# Salt Timber Harvest and Fuels Hazard Reduction Project

## Fisheries Biological Assessment

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**for:**

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# Purpose of and Need for Action

See Salt Project EIS (USDAFS 2008)

# Alternatives

See Salt Project EIS (USDAFS 2008)

## *Project Design Features and Mitigation Measures*

The following features should be followed during project design to alleviate negative impacts to aquatic resources:

1. Limit skid roads, trails, and landings to no more than 15% of the treatment area.

2. All applicable Best Management Practices are included in Appendix B of the Fisheries BA/BE and the Hydrology Specialist Report for this project.

3. Excess activity created slash and existing surface fuels would be machined piled or masticated on slopes less than 35% and hand piled or lopped and scattered on slopes greater than 35%. All piles, except those designated for retention, would be burned.

4. The following specifications and restrictions will apply to activities within Riparian Management Zones (RMZ) and Equipment Exclusion Zones (EEZ):

   a. Width of protection zone is measured along the slope from the high watermark up the hillslope. Riparian Reserves of intermittent and ephemeral streams that display annual scour will have a minimum 150 foot Riparian Reserve. In areas where inner gorges are greater than 150 feet, Riparian Reserve will cover the entire inner gorge area and therefore, be greater than 150 feet in width. Riparian Reserves of fish bearing streams that display annual scour will have a 300 foot Riparian Reserve.

   b. The riparian reserve width will meet the minimum width; however, the site tree may increase the distance (see Shasta-Trinity Land Resource Management Plan, 1994).

   c. No equipment within the EEZ.

   d. Prohibit heavy equipment from entering Watercourse and Lake Protection Zones (WLPZs) except at designated crossings.

   e. Thinning within riparian zone needs to meet Aquatic Conservation Strategy objectives.

   f. Thinning within the EEZ of Class I and II streams is limited to understory removal and cannot disturb riparian plant species.

   g. A minimum of a 50-foot buffer will be flagged along the edge of the inner gorge (i.e., >65% slope and unstable areas) or as prescribed by geoscientist.

   h. A minimum of a 50-foot buffer will be flagged above the crown or head of active or potentially active landslides or as prescribed by geoscientist.

   i. Equipment will be excluded from operating on active or potentially active landslides and thinning will be prescribed by a geoscientist.

j. Thinning will occur in the Riparian Reserves (but not within the inner gorge, or within 50 feet from the defined channel if no inner gorge exists) for the purpose of enhancing Riparian Reserve timber stand health and treating hazardous fuels. Thinning and fuels treatment will not reduce crown cover to less than 60% within Riparian Reserves.

k. A wet weather limited operating period (LOP) will be in effect from October 15 to May 15. Activities may occur within the LOP, in dry conditions with approval of the Timber Sale Contract Administrator.

l. hazard trees 16” dbh or greater within riparian reserves must be dropped and retained on site.

5. Minimize soil erosion by water-barring all skid trails, mulching with straw or fine slash (achieve 75%+ cover) the last 50 feet of all skid trails where they enter landings or roads.

6. Contour rip (with winged subsoiler to 12 inches deep), seed and mulch (straw) all temporary roads, main skid trails, landings, and regeneration units identified by the project soil scientist to break up compaction

7. Reuse existing primary skid trails and landings.

8. Prevent road runoff from draining onto landings and skid trails.

9. Retain existing down coarse woody debris (CWD) whenever possible providing the amount of logs does not exceed fuel management objectives.

10. All yarding requires one-end log suspension (leading end of log).

11. Tractor skidding generally restricted to slopes <35%.

12. Mechanical skidding equipment is restricted to slash covered primary skid trails where slopes are <35%. Endlining will be used in those areas where skid trails may exceed 35%.

13. Spread fine slash material (50% soil cover) on primary skid trails when they occur on >35% slopes.

14. Ground-based mechanical equipment will only operate when the soils are dry down to 12 inches or as approved by a Timber Sale Contract Administrator.

15. Maintain post-treatment soil cover to at least 50% with at least 50% cover as fine slash (<3 inch material).

16. Masticated material will be kept to a depth of 3 inches or less OR if the masticated material will be burned it will be burned in the spring (moist soil conditions).

17. Locate water drafting sites to minimize adverse effects on stream channel stability, sedimentation, and in-stream flows needed to maintain riparian resources, channel conditions, and fish habitat. If water drafting occurs in coho salmon critical habitat (there is no critical habitat within the project area so this would occur outside of the project area) the National Marine Fisheries Service water drafting specifications will be adhered to.

Northwest Forest Plan Standards and Guidelines Applicable to this Project

## Timber Management

TM-1. Prohibit timber harvest, including fuelwood cutting, in Riparian Reserves, except as described below. Riparian Reserve acres shall not be included in calculations of the timber base.

c. Apply silvicultural practices for Riparian Reserves to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy Objectives.

## Roads Management

RF-2. For each planned or existing road, Meet Aquatic Conservation Strategy Objectives by:

a. minimizing road and landing locations in Riparian Reserves.

b. completing watershed analysis (including appropriate geotechnicial analysis) prior to construction of any new roads or landings in Riparian Reserves.

c. preparing road design criteria, elements, and standards that govern construction and reconstruction.

d. preparing operation and maintenance criteria that govern road operation maintenance and management.

e. minimizing disruption of natural hydrologic flow paths, including diversion of streamflow and interception of surface and subsurface flow.

f. restricting side casting as necessary to prevent the introduction of sediment to streams.

g. avoiding wetlands entirely when constructing new roads.

RF-3. Determine the influence of each road on the Aquatic Conservation Strategy objectives through watershed analysis. Meet Aquatic Conservation Strategy objectives by:

a. reconstructing roads and associated features that pose a substantial risk.

b. prioritizing reconstruction based on current and potential impact to riparian resources and the ecological value of the riparian resources affected.

c. Closing and stabilizing, or obliterating and stabilizing roads based on the ongoing and potential effects to Aquatic Conservation Strategy objectives and considering short-term and long-term transportation needs.

RF-5. Minimize sediment delivery to stream from roads. Outsloping of the roadway surface is preferred, except where outsloping would increase sediment delivery to streams or where outsloping is unfeasible or unsafe. Route road drainage away from potentially unstable channels, fills, and hillslope.

RF-6. Develop and implement a Road Management Plan or a Transportation Management Plan that will meet the Aquatic Conservation Strategy objectives. As a minimum, this plan shall include provisions for the following activities:

a. inspections and maintenance during storm events.

b. inspections and maintenance after storm events.

c. road operation and maintenance, giving high priority to identifying and correcting road drainage problems that contribute to degrading riparian resources.

d. traffic regulation during wet periods to prevent damage to riparian resources.

e. establish the purpose of each road by developing road management objectives.

### Fire/Fuels Management

FM-1. Design fuel treatment and fire suppression strategies, practices, and activities to meet Aquatic Conservation Strategy objectives, and to minimize disturbance of riparian ground cover and vegetation. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuels management activities could be damaging to long-term ecosystem function.

## Affected Environment

The Salt Creek watershed has a drainage area of 124.3 mi2. A dendritic channel network drains the watershed. Major tributaries in the Salt Creek 5th field watershed include Philpot Creek, Ditch Gulch, Dobbins Gulch, Salt Gulch and Deer Gulch. There are approximately 54.9 miles of perennial streams, 84.4 miles of intermittent streams, and 157.8 miles of ephemeral streams in the watershed. Annual precipitation ranges from approximately 70 inches in the highest elevations to less than 40 inches at lowest elevations in the Hayfork Valley. Most precipitation falls as rain below the 4,000 feet elevation and as snow above 4,000 feet, although a winter long snow pack does not occur below about 5,500 feet elevation (URS Greiner Woodward Clyde 2000).

Headwater streams within the Salt Creek Watershed serve generally as transport channels and are characterized by high stream gradients (10+ %) and steep sideslopes (70+ %). Large woody debris and sediment have relatively low residence times in these areas, as these materials are readily moved downstream during high flow events. These channels generally lack suitable amounts of fish habitat needed for spawning and rearing and natural fish passage is often limited by gradient and highly fluctuating flows.

Salt Creek, above its confluence with Hayfork Creek supports a limited run of Klamath Mountain Province (KMP) steelhead (USDAFS, unpublished data). Upper Hayfork Creek (above the confluence with Salt Creek) currently supports anadromous runs of KMP steelhead (*O. mykiss*), Pacific lamprey (*Lampetra tridentata*), and a remnant run of Upper Klamath/Trinity River (UKTR) Chinook salmon (*O. tshawytscha*). Historically, spring-run Chinook salmon utilized the lower reaches of Salt Creek, Big Creek, Tule Creek, and East Fork Hayfork Creek (PWA, 1994), but no appreciable number of Chinook are believed to use Salt Creek currently.

There are no proposed units in riparian reserves of perennial streams in the project area. Intermediate thinning units adjacent to perennial streams, but outside of the riparian reserves, include Units 1, 2C, 5 and 12 near Ditch Gulch, and Units 25A and 26 near Cold Creek. Seven old plantation thinning units are also adjacent to the perennial stream riparian reserves.

### *TES, Sensitive Species, MIS*

The following section is based largely on existing information. Middle Hayfork – Salt Creek Watershed Analysis (URS Greiner Woodward Clyde, 2000) was used as a source document for this discussion. A current federal endangered and threatened species list (Table 1) for the project

area (Dubakella Mtn., Wildwood, and Smoky Ck. quads) was obtained 10 January 2007 from the U.S. Fish and Wildlife Service, Arcata Field Office website (available at http://www.fws.gov/cno/arcata). A sensitive species list was created using the latest revision of the Forest Service Region 5, Regional Forester's sensitive species list (Table 1).

The Shasta-Trinity National Forest LRMP (USDAFS 1995) uses the concept of a single Management Indicator Species (MIS) to represent groups of species. All MIS fish species identified by the Shasta-Trinity National Forest were addressed (Table 2).

## Critical Habitat and Essential Fish Habitat

There is no coho salmon critical habitat or essential fish habitat (EFH) in the Salt project area. The distance downstream, outside of the project area, to critical habitat or EFH ranges from 0.4 miles to 1.4 miles as displayed in Table 3. The distance from the project area to occupied habitat ranges from 28 miles to 32 miles.

The Trinity River and tributaries contain suitable habitat for anadromous fishes.

The National Marine Fisheries Service designated critical habitat for coho salmon on May 5, 1999. Critical habitat includes all stream reaches accessible to anadromous fishes, regardless of the presence or absence of coho salmon. The Magnuson-Stevens Fishery Conservation Management Act, as amended by the Sustainable Fisheries Act of 1996 (public Law 104-297), designates Essential Fish Habitat (EFH) for commercially valuable fish species as those waters and substrate necessary to fish for spawning, breeding, feeding, and growth to maturity. The Trinity River and tributaries contain EFH for coho salmon and chinook salmon (*Oncorhynchus tshawytscha*).

**Table 1: Threatened, Endangered and Sensitive species considered in this analysis**

| Species | Status | Considered | Rationale |
|---|---|---|---|
| Southern Oregon Northern California Coast (SONCC) coho salmon | Threatened | Y | Although the species has not been documented, the project area has habitat |
| California floater | Sensitive | N | No suitable habitat |
| Klamath mts. Province steelhead | Sensitive | N | No suitable habitat |
| Montain peaclam | Sensitive | N | No suitable habitat |
| Rough Sculpin | Sensitive | N | No suitable habitat |
| Hardhead minnow | Sensitive | N | No suitable habitat |
| McCloud River redband trout | Sensitive | N | No suitable habitat |
| Upper Klamath/Trinity Chinook spring-run | Sensitive | N | No suitable habitat |
| Upper Trinity River Chinook fall-run | Sensitive | N | No suitable habitat |
| Nugget Pebblesnail | Sensitive | N | No suitable habitat |
| Scalloped juga | Sensitive | N | No suitable habitat |

**Table 2: Summary of Shasta-Trinity National Forest Management Indicator Fish Species**

| Species | Assemblage | Considered | Rationale |
|---|---|---|---|
| Winter-run steelhead | Anadromous | Y | Habitat exists within the analysis area |
| Spring-run Chinook salmon | Anadromous | Y | Habitat exists within the analysis area |
| Summer steelhead | Anadromous | Y | Habitat exists within the analysis area |
| Rainbow trout | Inland Coldwater | Y | Habitat exists within the analysis area |
| Largemouth bass | Inland Warmwater | N | No suitable habitat |

## COHO SALMON

The following excerpts for SONCC coho salmon were taken from Chapter 2 in the CDFG publication "Recovery strategy for California coho salmon, Report to the California Fish and Game Commission" (CDFG 2004b). Note: Figure 2 (coho distribution on the STNF) was inserted by the Forest Service.

Coho salmon are now found in less than 60% of the SONCC Coho ESU streams that were historical coho salmon streams. However, these declines appear to have occurred prior to the late 1980s and the data do not support a significant decline in distribution between the late 1980s and the present. Some streams in this ESU have lost one or more brood-year lineages.

The major stream systems within the California portion of the SONCC Coho ESU still contain coho salmon populations, although many tributaries may have missing runs. Department analysis of the SONCC data when grouped (1986 to 1991 vs. 1995 to 2000) indicates that the decline is not statistically significant, whereas the NOAA Fisheries analysis of the ungrouped data (1989 to 2000) indicates that the decline in the northern ESU is significant.

Because of the decline in distribution prior to the 1980s, together with the possibility of a severe reduction in distribution as indicated by the field surveys and the downward trend of most abundance indicators, the Department believes that coho salmon populations in the California portion of this ESU will likely become endangered in the foreseeable future in the absence of the protection and management.

## LIFE HISTORY

Adult coho salmon enter fresh water from September through January in order to spawn. In the short coastal streams of California, migration usually begins between mid-November and mid-January (Baker and Reynolds 1986). Coho salmon move upstream after heavy rains have opened the sand bars that form at the mouths of many California coastal streams, but may enter larger rivers earlier. On the Klamath River, coho salmon begin entering in early to mid-September and reach a peak in late September to early October. On the Eel River, adult coho salmon return four to six weeks later than on the Klamath River (Baker and Reynolds 1986). Arrival in the upper reaches of these streams generally peaks in November and December. Timing varies by stream and/or flow (Neave 1943; Brett and MacKinnon 1954; Ellis 1962) (Figure 1).

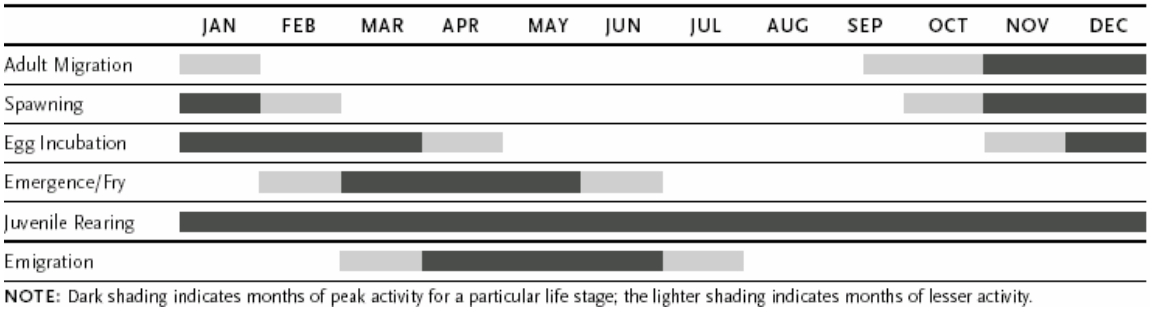


**Figure 1: Calendar indicating the seasonal presence of coho salmon in California coastal watersheds (Adapted from CDFG 2004b).**

Generally, coho salmon spawn in smaller streams than do Chinook salmon. In California, spawning occurs mainly from November to January, although it can extend into February or March if drought conditions are present (Shapovalov and Taft 1954). In the Klamath and Eel rivers, spawning occurs in November and December (USFWS 1979). Shapovalov and Taft (1954) note that females usually choose spawning sites near the head of a riffle, just below a pool, where the water changes from a laminar to a turbulent flow and there is a medium to small gravel substrate.

