 42                 | 20 : 40 : 40             | 0            |
| Mean values for Prairie Creek Subbasin sample sites |              | 611                 | 16          | 26                  | 5 : 1                       | 34 : 33 : 31                 | 27 : 35 : 38             | 0.7          |
| Godwood Creek                                       | 2            | 14,559              | 580         | 16                  | 7 : 1                       | 23 : 43 : 31                 | 26 : 45 : 26             | 3            |

\*Total number of pool, runs, and riffles counted.

### Pool Depth

**Significance:** Deep pools are important for adult salmonid holding areas during spawning migrations and as year round habitat for rearing juvenile salmonids. Quantifying the amount of deep pool habitat in a stream reach is a useful indicator to assess stream conditions. Lack of deep pools may indicate a disruption to channel forming processes and/or elevated levels of sediments. Generally, the desirable length of a coastal anadromous stream reach should consist of approximately 30 – 40% pools with moderate maximum depths. Moderate

maximum depths for the Redwood Creek streams are pools with maximum depths of from 2.0 to 2.5 feet for 1<sup>st</sup> and 2<sup>nd</sup> order streams, >3 feet for 3<sup>rd</sup> order streams and >4 feet deep for 4<sup>th</sup> order streams. These target values were developed to help assess the pool condition of anadromous salmonid habitat in typical North Coast California streams. However, shallow pool conditions are more likely in low gradient reaches within small watersheds that lack sufficient discharge to deeply scour the channel. Therefore, some smaller streams may not meet the general target values, but still provide important fish habitat.

Pools of the Prairie Creek Subbasin sample sites and Godwood Creek were often below target values for depth and percent of stream length in deep pools (Figure IV- 15). The deepest pools were found on undisturbed portions of Prairie Creek, and on a tributary to Lost Man Creek. The mean maximum depth for pools measured at sample sites were 1.8 ft. for 1<sup>st</sup> and 2<sup>nd</sup> order streams and 2.7 ft. for Prairie Creek (Table IV- 23).

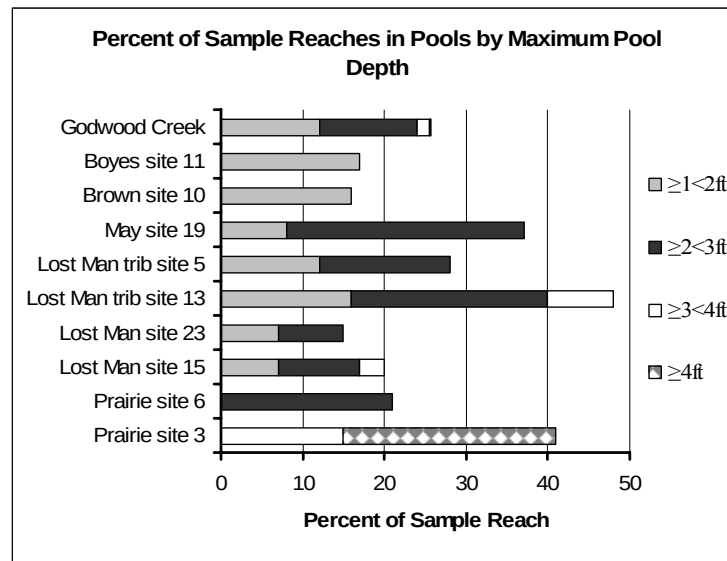


Figure IV- 15. Percent of sample reaches in pools grouped by maximum pool depth.

The sample size of pools shown in this figure range from four to eight pools per site. The sample reach length for each site is shown in Table IV- 23. The entire anadromous of Godwood Creek was surveyed.

Table IV- 23. Prairie Creek Subbasin mean maximum pool depths for sample reaches 2001 and Godwood Creek (2002).

| Prairie Creek Subbasin   | 1 <sup>st</sup> & 2 <sup>nd</sup> Order Streams | 3 <sup>rd</sup> Order Streams | Godwood Creek (2 <sup>nd</sup> Order) |
|--------------------------|-------------------------------------------------|-------------------------------|---------------------------------------|
| Mean Maximum Depth       | 1.8                                             | 2.7                           | 1.8                                   |
| Mode                     | 1.2                                             | 2.8                           | 1.2                                   |
| Minimum Max Depth        | 0.9                                             | 1.5                           | 0.7                                   |
| Maximum Depth            | 3.4                                             | 5.1                           | 4.2                                   |
| Standard Error           | 0.1                                             | 0.25                          | 0.05                                  |
| Number of Pools Measured | 32                                              | 15                            | 128                                   |

### Pool Shelter

**Significance:** Salmonid abundance in streams increases with the abundance and quality of shelter of pools (Meehan 1991). According to a CDFG survey protocol, pool shelter complexity is rated by a relative measure of the quantity and composition of LWD, root wads, boulders, undercut banks, bubble curtain, and submersed or overhanging vegetation (Flosi et al. 1998). These elements serve as instream habitat, create areas of diverse velocity, provide protection from predation, and separates territorial units to reduce density related competition. The ratings range from 0-300, with ratings of ≥100 considered good shelter values. They do not consider factors related to changes in discharge, such as water depth.

Pool shelter ratings at the sample sites and Godwood Creek were generally below the 100 target value (Flosi et al. 1998) (Figure IV- 16). Cover in the tributaries and mainstem of Prairie Creek are mostly provided by woody debris undercut banks, and boulders (Table IV- 24). Cover in the tributaries and mainstem of Prairie Creek are

mostly provided by woody debris and undercut banks. Boulders were dominant in the Lost Man Creek sampling sites.

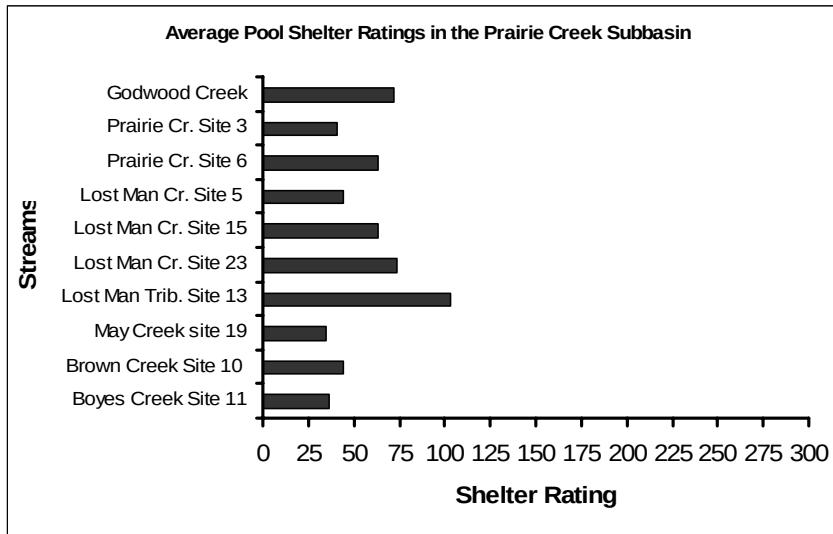


Figure IV- 16. Prairie Creek Subbasin average pool shelter ratings from CDFG sample reaches.

Average pool shelter ratings exceeding 100 are considered fully suitable and average pool shelter ratings less than 30% are unsuitable for contributing to shelter that supports salmonids.

Table IV- 24. Summary of mean percent cover.

| Sample sites             | Undercut Banks | Woody Debris | Terrestrial Vegetation | Aquatic Vegetation | White-water | Boulders | Bedrock Ledges |
|--------------------------|----------------|--------------|------------------------|--------------------|-------------|----------|----------------|
| Boyes Creek site 11      | 2              | 1            |                        |                    |             |          |                |
| Brown Creek site 10      | 1              |              |                        |                    |             | 2        |                |
| Godwood Creek            | 2              | 1            |                        |                    |             |          |                |
| Lost Man Ck site 23      |                | 2            |                        |                    |             | 1        |                |
| Lost Man Ck site 5       |                | 1            | 2                      |                    |             |          |                |
| Lost Man Ck site 15      |                | 2            |                        |                    |             | 1        |                |
| Lost Man Ck trib site 13 | 2              | 1            |                        |                    |             |          |                |
| May Creek site 19        | 2              | 1            |                        |                    |             |          |                |
| Prairie Creek site 3     | 1              | 2            |                        |                    |             |          |                |
| Prairie Creek site 6     | 1              | 2            |                        |                    |             |          |                |

Dominant (1) and Subdominant (2) Shelter Types in Pool and Flatwater Units in the Prairie Creek Subbasin. For details see figures in Appendix D.

### Streamside Canopy Density

**Significance:** Stream side canopy density is an estimate of the percentage of stream channel that is shaded by riparian tree canopy. An effective tree canopy provides shade to reduce direct sun light from warming water. Generally management to increase shade canopy including re-vegetation projects are considered when canopy density is less than 80% (Flosi et al. 1998). A second attribute of stream side canopy data is the percent of coniferous and deciduous tree species providing the shade. The percent coniferous and deciduous component of the stream side canopy influences the potential for LWD loading. Streams flowing through mature conifer stands tend to have larger amounts of wood with larger average piece size than streams with younger riparian stands, which often are dominated by smaller deciduous species (Bilby and Bisson 1998). LWD produced by conifers is generally favored over deciduous wood because it tends to be larger and less likely to move downstream, it decays more slowly, and stays longer in stream systems.

