

SECTION F FISH HABITAT CONDITION AND AQUATIC SPECIES DISTRIBUTION

INTRODUCTION

The anadromous fish species inhabiting the Navarro River WAU are steelhead trout (*Oncorhynchus mykiss*), coho salmon (*O. kisutch*) and Pacific lamprey (*Lampetra tridentata*). Non-anadromous species include sculpin (*Cottus spp.*), threespine stickleback (*Gasterosteus aculeatus*), California roach (*Lavinia symmetricus*), and Sacramento sucker (*Castomus occidentalis*). On MRC's property there are approximately 63 stream miles of habitat being utilized by coho and 95 stream miles of habitat being utilized by steelhead in the Navarro River watershed.

Field surveys were conducted to evaluate the quality and quantity of salmonid habitat in the Navarro WAU. Surveys included salmonid habitat typing and assessment, stream gravel permeability measurements and bulk gravel samples. The fish habitat assessment evaluated spawning, rearing and overwintering habitats based on targets derived from scientific literature (Bilby and Ward, 1989; Bisson et al., 1987; CDFG, 1998; Montgomery et al., 1995; Washington Forest Practices Board, 1995) and professional judgment. The habitat data are combined into indices of habitat quality for the different life history stages.

Aquatic species distribution surveys were conducted by the previous landowners (Louisiana-Pacific Corp.) from 1994-1996, and were repeated by MRC from 2000-2002 (MRC 2002). The study consisted of single pass electrofishing or snorkeling surveys in the summer months to assess aquatic species distribution and composition in the Navarro WAU. All organisms observed were identified to the lowest possible taxonomic level.

Permeability and bulk gravel samples were taken in select fish bearing reaches of the Navarro WAU to determine an index of spawning gravel quality. Permeability and gravel particle size distributions are stream substrate parameters, which affect survival of incubating salmonid embryos. Salmonid eggs buried under up to a foot of gravel depend on sufficient intragravel water flow for their survival and development. Fine sediment within spawning gravel can impede intragravel water flow, reducing the delivery of dissolved oxygen to eggs, which can increase mortality in the egg to emergence stage. Forest management practices may increase the delivery of fine sediment to the stream channel, potentially impacting spawning gravel. The assessment of substrate permeability and composition are useful in monitoring the effects of increased sediment delivery on salmonid spawning and incubation conditions.

METHODS

Fish Habitat Assessment

The habitat inventory used to evaluate the habitat condition of the Navarro WAU was conducted during low flow conditions using methods modified from the California Salmonid Stream Restoration Manual (Flosi et al., 1998). Stream segments were created based on stream gradient and channel confinement (see section E Stream Channel Condition module). Fish habitat

conditions were determined by sampling representative stream segments throughout the watershed. Factors that determined fish habitat assessment locations included fish presence, accessibility and stream channel type (response, transport or source reach). Since high gradient streams were likely to be non-fish bearing, survey efforts were concentrated on low gradient reaches of the stream network.

A distance of 20-30 bankfull widths determined the survey length to ensure that approximately two meander bends of the stream channel were observed. Data collected during the fish habitat and stream channel surveys provided information on pool, riffle and flatwater frequency; pool spacing; spawning gravel quantity and quality; overwintering substrate; shelter complexity and large woody debris (LWD) frequency, condition and future recruitment.

The fish habitat observations were evaluated for quality for each salmonid life stage: spawning, summer rearing and overwintering. Table F-1 displays the targets used for rating measured habitat parameters. These indices are based on scientific literature (Bilby and Ward, 1989; Bisson et al., 1987; Bjornn and Reiser, 1994; CDFG 1998; Montgomery et al., 1995; Washington Forest Practices Board, 1995) and professional judgment. Spawning habitat conditions are evaluated on the basis of gravel availability and quality (gravel sizes, subsurface fines, embeddedness), and are evaluated for preferred salmonid spawning areas located at the tail-outs of pools. Summer rearing habitat conditions for salmonids are evaluated on the size, depth and availability of pools and the complexity and quantity of cover (particularly large woody debris). Overwintering habitat is evaluated on the size, depth and availability of pools, the proportion of habitat units with cobble or boulder-dominated substrate and the quantity of cover.

The habitat data are combined into indices of habitat quality for the different salmonid life stages. Measured fish habitat parameters were weighted and given a numeric scale to develop a quality rating for individual life history stages. Parameters were divided into subsets that correspond with individual life history stages (spawning, summer rearing, and overwintering habitat). Parameters were scored as follows: 1 (poor), 2 (fair), and 3 (good). Parameter weights were applied to the total score calculated as shown below. The parameter codes (see Table F-1) are in bold and the weights in parentheses.

Spawning Habitat

$$\mathbf{E} (0.25) + \mathbf{F} (0.25) + \mathbf{G} (0.25) + \mathbf{H} (0.25)$$

Summer Rearing Habitat

$$\mathbf{A} (0.20) + \mathbf{B} (0.15) + \mathbf{C} (0.15) + \mathbf{D} (0.15) + \mathbf{F} (0.15) + \mathbf{I} (0.20)$$

Overwintering Habitat

$$\mathbf{A} (0.20) + \mathbf{B} (0.15) + \mathbf{C} (0.15) + \mathbf{D} (0.10) + \mathbf{I} (0.20) + \mathbf{J} (0.20)$$

The overall score is rated as follows:

1.00 - 1.66 = Poor

1.67 - 2.33 = Fair

2.34 - 3.00 = Good

TableF-1. Fish Habitat Condition Indices for Measured Parameters

Fish Habitat Parameter	Feature	Fish Habitat Quality		
		Poor	Fair	Good
Percent Pool (By length) (A)	Anadromous Salmonid Streams	<25%	25-50%	>50%
Pool Spacing (Reach length/Bankfull/#pools) (B)	Anadromous Salmonid Streams	≥ 6.0	3.0 - 5.9	≤ 2.9
Shelter Rating (Shelter value x % of habitat covered) (C)	Pools	<60	60-120	>120
% Of Pools that are ≥3 ft. residual depth (D)	Pools	<25%	25-50%	>50%
Spawning Gravel Quantity (% of Surface Area) (E)	Pool Tail-outs	<1.5%	1.5-3%	>3%
Percent Embeddedness (F)	Pool Tail-outs	>50%	25-50%	<25%
Subsurface Fines (L-P watershed analysis manual) (G)	Pool Tail-outs	2.31-3.0	1.61-2.3	1.0-1.6
Gravel Quality Rating (L-P watershed analysis manual) (H)	Pool Tail-outs	2.31-3.0	1.61-2.3	1.0-1.6
Key LWD +root wads / 328 ft of stream. (I)	Streams < 40 ft. BFW	<4.0	4.0-6.5	>6.6
	Streams ≥ 40 ft. BFW	<3.0	3.0-3.8	>3.9
Substrate for Over-wintering (J)	All Habitat Types	<20% of Units Cobble or Boulder Dominated	20-40% of Units Cobble or Boulder Dominated	>40% of Units Cobble or Boulder Dominated

Aquatic Species Distribution

A hierarchical framework was used to select the initial locations of survey sites in each stream. Major streams were broken into lower, middle and upper reaches. Smaller streams were divided into lower and upper reaches. One site is surveyed in each reach, resulting in 3 sites in larger streams, and 2 sites in smaller streams. Additional sites are added directly downstream and upstream of potential migration barriers to determine which salmonid species these barriers are impacting.

A survey site contains a minimum of two consecutive habitat sequences (pool-riffle sequences) and has a minimum length of ninety feet. The survey method used to determine the aquatic species present is single pass electrofishing or snorkeling.

The effort put forth at each survey site is not sufficient to delineate the absence of a species. If future fishery research develops reasonable methods to determine the probability that a species is absent, these methods will be incorporated into future distribution surveys.

Prior to initiating surveys water quality is measured using a Horiba™ U-10 Water Quality Checker. Measurements taken are water temperature (°C), conductivity (microS/cc), dissolved oxygen (mg/L), and pH. Air temperature is measured with a pocket thermometer and water visibility is estimated. Stream discharge is estimated or measured with a Swiffer™ Model 2100 flow meter. The actual physical parameters measured at each site vary depending on equipment availability. Horiba™ U-10 Water Quality Checkers were not used prior to the surveys in 2000.

The primary survey method is electrofishing using a Smith-Root™ Model 12 (Smith-Root Inc., Vancouver, WA) backpack electrofisher. One person operates the backpack electrofisher while one or two other individuals use dip nets to capture the stunned species. The captured specimens are placed into a five-gallon bucket containing stream water. The aquatic species are enumerated, measured to fork length (fish) or snout-vent length (amphibians) and released back into the units from which they were captured. All vertebrate species are identified to the lowest possible taxonomic level.