In California, eggs incubate in the gravels from November through April. The incubation period is inversely related to water temperature. California coho salmon eggs hatch in about forty-eight days at 48°F, and thirty-eight days at 51.3°F (Shapovalov and Taft 1954). After hatching, the alevins (hatchlings) are translucent in color (Shapovalov and Taft 1954; Laufle et al.1986; Sandercock 1991). This is the coho salmon's most vulnerable life stage, during which they are susceptible to siltation, freezing, gravel scouring and shifting, desiccation, and predation (Sandercock 1991; Knutson and Naef 1997; Pacific Fisheries Management Council [PFMC] 1999). Alevins remain in the interstices of the gravel for two to ten weeks until their yolk sacs have been absorbed, at which time their color changes to that more characteristic of fry (Shapovalov and Taft 1954, Laufle et al. 1986, Sandercock 1991). The fry are silver to golden with large, vertical, oval, dark parr marks along the lateral line that are narrower than the spaces between them.

Fry emerge from the gravel between March and July, with peak emergence occurring from March to May, depending on when the eggs were fertilized and the water temperature during development (Shapovalov and Taft 1954). They seek out shallow water, usually moving to the stream margins, where they form schools. As the fish feed heavily and grow, the schools generally break up and individual fish set up territories. At this stage, the fish are termed parr (juveniles). As the parr continue to grow and expand their territories, they move progressively into deeper water until July and August, when they inhabit the deepest pools (CDFG 1994a). This is the period when water temperatures are highest, and growth slows (Shapovalov and Taft 1954). Food consumption and growth rate decrease during the winter months of highest flows and coldest temperatures (usually December to February). By March, parr again begin to feed heavily and grow rapidly.

Rearing areas used by juvenile coho salmon are low-gradient coastal streams, lakes, sloughs, side channels, estuaries, low-gradient tributaries to large rivers, beaver ponds, and large slackwaters (PFMC 1999). The most productive juvenile habitats are found in smaller streams with low-

gradient alluvial channels containing abundant pools formed by large woody debris (LWD). Adequate winter rearing habitat is important to successful completion of coho salmon life history.

After one year in fresh water, smolts begin migrating downstream to the ocean in late March or early April. In some years emigration can begin prior to March (CDFG unpublished data) and can persist into July (Shapovalov and Taft 1954; Sandercock 1991). Weitkamp et al. (1995) indicate that peak downstream migration in California generally occurs from April to early June. Factors that affect the onset of emigration include the size of the fish, flow conditions, water temperature, dissolved oxygen (DO) levels, day length, and the availability of food. In Prairie Creek, Bell (2001) found that a small percentage of coho salmon remain more than one year before emigrating to the ocean. Low stream productivity, due to low nutrient levels or cold water temperatures, can contribute to slow growth, potentially causing coho salmon to postpone emigration (PFMC 1999). There may be other factors that contribute to a freshwater residency of longer than one year, such as late spawning, which can produce fish that are too small at the time of smolting to migrate to sea (Bell 2001).

## HABITAT REQUIREMENTS FOR ADULTS

Most coho salmon spend approximately half of their three-year life cycle in the ocean environment before returning to fresh water. They then migrate upstream and spawn mainly in small streams that flow directly into the ocean or in tributaries of large rivers.

### *Migration*

Coho salmon usually migrate during late summer and fall and their specific timing may have evolved in response to particular flow conditions. For example, obstructions that may be passable in high waters may be insurmountable during low flows. Conversely, early-running stocks are thought to have developed because those fish could surmount obstacles during low or moderate flows but not during high flows. If flow conditions in a stream are unsuitable, the fish will often mill about in the vicinity of the stream mouth, sometimes waiting weeks, or even (in the case of early-run fish) months for conditions to change (Sandercock 1991). Although substantially greater depth may be needed to negotiate some barriers, minimum depth to allow passage of coho salmon is approximately 7.1 inches (Bjornn and Reiser 1991).

Reiser and Bjornn (1979) indicate that adult migration normally occurs when water temperature is in the 45 to 61°F range. Excessively high temperature may result in delays in migration (Monan et al. 1975). Additionally, excessively high temperature during migration may lead to disease outbreaks (Spence et al. 1996) and may reduce the egg viability (Leitritz and Lewis 1980).

The high-energy expenditure during sustained upstream swimming requires adequate concentrations of DO (Davis et al. 1963). Supersaturation of dissolved gases (especially nitrogen), however, has been found to cause gas-bubble disease in migrating salmonids (Ebel and Raymond 1976).

Reid (1998) found that high turbidity affects all life stages of coho salmon. In the case of adults, high concentrations of suspended sediment may delay or divert spawning runs (Mortensen et al. 1976). As an example of a response to a catastrophic event (the eruption of Mount St. Helens, Washington) coho salmon strayed from the highly impacted Toutle River to nearby streams for the two following years (Quinn and Fresh 1984). Salmonids have been found to wait rather than travel up a stream where the suspended sediment load reached 4,000mg/l (Bell 1986).

Migrating coho salmon require deep and frequent pools for resting and to escape from shallow riffles where they are susceptible to predation. Deep pools are also necessary for fish to attain swimming speeds necessary to leap over obstacles. Pools need to be 25% deeper than the height of the jump for adult fish to attain the necessary velocity for leaping (Flosi et al. 1998).

Large Woody Debris and other natural structures such as large boulders provide hydraulic complexity and pools. They also facilitate temperature stratification and the development of thermal refugia by isolating pockets of cold water (Bilby 1984; Nielsen et al. 1994). Riparian vegetation and undercut banks provide cover from terrestrial predators in shallow reaches.

### *Spawning*

Coho salmon typically spawn in small streams where the flow is 2.9 to 3.4 cubic feet per second (cfs) and the stream depth ranges between 3.94 and 13.78 inches, depending on the velocity (Gribanov 1948; Briggs 1953; Thompson 1972; Bovee 1978; Li et al. 1979). On the spawning grounds, they seek out sites of groundwater seepage and favor areas where the stream velocity is 0.98 to 1.8 ft/s. They also prefer areas where water upwells through redds, eliminating wastes, and preventing sediments from filling the interstices of the spawning gravel. The female generally selects a redd site at the outlet of a pool or at the head of a riffle, where there is good circulation of oxygenated water through the gravel. A pair of spawning coho salmon requires about 126 square feet for redd and inter-redd space.

About 85% of redds are located in areas where the substrate is comprised of gravel of 15cm diameter or smaller. There must be sufficient appropriately sized gravel and minimal fine sediments to ensure adequate interstitial space for egg survival. In situations where there is mud or fine sand in the nest site, it is removed during the digging process. LWD and other structures such as large boulders provide stream-bank support, which over time helps to reduce sediment input resulting from bank erosion.

Eggs deposited within a zone of scour and fill can wash downstream. LWD, riparian vegetation, and upslope stability enhance bank stability, which in turn promotes gravel stability and minimizes the risk to redds from the scouring effects of high flows. In addition to promoting bank stability, LWD also diversifies flows, reducing stream energy directed towards redds (Naiman et al. 1992).

## HABITAT REQUIREMENTS FOR JUVENILES

The coho salmon typically spends the first half of its life in the freshwater or estuarine environment. The following sections describe habitat requirements for the early life stages.

### *Eggs and Alevin Incubation*

Low winter flows can result in the desiccation of redds or may expose eggs to freezing temperatures. High water flows can disturb redd gravel, resulting in eggs being dislodged and swept downstream. Winter storms often cause excessive siltation that can smother eggs and inhibit intragravel movement of alevins. Siltation from these storms can reduce water circulation in the gravel to the point where low oxygen levels become critical or lethal.

According to Bjornn and Reiser (1991), the optimum temperature for coho salmon egg incubation is between 40 and 55°F. In one study, coho salmon embryos suffered 50% mortality at temperatures above 56.3°F (Beacham and Murray 1990). Because of the close connection between temperature and developmental processes, changes in thermal regime, even when well

within the physiologically tolerable range for the species, can have significant effects on development time (and hence emergence timing), as well as on the size of emerging fry.

A high proportion of fine sediments in the gravel effectively reduce DO levels and also results in smaller emergent fry. Embryos and alevins need high levels of oxygen to survive (Shirazi and Seim 1981), and Phillips and Campbell (1961) suggest that DO levels must average greater than 8.0 mg/l for embryos and alevins to thrive. Excessive sediment deposition may also act as a barrier to fry emergence (Cooper 1959). McHenry et al. (1994) found that when sediment particles smaller than 0.85 mm1 made up more than 13% of the total sediment, it resulted in intragravel mortality for coho salmon embryos because of oxygen deficiency. Cederholm et al. (1981) found that in the Clearwater River in Washington, the survival of salmonid eggs to emergence from gravel was inversely correlated with the percent of fine sediment when the proportion of fines exceeded the natural level of 10%. Tagart (1984) found that if sediment composition included a high concentration (up to 50%) of fine sediment (<0.85 mm), survival rate was lowered.

Shade provided by tall and/or mature vegetation is an important temperature regulator. LWD and large boulders provide stream-bank support that helps to meter out sediment deposition resulting from bank erosion and runoff, thus decreasing sediment input to spawning gravel.

### *Fry Emergence*

Recently emerged coho salmon fry prefer shallow water, which leaves them vulnerable to floods that can displace them downstream into unsuitable habitat. This problem is greatly exacerbated in streams having little complexity due to lack of in-channel LWD. Displacement downstream may lead to early migration toward the estuary, and fry are poorly equipped to survive in brackish or salt water.

After emergence, fry continue to hide in gravel and under large stones, and within a few days they progress to swimming close to the banks, taking advantage of available cover. They congregate in quiet backwaters, side channels, and small creeks, especially in shady areas with overhanging branches. Fry are found in both pools and riffles, but they are best adapted to holding in pools. Cold, deep, dark, complex pools surrounded by streamside vegetation are optimal for coho salmon rearing. LWD and associated pool habitats provide cover from predators and refugia during high flow events (Everest et al. 1985).

### *Juvenile Rearing*

The area of a particular stream available to juveniles for rearing is directly related to the turbidity of stream discharges (Everest et al. 1985). Lloyd et al. (1987) found that juveniles avoided chronically turbid streams, although they appear to be little affected by short transitory occurrences (Sorenson et al. 1977). Published data suggest that the feeding efficiency of juvenile coho salmon drops by 45% at a turbidity of one hundred Nephelometric Turbidity Units (NTUs) (Reid 1998). Coho salmon rarely eat stationary food or from the bottom, preferring food in suspension or on the surface of the water. At the yearling stage, they may supplement their insect diet with the fry of their own or of other species.

By late summer or early fall, juvenile feeding activity decreases and the fish move into deeper pools, especially those with overhanging logs, submerged woody debris and dense riparian vegetation. Juveniles spend time hiding under the cover of logs, exposed tree roots, and undercut banks. Lack of adequate pools and side channels makes them more susceptible to predation and

to being swept out of the stream during winter high flows. At this stage they are especially vulnerable as their swimming ability is reduced because of lowered metabolic rate.

Salmonid behavior for coping with high turbidity includes the use of off-channel and clean-water refugia and holding temporarily at clean-water tributary mouths. These coping strategies are partially defeated by sediment inputs from roads, for example, when road runoff discharges into small tributaries that formerly provided clean inflows. In addition, roads adjacent to streams can reduce availability of flood-plain and off-channel pools to juvenile coho salmon (Reid 1998). Coho salmon streams with the best over-wintering habitat are those with LWD accumulations, spring-fed ponds adjacent to the main channel or protected and slow flowing side channels that may only be filled in winter. Backwaters and side channels that develop along unconstrained reaches in alluvial flood plains were historically important rearing habitats for juveniles (Sedell and Luchessa 1982).

In unstable coastal systems, coho salmon production may be limited by the lack of side channels and small tributaries to provide additional habitat for protection from winter floods. Beaver ponds can create additional habitat for coho salmon, both in winter to avoid high flows, and in summer to avoid stranding as a result of low flows. Habitat complexity contributes to the creation of microhabitats within reaches, thus providing more opportunities for inter- and intra-species stratification (Bjornn and Reiser 1991). Terrestrial insects and leaves falling into streams from riparian vegetation constitute much of the food base for stream macroinvertebrates, which in turn are a major food source for juvenile coho salmon.

### *Emigration*

Stream flow is important in facilitating the downstream migration of coho salmon smolts. Dorn (1989) found that increases in stream flow triggered downstream movement of coho salmon. Spence (1995) also found short-term increases in stream flow to be an important stimulus for smolt emigration. Thus, the normal range of stream flow may be required to maintain normal temporal patterns of migration. In years with low flows, emigration is earlier. Artificial obstructions such as dams and diversions of water may impede emigration where they create unnatural flow patterns.

Water temperature affects timing of emigration of smolts by influencing their rate of growth and physiological development, and their responsiveness to other environmental stimuli (Groot 1982). Alteration of thermal regimes through land-use practices and dam operations can influence the timing of emigration. The probability that coho salmon smolts will migrate downstream increases with rapid increases in temperature (Spence 1995). Holtby (1988) found that coho salmon smolts in British Columbia emigrated approximately eight days earlier in response to logging-induced increases in stream temperatures. In addition, the age-class distribution was shifted from populations evenly split between one- and two-year-old smolts to populations dominated by one-year-old fish. If most smolts emigrate at the same age, poor ocean conditions would have a greater effect on that particular year class than if the risk were spread over two years. Coho salmon have been observed throughout their range to emigrate at temperatures ranging from 36.6°F up to as high as 55.9°F (Sandercock 1991). Coho salmon have been observed emigrating through the Klamath River estuary in mid- to late-May when water temperature ranged from 53.6 to 68°F (CDFG unpublished data).

Supersaturation of dissolved gases (especially nitrogen) has been found to cause gas-bubble disease in downstream-migrating salmonids (Ebel and Raymond 1976). Smolts are particularly

vulnerable to predation (Larsson 1985). Physical structures in the form of undercut banks and LWD provide refugia during resting periods and cover from predators.

Estimates of coho salmon run-size, spawner escapement and angler harvest have been conducted in the Trinity River since 1977. Estimates are generated using mark-recapture methods. Fish are trapped and tagged at a mainstem trapping weir near the town of Willow Creek (RM 30). Recoveries occur at Trinity River Hatchery (TRH), the upper-most point of migration. Mean run-size (grilse and adults combined) between 1977 and 1999 was 15,959 coho salmon. Problems facing coho salmon in the Trinity River HU include degradation of spawning and winter rearing habitat due to sedimentation and past land-use practices, sparse spawning gravel recruitment, high summer water temperatures due to diversion of natural flow of Lewiston Dam, lack of deep pools, water diversions, irregular timing of flows, fragmentation of populations, possible genetic swamping from presumably inferior hatchery strains, migration barriers, water quality problems and unscreened diversions.

### *Hyampom Hydrologic SubArea (HSA)*

The Hyampom HSA includes the South Fork of the Trinity River and its tributaries from Eltapom Creek up stream to Hayfork Creek. Historical data show that the SFTR and its larger tributaries were once important spawning grounds for coho salmon. The frequency and size of coho salmon runs in the South Fork are not well documented, though they have been reported to migrate as far upstream as Hyampom (Figure 2).

Problems facing coho salmon in the Hyampom HSA include sediment load, unstable stream banks, migration barriers, low flows, the lack of pools and cover resulting from large-scale water diversions and other land-use practices, lack of high quality rearing habitat, and a substantial change in channel morphology.

### *Hayfork HSA*

The Hayfork Valley HSA includes Hayfork Creek upstream of Little Creek. Coho salmon are thought to have been extirpated in this HSA. Problems in the Hayfork Valley HSA include mass wasting, erosion caused by fire, excessive stored sediment, migration barriers, low flows, lack of pools and cover due to large-scale water diversions, water pollution, and lack of high quality rearing habitat.”