Overall, the stream side canopy density is suitable for providing shade over the sample sites within the Prairie Creek subbasin (Figure IV- 17). The coniferous component providing shade was low at the Lost Man, May, and Boyes creek sites compared to sites on Godwood and Brown creeks. The Lost Man, May, and Boyes creek sites were located within areas that were harvested for timber in the 1950s-1960s whereas the Godwood and Brown Creek sites are in un-harvested areas. These data suggest a relatively slow re-growth of coniferous trees after

timber harvests along riparian zones of Lost Man, May, and Boyes creek sites and may indicate a reduced potential for LWD inputs from conifers into these streams.

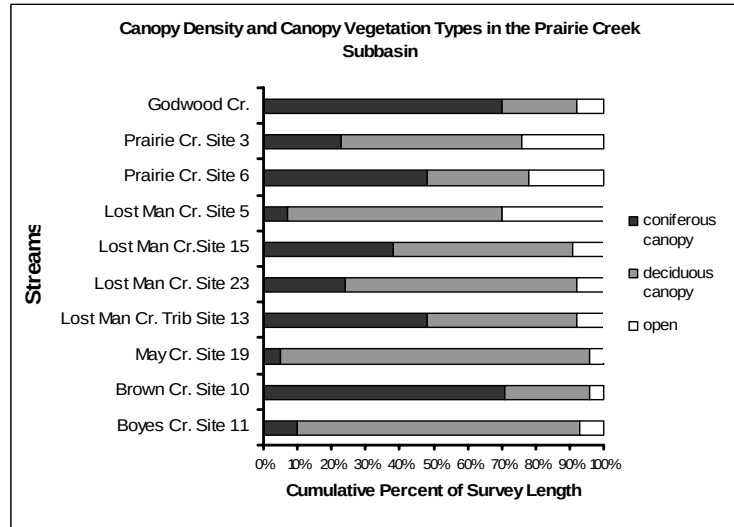


Figure IV- 17. Prairie Creek percent canopy density measurements and the percent vegetation type contributing to shade canopy.

### Spawning Cobble Embeddedness

**Significance:** Cobble embeddedness is the percent of an average-sized cobble piece at a pool tail out that is embedded in fine substrate. Percent cobble embeddedness provides a measure of spawning substrate suitability for egg incubation, and fry emergence. Excessive accumulations of fine sediments reduce water flow (permeability) through gravels in redds, which may suffocate eggs or developing embryos. Excessive levels of fine sediment accumulations within gravel and cobble substrate may also alter aquatic insect species composition and may also reduce connectivity of flow between surface and subsurface stream flows needed to moderate water temperature.

High embeddedness ratings may indicate elevated levels of erosion occurring somewhere in the watershed due to natural and/or human causes. The potential for high levels of fine sediments is higher in watersheds like Prairie Creek where the geology, soils, precipitation, and topography cumulatively exacerbate erosional processes (Duncan and Ward 1985). Fine sediments are typically more abundant where land use activities such as road building or land clearing expose soil to erosion and increase mass wasting (Cederholm et al. 1981, Swanson et al. 1987, Hicks et al. 1991).

Cobble embeddedness varied between the sample sites (Figure IV- 18). The best embeddedness ratings were from site 19 on May Creek and site 3 located in the upper reach of Prairie Creek and Godwood Creek where little disturbance to the landscape has occurred. The absence of category 1 embeddedness values in Boyes and Brown creeks may indicate fine sediment delivery is still occurring from sources associated with the Highway 101 bypass construction or other land use.

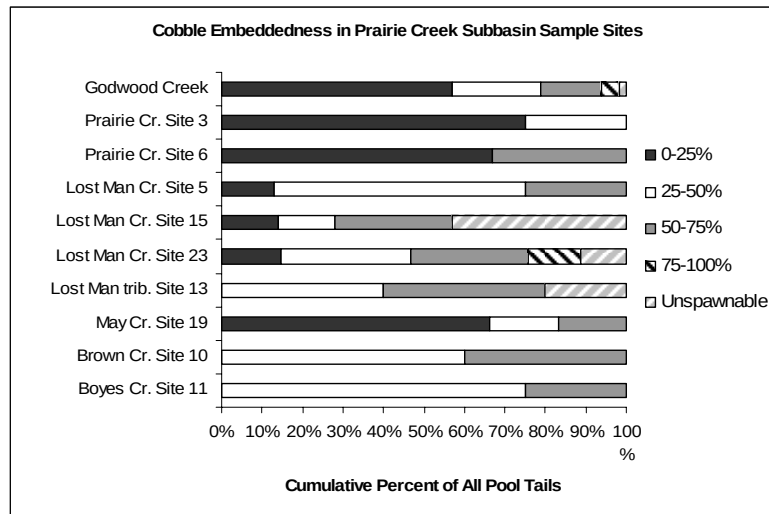


Figure IV- 18. Prairie Creek Subbasin average cobble embeddedness from sample sites. Unspawnable is unsuitable for due to factors other than embeddedness (e.g. log, bedrock, boulders).

## Salmonid Fishery Resources

Prairie Creek watershed is an excellent field laboratory that has produced numerous studies of California's anadromous salmonids and their habitat. Some studies have reported on life history strategies and carrying capacity (Hallock et al. 1952; Briggs 1953; DeWitt 1954; Burns 1971; Manning 2000; and Bell 2001), while others have focused on species distribution, abundance, and response to sediment inputs (Anderson 1988; Brown 1988; Klatte and Roelofs 1996 and 1997; Coey 1998; and Brakensiek 2002).

One of the first fish sampling efforts in Prairie Creek is presented in DeWitt (1954) and was part of a coastal cutthroat survey conducted in 1951. The results show a few (9) coastal cutthroat in the sample as well as numbers of other fish species collected (Figure IV- 19). Coastal cutthroat trout populations of Prairie Creek have been described as over fished and sensitive to changes in habitat (Van Kirk 1994 and Gerstrung 1996). In addition, note that coho were more abundant than steelhead in the sample reach.

Beginning in 1983, spawner surveys were conducted in the Prairie Creek Subbasin by RNSP staff and Humboldt State University (HSU). However, in some cases the same streams were not surveyed regularly or survey protocols were inconsistent. Logistical constraints such as lack of funding, limited personnel, and variable stream conditions contributed to irregularity of spawner surveys (D. Anderson, RNSP, personnel communication). In addition, the length of survey distances may vary between years and tributaries (Meyer 1994). Thus, deriving trends in redd, carcass and live fish counts from spawning surveys is problematic for most streams.

Weirs in Prairie Creek and Lost Man Creek were used to trap migrating salmonids for egg collection and propagation at the Prairie Creek Hatchery. Counts of fish were also made at the two weirs but, due to variability in effort, protocols, and locations it is difficult to interpret data and to identify trends over time. The most consistent adult trapping data for the Prairie Creek weir site are shown in Table IV- 25. Overall, counts of Chinook, coho and steelhead were highest at the Lost Man Creek weir possibly as a result of enhanced runs returning to the hatchery located on Lost Man Creek (Meyer 1994).

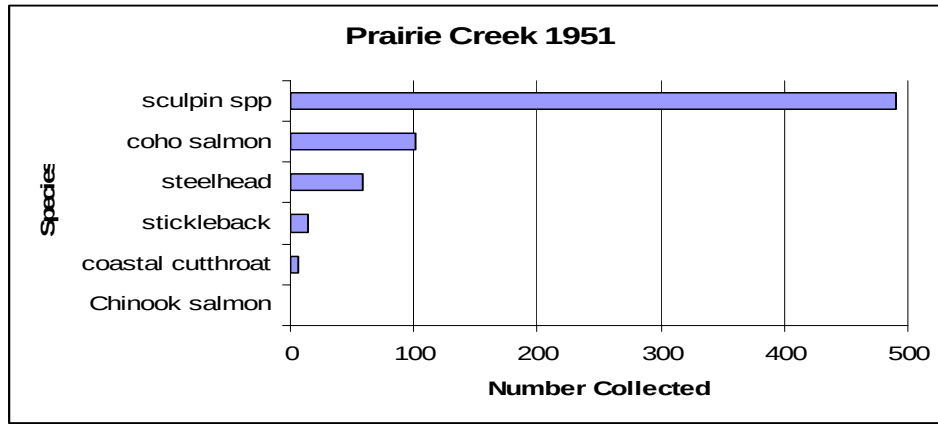


Figure IV- 19. *Prairie Creek, 1951 sampling.*

In September of 1951 a 779-foot section of Prairie Creek was cut-off by diverting the flow into an artificial channel. The cut-off section was seined, treated with rotenone, and re-seined. Two Chinook salmon were collected. "Scale readings of the nine cutthroat collected indicated that none had undergone any ocean or tidal growth. The ages of these fish varied from two to six years. No cutthroat-of-the-year were found in the cut-off section" (DeWitt 1954).

In contrast to the Prairie Creek spawner survey data, the weir trapping data shows that coho salmon usually were more abundant than Chinook salmon. Klatte and Roelofs (1996 and 1997) provided the most accurate counts of coho returning to Prairie Creek. A review of these data indicate that Lost Man Creek often had the most redds, carcasses and live fish per mile of all surveyed streams in the Prairie Creek Subbasin (Meyer 1994).