Diving (snorkeling) is used to assess species presence when stream conditions are considered adequate or when elevated stream temperatures have the potential to adversely impact the health of the animals being electrofished. The basic survey unit for diving consists of a minimum of two pools, however if riffles are deep enough to allow underwater observation these units are sampled. Depending on the channel width, one to four divers are used for the field surveys. The diver(s) enters the survey unit from the downstream end and waits approximately one-minute before proceeding upstream to observe species. If the water velocity is too fast for divers to proceed upstream, the unit is surveyed by floating downstream. Dive slates are used to record data underwater. During the survey, salmonid species are enumerated by size class according to pre-determined size class categories (<70mm, 70–130mm, >130mm). All other vertebrate species observed during the field surveys are identified to the lowest possible taxonomic level.

Permeability and Stream Bulk Gravel Samples

Stream gravel permeability and bulk gravel samples were collected on eight stream monitoring segments in the Navarro River WAU in 1999. In 2001, two segments were surveyed for permeability and no bulk gravel samples were collected. The stream gravel permeability was measured using a 1-inch diameter standpipe similar to the standpipe discussed in Terhune (1958) and Barnard and McBain (1994) with the exception that our standpipe is smaller in diameter. We used the smaller diameter standpipe because we hypothesize that it creates fewer disturbances to the stream gravel when inserted. Bulk stream gravel samples were taken with a 12-inch diameter sampler as described in Platts, Megahan and Minshall (1983).

An electric pump was used to create the water suction in the standpipe for the permeability measurements. The permeability measurements were taken at a depth of 25 centimeters, near the maximum depth of coho and steelhead spawning. The permeability measurements were taken in 4 randomly selected pool tail-out sections along the monitoring segment. At each pool tail-out sampled permeability measurements were taken at 3 sites; the ¼, ½ and ¾ mark of the wetted

channel. This gave a total of 12 permeability sites along each monitoring segment in 1999. A recent analysis of MRC permeability data has shown that more samples should be taken to more accurately predict the survival to emergence percentage calculated from the permeability data. From a power analysis it was determined that 26 measurements per segment are needed to predict within 20 percent accuracy the survival of emerging fry (Stillwater Science, 2000). Future measurements will be evenly distributed among all pool tail-outs in the segments. Caution must be taken in interpreting calculated values from the Navarro permeability measurements of 1999 as the number of samples is lower than desirable.

A bulk gravel sample was taken in 1999 in each of the 4 randomly selected pool tail-outs, except for segment WM2 which only had 2 samples. The gravel sample was taken directly over the permeability site that is closest to the thalweg of the channel. After the bulk gravel samples were collected the gravel was dried and sieved through 7 different size-class screens (50.8, 25.4, 12.5, 6.3, 4.75, 2.36, 0.85 mm). The weight of each gravel size class was determined for each of the bulk gravel samples using a commercial quality scale.

From the sieved bulk gravel samples the percent fine particles less than 0.85 mm sieve size class was determined. The survival index for steelhead trout was calculated from the bulk gravel samples using the method described in Tappel and Bjorn (1983). The index for percent survival of steelhead was used because Tappel and Bjorn (1983) only present two survival indices for chinook salmon and steelhead trout. The steelhead index was used because it more closely approximates the fishery in the Navarro WAU (coho salmon and steelhead trout). Chinook salmon are larger fish than coho or steelhead and can spawn in larger substrate making the index based on Chinook salmon impractical for the Navarro WAU.

In the year 2001, a total of 26 permeability measurements were taken in each selected monitoring segment. Bulk gravel samples were not collected in 2001. The measurements were evenly distributed among all pool tail-outs in the segments, with any additional measurements taken in tail-outs behind the deepest pools. The measurement location in each tail-out was randomly selected from an evenly selected 12-point grid in the tail-out. At each measurement location permeability repetitions were taken until the permeability readings no longer were increasing.

The median permeability measurement for each permeability site in the monitoring segment was used as representative of the site. To characterize the entire monitoring segment the natural log of the mean of the median permeability measurements was determined. The natural log of the permeability is used because of a relationship developed from data from Tagart (1976) and McCuddin (1977) (Stillwater Sciences, 2000) to estimate survival to emergence from permeability data. This relationship equates the natural log of permeability to fry survival ($r^2 = 0.85$, $p < 10^{-7}$). This index needs further improvements, but is currently all we have for interpreting permeability information and biological implications. This relationship is:

$$\text{Survival} = -0.82530 + 0.14882 * \ln \text{ permeability}$$

It is important to understand that the use of this survival relationship is only an index of spawning gravel quality in the segment. The permeability measurements were taken in randomly selected pool tail-outs and are not indicative of where a salmon may select to spawn. Furthermore, spawning salmon have been shown to improve permeability in gravel where a redd was developed (MRC, 2000). Therefore the survival percentage developed is only indicative of the quality of potential spawning habitat and not as an absolute number.

RESULTS AND DISCUSSIONS

Salmonid Habitat Condition and Aquatic Species Distribution

Tables F-2 and F-3 summarize the 1999 fish habitat assessment data. A total of 40 segments were evaluated. The habitat parameters used to evaluate individual stream segments can be found in Table F-2. The 'rating' is the quality value for calculation of weighted habitat indices (see Table F-1). The ratings were used to calculate habitat quality for each life history stage. A summary of the habitat ratings corresponding to each life history stage can be found in Table F-3.

Map F-1(a) and F-1(b) were generated using data collected during the distribution surveys. Some additional field work was conducted to investigate the location of migration barriers. If no adult salmonid migration barrier was found, then the upper extent of salmonid (steelhead and coho) distribution is mapped as far upstream as juveniles have been found. In most circumstances this is close to the actual extent of salmonid distribution. However, in some streams salmonid distribution may extend further upstream.

Table F-4 indicates scientific names of the species discussed. There are three taxonomic uncertainties that are important to note. 1) Juvenile steelhead and resident rainbow trout cannot be distinguished between in the field. For the purpose of this report, *Oncorhynchus mykiss* juveniles are referred to as "steelhead" if there is not a known migration barrier downstream. If there is a migration barrier downstream the juveniles are referred to as "rainbow trout". 2) California roach of the sub-species *Lavinia symmetricus navarroensis* are known to occur in the Navarro River watershed. It is unknown if other California roach sub-species occur in the drainage. California roach are not identified to the sub-species level in this report. 3) The Navarro River watershed is known to contain signal crayfish (*Pacifastacus leniusculus*). Other species of crayfish may also be present. Crayfish are not identified to the species level in this report.

The Navarro River WAU is comprised of seventeen planning watersheds of which fifteen were surveyed for fish habitat and/or aquatic species distribution. The planning watersheds range in size from 3,500 to 8,900 acres. The discussion of results is separated into planning watersheds and stream names of the Navarro River WAU. Some streams lack fish habitat or aquatic species distribution information. Available information for each stream is summarized in the discussion below.

Lower Navarro River Planning Watershed

Mainstem Navarro River (Habitat segment WL3)

Habitat

Spawning, summer rearing and over-wintering habitat rated fair. The segment was deficient in large woody debris and over-wintering substrate.

Steelhead

This segment was surveyed during the summer of 1995, 1996, 2000, 2001 and 2002. Each year multiple age classes of juvenile steelhead were observed.

Coho Salmon

Though coho are found in tributaries to the mainstem Navarro River, coho have not been found in the mainstem during summer. This may be due to high summer water temperatures. Annual maximum weekly average temperatures (MWAT) typically exceed 20° C. (See Section D "Riparian Function").

Other Species

Other species found in this segment include California roach, threespine stickleback, sculpin, crayfish, and bullfrog.

Marsh Gulch (Habitat segment WLA)*Habitat*

Summer rearing and over-wintering habitat rated fair. Spawning habitat rated poor due to highly embedded gravel and large quantities of sub-surface fine sediment.

Steelhead

Steelhead have been found as far upstream as Site 82-2. Increased stream gradient up-stream of Site 82-2 is believed to impede upstream passage of adult steelhead.

Coho Salmon

Coho have been found as far upstream as Site 82-1. Between Site 82-1 and Site 82-2 stream gradient increases slightly. The increased gradient may impede the upstream passage of adult coho.

Other Species

Other species found in Marsh Gulch include coast range sculpin, prickly sculpin, Pacific lamprey, California roach, Olympic tailed frog, Pacific giant salamander and crayfish.

Murray Gulch (Habitat segment WL19)*Habitat*

Spawning and summer rearing habitat rated fair. Over-wintering habitat rated poor due to a lack of deep pools and over-wintering substrate.

Steelhead

Steelhead have been found as far upstream as Site 82-46. Increased stream gradient upstream of site 82-46 is believed to impede upstream passage of adult steelhead.

Coho Salmon

Coho have been found as far upstream as Site 82-3. Upstream of Site 82-3 stream gradient increases slightly. The increased gradient may impede the passage of adult coho.

Other Species

Other species found in Murray Gulch include California roach, prickly sculpin, Pacific giant salamander, Olympic tailed frog, red legged frog, and crayfish.

Flume Gulch (Habitat segments WL27 and WL28)*Habitat*

Spawning, summer rearing and over-wintering habitat rated fair in both segments. However, both segments lacked deep pools.