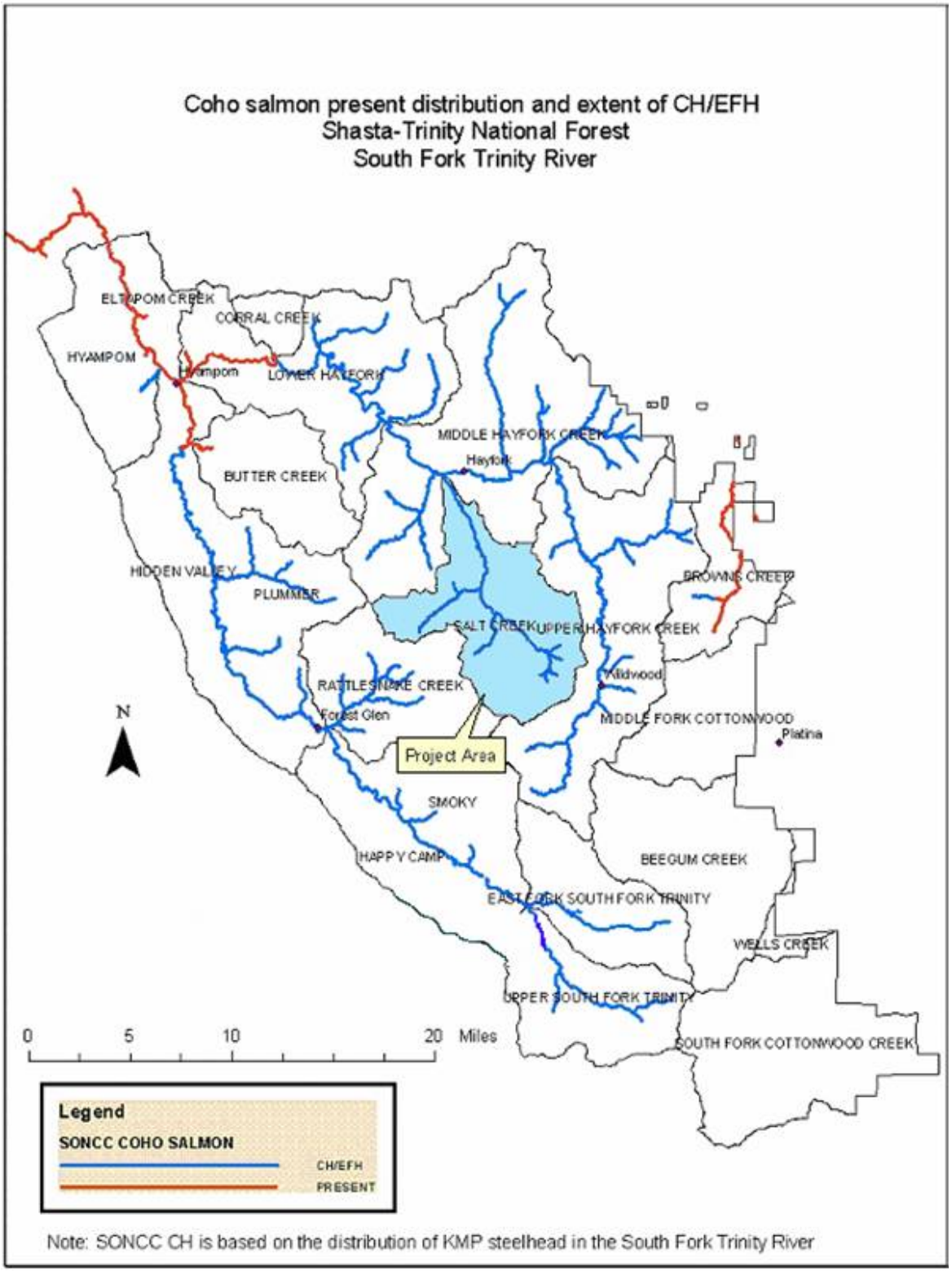


**Figure 2: SONCC coho salmon CH/EFH distribution on the Shasta-Trinity National Forest, South Fork Management Unit**

### *Critical Habitat*

NMFS announced designation of Critical Habitat (CH) for the SONCC ESU coho salmon in the May 5, 1999 Federal Register (64 FR 24049-24062). The notice defined critical habitat as follows:

"Critical habitat is designated to include all river reaches accessible to listed coho salmon between Cape Blanco, Oregon, and Punta Gorda, California. Critical habitat consists of the water, substrate, and adjacent riparian zone of estuarine and riverine reaches (including off-channel habitats) in hydrologic units and counties identified in this part [includes the SFTR in Trinity County]. Accessible reaches are those within the historical range of the ESU that can still be occupied by any life stage of coho salmon. Inaccessible reaches are those above specific dams or above longstanding, naturally impassable barriers (i.e. natural waterfalls in existence for at least several hundred years)." No dams or barriers were identified on the SFTR (NMFS 1999, 64 FR 24061).

The "adjacent riparian zone" was defined in the preamble to the Critical Habitat Designation as follows: "…Specifically, the adjacent riparian area is defined as the area adjacent to a stream that provides the following functions: shade, sediment, nutrient or chemical regulation, streambank stability, and input of large woody debris or organic matter." (NMFS 1999, 64 FR 24055).

The reaches of SONCC ESU coho salmon critical habitat applicable to this project are shown in Figure 2 and are summarized in the following table:

**Table 3: Summary of SONCC coho salmon designated critical habitat relative to Salt Project analysis area and currently occupied coho salmon habitat (Hayfork Creek, near Corral Creek confluence). 1 - West Fork is confluent with Salt Creek 0.8 miles below upper CH boundary. 2 - Includes reaches of Hayfork Creek below the confluence with each respective stream**

| Stream Name | Miles From Analysis Area to CH/EFH | Miles From Upstream CH/EFH Boundary to Occupied Habitat [2] |
|---|---|---|
| Ditch Gulch | 0.40 | 28.2 |
| West Fork (Salt Creek) [1] | 1.20 | 31.8 |
| Salt Creek | 1.36 | 32.2 |

## CHINOOK SALMON

In North America, Chinook salmon range as far south as the Ventura River, California, and as far north as Kotzebue Sound, Alaska. In Asia, they occur from northern Japan and the Amur River of Russia in the south to the Aanadr River of Russia in the north (Moyle 2002). Life history strategies for chinook salmon in coastal North American streams are predominately "ocean-type" (NMFS 1998). Ocean-type chinook salmon migrate from the freshwater environment to the ocean environment within their first year. Ocean-type chinook salmon tend to use estuaries within the first several weeks after emergence and prior to immigrating to the ocean. Residence in the Pacific Ocean is variable and complex with most fish returning to natal streams to spawn as adults between their third and fifth year (NMFS 1998). Chinook salmon die soon after spawning.

Chinook salmon present in the Klamath River basin upstream of the Trinity River confluence comprises the UKTR ESU. The USDA-FS designated river-type "spring-run" chinook salmon a "Sensitive" species. Adult spring chinook salmon have a unique life history that involves migrating to the upper reaches of the natal stream during spring and summer. Much of the summer is spent holding in pools where they mature sexually. The spawning period usually

begins during the latter part of September and continues through October. This life history pattern differs from the fall-run, which enter freshwater with nearly mature gametes and spawn soon after during the fall period, usually lower in the watershed than spring-run chinook salmon (Hillemeier, 1993). Hyampom, located at the confluence of the SFTR and Hayfork Creek is loosely considered the break between the distribution of spring and fall chinook salmon on the SFTR. However, during years of drought or years having above average precipitation and higher fall flows, there may be considerable overlap in the distribution and use of spawning areas. The approximate distribution of spring and fall-run Chinook salmon on the STNF South Fork Management Unit is depicted in Figure 3.

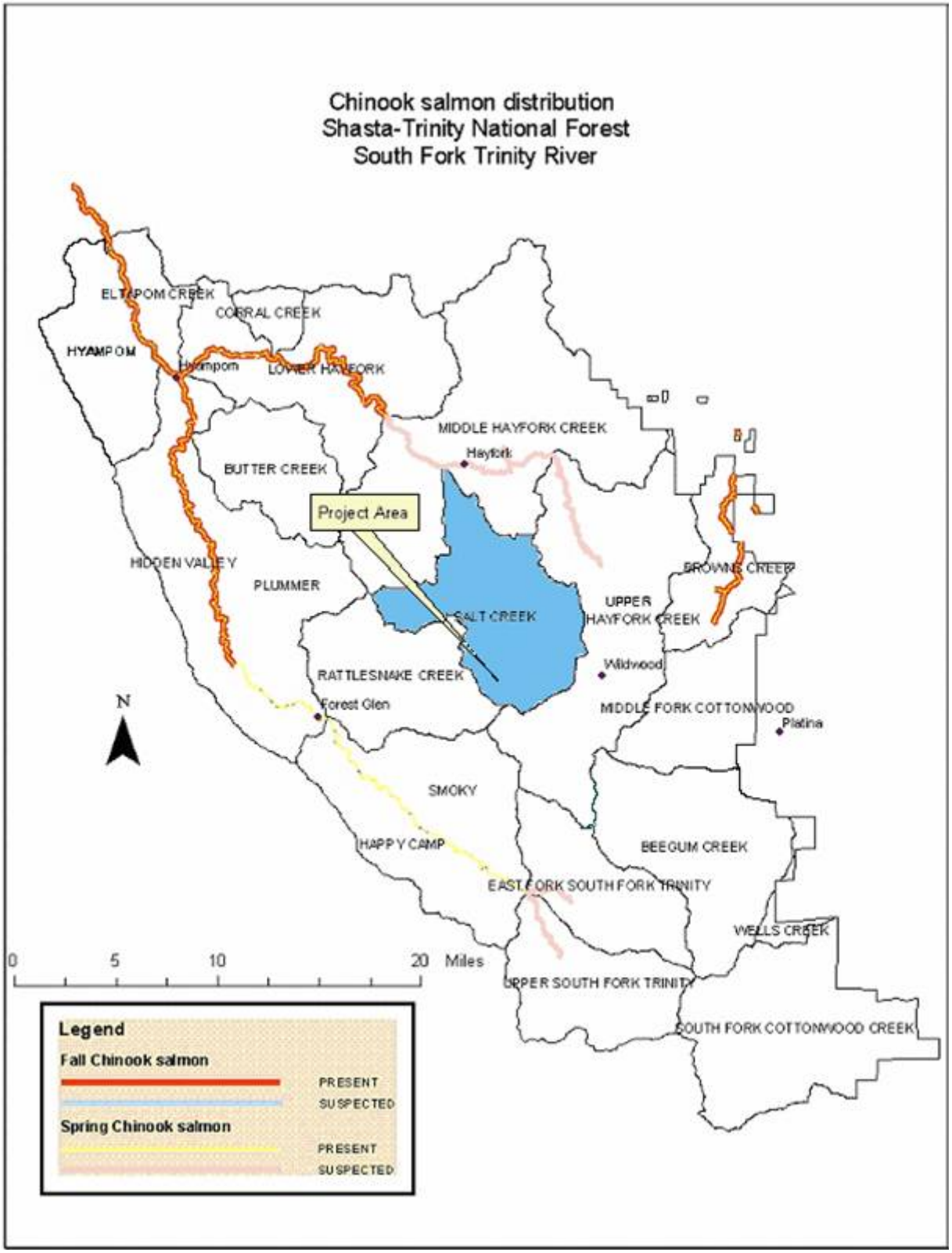


**Figure 3: Chinook salmon distribution on the Shasta-Trinity National Forest, South Fork Management Unit**

Chinook salmon spawn in clean gravels in streams and in the mainstem of some rivers. Depending on temperature, eggs incubate in redds for 1.5 to 4 months before hatching as alevins. Following yolk-sac absorption, alevins emerge from the gravel as fry and begin feeding. They require cold water, deep pools, and cover. Fall-run chinook salmon fry grow quickly and will emigrate from freshwater between 60 and 120 days after emergence (NMFS 1998). In contrast, Spring-run chinook salmon fry will rear in river for approximately 1 year before immigrating to the ocean in early spring. A major limiting factor for juvenile chinook salmon is water temperature which strongly affects growth and survival (Moyle 2002). For a complete life history description and status review see Meyers et al. (1998). For additional information regarding the freshwater habitat requirements for chinook salmon see Bjornn and Reiser (1991).

Studies conducted before the 1964 flood found that spring-run chinook salmon spawning began near the SFTR around mid September and progressed downstream (La Faunce 1967). The peak of spawning activity occurred by mid October. The lower extent of spawning activity on the SFTR was at Hyampom, but also extended from approximately 2 to 7 miles up Hayfork Creek (PWA 1994). Recently spring-run chinook salmon have been observed in the proximity of the Middle and Lower Hayfork Creek 5th field watersheds (CDFG 2004a). Historically, spring-run chinook salmon utilized the lower reaches of Salt Creek, Big Creek, Tule Creek, and East Fork Hayfork Creek (PWA, 1994).

In August, CDFG and participating agencies and individuals conduct annual spring chinook salmon and summer steelhead counts on the SFTR. Reach locations (A through N) are depicted in Figure 4 and Figure 5. From 1988 to 2004, adult survey reaches E, F, G and H, have had the highest concentrations of spring Chinook observed (Figure 6).

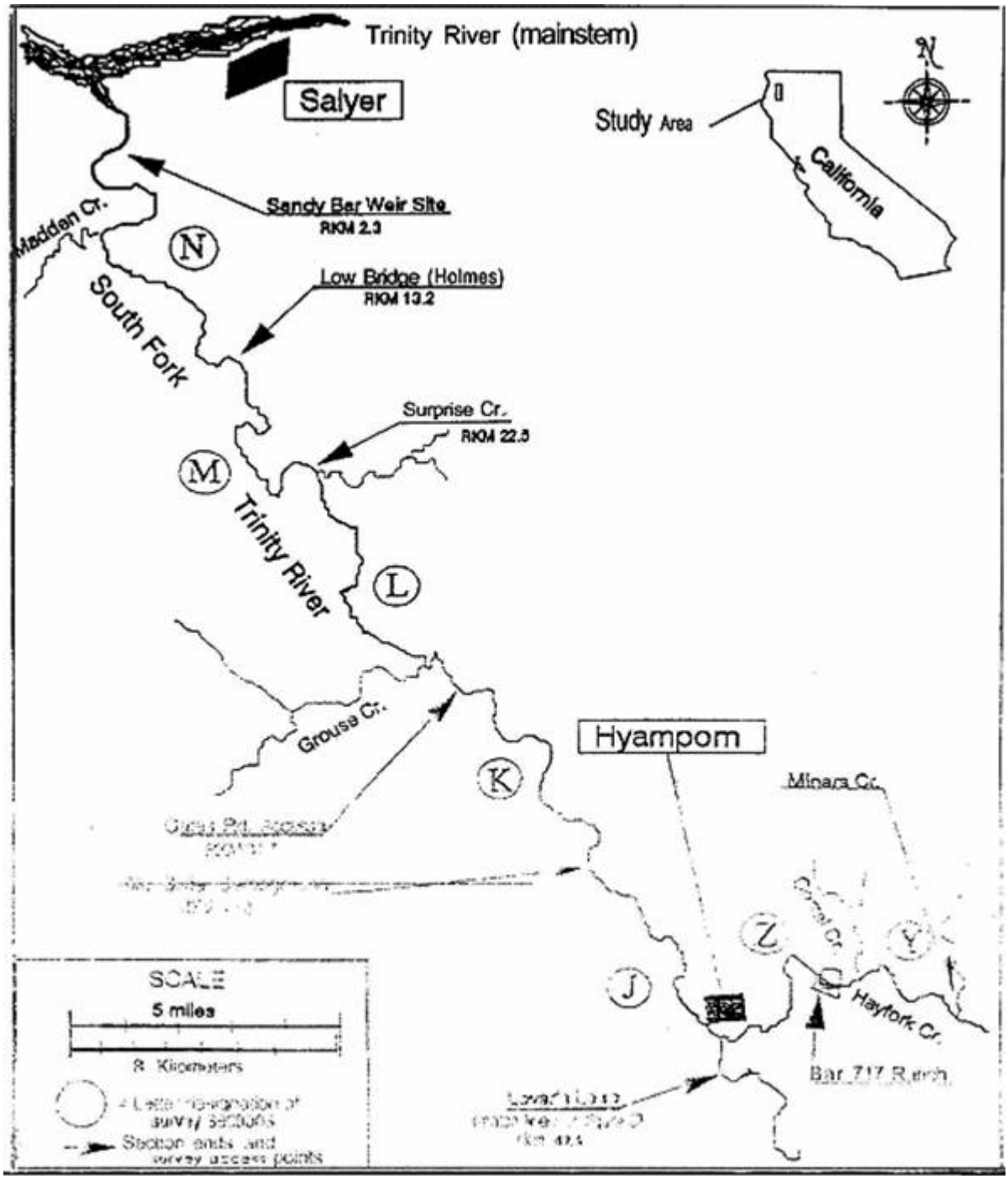


**Figure 4: South Fork Trinity River Upper and Middle reaches, A through I (adapted from Dean 1995). Reaches A and B (lower right hand corner) begin at the confluence of the East Fork and SFTR. Reach I ends just upstream of the community of Hyampom.**