Table IV- 25. *Adult salmonid counts at Prairie Creek Weir.*

| Spawning Year                         | Chinook |      |      |       | Coho   |      |      |       | Steelhead |      |       | Total All Species |
|---------------------------------------|---------|------|------|-------|--------|------|------|-------|-----------|------|-------|-------------------|
|                                       | Female  | Male | Jack | Total | Female | Male | Jack | Total | Female    | Male | Total |                   |
| 1989-90<br>Nov 26, '89 to Mar 13, '90 | 13      | 19   | 25   | 57    | 22     | 15   | 115  | 152   | 9         | 18   | 27    | 236               |
| 1990-91<br>Nov 25, '90 to Jan 7, '91  | 19      | 30   | 17   | 66    | 34     | 29   | 16   | 79    | 0         | 0    | 0     | 145               |
| 1991-92<br>Nov 20, '91 to Mar 6, '92  | 7       | 26   | 7    | 40    | 23     | 35   | 12   | 70    | 12        | 19   | 0     | 141               |
| 1992-93<br>Nov 18, '92 to Jan 7, '93  | 19      | 33   | 10   | 62    | 18     | 26   | 23   | 67    | 0         | 1    | 31    | 130               |
| 1993-94<br>(dates not available)      | 28      | 41   | 10   | 79    | 45     | 32   | 1    | 78    | 2         | 8    | 1     | 167               |
| 1994-95<br>Nov 18, '94 to Feb 9, '95  |         |      |      |       |        |      |      |       |           |      |       |                   |
| 1995-96<br>Dec 1, '95 to Feb 28, '96  | 30      | 76   |      | 106   | 66     | 49   |      | 115   |           |      |       | 221               |
| 1996-97                               | 33      | 80   | 37   | 113   | 45     | 79   | 10   | 124   |           |      |       | 237               |

Located between the confluences with Boyes and Streelew creeks, 1989 to 1996 (Meyer 1994 and Klatte and Roelofs 1996 and 1997). The trap was monitored 24 hours a day and seven days a week during 1996 and 1997.

### Coho Salmon

The Prairie Creek Subbasin provides the most coho habitat and the likely largest coho population in the Redwood Creek Basin. Coho are found in Prairie Creek and at least eight other tributaries in the subbasin. Counts of live coho combined from Prairie Creek and Lost Man Creek weirs from 1973 to 1992 have ranged from less than 50 in 1978 to approximately 1800 fish in 1989 (Meyer 1994). The Lost Man Creek weir counts were usually much higher than the Prairie Creek site as coho production was enhanced by hatchery production. The most recent counts of 115 and 124 adult coho from the Prairie Creek weir site are for 1995-96 and 1996-97 spawning seasons respectively (Table IV- 25). The weir was located between Streelew and Boyes creeks and counts do not include coho that spawned in tributaries located downstream (such as Little Lost Man, Lost Man etc.) from the weir.

Recent spawner and carcass counts in Prairie Creek provide similar numbers as the weir counts (Figure IV- 20). Coho carcass counts yielded the highest numbers during the 1995-1996 spawning season and live coho counts

peaked in 1997-98, and then declined during the next two years. For some years, it is unclear if the higher fish counts are due to a greater number of fish returning to Prairie Creek or a consequence of increased survey effort.

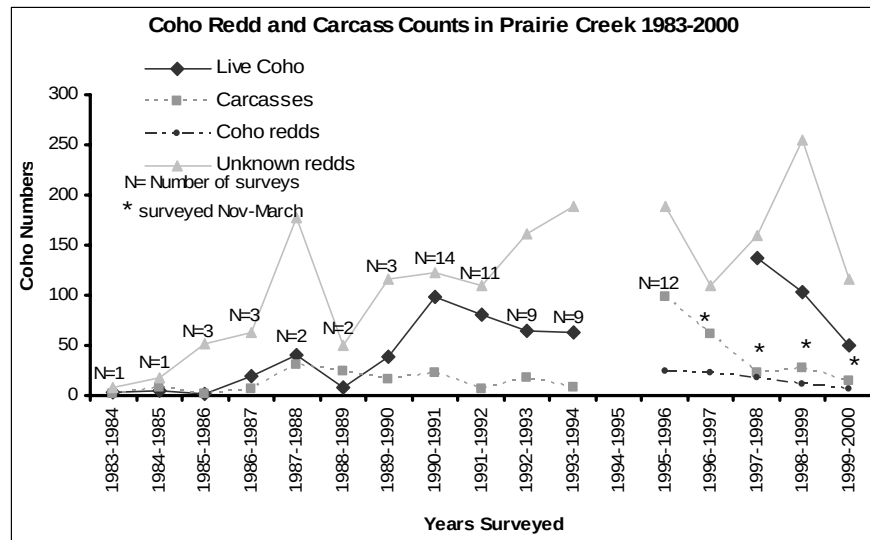


Figure IV- 20. Prairie Creek live coho, redd, and carcass counts, 1983 to 2000.

Information derived from Meyer (1994) and Redwood National and State Parks spawning and carcass surveys 1991 to 2000.

During 2001 electrofishing surveys, twenty-seven juvenile coho were captured over approximately 400 feet of sample site located in Lost Man Creek (Appendix D, attachment 1). No coho were captured from the sample sites located on the Unnamed Tributary to Lost Man Creek or Brown Creek in 2001. No electrofishing surveys were performed at the Prairie Creek sample sites to avoid interference with other studies in progress.

### Chinook Salmon

Chinook salmon are found in most fish bearing streams of the Prairie Creek Subbasin. Chinook counts combined from Prairie Creek and Lost Man Creek weirs from 1973 to 1992 have ranged from less than 5 in 1973 and 1975 to approximately 175 fish in 1988 (Meyer 1994). As with the coho salmon counts, Chinook counts at the Lost Man Creek weir include fish that were returning to the hatchery located on Lost Man Creek. The most recent counts from the Prairie Creek weir site of 106 and 113 adult Chinook are from the 1995-96 and 1996-97 spawning seasons respectively (Table IV-25). Results from Prairie Creek spawner surveys 1983 to 1999 show a general increase in counts of live Chinook and carcasses since 1983, but also an increase in survey effort (Figure IV- 21). Spawner survey results show a peak of almost 500 Chinook counted in Prairie Creek in the 1998-99 spawning season. Within the past few spawning years (1995-2000) runs of adult Chinook have outnumbered coho by a sizeable margin, which is a reversal from the late 1980s and early 1990s when adult coho numbers outnumbered returning Chinook.

### Steelhead

Most fish bearing streams of the Prairie Creek Subbasin support runs of winter run steelhead. However, the streams seem to favor production of coastal cutthroat and coho salmon rather than steelhead. Brown (1988) found that where they co-occurred with other salmonid species in the Prairie Creek Subbasin, steelhead were relatively less abundant compared to coastal cutthroat and coho salmon. The numbers of steelhead in the Prairie Creek watershed were enhanced by hatchery production beginning in the 1930's when steelhead from the Sacramento River system were introduced via the Prairie Creek Hatchery in an effort to supplement the sport fishery.

Steelhead counts combined from Prairie Creek and Lost Man Creek weirs from 1973 to 1992 have ranged from less than 25 in 1974 and 1975 to approximately 1200 fish in 1986 (Meyer 1994). During 2001 electrofishing surveys, 36 juvenile steelhead were captured from Lost Man Creek, three were captured from the Unnamed

Tributary to Lost Man Creek, and only one was captured in Browns Creek. These numbers of juvenile steelhead appear low in consideration of amount of habitat sampled.

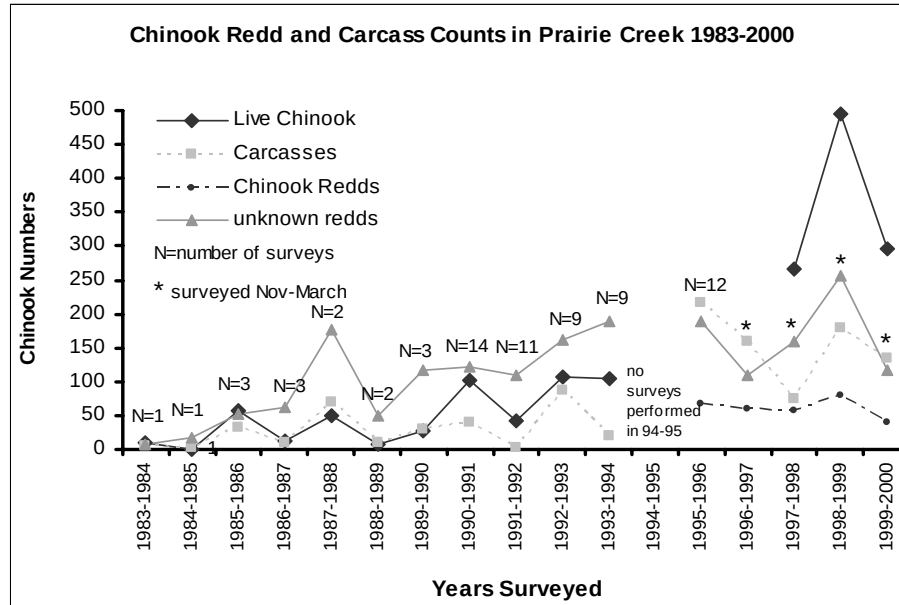


Figure IV- 21. *Prairie Creek live Chinook, redd, and carcass counts 1983 to 2000.*

Information derived from Meyer (1994) and Redwood National and State Parks Spawning and Carcass surveys 1991-2000. The 1997 through 2000 live, adult Chinook numbers may be inflated due to double counts of the same fish (Anderson personal communications 2002).

### Coastal Cutthroat

The majority of the known sea run coastal cutthroat population of Redwood Creek basin resides in the Prairie Creek drainage. They can be found in nearly all tributaries of the subbasin (Gerstrung 1996). In the late 1800s and into the early 1900s, Prairie Creek watershed supported a large coastal cutthroat population which attracted many sport anglers (Snyder 1908, Dewitt 1954, USDI 1960, Van Kirk 1994). However, they were vulnerable to fishing pressure and by 1925 the coastal cutthroat population of Prairie Creek was over harvested by sportfishers (Van Kirk 1994). While populations continued to decline slowly, it was not until later that coastal cutthroat populations crashed in response to detrimental habitat changes during the 1950s to 1960s (Gerstrung 1996). Counts of coastal cutthroat from weir sites are not available. In the summer of 2001, CDFG survey crews collected only small numbers of coastal cutthroat during electrofishing surveys in Lost Man Creek, unnamed tributary to Lost Man Creek and Brown Creek (Appendix D, Attachment 1).