Steelhead

Steelhead have been found upstream as far as Site 82-8. The upper extent of steelhead distribution is unknown and merits investigation.

Coho Salmon

Coho have been found as far upstream as Site 82-7. Upstream of Site 82-7 stream gradient increases. The increased gradient may impede the upstream passage of adult coho.

Other Species

Other species found in Flume Gulch include coast range sculpin, prickly sculpin, California roach, Pacific giant salamander, and crayfish.

Ray Gulch Planning WatershedBarton Gulch (Habitat data has not been collected)*Steelhead*

Steelhead have only been found at Site 82-05. However, sampling at site 82-06 is difficult due to vegetation overhanging the stream channel. No known barrier to steelhead migration exists in Barton Gulch.

Coho Salmon

Coho have not been found in Barton Gulch.

Other Species

Other species found in Barton Gulch include prickly sculpin, threespine stickleback, California roach, Pacific giant salamander, and crayfish.

Comments

The Hwy 128 road crossing should be surveyed to determine if it has the potential to impede salmonid migration.

*Roller Gulch (Habitat segment WR11)**Habitat*

Spawning habitat rated fair. Summer rearing and over-wintering habitat rated poor, primarily due to a lack of deep pools, large woody debris and over-wintering substrate.

Steelhead

Steelhead have not been found in Roller Gulch. Steelhead may be absent from Roller Gulch because the lower reach is marshy and lacks a defined channel that fish can migrate through.

Coho Salmon

Coho have not been found in Roller Gulch.

Other Species

Other species found in Roller Gulch include sculpin, threespine stickleback, Pacific giant salamander, California newt, rough skinned newt, yellow legged frog and red legged frog.

*Ray Gulch (Habitat segments WR14 and WR15)**Habitat*

Summer rearing and over-wintering habitat rated fair in both segments. Spawning habitat rated good in segment WR14 and poor in segment WR15. In general, both segments were deficient in deep pools and over-wintering substrate. Large woody debris was abundant.

Steelhead

Steelhead have been found as far upstream as Site 82-45. Surveys have not been conducted upstream of this site due to limited surface water during the survey season.

Coho Salmon

Coho have not been found in Ray Gulch.

Other Species

Other species found in Ray Gulch include prickly sculpin, California roach, threespine stickleback, bull frog, red-legged frog, Pacific giant salamander, and crayfish.

Comments

The Hwy 128 road crossing should be surveyed to determine if it has the potential to impede salmonid migration.

*Mustard Gulch (Habitat segment WR26)**Habitat*

Spawning, summer rearing and over-wintering habitat rated fair. The segment was deficient in over-wintering substrate and deep pools. Large woody debris was abundant.

Steelhead

Steelhead have not been found in Mustard Gulch since 1995. In 1995 steelhead were found at Site 82-11.

Coho Salmon

Coho have not been found in Mustard Gulch.

Other Species

Other species found in Mustard Gulch include prickly sculpin, California roach, threespine stickleback, Pacific giant salamander, and crayfish.

Comments

The Hwy 128 road crossing should be surveyed to determine if it has the potential to impede salmonid migration.

White Gulch (Habitat Segment (WR23) (Aquatic species distribution surveys have not been conducted in White Gulch)

Habitat

Summer rearing and over-wintering habitat rated poor, primarily due to a lack of deep pools and over-wintering substrate. Spawning habitat rated fair.

Middle Navarro River Planning Watershed

Mainstem Navarro River (Habitat segments WM2 and WM5)

Habitat

Spawning, summer rearing and over-wintering habitat were rated fair in both segments. Segment WM2 was deficient in large woody debris. Segment WM5 was deficient in large woody debris, and substrate suitable for over-wintering. Additionally, fine sediment levels were high.

Steelhead

Multiple age classes of juvenile steelhead have been found in these segments.

Coho

Though coho are found in tributaries to the mainstem Navarro River, coho have not been found in the mainstem during summer.

Other Species

Other species found in these segments include California roach, prickly sculpin, three spine stickleback and crayfish.

Tramway Gulch (Habitat data has not been collected)

Steelhead

Steelhead have been found as far upstream as site 82-16. Surveys have not been conducted upstream of this site.

Coho Salmon

Coho have not been found in Tramway Gulch.

Other Species

Other species found in Tramway Gulch include Pacific giant salamander and crayfish.

Berry Creek (Habitat segment WM36)

Habitat

Spawning habitat rated good. Summer rearing and over-wintering habitat rated poor, primarily due to a lack of deep pools and large woody debris.

Steelhead

Steelhead have been found as far upstream as Site 82-29. Upstream of Site 82-29 there is a log jam that appeared to be a barrier to upstream salmonid migration in 2002. It is believed that the log jam will eventually break up allowing steelhead to migrate further upstream.

Coho Salmon

Coho have not been found in Berry Gulch.

Other Species

Other species found in Berry Gulch include Pacific giant salamander, yellow legged frog, rough skinned newt, and crayfish.

Floodgate Creek Planning Watershed***Perry Gulch (Habitat data has not been collected)******Steelhead***

Steelhead have been found at Site 82-26. Surveys have not been conducted upstream of this site due to a change in land ownership.

Coho Salmon

Coho have not been found in Perry Gulch.

Other Species

Other species found in Perry Gulch include California roach, sculpin, yellow legged frog, Pacific giant salamander, and crayfish.

Comments

Perry Gulch could not be surveyed in 2000-2002 due to limited surface water during the survey season.

Floodgate Creek (Habitat data has not been collected)***Steelhead***

Steelhead have been found at Site 82-30. Surveys have not been conducted further upstream due to a change in land ownership.

Coho Salmon

Coho have not been found in Floodgate Creek.

Other Species

Other species found in Floodgate Creek include California roach, threespine stickleback, prickly sculpin, yellow legged frog, Pacific giant salamander, rough skinned newt, and crayfish.

Upper Navarro River Planning Watershed***Mainstem Navarro River (Habitat segment WU1)******Habitat***

Spawning, summer rearing and over-wintering habitat all rated fair. Similar to the lower Navarro River segment, this segment was deficient in large woody debris, and substrate suitable for over-wintering.

Steelhead

Steelhead have been found within this segment.

Coho

Though coho are found in tributaries to the mainstem Navarro River, coho have not been found in the mainstem during summer.

Other Species

Other species found within this segment include California roach, prickly sculpin, threespine stickleback and yellow legged frog.

Black Rock Creek (Habitat segment WU4)***Habitat***

Spawning and over-wintering habitat were rated fair. Summer rearing habitat was rated poor, primarily due to shallow pool depths and a lack of large woody debris.

Steelhead

Steelhead have been found at Site 82-40. Upstream of Site 82-40 there is a log jam that appeared to be a barrier to salmonid migration in 2002. It is believed that the log jam will eventually break up allowing salmonids to migrate further upstream.

Coho Salmon

Coho have not been found in Black Rock Creek.

Other Species

Other species found in Black Rock Creek include Pacific giant salamander, yellow legged frog and crayfish.

Sage Gulch (Habitat data has not been collected)*Steelhead*

Steelhead have been found at Site 82-33. There is a waterfall directly upstream of Site 82-33 that is believed to be a barrier to upstream salmonid migration.

Coho Salmon

Coho have not been found in Sage Gulch.

Other Species

Other species found in Sage Gulch include Pacific giant salamander, yellow legged frog and crayfish.

Mill Creek Planning Watershed*Hungry Hollow Creek (Habitat data has not been collected)**Steelhead*

Neither steelhead nor resident rainbow trout have been found in Hungry Hollow Creek. A waterfall downstream of MRC's property is believed to impede upstream migration of adult steelhead.

Coho Salmon

Coho have not been found in Hungry Hollow Creek.

Other Species

Other species found in Hungry Hollow Creek include rough skinned newt, California newt, Pacific giant salamander and yellow legged frog.

Hendy Woods Planning Watershed*Mainstem Navarro River (Habitat segment WH2)**Habitat*

Spawning and summer rearing habitat were rated fair. Over-wintering habitat was rated poor due to a lack of large woody debris, deep pools and over-wintering substrate.

Steelhead

Juvenile steelhead of multiple age classes have been found in this segment.

Coho

Though coho are found in tributaries to the mainstem Navarro River, coho have not been found in the mainstem during summer.

Other Species

Other species found in this segment include prickly sculpin, California roach, threespine stickleback and crayfish.

North Fork Indian Creek Planning Watershed*North Fork Indian Creek (Habitat segment EI2)**Habitat*

Spawning habitat was rated good. Both summer rearing and over-wintering habitat were rated fair. The segment was deficient in deep pools.

Steelhead

Multiple age classes of steelhead have been found throughout North Fork Indian Creek.

Coho Salmon

Coho have not been found in North Fork Indian Creek.

Other Species

Other species found in North Fork Indian Creek include California roach, Pacific lamprey, rough skinned newt, California newt, Pacific giant salamander, and yellow legged frog.

*West Branch North Fork Indian Creek (Habitat data has not been collected)**Steelhead*

Steelhead have been found at Site 86-6. Upstream of site 86-6 stream gradient increases. The increased gradient is believed to impede upstream passage of adult steelhead.