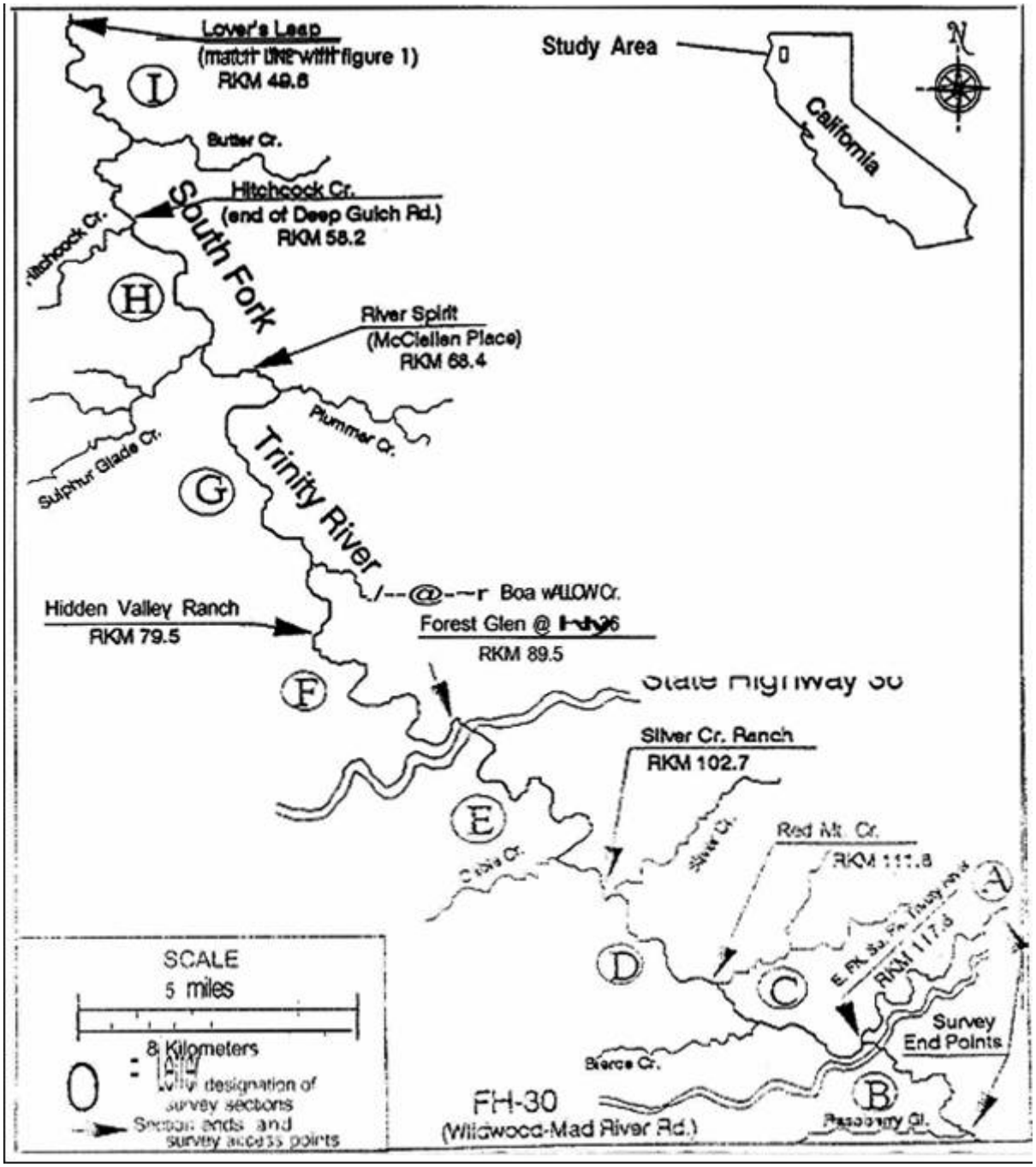


**Figure 5: South Fork Trinity River middle and lower reaches, I through N (adapted from Dean 1995). Reach I (lower right hand corner) ends just upstream of the confluence with Hayfork Creek. Reach N ends at the confluence with the mainstem Trinity River.**

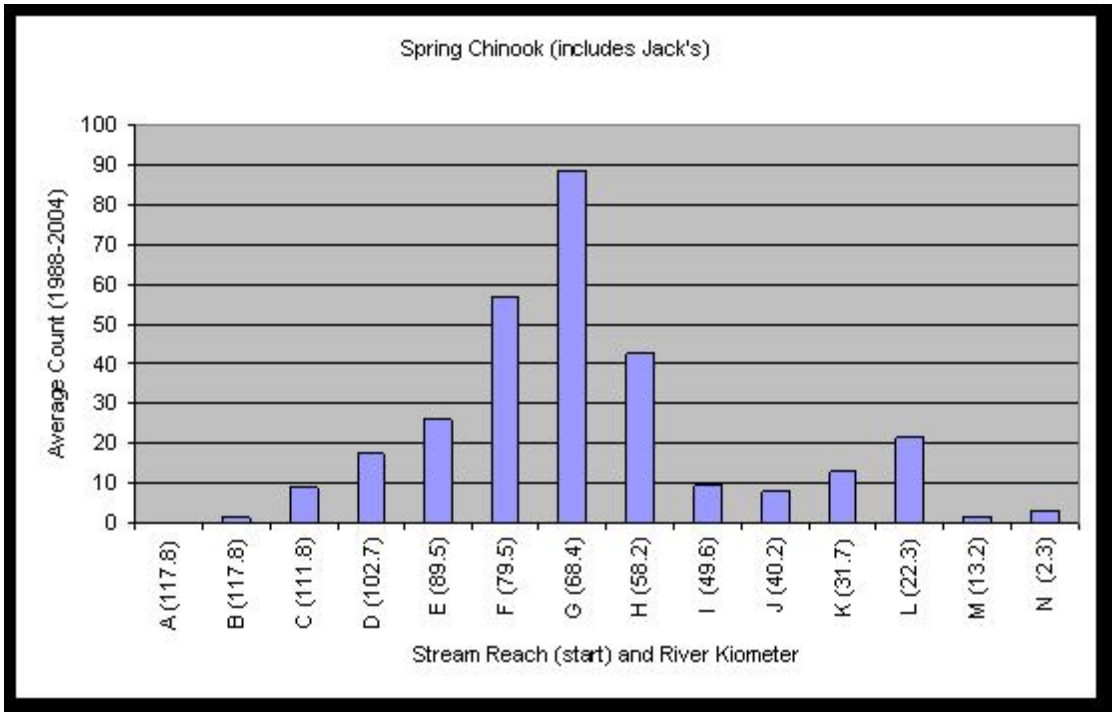


**Figure 6: Spring Chinook salmon over summer holding distribution (1988 to 2004) in the South Fork Trinity River.**

## POPULATION TREND

Spring-run chinook in the Klamath-Trinity system are on the verge of disappearing (Moyle 2002). They are lumped in with fall-run and late-fall-run fish in the UKTR ESU by NOAA because of genetic similarities (Meyers et al. 1998). In the Klamath drainage, the principle run is in the north and south forks of the Salmon River and in Wooley Creek, tributary to the Salmon River (Moyle 2002). The north and south fork of the Trinity River, and possibly New River, also support a few fish (CDFG 1990, in Moyle 2002).

Salmon River spring-run chinook salmon counts have been conducted annually since 1980. In the 24 years, 1980 to 2003, Salmon River spring-run chinook salmon have averaged 739 fish annually, ranging from 1,300 fish in 1993, to 6 fish in 1983 (Brenda Olsen, Personal Communication to Donnie Radcliffe 2005).

On the SFTR, during the summer of 1964, La Faunce (1967), as cited in Hillemeier (1993), estimated the spring-run chinook salmon population to be 11,604 fish. In the 16 years between 1989 and 2004, SFTR counts of adult spring-run chinook salmon averaged 290 fish annually, ranging from 1,097 fish in 1996, to 7 fish in 1989 (CDFG 2004a). During this same time period (1989-2004), Salmon River spring-run chinook have averaged 681 fish annually, ranging from 1,300 fish in 1993, to 148 fish in 1990 (Figure 7). The low number of spring-run chinook salmon in the SFTR is largely a response to the 1964 flood, which triggered landslides that filled in holding pools and covered spawning beds (Moyle 2002).

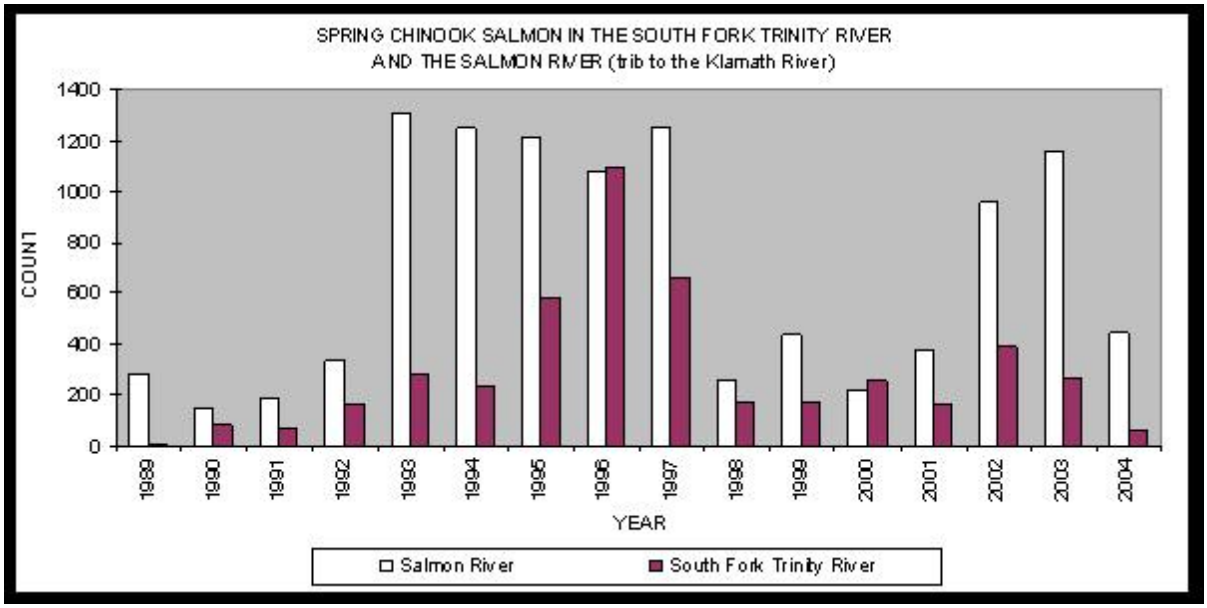


**Figure 7: Adult spring-run Chinook salmon counts for the Salmon River (Klamath River) and the South Fork Trinity River, 1989-2004. (Source: Brenda Olsen - Salmon River, CDFG 2004a).**

### *Essential Fish Habitat*

The Magnuson-Stevens Fishery Conservation Management Act (MSFCMA), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-297), requires all Federal agencies to consult with NMFS on all actions or proposed actions (permitted, funded, or undertaken by the agency) that may adversely affect Essential Fish Habitat. Essential Fish Habitat (EFH) is defined as those waters and substrate necessary to commercially important fish, including various Pacific salmon species, for spawning, breeding, feeding, and growth to maturity. In addition to their listing under the ESA, coho salmon (*O. kisutch*) are also managed by NMFS under the MSFCMA, which may prompt an EFH consultation in addition to an ESA consultation. Similarly, EFH consultation is required for Chinook salmon (*O. tshawytscha*) habitat, even though they are not listed under ESA. EFH analysis is being consolidated with ESA consultation in this document based upon the NMFS finding that the ESA Section 7 consultation process used by the U.S. Department of Agriculture – Forest Service (FS) can be used to satisfy EFH analysis and/or consultation needs. In this regard, this BA/BE is also the EFH assessment of the action.

The reaches of UKTR and UTR ESU Chinook salmon occupied/suspected-occupied habitat applicable to this project are shown later in this document in Figure 3 (page 22) and are summarized in the following table:

**Table 4: Summary of UKTR and UTR occupied/suspected-occupied habitat relative to Salt Project analysis area 1 - West Fork is confluent with Salt Creek 0.8 miles below upper CH boundary. 2 - Includes reaches of Hayfork Creek below the confluence with each respective stream.**

| Stream Name | Miles From Analysis Area to Suspected-occupied Habitat | Miles From Analysis Area to Occupied Habitat [2] |
|---|---|---|
| Ditch Gulch | 11.2 | 18.5 |
| West Fork (Salt Creek) [1] | 14.6 | 21.9 |
| Salt Creek | 14.8 | 22.1 |

### *Rainbow trout and steelhead*

Life History, Ecology, and Status of Klamath River basin Steelhead (except for specific reference to the SFTR "Local population") was incorporated from Israel (2003).

Coastal steelhead (*O. mykiss irideus*) in the Klamath basin, have evolved multiple life history and reproductive strategies for persisting in a system where critical habitat parameters are highly variable. Klamath River basin steelhead are recognized to constitute two distinct reproductive ecotypes that migrate from the ocean into tributaries during different time periods (Busby et al., 1996). However, different life stages of steelhead are found in the Klamath mainstem every month of the year, including a run of immature fish (commonly referred to as "halfpounders"), which overwinter in freshwater before returning to the ocean the following spring (USFWS, 1998). Klamath River basin steelhead are an anadromous form of coastal rainbow trout (O. m. irideus).

Steelhead exhibit the largest geographic range and most complex suite of traits of any salmonid species. Steelhead share many of the characteristics of rainbow trout that contribute to their ability to adapt to systems that are highly unpredictable and undergo frequent disturbance. Particularly important characteristics of Klamath River basin steelhead include anadromy (emigrating to the ocean and returning to spawn in freshwater) or nonanadromous freshwater residency, iteroparity (multiple spawning migrations), and natal homing. Watershed disturbances caused by agriculture, timber harvest practices, past mining and water diversions have negatively affected the fishery resources within the basin (KRBFTF, 1991).

During the past century, managing salmonid species for commercial and recreational purposes has focused on artificially producing large numbers of fish in hatcheries. Natural environmental fluctuations (climatic cycles and marine conditions) have likely played less of a role in the decline of this species than these human-induced impacts. However, the Klamath River basin and its tributaries support the largest population of coastal steelhead remaining in California (McEwan and Jackson, 1996). Klamath River basin steelhead are part of the KMP ESU, which the NMFS determined was not warranted for listing under the ESA (NMFS, 2001).

## Life History

### *Nonanadromous Phenotype (Coastal Rainbow trout)*

Coastal rainbow trout (resident) are the common wild rainbow trout in most of California, either as natural populations or through introductions in to other areas. Although the genetic identities of distinct local populations have been lost in many instances as a result of planting hatchery fish, wild strains adapted to local environmental conditions may persist (Gard and Seegrist 1965, in Moyle 2002). Some resident fish present above dams may represent landlocked versions of the original steelhead populations.

In the Klamath-Trinity River basins, these salmonids display one of the most diverse sets of life history patterns found in the Oncorhynchus genus. This species encompasses two distinct phenotypes. Typically, the resident form (called a rainbow or redband trout) spends their entire life in fresh water isolated above natural barriers (e.g., waterfalls, landslides, subsurface stream flows). This natural form of *O. m. irideus* is apparently uncommon in the Klamath River basin.

Residualization of steelhead progeny in the Klamath River basin occurs, but is poorly understood. Possible hypotheses regarding this issue include accelerated growth rate of fish in hatcheries or, excessively high water temperatures downstream delaying outmigrant behavior in these fish

(Healey, 1991; Viola and Schuck, 1995). Steelhead have also residualized above recent manmade barriers in the basin (e.g. Lewiston, Iron Gate, and Dwinnell Dams), although the genetic integrity of these fish is questionable given the stocking of nonnative rainbow trout into the waterbodies. These potadromous fish remain migratory and utilize tributaries to these reservoirs during spawning.

The relationship of steelhead to nonanadromous Upper Klamath redband trout (*O. mykiss* newberri, Behnke 1992) remains unknown. However, redband trout inhabit the upper Klamath basin in Oregon that is currently isolated by dams along the mainstem. Prior to the construction of Copco Dam in 1917, steelhead migrated up to the falls at the outlet of Klamath Lake. Behnke (1992) suggested that *O. m. irideus* did not reside above this location and designated the migratory Upper Klamath trout as a separate subspecies, *O. m. newberrii*. Moyle (2002) suggests steelhead invaded the upper Klamath basin during the Pleistocene and nonandromous coastal rainbow trout are present above Klamath Lake. Fortune et al. 1996 (in Hardy and Addley 2001) suggested that steelhead utilized tributaries above Upper Klamath Lake. It is likely that redband trout moved downstream of the outlet falls.