### Prairie Creek Hatchery

The Prairie Creek Hatchery is located a few miles north of the town of Orick. The hatchery operated from 1927 until 1993. Throughout its years in operation, the hatchery propagated Chinook, coho, steelhead, rainbow trout, and coastal cutthroat trout. The fish were released mostly in the Redwood Creek watershed and other Humboldt County streams.

The Prairie Creek Hatchery supplied fish to multiple streams in and out of the Redwood Creek basin as well as several local lagoons, the Arcata Wastewater Facility, and Humboldt Bay until it closed in 1993. The coastal cutthroat fishery, for which the hatchery was originally intended, never returned to its former strength or popularity noted from the early 1900s (Van Kirk 1994). In its later years the hatchery provided fish to private programs such as Humboldt Fish Action Council and the Pacific Lumber Company. Salmonids from the hatchery were distributed rather freely to various watersheds without much consideration for the natal stocks. Eventually, stocking was limited to the Redwood Creek basin, surrounding lagoons, and the Humboldt Bay and Arcata Wastewater Facility for experimental studies for waste water treatment.

Total fish counts were not made during the first fifty years of hatchery operations. The hatchery operated along the guidelines of collecting the desired number of salmonid eggs for each year and then focused on hatching and releasing fry. Fish were only collected to meet demand for eggs from the early portion of the run. Late running fish were allowed to freely pass through the facility uncounted. Generally, fish were not trapped during high flows because of the trap being washed out. Therefore, for most years prior to the late 1980's, accurate, total yearly migrating adult salmon counts are not available.

From 1930 to 1936 the hatchery supplied an average of 324,174 coho salmon fry and 105,582 steelhead trout fry per year primarily to Prairie Creek and Lost Man Creek (Meyer 1994). An average of 54,289 Chinook salmon and 39,787 coastal cutthroats were planted per year during the early years of hatchery operations (Meyer 1994). In 1937, the hatchery was moved to Lost Man Creek. Hatchery production records from 1927 to 1993 are presented in Appendix D, Attachment 3.

Humboldt County officially took over the title and operation of the hatchery in 1961. The hatchery was closed in 1962 for extensive repairs (Meyer 1994 draft). In cooperation with Humboldt State University, the facility was improved to accommodate greater fish production. During the hatchery's peak production (mid- 1960s through mid-1970s) larger numbers of fish were being propagated and distributed to Humboldt county streams. For instance, in the 1971-1972 season, the hatchery produced approximately 1,462,919 fish totaling 35,087 pounds. The 1973-1974 season was another substantial year producing approximately 1,589,581 fish, totaling 31,603 pounds. The majority of these fish were Chinook and coho salmon. Steelhead propagation ceased temporarily from 1956 to the early 1970's, in part, due to closure and upgrade of the hatchery facility. Propagation of steelhead resumed during the 1972-1973 season, and became the dominant species produced through the 1980s. With the exception of steelhead, overall production decreased slightly during the 1980s and into the early 1990s. Approximately 25,000 Chinook, 81,000 coho, 94,000 steelhead yearlings were released during the ten-year period of 1981 through 1991. Some coho salmon stocks taken from out of the basin (Kalama River in Washington, Alsea River, Sooes River, Sandy River, and Trask Rivers in Oregon, and from California; Klamath River, Trinity River, Mad River, and Noyo River) during the years from 1978 to 1983 and were planted in Prairie Creek (Meyer 1994). After 1983, hatchery releases of coho and steelhead trout were produced from parental stocks collected from Lost Man or Prairie Creek (Meyer 1994). In addition, 300 to 400 coastal cutthroat yearlings were released into Lost Man Creek from 1988 to 1991.

During the period from 1977 to 1980 the percentage of trapped fish from Prairie Creek Hatchery stock was estimated for Chinook and coho salmon and steelhead trout. Steelhead trout had the highest percentage of the three species averaging 57% of fish trapped estimated from hatchery origin. Coho followed with 42% and Chinook with only 17% (Meyer, 1994). Although these percentages of steelhead and coho represent a substantial proportion of the runs, there is no discernible evidence that the hatchery consistently lead to improved numbers throughout the Prairie Creek watershed. Initially, returning adult steelhead numbers did raise when propagation resumed again in the early 1970s, but these numbers leveled off to resemble runs of the 1960s. Based on a comparison of proportional numbers of fry released to numbers of returning adults for respective years during the 1970s and early 1980s, adult coho numbers may never have benefited from hatchery production. Since the hatchery closed, numbers of salmonids in Prairie Creek have remained somewhat stable except for Lost Man Creek where recent carcass counts have declined. However, this could be based on a variety of factors other than closure of hatchery. Unlike Lost Man Creek figures, Prairie Creek spawner surveys have shown relatively consistent numbers of adult Chinook and coho since the closure of the hatchery.

Insufficient funds from Humboldt County caused the hatchery to rely on state funding sources during the 1980s. But, state funding became unavailable to the hatchery "because instream habitat was not being improved to support fish the hatchery produced" (Farley, 1992). With the termination of state funding, the county itself could not afford to maintain the hatchery operations and closed the facility in the spring of 1993

## **Prairie Creek Subbasin General Issues**

**RNSP management goals include the protection of natural resource values including anadromous salmonids and their habitat:**

- The RNSP has done a significant amount of work to survey road systems, identify problems, and implement road removals and upgrades that should result in reducing erosion and sediment inputs into stream channels.

**Before RNSP was expanded to include the great majority of the Prairie Creek Subbasin, approximately half of the subbasin was logged using timber harvest practices that resulted in excessive erosion, logging debris that clogged stream channels, and removal of valuable riparian forests:**

- Impacts from past timber harvest still effect some riparian and stream habitat;
- Debris accumulations on Lost Man Creek may impede anadromous fish passage to upstream spawning grounds;
- Lost Man Creek watershed still has a relatively high density road network.

**Impacts from Prairie Creek Hatchery operations.**

**Sediment impacts from the Highway 101 bypass are a concern.**

## Integrated Analysis and Cumulative Effects

The following section summarizes and integrates the above information to provide an interdisciplinary analysis of the subbasin condition. Summary tables facilitate the analysis of factors that cumulatively affect watershed processes and anadromous salmonid stream habitat. The tables include results from the EMDS sediment production and stream reach condition evaluations. A goal of the integrated analysis is to discern links or relations between geologic framework, watershed processes, land management activities, and stream habitat conditions.

The subbasin is divided by Prairie Creek into low gradient streams to the west (Skunk Cabbage, Stree-low and Godwood creeks and others), and somewhat steeper streams to the east (including Lost Man, Little Lost Man, May creeks and others). Water temperatures in Prairie Creek measured by MWATs are usually below 60°F which is considered desirable for cold water species like anadromous salmonids. The coastal climate in combination with old growth near stream forests over much of the area helps keep air and stream temperatures cool. The low gradient profile of Prairie Creek and reaches of most of the subbasin streams allows access to all four salmonid species found in the Redwood Creek basin, including coho salmon which are typically found in cool, low gradient stream reaches.

Approximately 14,000 acres located in the upper half of the Prairie Creek watershed and within the May Creek Planning Watershed were converted to State Parkland in the 1920s. These parklands in May Creek Planning Watershed still sustain nearly pristine old growth redwood forest conditions. The remaining lands, mostly within the Lost Man Creek Planning Watershed and Skunk Cabbage Creek, were subjected to timber harvests.

Approximately 56% of the land in the subbasin has a high or very high relative landslide potential. This relationship is nearly the same across the Prairie Creek Subbasin (Table IV- 26). However, Lost Man Creek Planning Watershed which covers 30% of the subbasin area has 279 acres of the 348 acres (80%) in historically active landslides (Table IV- 26 and Table IV- 27). Historically active and dormant landslide features in close proximity to streams were also highest in the Lost Man Creek Planning Watershed (Table IV-29). In addition, 86 of the 92 (93%) streamside landslides counted in the Prairie Creek Subbasin from 1984 aerial photographs were located in the Lost Man Creek Planning Watershed. The relatively high level of disturbance in the Lost Man Creek Planning Watershed is likely linked to the amount of roads located on areas of high or very high relative landslide potential (Table IV-27) and legacy impacts from past land use. Aerial photos from 2000 show that the number of active streamside landslides fell to 12 compared to 86 observed in 1984, indicating that conditions are improving.

When integrating land use, landslide potential, and active landslide data, a clear relationship becomes apparent. Lost Man Creek Planning Watershed has had the most land disturbance—measured by timber harvests and road density, and also the most area in active landslides and streamside landslides in the subbasin. It appears that land use has exacerbated landsliding in the Lost Man Creek Planning Watershed and the landscape has not fully recovered from past disturbances.