Coho Salmon

Coho have not been found in West Branch North Fork Indian Creek.

Other Species

Other species found in West Branch North Fork Indian Creek include yellow legged frog, California newt and Pacific giant salamander.

*Sherman Gulch (Habitat data has not been collected)**Steelhead*

Steelhead have been found at Site 86-2. Surveys have not been conducted further upstream due to a change in land ownership.

Coho Salmon

Coho have not been found in Sherman Gulch.

Other Species

Other species found in Sherman Gulch include yellow legged frog and Pacific giant salamander.

Rancheria Creek Planning Watershed*Dago Creek (Habitat data has not been collected)**Steelhead*

Steelhead have been found at Site 88-5. Surveys have not been conducted further upstream due to a change in property ownership.

Coho Salmon

Coho have not been found in Dago Creek. It is possible that coho occur downstream of the area that has been surveyed.

Other Species

Other species found in Dago Creek include sculpin, Pacific giant salamander, and California newt.

*Cold Springs Creek (Habitat data has not been collected)**Steelhead*

Steelhead have been found at Site 88-2. Surveys have not been conducted further upstream due to a change in property ownership.

Coho Salmon

Coho have not been found in Cold Spring Creek. It is possible that coho occur downstream of the area that has been surveyed.

Other Species

Other species found in Cold Springs Creek include Pacific giant salamander and yellow legged frog.

North Fork Navarro River Planning Watershed***Dead Horse Gulch (Habitat segment WN10)******Habitat***

Spawning, over-wintering and summer rearing habitat rated fair. This segment was deficient in deep pools and fine sediment levels were high.

Steelhead

Steelhead have been found at Site 82-14. Surveys have not been conducted upstream of this site due to limited surface water during the survey season.

Coho Salmon

Coho have been found at Site 82-14.

Other Species

Other species found in Dead Horse Gulch include California roach, sculpin, Pacific giant salamander and crayfish.

Comments

The Hwy 128 road crossing should be surveyed to determine if it has the potential to impede salmonid migration.

Coon Creek (Habitat segment WN20)***Habitat***

Spawning, over-wintering and summer rearing habitat rated fair. The segment was deficient in deep pools and fine sediment levels were high.

Steelhead

Steelhead have been found as far upstream as Site 82-17. Surveys have not been conducted upstream of this site due to limited surface water during the survey season.

Coho Salmon

Coho have not been found in Coon Creek.

Other Species

Other species found in Coon Creek include Pacific giant salamander and crayfish.

Comments

The Hwy 128 road crossing should be surveyed to determine if it has the potential to impede salmonid migration.

Flynn Creek Planning Watershed***Flynn Creek (Habitat segments WF1 and WF1(U))******Habitat***

Across these segments: spawning habitat ratings ranged from fair to good, over-wintering habitat ratings ranged from poor to fair and summer rearing habitat rated fair. The segments were deficient in large woody debris and deep pools.

Steelhead

Steelhead have been found as far upstream as Site 82-25. Surveys have not been conducted upstream of this site due to limited surface water during the survey season..

Coho Salmon

Coho have been found as far upstream as Site 82-25.

Other Species

Other species found in Flynn Creek include threespine stickleback, coastrange sculpin, prickly sculpin, California roach, Pacific giant salamander, yellow legged frog, and crayfish.

Camp 16 Gulch (Habitat segment WF13)***Habitat***

Spawning habitat rated good. Summer rearing and over-wintering habitat rated fair. The segment was deficient in large woody debris and deep pools.

Steelhead

Steelhead have been found as far upstream as Site 82-22. Surveys have not been conducted upstream of this site due to limited surface water during the survey season.

Coho Salmon

Coho have been found as far upstream as Site 82-22.

Other Species

Other species found in Camp 16 Gulch include prickly sculpin and Pacific giant salamander.

*Tank 4 Gulch (Habitat data has not been collected)**Steelhead*

Steelhead have been found as far upstream as Site 82-24. Surveys have not been conducted upstream of this site due to limited surface water during the survey season.

Coho Salmon

Coho have been found at site 82-23.

Other Species

Other species found in Tank 4 Gulch include sculpin, Pacific giant salamander and crayfish.

Lower South Branch Navarro River Planning Watershed*South Branch North Fork Navarro River (Habitat segment ELL)**Habitat*

Spawning habitat rated good. Over-wintering habitat rated fair and summer rearing habitat rated poor due to shallow pools and very little large woody debris.

Steelhead

Multiple age classes of juvenile steelhead have been found in this segment.

Coho

Coho have been found within this segment.

Other Species

Other species found within this segment include coast range sculpin, California roach, three spine stickleback, Pacific lamprey, yellow legged frog, Pacific giant salamander and crayfish.

Middle South Branch Navarro River Planning Watershed*South Branch North Fork Navarro River (SBNF) (Habitat segment EM1)**Habitat*

Spawning, summer rearing and over-wintering habitat rated fair. The segment was deficient in deep pools and fine sediment levels were high.

Steelhead

Steelhead have been found within this segment.

Coho

Prior to 2002, coho had only been found at Site 85-1, near the mouth of the SBNF. In 2002 coho were found upstream of this segment as far as Site 85-18, approximately 15 stream miles upstream of where they had previously been found.

Other Species

Other species found in this stretch of river include Pacific lamprey, California roach, threespine stickleback, yellow legged frog, Pacific giant salamander and crayfish.

*Bailey Creek (Habitat data has not been collected)**Steelhead*

Steelhead have been found as far upstream as Site 85-4. Surveys have not been conducted further upstream due to limited surface water during the survey season.

Coho Salmon

Coho have not been found in Bailey Creek.

Other Species

Other species found in Bailey Creek include prickly sculpin, Pacific giant salamander and crayfish.

*Camp Creek (Habitat data has not been collected)**Steelhead*

Steelhead have been found as far upstream as Site 85-23. Between Site 85-23 and Site 85-24 there is a culvert that is a barrier to upstream salmonid migration. MRC is currently making plans to remove this barrier.

Coho Salmon

Coho have not been found in Camp Creek.

Other Species

Other species found in Camp Creek include sculpin and Pacific giant salamander.

*Bear Creek (Habitat segment EM20)**Habitat*

Spawning habitat rated fair. Summer rearing and over-wintering habitat rated poor, primarily due to a lack of deep pools, large woody debris and over-wintering substrate. The substrate was highly embedded.

Steelhead

Steelhead have been found as far upstream as Site 85-30. Directly downstream of Site 85-6 there is a waterfall that is a barrier to adult steelhead upstream migration. Resident rainbow trout have not been found above the waterfall.

Coho Salmon

Prior to 2002, coho had not been found in Bear Creek. In 2002, coho were found at Site 85-5.

Other Species

Other species found in Bear Creek include California newt, yellow legged frog, Pacific giant salamander and crayfish.

*Bridge Creek (Habitat segments EM29 and EM30)**Habitat*

Summer rearing and over-wintering habitat rated fair in both segments. Spawning habitat rated fair in segment EM29 and good in segment EM30. Both segments were deficient in deep pools and large woody debris,

Steelhead

Steelhead have been found at Site 85-25. Directly upstream of this site there is a series of bedrock cascades. Two culverts are perched on top of the cascades. The culverts are a barrier to adult salmonid upstream migration.

Coho Salmon

Prior to 2002, coho had not been found in Bridge Creek. In 2002, coho were found at Site 85-25 (downstream of the culverts discussed above).

Other Species

Other species found in Bridge Creek include prickly sculpin, Pacific giant salamander, yellow legged frog and crayfish.

Comments

Removal of the culverts to allow for fish passage is currently being planned by Mendocino Redwood Company.

*Shingle Mill Gulch (Habitat segment EM39)**Habitat*

Spawning habitat rated fair. Summer rearing and over-wintering habitat rated poor, primarily due to a lack of deep pools.

Steelhead

Steelhead have been found at Site 85-8. Directly upstream of this site a culvert was present prior to the summer of 2002. This culvert was believed to be a barrier to adult steelhead upstream migration. Resident rainbow trout had been found upstream as far as Site 85-9. In 2002, the culvert was replaced with a bridge that will not impede steelhead migration.

Coho Salmon

Coho have not been found in Shingle Mill Gulch.

Other Species

Other species found in Shingle Mill Gulch include Pacific giant salamander, yellow legged frog and crayfish.

Upper South Branch Navarro River Planning Watershed*South Branch North Fork Navarro River (SBNF) (Habitat segments EU1 and EU4)**Habitat*

Spawning, summer rearing and over-wintering habitat rated fair in both segments. Both segments were deficient in large woody debris.

Steelhead

Multiple age classes of steelhead have been found in this stretch of river.

Coho

Prior to 2002, coho had only been found at Site 85-1, near the mouth of the SBNF. In 2002 coho were found as far upstream as Site 85-18.

Other Species

Other species found in this stretch of river include California roach, yellow legged frog, Pacific giant salamander and crayfish.