### *Anadromous Phenotype (Steelhead)*

The second phenotype of coastal trout is the more common anadromous form (known as steelhead). In the Klamath River basin, these fish display a variety of life history patterns based on different freshwater and saltwater rearing strategies (ODFW, 1995). The differences between these different life history patterns are not well understood, and researchers group anadromous steelhead "races" depending on the timing of adult migration into the Klamath River basin. The classification of different adult migratory run-timings is not widely agreed upon among authors (Table 5).

**Table 5: Classification of different run-timings and reproductive ecotypes of steelhead found in the Klamath River basin (as cited in Israel 2003).**

| Steelhead race | KRSIC (1993) | Hopelain (1998) | USFWS (1979) | Busby et al (1996) | Moyle (2002) |
|---|---|---|---|---|---|
| **Spring/Summer** | May- July | March-June | April-June | | April- June |
| **Fall** | August-October | July-October | | | August-November |
| **Winter** | November-February | November-March | November-February | | November-April |
| **Stream-maturing** | | | | April- October | |
| **Ocean-maturing** | | | | September-March | |

NOAA Fisheries does not classify Klamath River basin steelhead "races" based on run-timing of adults, but instead recognizes two distinct reproductive ecotypes of coastal steelhead in the Klamath based upon their reproductive biology and freshwater spawning strategy (Busby et al. 1996). Burgner et al. (1992) identified the stream-maturing type as entering the river sexually immature and still requiring several months before ripening to spawning condition. In the Klamath River basin, Busby et al. (1996) called these summer steelhead and found they migrated upstream between April and October with a peak in spawning behavior during January. The second type, ocean-maturing, enter the Klamath River basin between September and March with a peak in spawning in March. These fish enter the river sexually mature and spawn shortly after

reaching spawning grounds (Busby et al., 1996). The overlap in migration and spawning periods make differentiating these ecotypes difficult (Roelofs, 1983). A genetic study determined that different runs of steelhead within a particular subbasin of the Klamath-Trinity system shared more genetic similarities than populations of similar run-timings in adjacent basins (Reisenbichler et al., 1992).

Before establishing feeding locations, newly hatched steelhead move to shallow, protected margins of the stream (Royal, 1972, in McEwan and Jackson, 1996). Once aggressive behavior is exhibited, territories become established and are defended (Shapovalov and Taft, 1954) in or below riffles, where food production is greatest. Moffett and Smith (1950) found steelhead fry (individuals not yet surviving a winter) favored tributary streams with a peak in downstream movement during the early summer on the Trinity River. Possible physical influences leading to a decline in this behavior included decreasing river flows and increasing water temperatures. As higher flows and lower water temperatures returned to the mainstem during the late fall and winter, Moffett and Smith (1950) observed an increase in downstream movement. Steelhead parr (individuals surviving at least one winter) showed the greatest freshwater movement towards the end of their first year and spent their second year inhabiting the mainstem. The large majority of steelhead (86%) in the Klamath River basin apparently spend two years in fresh water before undergoing smoltification (the physiological process of preparing to survive in ocean conditions) and migrating to sea (Hopelain, 1998). Kesner and Barnhardt (1972) determined that steelhead rearing in fresh water for longer periods made their seaward migration more quickly. Klamath River basin steelhead remain in the ocean for one to three years before returning to spawn and their ocean migration patterns are unknown. It is believed that steelhead use their excellent homing sense to return to the same area they lived in as fry to spawn (Moyle, 2002).

The presence of the “half-pounder” life-history stage in the Klamath River basin steelhead population is a distinguishing trait of the KMP ESU. Half-pounder steelhead are subadults that have spent 2-4 months in the Klamath estuary or nearshore before returning to the river to overwinter. They overwinter in the lower and mid-Klamath regions before returning to the ocean the following spring. The presence of half-pound fish is uncommon above Seiad Valley (Kesner and Barnhardt, 1972). The occurrence of half-pounders was greater in spawning fish of mid-Klamath region tributaries (86-100%) when compared to the Trinity River (32-80%). There is a negative linear relationship between rates of half-pounder migration and first-time spawning size. The lowest occurrence of half-pounders was from Lower Klamath River basin winter-run steelhead (17%), which also demonstrated the greatest first-year growth rate (Hopelain, 1998). The proportion of “half-pounders” that become stream- or ocean-maturing ecotypes is not known.

Iteroparity (the ability to spawn more than once) is a characteristic unique to steelhead within the genus Oncorhynchus. Hopelain (1998) reported that repeat spawning varied between different run-timings. The frequencies of steelhead having undergone multiple reproductive events ranged from 17.6 to 47.9% for fall run fish, 40.0 to 63.6% for spring run fish, and averaged 31.1% for winter run fish. Females make up the majority of repeat spawners (Busby et al., 1996), and lay between 200 and 12,000 eggs (Moyle, 2002). Nonanadromous coastal rainbow trout typically contain fewer than 1,000 eggs, while steelhead contain about 2,000 eggs per kilogram of body weight (Moyle, 2002).

### *Habitat Utilization*

Steelhead require different habitats for each stage of life in the Klamath River basin. The abundance of steelhead in a particular location is influenced by the quantity and quality of suitable habitat, food availability, and interactions with other species. During the first couple

years of freshwater residence, steelhead juveniles require cool, clear, fast-flowing water (Moyle, 2002). Although steelhead have a greater physiological tolerance to many variables than do other salmonids, certain requirements must be met for a watershed to support these highly-adaptable fish, including cool water throughout their life history (Table 6). Many physiological cues during their lifecycle depend on temperatures remaining within these critical ranges.

**Table 6: Utilized (McEwan and Jackson, 1996) and optimal (Moyle, 2002) water temperatures (°C) for various steelhead life history stages. NR= Not Reported.**

| Life History Stage | McEwan and Jackson (1996) | Moyle (2002) |
|---|---|---|
| Spawning | 3.8 to 11.0$^{O}$C (38.8 to 51.8$^{O}$F) | NR |
| Incubation and emergence | 8.8 to 11.0$^{O}$C (47.8 to 51.8$^{O}$F) | 10 to 15$^{O}$C (50.0 to 59.0$^{O}$F) |
| Fry and Juvenile rearing | 7.2 to 11.0$^{O}$C (44.9 to 51.8$^{O}$F) | 15 to 18$^{O}$C (59.0 to 64.4$^{O}$F) |
| Smoltification | 7.2 to 15.0$^{O}$C (44.9 to 59.0$^{O}$F) | NR |
| Adult migration | 7.7 to 11.0$^{O}$C (45.8 to 51.8$^{O}$F) | NR |
| Summer steelhead holding | 10.0 to 15.0$^{O}$C (50.0 to 59.0$^{O}$F) | 10 to 15$^{O}$C (50.0 to 59.0$^{O}$F) |

Length of time for eggs to hatch is a function of water temperature and dissolved oxygen concentration. Hatchery steelhead take 30 days to hatch at 10.5°C (Leitritz and Lewis, 1980 in McEwan and Jackson, 1996), and emergence from the gravel occurs after two to six weeks (Moyle, 2002; McEwan and Jackson, 1996). Egg mortality begins at 13.3°C (McEwan and Jackson, 1996).

Redd construction typically occurs in gravel substrates of 0.5 to 10.0 cm in diameter (Reiser and Bjornn, 1979 in Spence et al., 1996). Preferred water velocities over the redd range between 20 and 155 cm sec-1, and water depths are often 10 to 150 cm (Moyle, 2002). Low levels of sedimentation (>5% sand and silt) can reduce egg survival and emergence due to decreased permeability of the substrate and dissolved oxygen concentrations available for incubating eggs (McEwan and Jackson, 1996). Once out of the gravels, steelhead fry can survive at a greater range of temperatures than other salmonid species, but have difficulty obtaining oxygen from water above 21.1°C (McEwan and Jackson, 1996). When physiologically stressed, steelhead have increased difficulty acquiring food, defending territories, avoiding predators, and are more likely to succumb to infectious diseases and parasites (Spence et al., 1996).

Hawkins and Quinn (1996) found that the critical swimming velocity for juvenile steelhead was 7.69 body lengths sec-1 compared to juvenile cutthroat trout that moved between 5.58 and 6.69 body lengths sec-1. Adult steelhead swimming ability is hindered at water velocities above 3 to 3.9m sec-1 (Reiser and Bjornn, 1979 in Spence et al., 1996). Preferred holding velocities are much slower, and range from 0.19m sec-1 for juveniles and 0.28m sec-1 for adults (Moyle and Baltz, 1985). Physical structure like boulders, large woody debris, and undercut banks create hydraulic heterogeneity that increase the habitat available for steelhead in the form of cover from predators, visual separation of juvenile territories, and refuge during high flows (Everest et al., 1985). Reiser and Peacock (1985 in Spence et al., 1996) reported the maximum leaping ability of steelhead to be 3.4m and they require water approximately 18cm deep for passage (Bjornn and Reiser 1991, in Spence et al., 1996).

Unlike fall and winter steelhead, summer steelhead do not utilize the majority of Klamath River basin tributaries. In particular, summer steelhead utilize Red Cap, Bluff, Elk, Dillon, Clear, Wooley, and Canyon Creeks and the Salmon, North and South Fork Trinity and New River. These rivers drain portions of the Klamath and Trinity Mountains providing deep pools for refugia

through the summer for subadults to mature sexually. Nielsen and Lisle (1994) found coldwater pockets in these thermally-stratified pools to be 3.5°C cooler than midday ambient stream temperatures of 29-36°C. In the New River, summer steelhead were found to occupy covered areas under bedrock ledges and boulders. Densities of these fish were highest where water velocities averaged 9.3cm sec-1 (Nakamoto, 1994).

### *Growth rate and feeding habitats*

The growth rate of steelhead is quite rapid after emergence and by the end of the first year individuals can reach between 10 and 12 cm (Moyle, 2002). Increased water temperature, which is one factor influencing production of aquatic invertebrates (Allan, 1995), accelerates growth rates until early fall (Moffett and Smith, 1950). By the end of the second year, steelhead are often 16 to 17 cm in length and sustain a short growth spurt during their third spring to prepare them for smoltification (Moyle, 2002). Smolts from Klamath River subbasins known to contain fall-runs of steelhead entered the ocean at 21-23 cm (Hopelain, 1998). Feeding habits of steelhead varied through the different periods of their life, although mean growth rates in juveniles were similar between run-timings and tributaries (Hopelain, 1998). In general, trout seem to specialize on an aquatic organism or terrestrial bug of choice, although they also seem to be somewhat opportunistic (Moyle, 2002). In April, Trinity River steelhead were found with ants in their stomachs (Boles, 1990). As they grow, their diets change to include larger prey, with fish being more important to nonanadromous trout than parr preparing for smoltification. Kesner and Barnhardt (1972) observed Trichoptera (caddisfly) larvae to be the primary food found in half-pounder steelhead stomachs. They also determined that half-pounders more frequently contained food in their stomachs compared to steelhead on a spawning migration.

### *Community associations and species interactions*

Steelhead trout are found in two distinct assemblages depending on their phenotype (Moyle, 2002). *O. mykiss irideus* are found above and below barriers to anadromy. Above barriers in cold, fast-moving tributaries in the Lower Klamath River basin, coastal rainbow trout are found alone or with coastal cutthroat trout (Moyle, 2002). The anadromous form of rainbow trout are found in an assemblage that includes other salmon, Klamath smallscale suckers, speckled dace, and marbled sculpin species in the Klamath River basin. This species association is a product of the physical landscape as well as interspecies interactions between fish. Potentially, environmental fluctuations keep the populations of each species from reaching a size where competition and territoriality are important (Moyle, 2002). Alternatively, in the reaches of streams where this diverse assemblage is observed, a high degree of habitat heterogeneity allows segregation of species into microhabitats and may eliminate interspecies interactions. In the presence of other juvenile salmonids (coho and chinook), steelhead have been observed to distribute themselves in microhabitats different from the other species (Everest and Chapman, 1972). Steelhead are successful competitors and can display aggressive behavior to defend territories (Jenkins 1969, in Moyle, 2002). Juvenile rainbow trout have a positive interaction with suckers in the Sacramento River, and possibly exhibit the same relationship in the Klamath River basin. In the Sacramento, juveniles were observed to follow large suckers around and feed on invertebrates disturbed by sucker feeding activities (Baltz and Moyle, 1984). Studies of intraspecies interactions have shown that steelhead segregate spatially into microhabitats within the same stream (Keeley and McPhail, 1998; Moyle, 2002). However, little is known about the relationship between different cohorts, including half-pounders, in the Klamath River basin. In one study on a coastal California stream (Harvey and Nakamoto, 1997), the intraspecific interactions among different cohorts were dependent on the habitat occupied by the fish. In deep water, Harvey and Nakamoto (1997) observed that larger steelhead in the presence of small

steelhead grew faster than when these fish were observed together in shallow waters. Food availability has a larger impact on territory size than body size, and juvenile steelhead were observed to intrude into adjacent steelhead territories to capture food (Keeley and McPhail, 1998). In the Trinity River, Moffett and Smith (1950) observed schools of steelhead parr along the river bottom in the thalweg during extended winter dry periods. This may be favored habitat because the deeper, faster water contains more invertebrate drift (Britain and Eikeland 1988) and offers greater protection from predators.

### *Status*

No long-term data is available to evaluate Klamath River basin steelhead population trends. An unpublished report estimated a basin wide annual run size of 283,000 adult steelhead (spawning escapement + harvest) in 1965. Busby et al. (1994 in Moyle, 2002) reported winter steelhead runs in the basin to be 222,000 during the 1960's. Based on creel and gill net harvest data, the winter-run steelhead population was estimated at 10,000 to 30,000 adults annually in the early 1980's (Hopelain, 2001). Population estimates of summer steelhead have also declined precipitously during the 1990's. The apparent decrease in population size of steelhead in the Klamath River basin has multiple causes. Main factors impacting steelhead in the Klamath Basin include hatcheries, harvest, hydroelectric operations, and human impacts.

### *Hatcheries*

Two hatcheries are currently operated by the CDFG as mitigation for lost habitat beyond Iron Gate and Lewiston Dams. While hatchery production has primarily relied upon native broodstock, numerous transfers of fish from outside the basin are documented. Prior to 1973, transfers came from the Sacramento, Willamette, Mad and Eel Rivers (Busby et al., 1996). Since the length of freshwater occupancy of juvenile Klamath River basin steelhead is long, wild fish are at a potentially increased risk from hatcheries. About 1,000,000 smolts per year are produced by the two hatcheries (Busby et al., 1994).

Historic returns of steelhead to both Iron Gate and Trinity River hatcheries do not seem correlated. No studies have been carried out to evaluate the impact of hatchery releases on wild steelhead and other salmonids in the Klamath River basin. However, studies elsewhere have shown that releases of large numbers of fish result in negative competitive interactions between wild steelhead and hatchery fish for food, habitat, and mates (Nickelson et al., 1986). Also, carrying capacity of rivers is often exceeded during the outmigration of hatchery smolts based on decreasing food availability (Steward and Bjornn, 1990 in Spence et al 1996). Hatchery steelhead have been documented to spatially displace a large percentage of wild steelhead (79%, McMichael et al., 1999).

Other risks from hatcheries include disease transmission (Steward and Bjornn, 1990), alterations of migration behavior in wild fish (Hillman and Mullen, 1989 in Spence et al., 1996), and genetic changes in the wild population (Waples, 1991). The behavioral and genetic interactions of residualized hatchery steelhead and wild steelhead in the Klamath River basin has not been evaluated but is recognized as an issue requiring attention (CDFG, 2001).

Currently, sportfishery regulation prohibits take of wild winter steelhead and does not allow fishing of summer steelhead. In particular locations, Poaching may pose a problem for these fish because of their localized concentration over a long time period (Eric Gerstung, pers. comm. in McEwan and Jackson, 1996).