Table IV- 26. Acres and percent of area by relative landslide potential and land use or type classes.

| Subbasin or Planning Watershed                                    | Relative Landslide Potential <sup>1</sup> | Entire Subbasin or Planning Watershed |             | Woodland or Grassland <sup>2</sup> |           | Conifer Forest |            | Roads          |                   |
|-------------------------------------------------------------------|-------------------------------------------|---------------------------------------|-------------|------------------------------------|-----------|----------------|------------|----------------|-------------------|
|                                                                   |                                           | Area (acres)                          | % of Area   | Area (acres)                       | % of Area | Area (acres)   | % of Area  | Length (miles) | % of Total Length |
| Prairie Creek Subbasin (25,305 acres) (110.2 road miles)          | Very Low                                  | 3,492                                 | 13.8        | 360                                | 1.4       | 3,068          | 12.1       | 28.6           | 26.6              |
|                                                                   | Low                                       | 3,017                                 | 11.9        | 3                                  | 0.0       | 2,989          | 11.8       | 14.5           | 13.5              |
|                                                                   | Moderate                                  | 4,565                                 | 18.0        | 8                                  | 0.0       | 4,526          | 17.9       | 19.2           | 17.8              |
|                                                                   | High                                      | 9,480                                 | 37.5        | 13                                 | 0.1       | 9,424          | 37.2       | 30.9           | 28.7              |
|                                                                   | Very High                                 | 4,750                                 | 18.8        | 4                                  | 0.0       | 4,731          | 18.7       | 14.4           | 13.4              |
|                                                                   | High/Very High Subtotal                   | 14,230                                | 56.2        | 17                                 | 0.1       | 14,155         | 55.9       | 45.3           | 42.1              |
|                                                                   | <b>TOTAL</b>                              | <b>25,304</b>                         | <b>100%</b> | <b>405</b>                         | <b>2%</b> | <b>24,738</b>  | <b>98%</b> | <b>107.6</b>   | <b>100%</b>       |
| Lost Man Creek Planning Watershed (7,678 acres) (66.3 road miles) | Very Low                                  | 1,627                                 | 12.8        | 207                                | 1.6       | 1,388          | 10.9       | 14.9           | 22.5              |
|                                                                   | Low                                       | 1,672                                 | 13.2        | 1                                  | 0.0       | 1,671          | 13.2       | 8.2            | 12.4              |
|                                                                   | Moderate                                  | 2,106                                 | 16.6        | 7                                  | 0.1       | 2,097          | 16.5       | 12.0           | 18.1              |
|                                                                   | High                                      | 4,288                                 | 33.8        | 9                                  | 0.1       | 4,279          | 33.7       | 20.4           | 30.8              |
|                                                                   | Very High                                 | 2,980                                 | 23.5        | 2                                  | 0.0       | 2,978          | 23.5       | 10.9           | 16.4              |
|                                                                   | High/Very High Subtotal                   | 7,268                                 | 57.2        | 11                                 | 0.1       | 7,257          | 57.2%      | 31.3           | 47.2              |
|                                                                   | <b>TOTAL</b>                              | <b>12,673</b>                         | <b>100%</b> | <b>226</b>                         | <b>2%</b> | <b>12,413</b>  | <b>98%</b> | <b>66.4</b>    | <b>100%</b>       |
| May Creek Planning Watershed (11,236 acres) (39.5 road miles)     | Very Low                                  | 1,664                                 | 14.8        | 138                                | 1.2       | 1,495          | 13.3       | 13.6           | 34.4              |
|                                                                   | Low                                       | 1,214                                 | 10.8        | 2                                  | 0.0       | 1,190          | 10.6       | 6.2            | 15.7              |
|                                                                   | Moderate                                  | 2,167                                 | 19.3        | 1                                  | 0.0       | 2,137          | 19.0       | 7.1            | 18.0              |
|                                                                   | High                                      | 4,538                                 | 40.4        | 0                                  | 0.0       | 4,496          | 40.0       | 9.1            | 23.0              |
|                                                                   | Very High                                 | 1,628                                 | 14.5        | 0                                  | 0.0       | 1,614          | 14.4       | 3.4            | 8.6               |
|                                                                   | High/Very High Subtotal                   | 6,166                                 | 54.9        | 0                                  | 0.0       | 6,110          | 54.4       | 12.5           | 31.6              |
|                                                                   | <b>TOTAL</b>                              | <b>11,211</b>                         | <b>100%</b> | <b>141</b>                         | <b>1%</b> | <b>10,932</b>  | <b>97%</b> | <b>39.4</b>    | <b>100%</b>       |
| Skunk Cabbage Creek Drainage (1,420 acres) (1.9 road miles)       | Very Low                                  | 201                                   | 14.2        | 15                                 | 1.1       | 185            | 13.0       | 0.1            | 5.6               |
|                                                                   | Low                                       | 131                                   | 9.2         | 0                                  | 0.0       | 128            | 9.0        | 0.1            | 5.6               |
|                                                                   | Moderate                                  | 292                                   | 20.6        | 0                                  | 0.0       | 292            | 20.6       | 0.1            | 5.6               |
|                                                                   | High                                      | 654                                   | 46.1        | 4                                  | 0.3       | 649            | 45.7       | 1.4            | 77.8              |
|                                                                   | Very High                                 | 142                                   | 10.0        | 2                                  | 0.1       | 139            | 9.8        | 0.1            | 5.6               |
|                                                                   | High/Very High Subtotal                   | 796                                   | 56.1        | 6                                  | 0.4       | 788            | 55.5       | 1.5            | 83.3              |
|                                                                   | <b>TOTAL</b>                              | <b>1,420</b>                          | <b>100%</b> | <b>21</b>                          | <b>1%</b> | <b>1,393</b>   | <b>98%</b> | <b>1.8</b>     | <b>100%</b>       |

<sup>1</sup> Refer to California Geological Survey appendix.<sup>2</sup> Woodland and grassland include areas mapped in 1998 as grassland and non-productive hardwood.Table IV- 27. Historically active and dormant landslides and selected geomorphic features<sup>1</sup> within 180' of a blue line stream.

| Factor                                                                                                                     | Prairie Creek Subbasin |                 | Planning Watersheds |                 |           |                 | Skunk Cabbage Creek Drainage |                 |
|----------------------------------------------------------------------------------------------------------------------------|------------------------|-----------------|---------------------|-----------------|-----------|-----------------|------------------------------|-----------------|
|                                                                                                                            | % area                 | % stream length | Lost Man Creek      |                 | May Creek |                 | % area                       | % stream length |
| Historically active and dormant landslide and selected geomorphic features <sup>1</sup> within 180' of a blue line stream. |                        |                 | % area              | % stream length | % area    | % stream length |                              |                 |
|                                                                                                                            | 2.6                    | 8.0             | 3.7                 | 0.2             | 1.1       | 0.6             | 0.9                          | 0.0             |

<sup>1</sup> Landslide features and selected geomorphic features include earth flow, rock slide, debris slide, debris flow, debris slide slopes, disrupted ground, eroding banks and inner gorges.

Table IV- 28 provides an integrated information summary for the Prairie Creek subbasin. It provides the reader the opportunity to compare a large number of factors across the subbasin and to look at potential interactions between potential disturbance factors.

Table IV- 28. Prairie Creek Subbasin integrated information summary.

| Factor                                                          | Prairie Creek Subbasin |             | Planning Watersheds |              |               |              | Skunk Cabbage Creek Drainage |               |
|-----------------------------------------------------------------|------------------------|-------------|---------------------|--------------|---------------|--------------|------------------------------|---------------|
|                                                                 | Acres                  | % Area      | Lost Man Creek      |              | May Creek     |              | Acres                        | % Area        |
| Relative Landslide Potential <sup>1</sup>                       |                        |             | Acres               | % Area       | Acres         | % Area       |                              |               |
| Very Low                                                        | 3,492                  | 13.8%       | 1,627               | 12.8%        | 1,664         | 14.8%        | 201                          | 14.2%         |
| Low                                                             | 3,017                  | 11.9%       | 1,672               | 13.2%        | 1,214         | 10.8%        | 131                          | 9.2%          |
| Moderate                                                        | 4,565                  | 18.0%       | 2,106               | 16.6%        | 2,167         | 19.3%        | 292                          | 20.6%         |
| High                                                            | 9,480                  | 37.5%       | 4,288               | 33.8%        | 4,538         | 40.5%        | 654                          | 46.1%         |
| Very High                                                       | 4,750                  | 18.8%       | 2,980               | 23.5%        | 1,628         | 14.5%        | 142                          | 10.0%         |
| High/Very High Subtotal                                         | 14,230                 | 56%         | 7,268               | 57%          | 6,166         | 55%          | 796                          | 56.1%         |
| <b>GRAND TOTAL</b>                                              | <b>25,304</b>          | <b>100%</b> | <b>12,673</b>       | <b>100%</b>  | <b>11,211</b> | <b>100%</b>  | <b>1,420</b>                 | <b>100.0%</b> |
| <b>Landslide and Selected Geomorphic Features</b>               |                        |             |                     |              |               |              |                              |               |
| <b>Historically Active Landslide Features Total<sup>1</sup></b> | <b>348</b>             | <b>1.4%</b> | <b>279</b>          | <b>2.2%</b>  | <b>69</b>     | <b>0.6%</b>  | <b>0</b>                     | <b>0.0%</b>   |
| Earthflow                                                       | 13                     | 0.1%        | 12                  | 0.1%         | 1             | 0.0%         |                              |               |
| Rock Slide                                                      | 25                     | 0.1%        | 16                  | 0.1%         | 9             | 0.1%         |                              |               |
| Debris Slide                                                    | 161                    | 0.6%        | 157                 | 1.2%         | 4             | 0.0%         |                              |               |
| Debris Flow                                                     | 148                    | 0.6%        | 94                  | 0.7%         | 55            | 0.5%         |                              |               |
| <b>Dormant Landslide Features Total</b>                         | <b>2,022</b>           | <b>8%</b>   | <b>1,758</b>        | <b>13.9%</b> | <b>169</b>    | <b>1.5%</b>  | <b>95</b>                    | <b>6.7%</b>   |
| <b>Selected Geomorphic Features Total</b>                       | <b>2,493</b>           | <b>10%</b>  | <b>1,454</b>        | <b>11.5%</b> | <b>1,040</b>  | <b>9.3%</b>  |                              |               |
| Disrupted Ground                                                | 355                    | 1%          | 355                 | 2.8%         | 0             | 0.0%         |                              |               |
| Debris Slide Slope                                              | 2,067                  | 8%          | 1,083               | 8.5%         | 985           | 8.8%         |                              |               |
| Inner Gorge (area) <sup>2</sup>                                 | 71                     | 0%          | 16                  | 0.1%         | 55            | 0.5%         |                              |               |
| <b>Total of all above features</b>                              | <b>4,863</b>           | <b>19%</b>  | <b>3,490</b>        | <b>27.5%</b> | <b>1,278</b>  | <b>11.4%</b> | <b>95</b>                    | <b>6.7%</b>   |
| <b>Land Uses</b>                                                |                        |             |                     |              |               |              |                              |               |
| Grazing                                                         | 230                    | 0.9%        | 96                  | 0.8%         | 134           | 1.2%         |                              |               |
| Agriculture                                                     | 1,393                  | 5.5%        |                     |              |               |              |                              |               |
| Development                                                     | 1,421                  | 5.6%        | 28                  | 0.2%         |               |              |                              |               |
| Timber Harvest (1991-2000)                                      | 0                      | 0           | 0                   | 0            | 0             | 0            | 0                            | 0             |
| Road miles                                                      | 110                    |             | 66                  |              | 40            |              | 2                            |               |
| Road Density (miles/sq. mile)                                   | 2.7                    |             | 3.4                 |              | 2.3           |              | 0.8                          |               |
| Density of Road Crossings (#/stream mile)                       | 0.6                    |             | 0.7                 |              | 0.6           |              |                              |               |
| Roads within 200' of Stream (miles/stream mile)                 | 0.2                    |             | 0.2                 |              | 0.2           |              |                              |               |