*McGarvey Creek (Habitat segment EU7)**Habitat*

Spawning habitat rated fair. Summer rearing and over-wintering habitat rated poor, primarily due to a lack of deep pools and over-wintering substrate.

Steelhead

Steelhead have been found as far upstream as Site 85-12. Surveys have not been conducted further upstream due to limited surface water during the survey season.

Coho Salmon

Coho have not been found in McGarvey Creek.

Other Species

Other species found in McGarvey Creek include California roach, threespine stickleback, Pacific giant salamander, yellow legged frog and crayfish.

*Burns Gulch (Habitat data has not been collected)**Steelhead*

Steelhead have been found at Site 85-15. It is believed that increasing stream gradient upstream of Site 85-15 impedes upstream migration by adult steelhead.

Coho Salmon

Coho have not been found in Burns Gulch.

Other Species

Other species found in Burns Gulch include Pacific giant salamander, yellow legged frog and crayfish.

Rose Creek (Habitat segment EU24)*Habitat*

Spawning habitat rated fair. Summer rearing and over-wintering habitat rated poor, primarily due to a lack of deep pools.

Steelhead

Steelhead have been found as far upstream as Site 85-22. Surveys have not been conducted further upstream

Coho Salmon

Coho have not been found in Rose Creek.

Other Species

Other species found in Rose Creek include California roach, Pacific giant salamander, yellow legged frog and crayfish.

Low Gap Creek (Habitat segment EU20)*Habitat*

Spawning, summer rearing and over-wintering habitat rated fair. The segment was deficient in large woody debris and deep pools.

Steelhead

Steelhead have been found as far upstream as Site 85-17. Surveys have not been conducted further upstream due to a change in land ownership.

Coho Salmon

Prior to 2002, coho had not been found in Low Gap Creek. In 2002, coho were found upstream as far as Site 85-31.

Other Species

Other species found in Low Gap Creek include sculpin, California roach, California newt, yellow legged frog, Pacific giant salamander and crayfish

Hardscratch Creek (Habitat data has not been collected)*Steelhead*

Steelhead have been found as far upstream as Site 85-20. Surveys have not been conducted further upstream due to a change in land ownership.

Coho Salmon

Prior to 2002, coho had not been found in Hardscratch Creek. In 2002, coho were found as far upstream as Site 85-18.

Other Species

Other species found in Hardscratch Creek include Pacific lamprey, California roach, yellow legged frog, Pacific giant salamander and crayfish.

Dutch Henry Creek Planning Watershed*Deer Creek (Habitat data has not been collected)**Steelhead and Coho Salmon*

A waterfall near the mouth of Deer Creek impedes adult salmonid migration. Resident rainbow trout have not been found upstream of the waterfall.

Other Species

Other species found in Deer Creek include Pacific giant salamander, yellow legged frog and crayfish.

*North Branch North Fork Navarro River (Habitat segment ED1)**Habitat*

Summer rearing and over-wintering habitat were rated fair in this segment. Spawning habitat was rated good. The segment was deficient in large woody debris.

Steelhead

Multiple age classes of steelhead have been found in this segment.

Coho

Coho have been found in this segment.

Other Species

Other species found in this segment include sculpin, California roach, three spine stickleback, yellow legged frog, northwestern pond turtle and crayfish.

*Cooks Creek (Habitat segment ED8)**Habitat*

Summer rearing and over-wintering habitat were rated fair. Spawning habitat was rated good. This segment was deficient in deep pools.

Steelhead

Steelhead have been found as far upstream as Site 81-5.

Coho Salmon

Coho have been found as far upstream as Site 81-4.

Other Species

Other species found in Cooks Creek include prickly sculpin, threespine stickleback, California roach, Pacific giant salamander, yellow legged frog, rough skinned newt and crayfish.

John Smith Creek Planning Watershed*John Smith Creek (Habitat segments EJ1 and EJ1(2))**Habitat*

Summer rearing and over-wintering habitats were rated fair in both segments. Spawning habitat was rated fair in segment EJ1 and good in segment EJ1(2). These segments were deficient in large woody debris and deep pools.

Steelhead

Steelhead have been found upstream as far as Site 81-30. Surveys have not been conducted further upstream due to limited surface water during the survey season.

Coho Salmon

Coho have been found upstream as far as Site 81-30.

Other Species

Other species found in John Smith Creek include threespine stickleback, Pacific giant salamander, yellow legged frog and crayfish.

Comments

In the summer of 2002 the culvert at the outlet of John Smith Creek was replaced with a bridge. The culvert was a partial barrier to upstream adult salmonid migration and a complete barrier to upstream juvenile salmonid migration. This bridge was installed with an extra wide channel with rock boulder clusters in the stream bed to promote stream habitat and hydraulic conditions conducive to salmonid migration for a wide range of stream flows.

*Sheep Gulch (Habitat data has not been collected)**Steelhead*

Steelhead have been found upstream as far as Site 81-29. Surveys have not been conducted further upstream due to limited surface water during the survey season.

Coho Salmon

Coho have been found at Site 81-9,

Other Species

Other species found in Sheep Gulch include yellow legged frog and Pacific giant salamander.

Little North Fork Navarro River Planning Watershed***Big Gulch (Habitat data has not been collected)******Steelhead***

Steelhead have been found at Site 81-13. Upstream of Site 81-13 there is a series of small log jams which have resulted in sediment accumulation. It is believed that this formation is a temporary barrier to adult steelhead upstream migration.

Coho Salmon

Prior to 2002, coho had not been found in Big Gulch. In 2002, coho were found at Site 81-13.

Other Species

Other species found in Big Gulch include California roach, sculpin, threespine stickleback, yellow legged frog, Pacific giant salamander, and crayfish.

Little NF Navarro River (Habitat segments EN2 and EN25)***Habitat***

Spawning and over-wintering habitat rated fair in both segments. Summer rearing habitat was rated fair in segment EN2 and poor in segment EN25. Both segments were deficient in large woody debris and deep pools.

Steelhead

Steelhead have been found as far upstream as Site 81-19. Steelhead have not been found at Site 81-20. Migration barriers have not yet been surveyed for between these sites.

Coho

Coho have been found as far upstream as Site 81-19.

Other Species

Other species found in Little North Fork Navarro River include prickly sculpin, California roach, threespine stickleback, Sacramento sucker, Pacific giant salamander, newt, yellow legged frog and crayfish.

Redwood Creek (Habitat data has not been collected)***Steelhead***

Steelhead have been found at Site 81-15. Upstream of Site 81-15 there is a series of small log jams which have resulted in sediment accumulation. It is believed that this formation is a temporary barrier to adult steelhead upstream migration.

Coho Salmon

Prior to 2002, coho had not been found in Redwood Creek. In 2002, coho were found at Site 81-15.

Other Species

Other species found in Redwood Creek include prickly sculpin, California newt, yellow legged frog and Pacific giant salamander.

Bottom Creek (Habitat segment EN3)***Habitat***

Spawning, summer rearing and over-wintering habitat were rated fair. The segment was deficient in large woody debris and deep pools.

Steelhead

Steelhead have been found as far upstream as Site 81-27. Upstream of Site 81-27 stream gradient increases. The increased gradient is believed to impede upstream passage of adult steelhead.

Coho

Coho have been found as far upstream as Site 81-27.

Other Species

Other species found in Bottom Creek include prickly sculpin, Pacific giant salamander and crayfish.

*Spooner Creek (Habitat segment EN4)**Habitat*

Spawning and summer rearing habitat rated fair. Over-wintering habitat rated poor. The segment was deficient in quality over-wintering substrate, deep pools and large woody debris.

Steelhead

Steelhead have been found as far upstream as Site 81-26. Surveys have not been conducted further upstream.

Coho

Coho have been found as far upstream as Site 81-32.

Other Species

Other species found in Spooner Creek include prickly sculpin, Pacific giant salamander, California newt, and yellow legged frog,

*Sawyer Creek (Habitat segment EN38)**Habitat*

Spawning, summer rearing and over-wintering habitat rated fair. The segment was deficient in large woody debris and deep pools.

Steelhead

Steelhead have been found as far upstream as Site 81-22. Steelhead have not been found at Site 81-23. The segment of stream between these sites has not yet been surveyed for migration barriers.

Coho

Coho have been found as far upstream as Site 81-22.

Other Species

Other species found in Sawyer Creek include prickly sculpin, Pacific giant salamander, rough skinned newt and crayfish.

Table F-2 Summary of Fish Habitat Parameters and Corresponding Ratings. Navarro River Watershed Analysis Unit 1999.