### *Hydroelectric Operation*

Iron Gate Dam (and all the other dams in the basin) breaks the upstream-downstream connectivity of the Klamath River basin. A primary impact of dams on steelhead is the elimination of free passage through these barriers to historic spawning grounds upstream and the ocean downstream. Another direct impact that Iron Gate Dam has on Klamath River basin steelhead is the alteration of natural flow regimes. A river's flow regime controls the physical and hydrological processes of that river, and therefore is responsible for habitat and food availability, temperature regimes, and the concentration of dissolved gases (Spence et al., 1996). The loss of habitat from decreased flows intensifies inter- and intraspecies competition for suitable rearing and feeding of juvenile steelhead (Spence et al., 1996). Iron Gate Dam is responsible for changes in flow impacting the temperature regime on the mainstem Klamath River. Steelhead continuously exposed to temperatures above 24°C are unable to survive (Moyle, 2002). While water from Iron Gate Dam is not released at this temperature, the quantity of water released impacts the variability of downstream water temperatures (Moyle, 2002).

### *Human Impacts*

Klamath River basin steelhead spend a considerable part of their life in the tributaries where cool, high-quality water is typically common. Recent reports have documented the degradation of this habitat and potential impacts to juvenile salmonid production (Ricker, 1997; Jong, 1997; Borok and Jong, 1997). Particular impacts caused by increased sedimentation of spawning grounds include reduction of egg survival and sac fry emergence rates. Potential impacts from upslope erosion created by logging and road construction may negatively impact steelhead spawning (Burns, 1972). In many smaller Klamath River basin tributaries, where impacts from these activities are greatest, steelhead rely on unimpacted habitat for supporting the production and survival of juveniles. In some subbasins, road construction and placement of culverts has created barriers to migration.

Land use practices associated with agricultural and ranching operations can negatively impact adjacent waterbodies containing steelhead and other anadromous fish. The trampling and removal of riparian vegetation by grazing livestock destabilizes and denudes streambanks increasing sediment and temperature in the streams (Platts et al, 1991 in Spence et al., 1996). In the Klamath River basin, these activities have led to a reduction in canopy over the stream channel and siltation of pools necessary for juvenile rearing (Moyle, 2002). Agricultural practices can directly impact steelhead because of the massive alterations of the riparian and aquatic systems resulting from efforts to increase the quantity of land converted for food production (Spence et al., 1996). This includes stream channelization, large woody debris removal, and armoring of banks (Spence et al., 1996). All of these activities homogenize the aquatic habitats (e.g. temperature and water conditions) to conditions that are not favored by steelhead or other native biota, but do enhance the invasion of nonindigenous fish (Harvey et al., 2002). Humans have introduced 13 exotic species into the Klamath River system. Although none of these species have been observed to negatively impact steelhead in the Klamath River system, invasive species have played a role in the decline of steelhead through predation and competition in other Northern California rivers (Brown and Moyle, 1991).

### *SFTR Trends*

Winter-run steelhead are not at risk of extinction but their numbers have been reduced from historic levels. Local anglers on the SFTR reported a substantial decline in the abundance of winter steelhead following the 1964 flood. This observation is consistent with findings of

Rodgers (1972, 1973, as cited in PWA 1994). There are no current adult return estimates for winter-run steelhead.

In the 16 years between 1989 and 2004, SFTR counts of adult summer steelhead averaged 41 fish annually, ranging from 8 fish in 1991, to 95 fish in 1997 (CDFG 2004a, Figure 8).

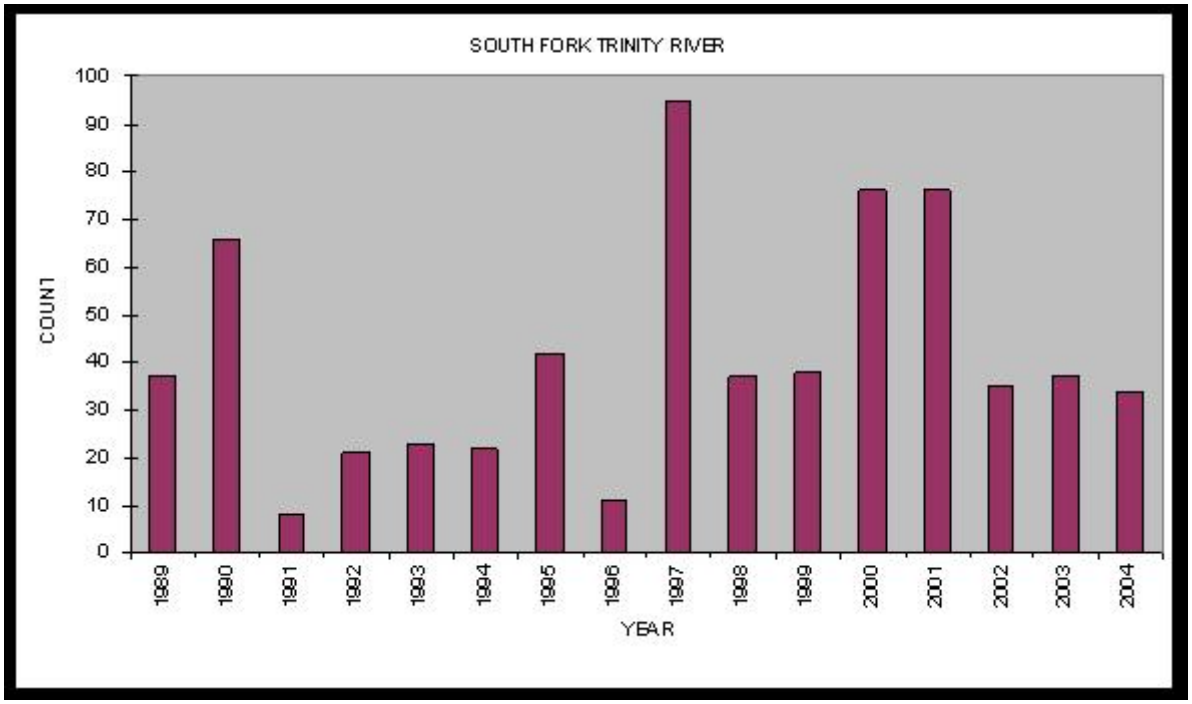


**Figure 8: Adult summer steelhead counts in the South Fork Trinity River, 1989-2004.**

NOAA Fisheries has reviewed the current population levels and long-term population trends of West Coast Salmon and Steelhead. NOAA Fisheries also considered available information on resident rainbow trout. Preliminary conclusions are that KMP steelhead are not likely to become endangered in the foreseeable future, and that Federal ESA listing is not currently warranted within the KMP ESU (NOAA Fisheries 2003).

### *Steelhead Summary*

Listed as a candidate for Threatened Status by NMFS in 1998, steelhead in the Klamath-Trinity basin have had their range reduced by the construction of major dams on the Klamath, Trinity, and Shasta Rivers. Further population declines have been caused by downstream changes to channel form and water temperatures attributable to decreased flows. Poor watershed management (connected with such practices as grazing, logging, and road building) has contributed to declines as well, especially as a result of siltation of holding pools and spawning riffles and increases in water temperatures due to loss of shading. Interactions with hatchery steelhead and fishing pressure (in freshwater and marine fisheries) may have contributed to further declines of wild population levels. Although much less abundant than historically, Fall- and Winter-run steelhead are still widely distributed and fairly common in the basin.

Summer steelhead populations remain the most imperiled in the Klamath River basin and have been reduced to a small number of key populations. In addition to all the usual causes of decline,

they are exceptionally vulnerable to poaching when oversummering in pools. As a consequence, during the 1990s there were perhaps 1,000-1,500 adults divided among eight populations; which is less than 10 percent of their historical abundance (Moyle et al. 1995, in Moyle 2002).

Key elements of the Steelhead Restoration and Management Plan for California for the Klamath River basin (McEwan and Jackson, 1996) included increasing flow releases through Iron Gate and Lewiston Dams and emphasized increasing naturally produced stocks. The plan recognized the importance of protecting functioning subbasins where natural processes must take precedence over human impacts, which may cause severely degraded habitat conditions. Watersheds identified by McEwan and Jackson (1996) requiring stream restoration to benefit steelhead included the SFTR, Scott River, and Shasta River.

### *Watershed Condition – Environmental Baseline*

## UPPER SOUTH FORK TRINITY RIVER SUBBASIN OVERVIEW

The SFTR basin is approximately 970 mi2 in size, undammed, and is the largest tributary of the Mainstem Trinity River. The terrain is predominately mountainous and forested, with only about 15 percent of the basin available for farmland. Most agricultural activity occurs in the Hayfork Valley, which also contains the largest tributary of the SFTR. Elevations in the basin range from more than 7,800 feet above sea level in the headwater areas, to less than 400 feet at the confluence with the Trinity River (TCRCD 2003).

Precipitation in the SFTR Watershed, as is typical of California, is highly seasonal, with 90 percent falling between October 1 and April 30. Rainfall runoff dominates the hydrologic budget. However, depending on location in the watershed and the given water-year, snowmelt runoff can be significant. There are few long-term annual precipitation records in the watershed, and instead records from the town of Weaverville were used. Weaverville has a mean annual precipitation of 36.29 inches, for 1906-2001, excluding 1981-1983 during which the records are incomplete (TCRCD 2003). For Weaverville, the wettest year contained in this record is 1974, when precipitation totals reached 63.58 inches, only slightly wetter than 1998, when 63.27 inches were recorded. The driest year at Weaverville was 1977, when only 12.57 inches of precipitation were recorded.

Much of the SFTR watershed lies in a region of deeply dissected mountains composed principally of the unstable rock formations of the South Fork Mountain Schist, the Galice Formation, and the Rattlesnake Creek terrane. As a result, the erosion rates in the watershed and sediment loads in the SFTR are extremely high compared to most rivers. The mean annual sediment discharge reported in a 1972 study was 1,650 tons/mile2 for the SFTR for the period 1940 to 1965 (SCS 1972, in PWA 1994). In comparison, at two locations in the Klamath Mountain Province, the North Fork of the Trinity River at Helena had an annual suspended sediment yield of 210 tons/mi2 and the Trinity River at Lewiston had an annual suspended sediment yield of 160 tons/mile2 (Hawley and Jones 1969, in PWA 1994).

The SFTR has been the subject of several studies following the 1964 flood, which was the largest on record. Following the flood, fish populations declined severely and continue to remain below pre-flood levels. The continued high rates of erosion and sedimentation are considered a major contributor to the depressed anadromous fish runs in the river basin (PWA 1994). The SFTR has one of the highest sediment loads in northern California. The high sediment loads have been attributed to unstable geology, management activities, and storm activity (Raines 1998).

In 1994, the SFTR was added to the Clean Water Act §303(d) list for sediment impairment triggering the development of a Total Maximum Daily Load (TMDL) threshold for sediment that was completed in 1998. In support of the TMDL, a detailed sediment source analysis was completed for the SFTR basin (Raines 1998).

The study divided the sediment sources into management-related and non-management-related sources, and three time periods based on aerial photograph availability and major changes in watershed activity. The first period was from 1944 to 1960, when timber harvest began in the basin; 1961 to 1975, when timber harvest was increased with pre-forest practices regulation and the largest storm event on record occurred; and 1976 to 1990, when timber harvest increased under newer regulations, and wildfires (in the Plummer and Rattlesnake watersheds) and three major floods occurred (Foster-Wheeler 2001).

The sources of sediment in the Upper SFTR subbasin from 1944 to 1990 and their relative contributions are shown in Figure 9. Non-management sediment sources accounted for two thirds of the sediment supply in the Upper SFTR subbasin, and non-management related mass wasting contributed half of the total sediment to the SFTR (Foster-Wheeler 2001). Non-management related bank erosion accounted for 14 percent of the total sediment supply and road related erosion contributed 17 percent of the sediment supply. It should be noted that the separation of sediment loads into management- and non-management-related is somewhat arbitrary and difficult to estimate. For example, timber harvesting could increase peak flows, which in turn could increase the rate of inner gorge mass wasting (USDAFS 2000), which would not be considered management-related by Raines (1998). The results of the Raines (1998) report are based on a combination of methods to assess sediment delivery including aerial photo interpretation (for large-scale mass wasting), complex numerical modeling (SEDMOD model for road erosion and delivery), and numeric estimates (for streambank erosion and surface erosion). Results from this study should be interpreted by keeping in mind the complexity of geomorphic responses and the differing methods used (Foster-Wheeler 2001).

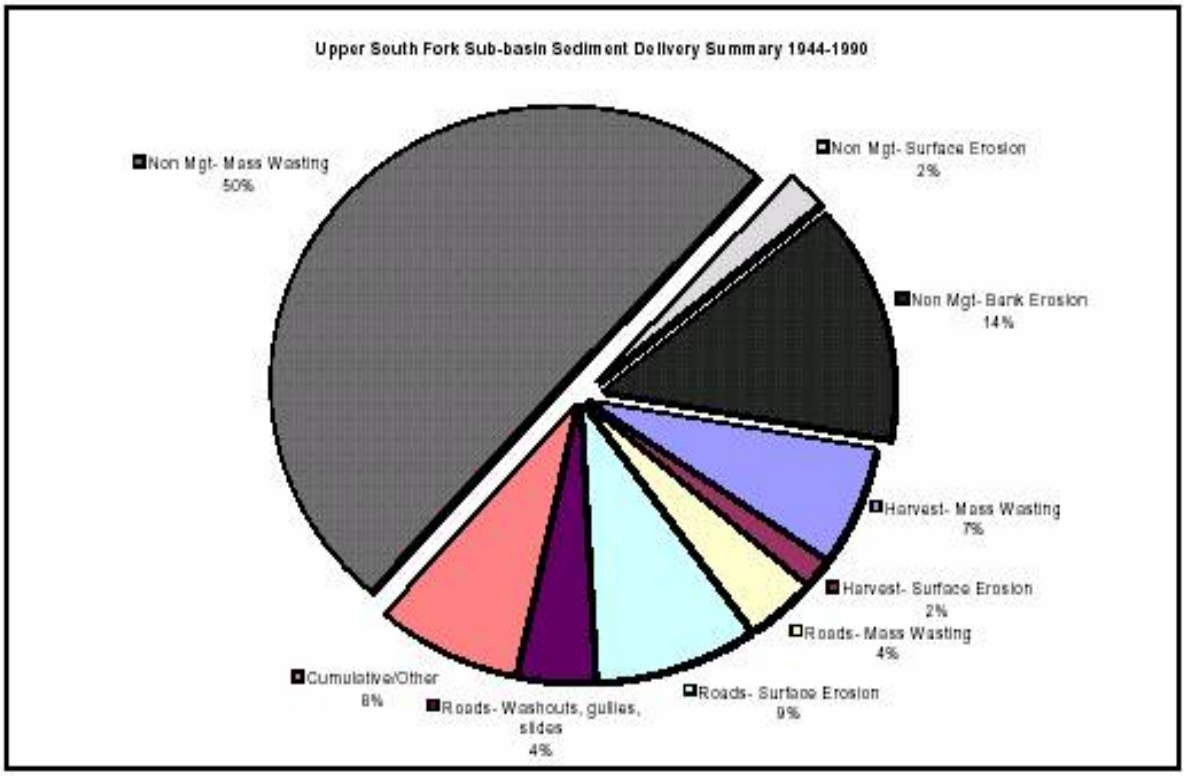


**Figure 9: Sources of Sediment in the Upper South Fork subbasin of the Trinity River, 1944 to 1990. Source: Foster-Wheeler (2001) as adapted from EPA (1998).**

## PROJECT AREA

The Salt Creek watershed has a drainage area of 124.3 mi2. A dendritic channel network drains the watershed. Major tributaries in the Salt Creek 5th field watershed include Philpot Creek, Ditch Gulch, Dobbins Gulch, Salt Gulch and Deer Gulch. There are approximately 54.9 miles of perennial streams, 84.4 miles of intermittent streams, and 157.8 miles of ephemeral streams in the watershed. Annual precipitation ranges from approximately 70 inches in the highest elevations to less than 40 inches at lowest elevations in the Hayfork Valley. Most precipitation falls as rain below the 4,000 feet elevation and as snow above 4,000 feet, although a winter long snow pack does not occur below about 5,500 feet elevation (URSGWC 2000).

Headwater streams within the Salt Creek Watershed serve generally as transport channels and are characterized by high stream gradients (10+ %) and steep sideslopes (70+ %). Large woody debris and sediment have relatively low residence times in these areas, as these materials are readily moved downstream during high flow events. These channels generally lack suitable amounts of fish habitat needed for spawning and rearing and natural fish passage is often limited by gradient and highly fluctuating flows.