<sup>1</sup> Areas of disrupted ground are not included as active landslide features in this analysis. These areas are likely underlain by earthflow or rockslide complexes. If so, this would substantially increase the miles of roads and area of land type and land use on active landslide features.

### EMDS Potential Sediment Model Results

Tables IV-29 to IV-32 shows the results from the EMDS potential sediment model. The model assesses potential landscape factors that may generate and deliver sediment to streams. We remind the reader that this model was still under development at the time of this assessment. Results are based on sediment production potential of the Prairie Creek Subbasin and its planning watersheds in relation to all the other subbasins and planning watersheds of the Redwood Creek Basin. While the sediment production model has utility in its current state, we caution that it be interpreted only as being indicative of relative conditions and not as a definitive assessment of conditions of any specific planning watershed. Details of the EMDS sediment production model are provided in Appendix F.

Table IV- 29 presents the results from the EMDS sediment production model (All Sources) and shows the contributions to the result from natural sediment sources and management-related sediment sources. In essence, Table IV -29 provides the final synthesis of the results from Tables IV-29 to IV-32 and other finer scale model evaluations. Overall, the Prairie Creek Subbasin and its planning watersheds ranked relatively low for potential sediment production delivered to streams compared to the rest of the Redwood Creek Basin. Most of the potential sediment production identified by EMDS is from legacy impacts from past timber harvests, particularly management related sources in the Lost Man Creek Planning Watershed. Natural processes alone are not contributing much sediment to Prairie Creek Subbasin streams.

Table IV- 29. EMDS ratings for potential sediment inputs to streams; top three levels of model.

| Subbasin or Planning Watershed | All Sources | Natural Processes |                 |                    |              | Management-Related Sources |                 |                    |              |
|--------------------------------|-------------|-------------------|-----------------|--------------------|--------------|----------------------------|-----------------|--------------------|--------------|
|                                |             | All               | Surface Erosion | Streamside Erosion | Mass Wasting | All                        | Surface Erosion | Streamside Erosion | Mass Wasting |
| Prairie Creek Subbasin         | ++          | ++                | U               | ++                 | ++           | +                          | +               | +                  | +            |
| Lost Man Creek                 | +           | ++                | U               | ++                 | ++           | -                          | -               | +                  | +            |
| May Creek                      | ++          | ++                | U               | ++                 | +++          | +                          | +               | +                  | ++           |
| Skunk Cabbage Creek Drainage   | ++          | ++                | U               | ++                 | ++           | ++                         | ++              | ++                 | ++           |

A 'U' represents data that lie in between suitable and unsuitable conditions, or there are data gaps.

The all sources column presents the cumulative results from all natural and Management-related sediment sources. The "+++" score represents the least amount of potential sediment delivery to streams on a relative scale; the "---"score represents the most potential sediment delivery to streams.

Table IV- 30 provides more detail on management related potential surface sediment sources. It indicates that overall the subbasin is not generating much sediment from surface erosion that reaches streams. However, both roads proximate to streams and past timber harvests likely contribute some sediment to subbasin streams. Again, most of this is from the Lost Man Creek Planning watershed. Table IV-31 indicates the same problems with density of roads proximate to streams for management related streamside erosion sources in the Lost Man Creek planning watershed. Even though the Lost Man Creek Planning Watershed has been identified to have a high density of roads, the positive EMDS evaluation is due to its lower road density relative to other planning watersheds in the basin.

Table IV- 30. Potential sediment input to streams from management-related surface erosion sources.

| Subbasin or Planning Watershed | All Mgmt.-Related Surface Sources | Road Related     |                                        |                                       | Land Use Related     |                 |
|--------------------------------|-----------------------------------|------------------|----------------------------------------|---------------------------------------|----------------------|-----------------|
|                                |                                   | All Road Related | Density of Roads by Hillslope Position | Density of Roads Proximate to Streams | All Land Use Related | Timber Land Use |
| Prairie Creek Subbasin         | +                                 | +                | ++                                     | +                                     | +                    | -               |
| Lost Man Creek                 | -                                 | +                | ++                                     | -                                     | --                   | --              |
| May Creek                      | +                                 | +                | ++                                     | +                                     | ++                   | +               |
| Skunk Cabbage Creek Drainage   | ++                                | +                | +++                                    | ++                                    | ++                   | -               |

The "+++" score represents the least amount of potential sediment delivery to streams on a relative scale; the "---"score represents the most potential sediment delivery to streams.

Table IV- 31. Potential stream sediment production from management-related streamside erosion sources.

| Subbasin or Planning Watershed | All Mgmt.-Related Streamside Sources | Road Related                          |                           |
|--------------------------------|--------------------------------------|---------------------------------------|---------------------------|
|                                |                                      | Density of Roads Proximate to Streams | Density of Road Crossings |
| Prairie Creek Subbasin         | +                                    | +                                     | +                         |
| Lost Man Creek                 | +                                    | -                                     | +                         |
| May Creek                      | +                                    | +                                     | +                         |
| Skunk Cabbage Creek Drainage   | ++                                   | ++                                    | +++                       |

The "+++" score represents the least amount of potential sediment delivery to streams on a relative scale; the "---"score represents the most potential sediment delivery to streams.

Table IV-32 presents the EMDS potential sediment production model results for management related mass wasting sources. The table indicates that overall the Prairie Creek Subbasin is at low risk from management related mass wasting. While the relative rankings for most factors in the table look suitable, there are some less positive areas. For the Prairie Creek Subbasin overall, there is a somewhat low suitability ranking for timberland use, which is related to past harvesting activities on areas with higher relative landslide potential. Past timber management activities appear linked to active landsliding on the Lost Man Creek planning watershed and, to a lesser extent, on the Skunk Cabbage Creek drainage.

Table IV- 32. Potential stream sediment production from management-related mass wasting sources.

| Subbasin or Planning Watershed | All Mgmt.-Related Mass Wasting Sources | Road Related     |                            |                                        |                                         | Land Use Related     |                 |
|--------------------------------|----------------------------------------|------------------|----------------------------|----------------------------------------|-----------------------------------------|----------------------|-----------------|
|                                |                                        | All Road Related | Density of Roads Crossings | Density of Roads by Hillslope Position | Density of Roads on Unstable III-Slopes | All Land Use Related | Timber Land Use |
| Prairie Creek Subbasin         | +                                      | ++               | +                          | ++                                     | ++                                      | +                    | -               |
| Lost Man Creek                 | +                                      | ++               | +                          | ++                                     | +++                                     | --                   | --              |
| May Creek                      | ++                                     | ++               | +                          | ++                                     | +++                                     | ++                   | +               |
| Skunk Cabbage Creek Drainage   | ++                                     | ++               | +++                        | +++                                    | -                                       | ++                   | -               |

The “+++” score represents the least amount of potential sediment delivery to streams on a relative scale; the “---” score represents the most potential sediment delivery to streams.

### EMDS Stream Reach Condition Results and Limiting Factors Analysis

The EMDS stream reach model evaluated sites in the Prairie Creek Subbasin as some of the best reaches for overall anadromous habitat suitability in the Redwood Creek Basin (Table IV- 33 and Figure IV- 22). The sample sites 3 and 6 located on Prairie Creek, Lost Man tributary Site 13, and both reaches of Godwood Creek received the highest overall evaluations. The Prairie and Godwood Creek sites are located in nearly pristine areas of the RNSP and retain much of their historic characteristics. There appears to be a link between areas with little disturbance and good quality salmonid habitat in the Prairie Creek Subbasin.