Segment	A. % Pool:Riffle: Flatwater by stream length		B. Pool Spacing		C. Shelter rating		D. % of all pools with residual depth \geq 3 ft.		E. Spawning gravel quantity (%)		F.% Embeddedness		G. Sub-surface fines		H. Gravel Quality		I. Key LWD + rootwads / 328 ft. with Debris Jams		J. % Over-wintering substrate	
	%	Rating	Spacing	Rating	Score	Rating	%	Rating	%	Rating	%	Rating	Score	Rating	Score	Rating	Score	Rating	%	Rating
ED1	67:31:2	Good	2.2	Good	60	Fair	38	Fair	>3	Good	25-50	Fair	3	Good	2	Fair	0.9	Poor	69	Good
ED8	75:25:0	Good	4.5	Fair	46	Poor	18	Poor	>3	Good	25-50	Fair	3	Good	2	Fair	2.7	Poor	55	Good
WF1	59:30:11	Good	2.3	Good	41	Poor	7	Poor	>3	Good	0-25	Good	1	Poor	2	Fair	1.8	Poor	0	Poor
WF1(U)	83:17:0	Good	2.6	Fair	48	Poor	6	Poor	>3	Good	0-25	Good	3	Good	2	Fair	0	Poor	76	Good
WF13	54:46:0	Good	3.7	Fair	68	Fair	0	Poor	1.5-3	Fair	0-25	Good	3	Good	2	Fair	2.6	Poor	76	Good
WH3	80:16:4	Good	3.9	Fair	46	Poor	0	Poor	1.5-3	Fair	25-50	Fair	2	Fair	2	Fair	0.6	Poor	16	Poor
EJ1	46:54:0	Fair	2.8	Good	76	Fair	7	Poor	1.5-3	Fair	25-50	Fair	2	Fair	2	Fair	0.9	Poor	94	Good
EJ1(2)	75:8:17	Good	2.9	Good	20	Poor	0	Poor	>3	Good	0-25	Good	3	Good	2	Fair	1.4	Poor	0	Poor
EN2	68:11:21	Good	2.7	Good	71	Fair	0	Poor	>3	Good	25-50	Fair	2	Fair	2	Fair	1.1	Poor	0	Poor
EN3	85:15:0	Good	5.2	Fair	41	Poor	0	Poor	1.5-3	Fair	25-50	Fair	3	Good	2	Fair	2.7	Poor	33	Fair
EN4	57:19:24	Good	3.8	Fair	58	Poor	6	Poor	>3	Good	25-50	Fair	2	Fair	2	Fair	1.3	Poor	18	Poor
EN25	54:39:7	Good	3.9	Fair	44	Poor	0	Poor	>3	Good	>50	Poor	2	Fair	2	Fair	1.3	Poor	74	Fair
EN38	53:47:0	Good	4.9	Fair	95	Fair	0	Poor	1.5-3	Fair	25-50	Fair	3	Good	2	Fair	2.2	Poor	44	Fair
WL3	79:13:8	Good	2.0	Good	41	Poor	33	Fair	>3	Good	25-50	Fair	2	Fair	2	Fair	0	Poor	0	Poor
WL4	38:17:45	Fair	2.5	Good	46	Poor	0	Poor	1.5-3	Fair	>50	Poor	1	Poor	2	Fair	4.4	Fair	47	Fair
WL19	16:6:78	Poor	5.0	Fair	53	Poor	0	Poor	1.5-3	Fair	0-25	Good	1	Poor	2	Fair	4.7	Fair	0	Poor
WL27	15:24:61	Poor	2.1	Good	72	Fair	0	Poor	1.5-3	Fair	25-50	Fair	1	Poor	2	Fair	1.0	Poor	42	Good
WL28	52:37:11	Good	2.8	Good	67	Fair	7	Poor	1.5-3	Fair	25-50	Fair	1	Poor	2	Fair	11.0	Good	0	Poor
EM1	55:16:29	Good	4.7	Fair	38	Fair	18	Poor	>3	Good	25-50	Fair	1	Poor	2	Fair	0.2	Poor	73	Good
EM20	49:51:0	Fair	4.3	Fair	38	Poor	0	Poor	>3	Good	>50	Poor	2	Fair	2	Fair	5.2	Fair	0	Poor
EM29	54:15:31	Good	3.0	Fair	49	Poor	0	Poor	>3	Good	25-50	Fair	2	Fair	2	Fair	1.9	Poor	0	Poor
EM30	54:25:21	Good	2.6	Good	45	Poor	0	Poor	>3	Good	25-50	Fair	3	Good	2	Fair	2.3	Poor	31	Fair
EM39	28:41:31	Poor	9.9	Poor	41	Poor	0	Poor	>3	Good	>50	Poor	2	Fair	2	Fair	4.7	Fair	40	Fair

Table F-2 continued. Summary of Fish Habitat Parameters, with Scores and Corresponding Ratings. Navarro River Watershed Analysis Unit 1999.

Segment	A. % Pool:Riffle: Flatwater by stream length		B. Pool Spacing		C. Shelter rating		D. % of all pools with residual depth ≥ 3 ft.		E. Spawning gravel quantity (%)		F.% Embed-dedness		G. Sub-surface fines		H. Gravel Quality		I. Key LWD + rootwads / 328 ft. with Debris Jams		J. % Over-wintering substrate	
	%	Rating	Spacing	Rating	Score	Rating	%	Rating	%	Rating	%	Rating	Score	Rating	Score	Rating	Score	Rating	%	Rating
WU1	70:9:21	Good	2.1	Good	46	Poor	44	Fair	>3	Good	25-50	Fair	2	Fair	2	Fair	0	Poor	0	Poor
WU4	35:61:4	Fair	4.8	Fair	59	Poor	0	Poor	1.5-3	Fair	25-50	Fair	1	Poor	2	Fair	2.4	Poor	63	Good
EI2	61:12:27	Good	2.3	Good	42	Poor	17	Poor	>3	Good	25-50	Fair	3	Good	2	Fair	3.2	Fair	100	Good
EU1	85:8:7	Good	7.4	Poor	76	Fair	45	Fair	1.5-3	Fair	25-50	Fair	2	Fair	2	Fair	0.7	Poor	20	Fair
EU4	79:0:21	Good	1.3	Good	40	Poor	7	Poor	1.5-3	Fair	25-50	Fair	3	Good	2	Fair	1.3	Poor	93	Good
EU7	18:72:10	Poor	5.8	Fair	53	Poor	0	Poor	1.5-3	Fair	25-50	Fair	2	Fair	2	Fair	4.8	Fair	7	Poor
EU20	51:22:27	Good	4.5	Fair	29	Poor	6	Poor	1.5-3	Fair	25-50	Fair	3	Good	2	Fair	1.5	Poor	43	Good
EU24	16:13:71	Poor	3.3	Fair	40	Poor	14	Poor	1.5-3	Fair	25-50	Fair	2	Fair	2	Fair	4.1	Fair	21	Fair
WN10	60:19:21	Good	1.8	Good	87	Fair	0	Poor	1.5-3	Fair	25-50	Fair	1	Poor	2	Fair	5.9	Fair	0	Poor
WN20	50:35:15	Good	6.9	Poor	43	Poor	0	Poor	1.5-3	Fair	25-50	Fair	1	Poor	2	Fair	5.0	Fair	38	Fair
WM2	87:13:0	Good	2.3	Good	77	Fair	50	Fair	1.5-3	Fair	<25	Good	2	Fair	2	Fair	0	Poor	33	Fair
WM5	86:5:9	Good	2.8	Good	56	Poor	50	Fair	1.5-3	Fair	<25	Good	1	Poor	2	Fair	0.1	Poor	14	Poor
WR11	23:77:0	Poor	6.2	Poor	22	Poor	0	Poor	>3	Good	25-50	Fair	2	Fair	2	Fair	3.0	Poor	0	Poor
WR14	73:27:0	Good	2.0	Good	70	Fair	0	Poor	>3	Good	>50	Poor	3	Good	3	Good	9.8	Good	0	Poor
WR15	69:25:6	Good	2.3	Good	51	Poor	5	Poor	1.5-3	Fair	25-50	Fair	2	Fair	2	Fair	8.1	Good	0	Poor
WR23	14:86:0	Poor	3.3	Fair	72	Fair	0	Poor	>3	Good	>50	Poor	2	Fair	2	Fair	6.3	Fair	0	Poor
WR26	42:58:0	Fair	2.4	Good	53	Poor	0	Poor	>3	Good	25-50	Fair	2	Fair	2	Fair	11.5	Good	0	Poor
WM36	18:82:0	Poor	12.5	Poor	85	Fair	0	Poor	1.5-3	Fair	25-50	Fair	3	Good	3	Good	0	Poor	22	Fair
EL1	35:42:23	Fair	0.9	Good	43	Poor	20	Poor	>3	Good	25-50	Fair	2	Fair	3	Good	0.6	Poor	80	Poor

Table F-3. Summary of Fish Habitat Ratings for Three Life History Stages. Navarro River WAU, 1999.