The fisheries analysis area for this project is within the 6th level Salt-Creek-Hayfork watershed within two 7th field watersheds, the Ditch Gulch-Salt Creek and Upper Salt Creek – Hayfork Creek watersheds. Impacts to vegetation from the Salt project are expected to last approximately 20 years for thinning units and 20 – 30 years for the and regeneration with green tree retention and shelterwood with green tree retention cutting areas and 10 years in the fuel break thinning unit. Stream habitat recovery often lags 5-10 years behind vegetation recovery. Salt Creek,

above its confluence with Hayfork Creek supports a limited run of KMP steelhead (USFS, unpublished data). Upper Hayfork Creek (above the confluence with Salt Creek) currently supports anadromous runs of KMP steelhead (*O. mykiss*), Pacific lamprey (*Lampetra tridentata*), and a remnant run of UKTR Chinook salmon (*O. tshawytscha*, USDA Forest Service 1993; USDA Forest Service 1998). Historically, spring Chinook salmon utilized the lower reaches of Salt Creek, Big Creek, Tule Creek, and East Fork Hayfork Creek (PWA, 1994), but no appreciable number of Chinook are believed to use Salt Creek currently.

### *Evaluation of Habitat Indicators*

This analysis covers a broad range of information on habitat indicators 1) water quality, 2) habitat access, 3) habitat elements, 4) channel condition and dynamics, 5) flow hydrology and 6) watershed condition. The Shasta-Trinity National Forest Tributaries Matrix of Factors and Indicators was used to determine baseline conditions for each habitat indicator (Appendix C). Baseline indicators were analyzed for the three "upper salt creek" 7th field subwatersheds (defined above). Much of the information below is directly from stream surveys conducted by STNF personnel. Survey results are available in the Hayfork Ranger District fisheries files.

## WATER QUALITY

### *TEMPERATURE: Properly Functioning*

A maximum weekly water temperature of 63°F was documented in the upper Salt Creek Watershed (mostly 1st-3rd order streams) in 1996 (Farber et al., 1998). Forest Service Stream Surveys of Salt Creek and its tributaries support this finding.

### *TURBIDITY: Functioning At Risk*

Turbidity in the project areas has been characterized as moderate in most of the project area (URSGWC 2000). Moderate background turbidity levels are common in SF Trinity River watersheds due to the high frequency of unstable geographic formations found in the area.

### *CHEMICAL CONTAMINATION: Properly Functioning*

There is no evidence that any significant amount of chemical contamination has occurred or persists in the Salt Creek Watershed (URSGWC 2000).

## HABITAT ACCESS

### *PHYSICAL BARRIERS: Properly Functioning*

No known man-made barriers exist in the action area. Thermal barriers may limit juvenile salmonid migration between the action area and Hayfork Creek during seasonal periods of increased water temperatures (URSGWC 2000).

## HABITAT ELEMENTS

### *SUBSTRATE: Properly Functioning*

Historic stream surveys estimate percent "fines" (ocular estimation of fine sediment) at much less that 5% in pools and less that 1% in riffles in Salt Creek and its tributaries. These surveys also estimate embeddedness at 10-16%.

### *Large Woody Debris (LWD): Functioning At Risk*

LWD is limited throughout the Salt Creek Watershed, but is present in moderate levels within the upper watershed (i.e. action area). As described earlier, streams within the action area are generally transport-type channels and limited residence time for LWD is expected. Within action area watersheds LWD occurs near expected levels.

### *POOL FREQUENCY: Not Properly Functioning*

In main-stem Salt Creek, it is estimated that less than 10% of the channel area lies within pools. Surveys of the upper watersheds estimate much higher pool frequencies, but these estimates still fall below the criteria for properly functioning.

### *LARGE POOLS: Functioning at risk*

Surveyed reaches have some pools deeper than 1m. Very few (<5%) sections include adult holding, juvenile rearing, and overwintering reaches where streams are >3m in wetted width at baseflow.

### *OFF-CHANNEL HABITAT: N/A*

Channels within the action area are generally Rosgen A and B-type transport channels. These channels are expected to be well entrenched and contain very little off-channel habitat.

### *REFUGIA: Functioning At Risk*

Habitat refugia exist to a limited degree, are well protected and are sufficiently connected within the Salt Creek Watershed. The streams within the action area do not support viable populations of anadromous fish based on their limited size and habitat complexity.

## CHANNEL CONDITIONS AND DYNAMICS

### *WIDTH TO DEPTH RATIO: Properly Functioning*

Width to depth ratios fall within expected functioning values for A and B-type channels.

### *STREAMBANK CONDITION: Properly Functioning*

While the underlying unstable geology of these subwatersheds leads to increased probability of inner gorge slides, current observations show relatively high stability of streambanks within the action area.

### *FLOODPLAIN CONNECTIVITY: Properly Functioning*

Streams within the action area subwatersheds have limited floodplains, but those that do exist are generally well connected to their floodplains.

## FLOW/HYDROLOGY

### *CHANGE IN PEAK/BASE FLOWS: Properly Functioning*

Equivalent Roaded Acres (ERA) analysis of existing conditions indicates that the sixth level Salt Creek watershed is in watershed condition class 1, as are both 7th level watersheds, Upper Salt Creek-Hayfork Creek and Ditch Gulch – Salt Gulch. (Hydrologist Specialist Report).

#### *INCREASE IN DRAINAGE NETWORK: Properly Functioning*

Equivalent Roaded Acres (ERA) analysis of existing conditions indicates that the sixth level Salt Creek watershed is in watershed condition class 1, as are both 7th level watersheds, Upper Salt Creek-Hayfork Creek and Ditch Gulch – Salt Gulch. (Hydrologist Specialist Report).

### WATERSHED CONDITIONS

#### *ROAD DENSITY AND LOCATION: Functioning At Risk*

The Salt Creek 5th field watershed has a road density of 2.96 mi/mi2 with some valley bottom roads (URSGWC 2000). Road densities for the 7th field subwatersheds in the action area are equal or slightly less that the overall value for the 5th field watershed.

#### *DISTURBANCE HISTORY: Properly Functioning*

Equivalent Roaded Acres (ERA) analysis of existing conditions indicates that the sixth level Salt Creek watershed is in watershed condition class 1, as are both 7th level watersheds, Upper Salt Creek-Hayfork Creek and Ditch Gulch – Salt Gulch. (Hydrologist Specialist Report).

#### *RIPARIAN RESERVES: Properly Functioning*

Riparian reserves are generally intact and are properly functioning within the action area (URSGWC 2000).

#### *DISTURBANCE REGIME: Functioning at Risk*

Disturbance within the upper Salt Creek action area is localized and occurs infrequently. Resiliency of habitat to recover from environmental disturbance is moderate. (Professional judgment of Donald Ratcliff, fisheries biologist, Shasta-Trinity National Forsest).

#### *SUMMARY/INTEGRATION: Functioning at Risk*

Natural processes within the Salt Creek 5th field watershed have been altered by man, and to a lesser extent in the upper 7th field subwatersheds (i.e. action area). Within the action area, suitable habitat exists and is used to a limited degree by steelhead. Habitat would likely be used to a greater degree by steelhead and possibly Chinook salmon given improvements in the condition of lower Salt Creek and Hayfork Creek. (Professional judgment of Donald Ratcliff).

## Effects of the Proposed Action

The analytical process contains efficiency measures to limit duplicative analysis. Project elements that have similar effects (or no causal mechanism) to an indicator may be grouped for analysis. Indicators that address similar habitat characteristics (such as substrate and turbidity) may be grouped for analysis since they are similarly affected by project elements.

Direct effects to anadromous fishes are not expected to occur. There are no aspects of the project that will occur in streams where anadromous fish are present. Water drafting outside of the project area is the only aspect of the project that may occur in critical fish habitat. There are several good water drafting sites located within the Salt project area so drafting outside the project area is not anticipated (Paulo 2008). Within the project area water drafting sites will be located to minimize adverse effects on stream channel stability, sedimentation, and in-stream flows to maintain riparian resources, channel conditions, and fish habitat. If, for any reason, drafting outside the project area in critical habitat did occur, National Marine Fisheries Service water drafting specifications would be followed (NMFS 2001). Project Design Elements,

Mitigation Measures and RR specifications and restrictions will eliminate direct effects to resident Rainbow trout in the limited section of Ditch Gulch that they currently occupy. Units are located at least 300 feet away from perennial streams that may support fish.

Indirect effects to anadromous fishes and their habitats are analyzed by evaluating the expected effect of the PEs on habitat indicators and relating the effects to Primary Constituent Elements (PCEs) as described.

For evaluating effects, the Project is divided into Project Elements as described below.

- Harvest
- Yarding
- Fuels Treatment
- Hauling
- Road Work

Each of the Project elements is analyzed for its effect on habitat indicators that are used to characterize the health of aquatic habitat. Changes to an indicator are evaluated using factor analysis to determine if there is an effect to individuals of the species or anadromous fish habitat.

## *Indirect Effects*

### WATER TEMPERATURE

#### *Harvest*

**Proximity –** Thinning will occur in Riparian Reserves of intermittent and ephemeral watercourses within the project area. On the individual stream level, 1) no treatments will occur within Riparian Reserves of perennial fish-bearing streams, and 2) No thinning will occur within the inner gorge of intermittent and ephemeral streams or within 50 feet from the defined channel if no inner gorge exists. Equipment is excluded within 100 feet of perennial streams and 25-50 feet of intermittent and perennial streams, depending on slope. Based on the characteristics of each watercourse, the most applicable and conservative of these three areas (i.e. largest or greatest area) will be used.

**Probability –** It is extremely unlikely that thinning of RR's of intermittent tributaries would result in a change in water temperature that could impact aquatic resources. Intermittent streams generally go dry before water temperatures become limiting to fish or other aquatic organisms. In addition, conservative thinning operations in RR's have little to no impact on overall canopy cover.

**Element Summary –** This project element will have a neutral (0) effect on water temperature.

#### *Yarding*

**Proximity –** Yarding associated with thinning treatments will occur in Riparian Reserves of intermittent and ephemeral watercourses within the project area. On the individual stream level, 1) no treatments will occur within Riparian Reserves of perennial fish-bearing streams, and 2) No thinning will occur within the inner gorge of intermittent and ephemeral streams, or within 50 feet from the defined channel if no inner gorge exists. Equipment is excluded within 100 feet of perennial streams and 25-50 feet of intermittent and perennial streams, depending on slope.

Yarding activities will also be concentrated in areas near landings (which are located outside of RR's).

**Probability –**It is highly unlikely that yarding activities will cause measurable increases in sediment (see sediment/turbidity section), which will not significantly change channel form or surface area exposed to solar radiation. Yarding does not remove shade canopy over streams.

**Magnitude –** Limited increases in sediment will not be of sufficient size to result in channel form changes. Therefore, the amount of surface area exposed to solar radiation will not significantly change.

**Element Summary –** Yarding will have insignificant negative (-) effects on Water Temperature due to possible increases in water surface area from changes in stream channel configuration due to limited increases in sediment.

### *Fuels Treatment*

**Proximity –** Treatment of ladder and activity fuels (associated with thinning) will occur in Riparian Reserves of intermittent and ephemeral watercourses within the project area. On the individual stream level, 1) no treatments will occur within Riparian Reserves of perennial fish-bearing streams, or 2) no treatments will occur within inner gorge areas, or 3) no treatments will occur within an estimated 50 feet of the high water mark of intermittent and ephemeral stream Riparian Reserves. Based on the characteristics of each watercourse, the most applicable and conservative of these three areas (i.e. largest or greatest area) will be used.

**Probability –** Treatment of ladder and activity fuels will not remove shade canopy over streams. It is highly unlikely that fuels treatment activities will cause measurable increases in sediment (see sediment/turbidity section), which will not significantly change channel form or surface area exposed to solar radiation.

**Magnitude –** Limited increases in sediment will not be of sufficient size to result in channel form changes. Therefore, the amount of surface area exposed to solar radiation will not significantly change**.**

**Element Summary –** Fuels treatment will have insignificant negative (-) effects on Water Temperature due to possible increases in water surface area from changes in stream channel configuration due to limited increases in sediment.

### *Hauling*

**Proximity –** No critical habitat occurs within the Salt Creek project analysis area and therefore, no crossing of critical habitat will occur there. Other critical habitat crossings, outside of the analysis area but within the action area, are on paved county roads and state highways.

**Probability –** Hauling does not remove shade canopy over streams. It is highly unlikely that hauling activities will cause measurable increases in sediment (see sediment/turbidity section), which will not significantly change channel form or surface area exposed to solar radiation.

**Magnitude –** Limited increases in sediment will not be of sufficient size to result in channel form changes. Therefore, the amount of surface area exposed to solar radiation will not significantly change.

**Element Summary –** This project element will have an insignificant negative (-) effect on water temperature.

### *Road Work*

**Proximity –** No critical habitat occurs within the Salt Creek project analysis area and therefore, all project related forest road maintenance work will occur outside of critical habitat. Water drafting may occur in watercourses within the action area.

**Probability –** Only a limited number of hazard trees spread over a large area would be felled. Therefore, It is highly unlikely that road maintenance would result in any measurable reductions in stream shade.

If water drafting occurs in area creeks within the action area, NMFS operating guidelines will be followed if the drafting location is in critical habitat. NMFS operating guidelines do not allow more than 10% of the flow to be removed. Removing less than 10% of the flow will result in a low probability altering water temperature.

It is highly unlikely that road work activities will cause measurable increases in sediment (see sediment/turbidity section), which will not significantly change channel form or surface area exposed to solar radiation.

**Magnitude** – Removing individual hazard trees will not alter stream shade to any measurable degree, therefore no changes in water temperature will result. The implementation of NMFS operating guidelines will insure that changes in water temperature as a result of water drafting will not result in any measurable change to water temperature. Limited increases in sediment will not be of sufficient size to result in channel form changes. Therefore, the amount of surface area exposed to solar radiation will not significantly change**.**

**Element Summary –** This project element will have an insignificant negative (-) effect on water temperature.

### *Water Temperature Indicator Summary*

Although several Project elements will have insignificant negative (-) effects on water temperature, the combined effects are still expected to be insignificant. Decreases in stream shade will remain too small to be measured and will not result in any measurable increases in water temperatures within streams. Even when the effects of all Project elements are combined, only very limited increases in sediment are expected. Therefore, no measurable amount of channel change or increased amount of surface area exposed to solar radiation is expected to occur.

## TURBIDITY AND SUBSTRATE

These indicators will be addressed in the same section as they are affected similarly by project elements. Turbidity is used as an indicator of fine sediment suspended in the water, and substrate is an indicator of fine sediment that settles onto the streambed.

### *Harvest*

**Proximity –** See proximity description for harvest in water temperature section (above).

**Probability** – Areas of current and potential instability were assessed and mapped during the design phase of this project by the project geologist. These areas have been removed from units

and will be excluded during project implementation. Therefore, there is no probability that harvest would affect turbidity or substrate because harvest units are not located on unstable or potentially unstable soils. This is the only causal mechanism for this element to affect turbidity or substrate.

**Element Summary –** This project element will have a neutral (0) effect on turbidity and substrate.

### *Yarding*

**Proximity** – See proximity description for yarding in water temperature section (above).

**Probability –** Cable yarding, tractor yarding and landing use will cause ground disturbance that will lead to an increase in erosion. Soil that is eroded and reaches a stream would result in increased turbidity and, or a change in substrate.

**Magnitude –** Impacts of short-term increases in turbidity and any subsequent changes in substrate will not be great enough to reach downstream critical habitat. The filtering effects of the duff-litter, forbs and shrubs of Riparian Reserves will limit increases in turbidity or change in substrate of downstream critical habitat to levels that cannot be meaningfully measured or detected. Tractor yarding in RR thinning units away from critical habitat will occur outside of the inner gorge (at least 50 feet from the high water mark) and any runoff would have to pass through the duff-litter, forbs and shrubs of the Riparian Reserve. Eight crossings of intermittent stream channels are designated. Soils standards and guidelines require mulching with organic material for 50 feet on each side of the crossing to provide at least 50% ground cover and filter any runoff that occurs. Implementation of these standards and guidelines for channel crossings will limit increases in turbidity or change in substrate in critical habitat to levels that cannot be meaningfully measured or detected. Due to the limited amount of ground disturbance and adherence to project design criteria (i.e. Riparian Reserves), proper erosion control, and BMP's the negative effect of yarding throughout the project on turbidity and substrate in downstream critical habitat will not reach detectable levels. In all cases yarding will not occur within about 150 feet (one site tree) of fish bearing streams (Only fish bearing stream is Ditch Gulch). Broderson (1973) found that a buffer equal to one site potential tree would be effective to remove sediment in most situations. Riparian buffers of 30m (100 ft.) or greater have been documented to prevent adverse affects to salmonid eggs and aquatic insects when harvest activities occurred adjacent to fish-bearing streams (Moring 1982). Based on the results of both of these studies, and the similarities of the condition of the streamside buffer zones in this Project, the STNF expects that application of streamside protection buffers will arrest a substantial degree of sediment that is generated from erosion from soils disturbed by yarding.