Factors that received negative scores by the EMDS (Table IV- 33) should be considered as limiting factors to anadromous salmonid production in the Prairie Creek subbasin. The sites on Lost Man, Brown, Boyes, and May creeks are all in areas that are influenced by past timber harvesting activities or road construction. These sites had the poorest evaluations for cobble embeddedness values which typically indicates erosion and sediment delivery to stream channels.

The lack of deep pools and poor shelter ratings were other factors often identified by EMDS that may limit anadromous salmonid production in the Prairie Creek Subbasin. A deficiency in the EMDS model likely contributed to negative evaluations of the pool depth attribute throughout the basin. However, shallow pool conditions are often found in low gradient reaches within small watersheds that lack sufficient discharge to deeply scour the channel. For example, some of the smaller fish-bearing stream channels (Godwood Creek, Prairie Creek Site 6), may not have the stream power to scour pools of the depth and frequency considered to be of high value, or “primary,” pools by the Flosi et al. (1998) target values, or to be fully suitable according to EMDS. Therefore, some streams may not have the inherent ability to attain conditions that meet the suitability criteria or target values for pool depth. However, these streams may still be very important because of other desirable features that support valuable fishery resources.

Table IV- 33. Summary of the results from the Prairie Creek Subbasin EMDS Stream Reach Evaluation.

| Stream                     | Reach Length (ft) | Reach number | Canopy Density | Pool Depth | Pool Shelter | Embeddedness |
|----------------------------|-------------------|--------------|----------------|------------|--------------|--------------|
| Lost Man Creek Site 5      | 844               | 1            | +              | ---        | --           | -            |
| Lost Man Creek Site 23     | 962               | 2            | +++            | ---        | +            | --           |
| Lost Man Creek Site 15     | 634               | 3            | +++            | ---        | -            | -            |
| Lost Man Tributary Site 13 | 474               | 1            | +++            | ---        | +++          | --           |
| May Creek Site 19          | 449               | 1            | +++            | ---        | --           | ++           |
| Boyes Creek Site 11        | 508               | 1            | +++            | ---        | --           | -            |
| Brown Creek Site 10        | 512               | 1            | +++            | ---        | --           | --           |
| Prairie Creek Site 3       | 568               | 1            | +              | +++        | --           | +++          |
| Prairie Creek Site 6       | 544               | 2            | ++             | ---        | -            | +            |
| Godwood Creek              | 1701              | 1            | +++            | ---        | -            | ++           |
| Godwood Creek              | 12,858            | 2            | +++            | ---        | +            | +            |

+++ Fully Suitable      ++ Moderately Suitable      + Somewhat Suitable  
 - Somewhat Unsuitable      -- Moderately Unsuitable      --- Fully Unsuitable

The scores\* represent a range from fully suitable conditions to fully unsuitable conditions. Factors that received plus scores (+, ++, +++) should be considered to support anadromous salmonids and minus scores (-, --, ---) should be considered as limiting factors to anadromous salmonid production at the sampling sites in Prairie Creek Subbasin.

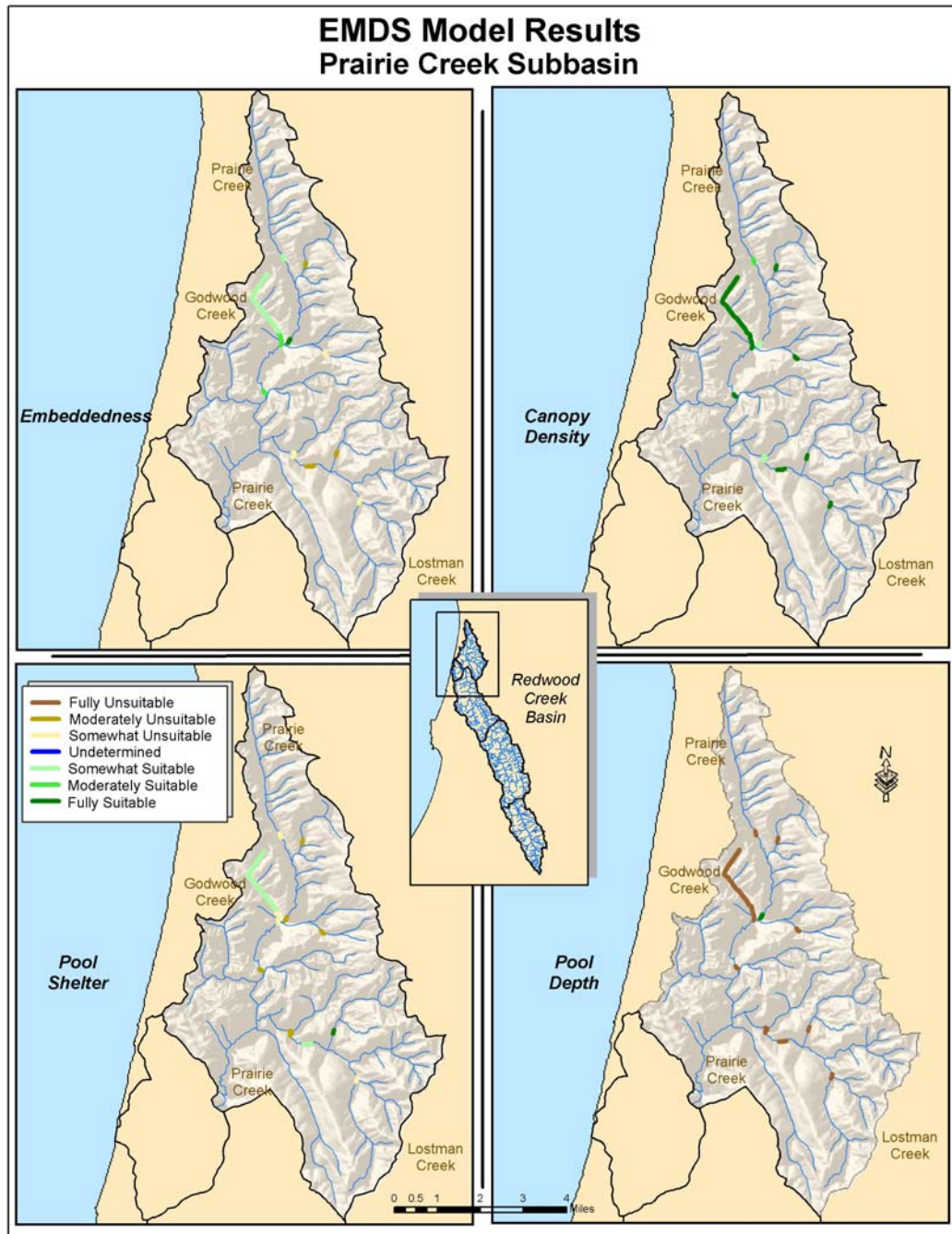


Figure IV- 22. *Prairie Creek Subbasin EMDS map results for selected stream reach factors.*

The colored coded areas represent the location of the sites sampled in the subbasin and the surveyed reaches in Godwood Creek.

### Refugia Areas

The NCWAP interdisciplinary team characterized refugia habitat by using criteria developed for north coast watersheds. These criteria consider the status of watershed and stream ecosystem processes, stream habitat conditions, the presence and status of fishery resources, land uses, land ownership, potential risks from human activities, and other factors that may affect stream refugia quality. A detailed discussion of refugia habitat categories is presented in the Methods section of this report.

The high quality and high potential refugia designation for streams of the Prairie Creek Subbasin were largely based on the known presence and status of Chinook and coho salmon and cutthroat and steelhead trout, overall habitat conditions and the protection provided against future risk to habitat under RNSP management goals (Table IV- 34). It is believed that Lost Man, Brown, Boyes, and May creeks will increase to high habitat quality

with time and/or management activities. Management activities that address limiting factors presented in Table IV- 34 will promote the advancement of these streams to the high quality refugia category.

Table IV- 34. *Prairie Creek Subbasin anadromous salmonid refugia designations for streams.*

| Stream                | Refugia Categories |                |               |             | Other Categories        |                                     |              |
|-----------------------|--------------------|----------------|---------------|-------------|-------------------------|-------------------------------------|--------------|
|                       | High Quality       | High Potential | Low Potential | Low Quality | Passage Barrier Limited | Critical Contributing Area/Function | Data Limited |
| Prairie Creek         | X                  |                |               |             |                         |                                     |              |
| Lost Man Creek        |                    | X              |               |             | X                       |                                     |              |
| Little Lost Man Creek | X                  |                |               |             |                         |                                     |              |
| Brown Creek           |                    | X              |               |             |                         |                                     |              |
| Boyes Creek           |                    | X              |               |             |                         |                                     |              |
| Streelaw Creek        | X                  |                |               |             |                         |                                     |              |
| Godwood Creek         | X                  |                |               |             |                         |                                     |              |
| Skunk Cabbage         |                    | X              |               |             |                         |                                     | X            |
| May Creek             |                    | X              |               |             | X                       |                                     |              |

## Responses to Assessment Questions

### **What are the history and trends of the size, distribution, and relative health and diversity of salmonid populations?**

- The Prairie Creek subbasin supports self sustaining populations of Chinook, coho, steelhead, and coastal cutthroat trout;
- The Prairie Creek Subbasin likely supports the largest coho salmon population of the Redwood Creek basin;
- Recent adult coho counts of 115 and 124 from the Prairie Creek weir site are for 1995-96 and 1996-97 spawning seasons respectively. These population counts are believed to be well below historic levels;
- Coastal cutthroats were once abundant in the Prairie Creek watershed, but today, are few in comparison to historic numbers. In 1925, over fishing was thought to be a leading cause of the initial decline of the coastal cutthroat population. In the following years their populations continued to decline;
- The historic abundance of steelhead in the Prairie Creek subbasin is not well described either by anecdotal information or the scientific literature. By the 1930s, steelhead were planted into Prairie Creek to supplement the declining coastal cutthroat fishery. These plantings occurred until into the 1990s and may have artificially increased the numbers of steelhead to equal or exceed historic levels in the Prairie Creek Subbasin.