Segment	Slope gradient class (percent)	Spawning habitat score	Spawning habitat rating	Rearing habitat score	Rearing habitat rating	Over-wintering habitat score	Over-wintering habitat rating
ED1	0-3	2.50	Good	2.15	Fair	2.35	Good
ED8	0-3	2.50	Good	1.70	Fair	1.95	Fair
WF1	0-3	2.25	Fair	2.00	Fair	1.70	Fair
WF1(U)	0-3	2.75	Good	1.85	Fair	1.95	Fair
WF13	0-3	2.50	Good	2.00	Fair	2.10	Fair
WH3	0-3	2.00	Fair	1.70	Fair	1.55	Poor
EJ1	0-3	2.00	Fair	1.80	Fair	2.05	Fair
EJ1(2)	0-3	2.75	Good	2.00	Fair	1.70	Fair
EN2	0-3	2.25	Fair	2.00	Fair	1.85	Fair
EN3	0-3	2.25	Fair	1.70	Fair	1.75	Fair
EN4	0-3	2.25	Fair	1.70	Fair	1.55	Poor
EN25	3-7	2.00	Fair	1.55	Poor	1.75	Fair
EN38	0-3	2.25	Fair	1.85	Fair	1.90	Fair
WL3	0-3	2.25	Fair	2.00	Fair	1.80	Fair
WL4	3-7	1.50	Poor	1.70	Fair	1.90	Fair
WL19	3-7	2.00	Fair	1.65	Poor	1.35	Poor
WL27	3-7	1.75	Fair	1.60	Poor	1.85	Fair
WL28	0-3	1.75	Fair	2.40	Good	2.25	Fair
EM1	0-3	2.00	Fair	1.85	Fair	2.10	Fair
EM20	3-7	2.00	Fair	1.55	Poor	1.55	Poor
EM29	0-3	2.25	Fair	1.70	Fair	1.55	Poor
EM30	3-7	2.50	Good	1.85	Fair	1.90	Fair
EM39	0-3	2.00	Fair	1.20	Poor	1.40	Poor
WU1	0-3	2.25	Fair	2.00	Fair	1.80	Fair
WU4	3-7,7-12	1.75	Fair	1.50	Poor	1.75	Fair
EI2	0-3	2.50	Good	2.05	Fair	2.30	Fair
EU1	0-3	2.00	Fair	1.85	Fair	1.85	Fair
EU4	0-3	2.25	Fair	1.85	Fair	2.10	Fair
EU7	0-3	2.00	Fair	1.50	Poor	1.35	Poor
EU20	0-3	2.25	Fair	1.70	Fair	1.95	Fair
EU24	3-7	2.00	Fair	1.50	Poor	1.55	Poor
WN10	0-3	1.75	Fair	2.20	Fair	2.45	Good
WN20	3-7	1.75	Fair	1.75	Fair	1.80	Fair
WM2	0-3	2.25	Fair	2.30	Fair	2.15	Fair
WM5	0-3	2.00	Fair	2.15	Fair	1.80	Fair
WR11	3-7	2.25	Fair	1.15	Poor	1.00	Poor
WR14	0-3	3.00	Good	2.55	Good	2.25	Fair
WR15	0-3	2.00	Fair	2.25	Fair	2.10	Fair
WR23	0-3,3-7	2.00	Fair	1.50	Poor	1.50	Poor
WR26	0-3	2.25	Fair	2.05	Fair	1.90	Fair
WM36	7-12	2.50	Good	1.30	Poor	1.35	Poor
EL1	0-3	2.50	Good	1.65	Poor	1.90	Fair

Table F-4. Species List for Aquatic Species Distribution Surveys in the Navarro River Watershed.

Common Name	Scientific Name
Coho Salmon	<i>Oncorhynchus kisutch</i>
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>
Steelhead/Rainbow Trout	<i>Oncorhynchus mykiss</i>
Pacific Lamprey	<i>Lampetra tridentata</i>
Threespine Stickleback	<i>Gasterosteus aculeatus</i>
Sacramento Sucker	<i>Catostomus occidentalis</i>
Sculpin	<i>Cottus spp.</i>
Prickly Sculpin	<i>Cottus asper</i>
Coast Range Sculpin	<i>Cottus aleuticus</i>
California Roach	<i>Lavinia symmetricus</i>
Bull Frog	<i>Rana catesbeiana</i>
Yellow Legged Frog	<i>Rana boylei</i>
Northern Red Legged Frog	<i>Rana aurora aurora</i>
Olympic Tailed Frog	<i>Ascaphus truei</i>
Pacific Giant Salamander	<i>Dicamptodon tenebrosus</i>
Newt	<i>Taricha spp.</i>
California Newt	<i>Taricha torosa</i>
Rough Skinned Newt	<i>Taricha granulosa</i>
Northwestern Pond Turtle	<i>Clemmys marmorata marmorata</i>
Crayfish	<i>Pacifasticus spp.</i>

Permeability and Bulk Gravel Samples

The results from the bulk gravel samples and permeability measurements are presented in Table F-5. The lowest survival ratings calculated were found in the North Branch Navarro River. These low ratings are likely due to a high proportion of fine sediment within small substrate. The survival-to-emergence index calculated for the permeability data showed survival rates that ranged from 19% to 63% (Table F-5). The highest gravel permeability was found in the mainstem Navarro, which subsequently relates to the highest survival-to-emergence index rating. The high permeability is probably due to the high sand content of the mainstem Navarro River's substrate. Sand is highly permeable. However, the predominance of smaller substrate in the mainstem Navarro River is not preferred spawning substrate size.

Percent survival index from permeability was found to be fair in Flynn Creek, South Branch North Fork Navarro and John Smith Creek, 58%, 46% and 48% respectively. Percent survival index from permeability was very low in both segments of the North Fork Navarro, 19% and 23%. Fine sediment levels in the North Fork Navarro are fair, ranging from 7 to 12%.

These survival indices reflect conditions at pool tail-outs where a spawning fish has not worked the gravel into a redd. Therefore they reflect the relative quality of stream gravel that a spawning fish encounters upon entering the stream. Areas of stream gravel with a high survival percentage would likely be preferred by spawning fish and likely have better survival success for emerging fish. Areas of stream gravel with a low survival index percentage may not be of completely poor quality; particularly because the permeability and gravel quality will be improved following redd development.

Generally, the percentage of fine sediment (<0.85 mm) was not found to be high in the Navarro River watershed with the exception of the mainstem Navarro River. Fine sediment (particles

smaller than .85mm) measurements exceeded 10% on several occasions throughout the Navarro WAU. However, we feel the use of permeability as an indicator of current stream gravel quality is the better indicator of conditions necessary for developing fish embryos. In most of the laboratory studies of fish emergence from incubating eggs, survival is related to the proportion of fine particles or the size class distribution of the gravel fish embryos are developed in. These measures are used to indicate the ability of water borne nutrients and dissolved oxygen to reach the embryos. Therefore, measures of fine particles or size class distribution indices, etc. are surrogates for gravel permeability. Direct measure of the permeability conditions that occur in the stream gravel is the best indication of this quality. When using permeability as an indicator of spawning gravel quality in Navarro River WAU, the results suggest improvement needed for the quality of spawning gravel.

Table F-5. Permeability, Survival Indices and % Fines collected from Long-Term Channel Monitoring Segments in the Navarro River WAU.

Seg ID	Stream	Year	Permeability cm/hr	Standard Error Permeability	Percent Survival Index	Tappel and Bjorn Percent Survival (steelhead)	% Fines <0.85mm
WL27	Flume Gulch	1999	1,396	596	25%	21-68%	8-13%
WM2	Navarro River	1999	3,651	1,954	40%	0-19%	13-25%
WM5	Navarro River	1999	17,464	5,401	63%	0-69%	7-26%
WF1	Flynn Creek	1999	13,103	1,726	58%	17-100%	3-13%
EL1	S.Branch N.Fork Navarro	1999	5,467	1,626	46%	29-87%	4-13%
EN1	N.Branch N.Fork Navarro	1999	944	164	19%	44-72%	7-12%
EN1	N.Branch N.Fork Navarro	2001	15,149	6,695	61%	--	--
EN2	Little N. Fork Navarro	1999	1,241	137	23%	41-70%	7-11%
EN2	Little N. Fork Navarro	2001	5,217	2,736	45%	--	--
EJ2	John Smith Creek	1999	6,516	1,644	48%	51-100%	5-10%

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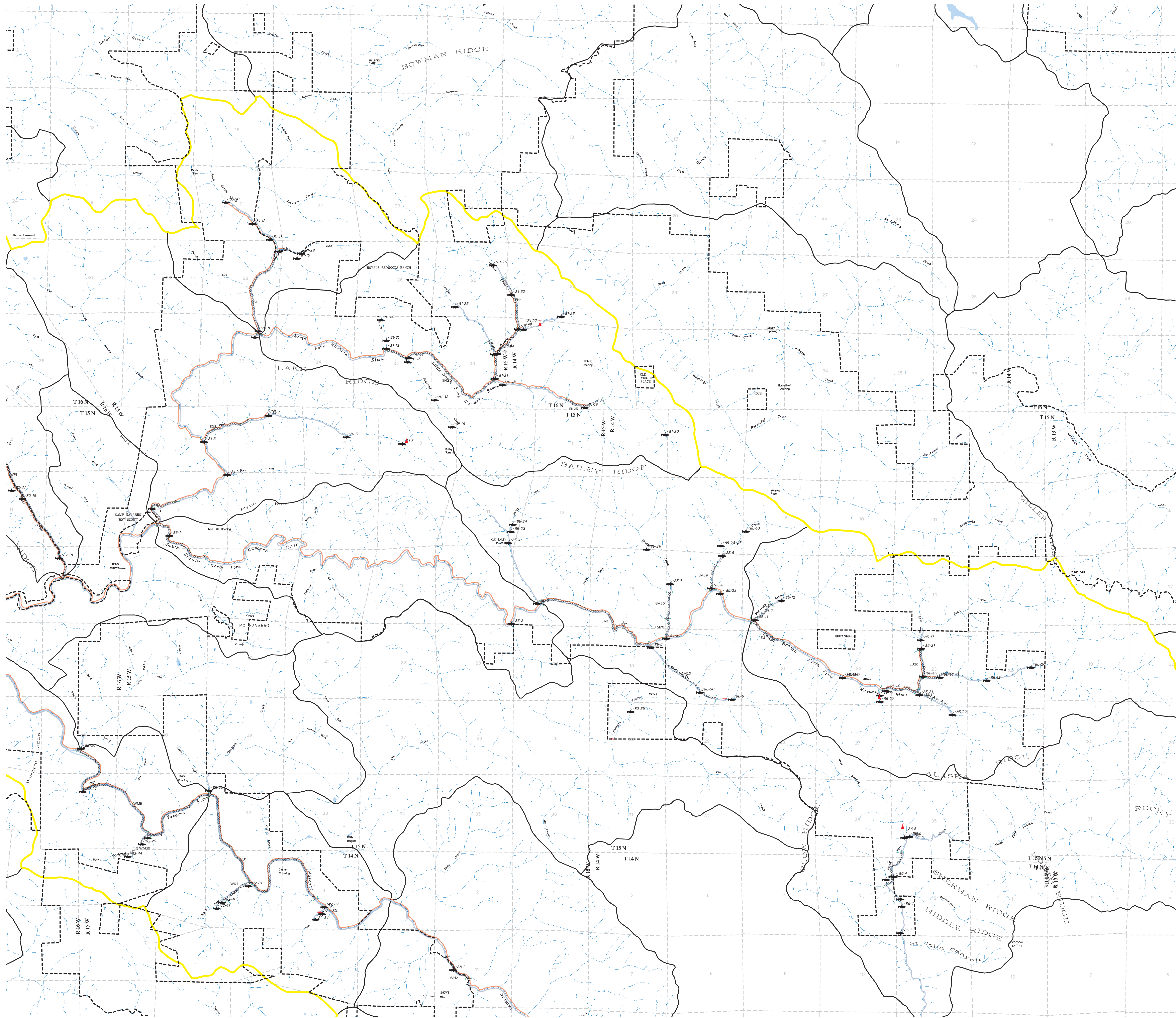
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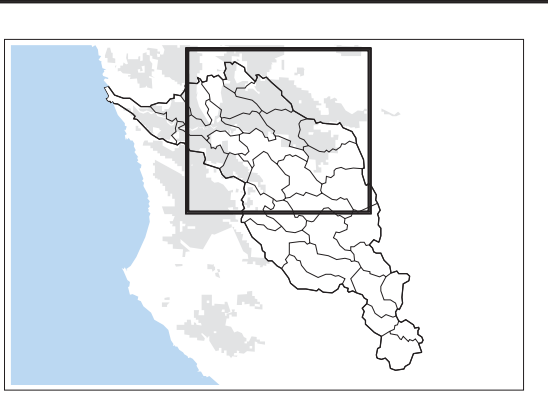
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Map F-1 (A)
Salmonid Distribution

This map illustrates the distribution of steelhead trout and coho salmon in the Navarro WMA. It is based on distribution surveys conducted by MRC in 1999-2000 and the previous landowner Louisiana-Pacific Corporation in 1984-1995. From the distribution surveys the presentation for the salmonid species is extrapolated from field evaluation, fish survey data and results of Navarro fish habitat assessment.

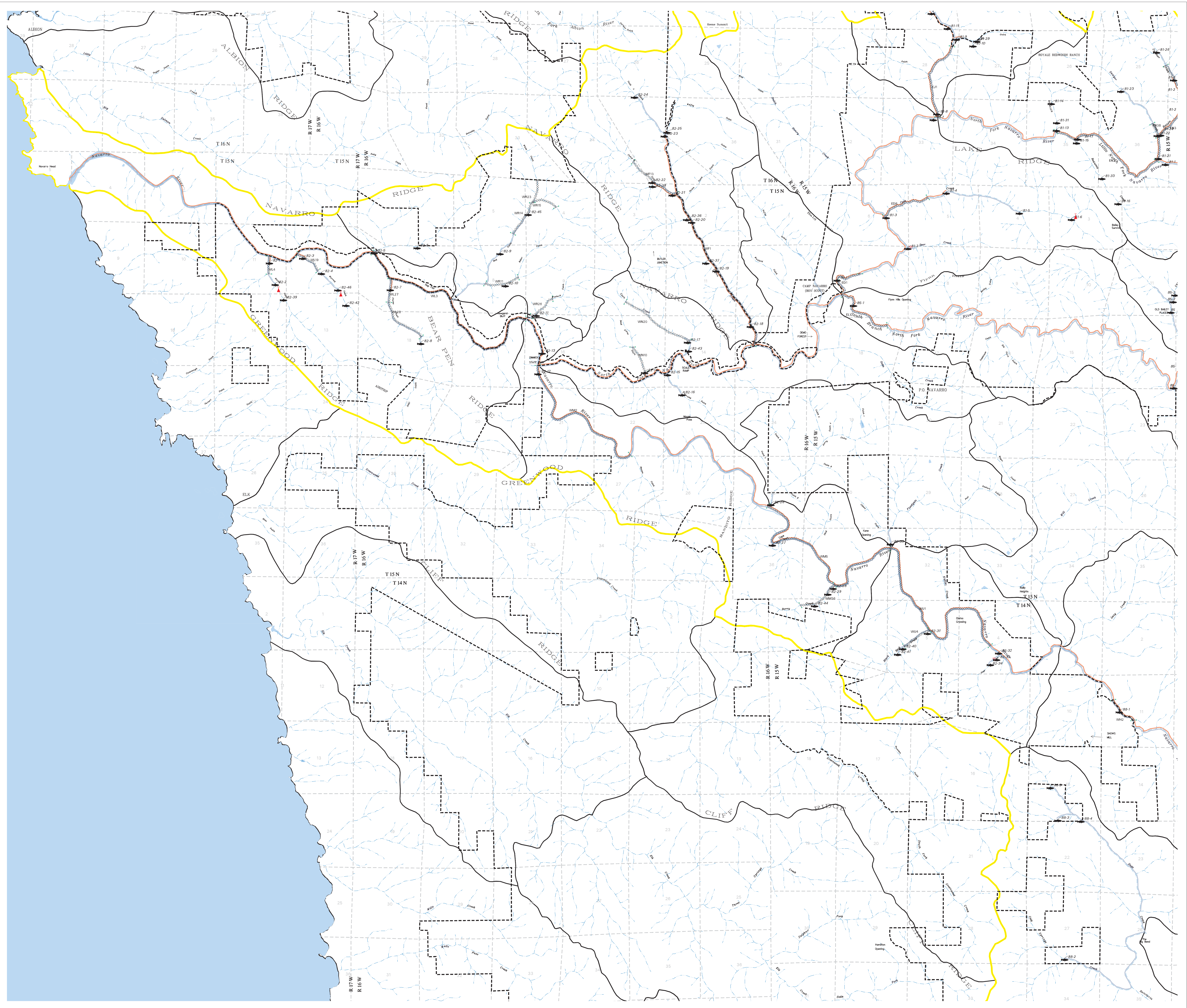


- Potential Salmonid Distribution
- Coho Salmon Distribution
- Steelhead Distribution
- Habitat Survey Segments
- Fish Distribution Sampling Locations
- Barriers to Adult Salmonid Upstream Migration
- Gradient
- Waterfall
- MRC Ownership
- Planning Watershed Boundary
- Navarro River Watershed Boundary
- Flow Class
 - Class I
 - Class II
 - Class III



Map F-1 (B)
Salmonid Distribution

This map illustrates the distribution of steelhead trout and coho salmon in the Navarro WMA. It is based on distribution surveys conducted by MRC in 1999-2000 and the previous landowner Louisiana-Pacific Corporation in 1984-1995. From the distribution surveys the presentation for the salmonid species is extrapolated from field evaluation, fish survey data and results of Navarro fish habitat assessment.



- Potential Salmonid Distribution
- Coho Salmon Distribution
- Steelhead Distribution
- Habitat Survey Segments
- Fish Distribution Sampling Locations
- Barriers to Adult Salmonid Upstream Migration
 - Gradient
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- Planning Watershed Boundary
- Navarro River Watershed Boundary

- Flow Class
- Class I
- Class II
- Class III