### **What are the current salmonid habitat conditions? How do these conditions compare to desired conditions?**

- The Prairie Creek Subbasin provides critical habitat for anadromous salmonids;
- Stream conditions range from almost pristine streams to reaches adversely impacted by past logging practices and excessive levels of fine sediment generated during highway construction;
- Water temperatures are within the optimum range (MWATs < 60°F) for salmonids based on data from 4 sites monitored from 1997 to 2001;
- Streams located in the undisturbed portion of the Prairie Creek Subbasin provide some of the best salmonid habitat in the Redwood Creek Basin due to the combination of beneficial riparian vegetation, cool water temperature, desirable pool characteristics, instream shelter and good spawning habitat;
- However, there are also sites in the Prairie Creek Subbasin that are lacking in one or more important habitat components. Sample sites within areas affected by past land use, Lost Man, Brown, and Boyes creeks were lacking in the amount of deep and complex pool habitat and lacked high quality spawning habitat;
- The most suitable spawning sites are located in undisturbed portions of Prairie Creek and Godwood Creek;

- Pool frequency and pool: riffle: run ratios are generally within desired ranges at all sites, however sites in Lost Man and Boyes creeks, the length of pool habitat is below a desired percent of reach length;
- All sites generally have good stream side canopy cover;
- Sites at Lost Man, Brown, and Boyes creeks lack stream side conifers as components of the shade canopy.

#### **What are the past and present relationships of geologic, vegetative, and fluvial processes to stream habitat conditions?**

- Geologically, the subbasin is dominated by a number of sub-parallel faults and folds in bedrock. These structural features appear to strongly influence the locations and orientations of the drainages, including Fern Canyon and Squashan, Little Lost Man, and Prairie Creeks;
- Drainages located west of Highway 101 have very gentle gradients at their heads and relatively broad, flat-floored valleys. Low-gradient, depositional stream reaches characterize much of the length of these streams. Small debris slides are the typically mode of failure on the hillslopes;
- The high rate of geologic uplift in the subbasin creates the potential for high natural sedimentation rates with a high potential for yielding a significant amount of relatively fine sediment that can be deleterious to fish and fish habitat;
- Franciscan rocks in the upper parts of Little Lost Man and Lost Man Creeks are resistant sandstone units, which form very steep slopes east of Highway 101. Mass wasting is characterized by debris flows, debris slides, numerous rotational slides, and earthflows. Such features tend to contribute sediment to streams when altered by landuses which may not be suitable to this type of terrain;
- While over half of the Prairie Creek Subbasin falls within the high to very high mass wasting potential category, historically active landslide features account for less than 1.5% of the subbasin area. That is the lowest percentage of active landslide features of all the subbasins;
- The number of active streamside landslides visible in aerial photographs decreased significantly between 1984 and 2000;
- Stream disturbance (measured from aerial photos) in Lost Man, Little Lost Man, and Brown Creeks decreased significantly between 1984 and 2000.

#### **How has land use affected these processes?**

- Land acquisition in the upper Prairie Creek Subbasin by Save the Redwoods League in the 1920s initiated protection of old growth redwood watershed processes and forest values;
- The maintenance and protection of natural resource values provided by RNSP is important to the recovery and expansion of anadromous salmonid populations of the Redwood Creek Basin;
- The habitat sample sites located in upper Prairie Creek, the unnamed tributary to Lost Man Creek and the survey reaches on Godwood Creek were ranked highest in overall stream habitat suitability by EMDS. These sites are located where there has been very little or no disturbance to the landscape;
- Approximately half of the Prairie Creek Subbasin was logged between 1950 and 1978. Most of the logging activity took place in the Lost Man Creek Planning Watershed;
- Nearly all of the active landslides were observed in the Lost Man Creek Planning Watershed, where the most timber harvesting and road construction has occurred. The effects of land use on stream habitat in the Lost Man Creek Planning Watershed have persisted for decades in some areas;
- Land use, has exacerbated landsliding and sediment delivery to streams in the Lost Man Creek Planning Watershed;
- Timber harvests and associated road construction occurred in the May Creek, Boyes Creek, Lost Man Creek, and Skunk Cabbage Creek watersheds. The activities resulted in soil erosion, landslides, sediment inputs, and large debris accumulations in the stream channels, which altered aquatic habitat. The affected landscape has not fully recovered from these past disturbances;

- Sediments and debris accumulations associated with legacy timber harvests are still stored in Lost Man Creek;
- Past CDFG surveys of May Creek and Lost Man Creek share a common theme, both streams were noted as in a disturbed condition and numbers of anadromous salmonids declined after logging activity;
- Surface and drainage alterations associated with the construction of the Highway 101 bypass resulted in the generation and delivery of large quantities of fine sediments into headwaters of tributary streams. Salmonid spawning and rearing habitat of Prairie, Brown, Boyes, and May Creeks were affected by the event.

**Based upon these conditions, trends, and relationships, are there elements that could be considered to be limiting factors for salmon and steelhead production?**

- Elevated levels of fine sediment in spawning gravels in Lost Man, Brown, Boyes, and May creeks impair spawning habitat and may affect aquatic insect production needed as food for juvenile salmonids;
- The lack of deep pool habitat and instream shelter may limit salmonid production in sites located on Lost Man, Boyes, Brown and May creeks;
- A large debris accumulation likely impedes passage of spawning adults to upstream reaches on Lost Man Creek.

**What watershed and habitat improvement activities would most likely lead toward more desirable conditions in a timely, cost effective manner?**

***Barriers***

- Modify large debris accumulation on Lost Man Creek to improve passage of spawning adults;

***Flow and Water Quality Improvement Activities:***

- Ensure that adequate streamside protection measures are used to maintain shade canopy in order to reduce moderate inputs to the lower reach of Prairie Creek and to maintain good water temperature in Lost Man Creek and other tributary streams;
- Water flow or water quality does not appear to be an issue at this time, but fish habitat requirements and channel maintenance flows should be considered prior to any water development projects.

***Erosion and Sediment Delivery Reduction Activities:***

- Continue road assessments and upgrades or removal of roads, especially in the Lost Man Creek planning watershed;
- Work with CalTrans to reduce sediment input potential to streams from HWY 101 activities;
- Consider bank stabilization projects in the Lost Man Creek watershed.

***Riparian and Instream Habitat Improvement Activities:***

- Ensure that any land management activities include protection and preservation of stream and riparian habitats;
- Restore riparian function in areas where vegetation removal or significant cattle impacts have been noted in lower Prairie Creek;
- Consider modifying debris accumulations in Lost Man Creek to facilitate fish passage;
- Consider adding pool enhancement structures to increase the number of pools or deepen existing pools in Lost Man Creek, May Creek, and Boyes Creek.

**Supplemental Fish Rescue and Rearing Activities:**

- The use of Prairie Creek hatchery can be considered to supplement fishery resources of Redwood Creek if populations fail to respond to current management strategies.

**Education, Research, and Monitoring Activities:**

- The wide range of habitat conditions within the watershed provides an opportunity to monitor channel and salmonid habitat recovery rates under various habitat improvement treatments within a variety of channel types and conditions;
- Humboldt State University and RNSP should continue and expand their salmonid population and continuous temperature monitoring tasks in the Prairie Creek subbasin. This includes the use of fish counting weirs, spawner and redd surveys and juvenile population studies;
- A long term, concerted monitoring effort between the land owners, interested parties and responsible agencies is needed to determine the status and trends of anadromous fish populations in the Prairie Creek Subbasin;
- Water temperature monitoring should occur at the confluence of Prairie Creek and the mainstem to determine the effects of colder Prairie Creek water on the mainstem and estuary;
- Nutrients contributed to streams from eggs and decaying carcasses has declined. Studies should be conducted to discern relationships between nutrient contributions from carcasses, stream productivity, and salmonid production;
- CalTrans should continue to monitor and reduce sediment delivery from the Highway 101 bypass.

**Subbasin Conclusions**

The Prairie Creek Subbasin supports self sustaining populations of Chinook and coho salmon, steelhead and coastal cutthroat trout. It is believed that the Prairie Creek Subbasin provides the most coho salmon habitat and supports the largest coho population of all subbasins in Redwood Creek. Recent counts of spawning Chinook and coho show an increase from the low numbers observed in the early 1980s. However, a review of available information concludes that salmonid populations are well below historic levels of abundance.

Physical factors including debris jams and sediment inputs that impair anadromous salmonid habitats are linked to past land use activities. In contrast, undisturbed areas of the subbasin generally maintain desirable conditions for anadromous salmonids. Overall, the best stream habitat of the subbasin was found in areas that received the least amount of land disturbance.

RNSP maintains and protects natural resources and refugia habitat that are important to the recovery and expansion of anadromous salmonid populations of the Redwood Creek Basin. In addition, the Prairie Creek Subbasin provides an excellent opportunity for planning and implementing management to maintain and improve stream habitat conditions and to strengthen anadromous stocks of Redwood Creek.

The Prairie Creek Subbasin is an excellent location to study watershed science and to observe responses of fish populations in disturbed versus undisturbed watersheds. These streams offer the opportunity to compare and contrast natural stream recovery with habitat improvement projects aimed at increasing aquatic habitat quality and fish abundance and diversity.