**Element Summary –** Yarding will have insignificant negative (-) effects on turbidity and substrate due to ground disturbance and subsequent erosion due to yarding of trees.

### *Fuels Treatment*

**Proximity –** See proximity description for fuels treatments in water temperature section (above).

**Probability –** All fuels treatments near streams (within Riparian Reserves) are designed to limit ground disturbance and therefore, limit any increases in turbidity and fine sediment. Ground disturbing fuels treatments will occur only outside of Riparian Reserves.

**Magnitude –** Treatment of fuels outside of Riparian Reserves would result in some fire line construction to bare mineral soil around pile to be burned. Fuels treatments will meet the minimum ground cover requirements mentioned in the preceding yarding section. As mentioned above, ground cover (including duff, litter and shrubs) in riparian reserves is adequate to effectively filter most sediment that leaves harvest units through overland flow and riparian buffers of 30m (100 ft.) or greater have been documented to prevent adverse affects to salmonid eggs and aquatic insects when harvest activities occurred adjacent to fish-bearing streams (Moring 1982). In all cases fuels treatment will not occur within a minimum of 150 feet (one site potential tree) of fish bearing streams. Broderson (1973) found that a buffer equal to one site potential tree would be effective to remove sediment in most situations.

**Element Summary –** Fuels treatment will have insignificant negative (-) effects on turbidity and substrate from ground disturbance and subsequent erosion.

### *Hauling*

**Proximity –** See proximity description for hauling in water temperature section (above).

**Probability –** Hauling on state and county roads has no probability of measurably affecting turbidity or substrate in critical habitat. State and county roads are paved roads suitable for all season use and use patterns associated with this project will not significantly increase the background use levels of these roads. Hauling on Forest Roads has a low probability of affecting turbidity or changing substrate in critical habitat due to restrictions on wet weather operation, improved road drainage and rocked surfaces from reconstruction of main haul roads, and the distance between the area where project activities will occur and critical habitat.

**Magnitude** – Hauling on Forest Roads may result in limited negative effects on turbidity and substrate, which cannot be meaningfully measured or detected. Measurable effects will not occur due to wet weather operation restrictions, improved road drainage and rocked surfaces from reconstruction of main haul roads, and the proximity of project activities to critical habitat. At any time hauling will occur on only a small proportion of the roads distributed throughout the subwatersheds.

**Element Summary –** This project element will have insignificant negative (-) effects on turbidity and substrate as a result of hauling on native and aggregate surfaced roads.

### *Road Work*

**Proximity –** See proximity description for road work in water temperature section (above).

**Probability –** Road reconstruction and maintenance activities (which include ditch cleaning, culvert inlet cleanout, and constructing rocked water dips) have a low probability of creating negative effects to turbidity and substrate. The majority of roads that will be treated fall outside of Riparian Reserves (except for crossings) and will have only limited short-term negative effects to project area watercourses and no measurable effect on critical habitat.

**Magnitude –**Road Work will have a short-term negative (-) effect, as well as a slight long-term positive (+) effect on the turbidity and substrate. The slight negative effects of road work will not be measurable in project area watercourses and will not measurably affect critical habitat.

A slight positive (+) effect for this element will occur from reducing road-related stream sediment in the long term. Positive effects will occur as a result of better cross drains moving water off the

road surface, rock surfacing to reduce erosion from the running surface and larger culverts to reduce the risk of catastrophic failure.

**Element Summary –** Road Work will have insignificant short-term negative (-) effects to turbidity and substrate in project area watercourses due to soil disturbance and insignificant long-term positive (+) effects resulting from better road drainage.

### *Turbidity and Substrate Indicator Summary*

Several Project elements will have insignificant negative (-) effects on turbidity and substrate. The combined effects are still expected to be insignificant because effects will be spatially and temporally separated. Any turbidity or sediment that is generated from the Project and reaches watercourses will be quickly diluted by the time it reaches downstream critical habitat and has no chance of being measured in currently occupied anadromous fish habitat.

## CHEMICAL CONTAMINATION/NUTRIENTS

### *Harvest / Yarding / Fuels Treatment / Hauling / Road Work*

The common mechanism for all Project elements with respect to chemical contamination would be an accidental spill of any petroleum product used to fuel or lubricate equipment. All equipment fueling sites will be located at landings well away from any watercourses and have appropriate spill containment (BMP 2.8) Chemical contamination in the form of a spill of petroleum products due to a motorized vehicle accident (log truck, tractor, and yarder) is, of course, not expected as part of the Project. Reinitiation of consultation will occur, as appropriate, if such an accident occurs.

### *Yarding, Hauling and Road Work*

No causal mechanism to measurably affect nutrient loading.

### *Harvest and Fuels Treatment*

**Proximity –** See proximity description for harvest and fuels treatment in water temperature section (above).

**Probability –** Harvest and fuels treatment has been shown to increase the nutrient supply in runoff for short time periods (Hicks et al. 1991). There is high probability the Project will increase nutrient levels in area streams.

**Magnitude –** Harvest and Fuels Treatment will result in short term increases in nutrient availability in stream channels (Scrivener 1988). Scrivener (1988) concluded, “Since the magnitude and duration of increase was so small no short term detrimental effect occurred in the stream” after logging and burning in two subbasins within the Carnation Creek watershed.

**Chemical Contamination/Nutrients Indicator and Element Summary**

The Project will have neutral (0) effects on Chemical Contamination and insignificant, short-term positive (+) effects to Nutrients levels in project area stream channels.

## PHYSICAL BARRIERS

### *Harvest / Yarding / Fuels Treatment / Hauling / Road Work*

The Project will not create or remove any fish passage barriers. There is no causal mechanism associated with the proposed Project to affect this indicator.

### *Physical Barriers Indicator and Element Summary*

The Project will have neutral (0) effects on Physical Barriers.

## LARGE WOODY DEBRIS (LWD)

### *Harvest*

**Proximity –** See proximity description for harvest in water temperature section (above).

**Probability –** There is no probability that thinning will have effects on LWD levels in critical habitat. Thinning will remove materials that are generally not large enough to be maintained by this type of system already. LWD and sediment have relatively low residence times in these streams at background levels, as these materials are readily moved downstream during high flow events. Any standing dead snags will be retained for future recruitment.

**Element Summary –** Harvest will have neutral (0) effects to LWD in project area watercourses.

### *Yarding / Fuels Treatment / Hauling*

These project elements are not directly related with any tree removal and therefore do not have any causal mechanism by which to affect LWD.

**Element Summary –** Yarding, Fuels Treatment, Hauling and Road Rehabilitation will have neutral (0) effects on LWD.

### *Road Work*

**Proximity –** See proximity description for road work in water temperature section (above).

**Probability –** Any hazard trees that are identified in road maintenance operations within Riparian Reserves will be dropped and left in place. Therefore, there is no probability that Road Work will reduce LWD levels in critical habitat or project area watercourses.

**Element Summary –** Road Work will have neutral (0) effects on LWD

### *Large Woody Debris Indicator Summary*

The Project will have neutral effects (0) on LWD.

## POOL FREQUENCY / QUALITY / LARGE POOLS

Project elements will not directly change pools but may alter processes that affect pool frequency and depth. This analysis focuses on sediment supply as related to pool filling and LWD as related to pool forming structures.

### *Harvest*

**Proximity –** See proximity description for harvest in water temperature section (above).

**Probability –** Areas of current and potential instability were assessed and mapped during the design phase of this project by the project geologist. These areas have been removed from units and will be excluded during project implementation. Therefore, there is no probability that harvest would affect turbidity or substrate because harvest units are not located on unstable or potentially unstable soils. This is the only causal mechanism for this element to impact pool characteristics.

**Element Summary –** Harvest will have neutral (0) effects on pool frequency and depth.

*Yarding*

**Proximity –** See proximity description for yarding in water temperature section (above).

**Probability –** Yarding and landing use cause ground disturbance that may lead to erosion and changes in sediment supply, an important factor in pool frequency.

**Magnitude –** Yarding and landing use will have highly limited negative (-) effects on substrate (see Turbidity and Substrate section above); due to the expected filtering characteristics of ground cover, changes in sediment supply are not expected to be measurable, therefore no change in pool frequency or depth is expected.

**Element Summary –** Yarding will have insignificant negative (-) effects on pool frequency due to some ground disturbance by tractor yarding and landing use.

*Fuels Treatment*

**Proximity –** See proximity description for fuels treatment in water temperature section (above).

**Probability –** Due to the location of treatments outside of RR's, implementation of project design criteria and meeting ground cover requirements, there is little probability that broadcast burning, burning concentrations, hand fireline construction and dozer fireline construction will change pool frequency.

**Magnitude** - Fuels treatment will have highly limited negative (-) effects on substrate (see Turbidity and Substrate section above); due to the expected filtering characteristics of ground cover, changes in sediment supply are not expected to be measurable, therefore no change in pool frequency or depth is expected.

**Element Summary –** Fuels Treatment will have insignificant negative (-) effects on pool frequency due to sediment from ground disturbance**.**

*Hauling*

**Proximity –** See proximity description for Hauling in water temperature section (above).

**Probability –** Hauling on state and county roads has no probability of measurably affecting sediment in critical habitat. State and county roads are paved roads suitable for all season use and use patterns associated with this project will not significantly increase the background use levels of these roads. Hauling on Forest Roads has a low probably of affecting sediment in critical habitat due to restrictions on wet weather operation, improved road drainage and rocked surfaces from reconstruction of main haul roads, and the distance between the area where project activities will occur and critical habitat.

**Magnitude –** Hauling on Forest Roads may result in small negative effects on sediment, which cannot be meaningfully measured or detected. Measurable effects will not occur due to wet weather operation restrictions, improved road drainage and rocked surfaces from reconstruction of main haul roads, and the proximity of project activities to critical habitat. At any time hauling will occur on only a small proportion of the roads distributed throughout the subwatersheds.

**Element Summary –** This project element will have insignificant negative (-) effects on sediment and therefore, insignificant negative (-) effects on pool frequency.

### *Road Work*

**Proximity –** See proximity description for Road Work in water temperature section (above).

**Probability –**The probability for road maintenance activities (which includes ditch cleaning, culvert inlet cleanout) to negatively (-) affect pool frequency is low because of the limited amount of sediment that could reach critical habitat. The likelihood that this project element would positively (+) affect (reduce) sediment supply in critical habitat under winter stream flow conditions is also low because relatively few road miles would be maintained compared to total road miles in the watershed.

**Magnitude –**Road maintenance would have a limited short-term negative (-) effect, as well as a slight long-term positive (+) effect on the indicator. The slight negative effects of road maintenance on sediment supply and therefore pool frequency in critical habitat would be undetectable and would not measurably affect critical habitat.

The slight positive (+) effect for this element will occur as a result of reducing road-related stream sediment in the long term. Positive effects will occur as a result of better cross drains moving water off the road surface to reduce erosion, rock surfacing to reduce erosion from the running surface and larger culverts to reduce the risk of catastrophic failure.

**Element Summary –** Road Work will have insignificant short-term negative (-) effects as a result of ground disturbance during maintenance and insignificant long-term positive (+) effects to pool frequency due to better road drainage.

### *Pool Frequency Indicator Summary*

The Project will have insignificant short-term negative (-) effects on pool frequency and depth by slightly increasing sediment supply due to ground disturbance. The Project is also expected to have insignificant long-term positive (+) effects to pool frequency through a reduction in sediment supply facilitated by better road drainage and surfaces**.**

## OFF-CHANNEL HABITAT

### *Harvest / Yarding / Fuels Treatment / Hauling / Road Work*

There is no causal mechanism to affect this indicator, in these channel types off-channel habitat is expected to be very limited even with limited disturbance.

### *Off-Channel Habitat Indicator and Element Summary*

Due the lack of background off-channel habitat the Project will have neutral (0) effects on this indicator.

## REFUGIA

### *Harvest / Yarding / Fuels Treatment / Hauling / Road Work*

There is no causal mechanism to affect the indicator. Refugia habitat within the action area is already limited and does not support all life-history stages of anadromous fish.

### *Refugia Indicator and Element Summary*

Due to the lack of existing refugia habitat the Project will have neutral (0) effects on this indicator.

## WIDTH/DEPTH RATIO

### *Harvest /Yarding / Fuels Treatment / Hauling / Road Work*

There is no causal mechanism associated with the proposed Project to affect the indicator. All stream sections within the action area have very narrow, steep valleys and are confined by existing geology.

### *Width/Depth Ratio Indicator and Element Summary*

Due to the existing nature of the stream channels in the action area the Project will have neutral (0) effects on this indicator.

## STREAMBANK CONDITION

### *Harvest*

**Proximity –** See proximity description for Harvest in water temperature section (above).

**Probability –** The mechanism that may cause streambank condition to be degraded is direct physical disturbance. Harvest will not occur on stream banks, however even with directional falling it is possible that a tree felled in a Riparian Reserve thinning unit along an ephemeral or intermittent stream may hit a stream bank, however it is extremely unlikely to occur.

**Element Summary –** Harvest will have discountable negative (-) effects on streambank condition.

### *Yarding*

**Proximity –** See proximity description for Yarding in water temperature section (above).

**Probability –** There are no channel crossings for yarding within critical habitat. The areas proposed for channel crossings are over 0.50 miles away from critical habitat. Streambank disturbance is a localized effect and will not affect streambanks of critical habitat downstream.

**Element Summary –** Yarding will have neutral (0) effects on streambank condition in critical habitat.

### *Fuels Treatment*

**Proximity –** See proximity description for Fuels Treatment in water temperature section (above).

**Probability –** The mechanism that may cause streambank condition to be degraded is direct physical disturbance. Fuels treatment will not occur within at least 50 feet of stream banks and

will occur on ladder and active fuels only, there is no probability that effects will occur from direct disturbance.

**Element Summary -** Fuels treatment will have neutral (0) effects on streambank condition.

### *Hauling*

Hauling only occurs on existing road systems and therefore has no causal mechanism to affect streambank condition.

**Element Summary –** Hauling will have neutral (0) effects on streambank condition.

### *Road Work*

**Proximity –** See proximity description for Road Work in water temperature section (above).

**Probability –** There are no culverts to be replaced or removed within critical habitat. Streambank disturbance at a culvert removal or replacement site is a localized effect and will not affect streambanks (neutral effect) of critical habitat downstream. It is likely that water drafting will occur on stream banks and has the potential to disturb the streambank.

**Magnitude -** Drafting sites are chosen based on accessibility for water trucks and are sites where roads or bridges are close to stream banks. Some minor streambank disturbance will occur in an area of about 6 linear feet at each site. Vegetation disturbance and minor erosion can be expected while a drafting site is in service; areas will vegetate quickly once the site is no longer used. Minor disturbance at several sites will not result in any measurable effects to streambanks at the subwatershed scale.

**Element Summary –** Road Work will have insignificant negative (-) effects on streambank condition in critical habitat due to physical disturbance at several sites.

### *Streambank Condition Indicator Summary*

The Project will have insignificant negative (-) effects on streambank condition in critical habitat due to physical disturbance at several sites as a result of water drafting for Road Work.

## FLOODPLAIN CONNECTIVITY

### *Harvest / Yarding / Fuels Treatment / Hauling / Road Work*

There is no causal mechanism to affect this indicator, none of these project elements will occur on floodplains

**Element Summary** – Harvest, Yarding, Fuels Treatment, Hauling, and Road Work will have neutral (0) effects on floodplain connectivity.

### *Floodplain Connectivity Indicator Summary*

The project will have neutral effects (0) on Floodplain Connectivity.

### *Change in Peak/Base Flow and Increase in Drainage Network*

The Flow/Hydrology indicators of Change in Peak/Base Flow and Increase in Drainage Network are related because changes in the drainage network affect peak and base flows. Both indicators are analyzed in the CWE analysis using the Equivalent Roaded Area model (Haskins 1986) and

the magnitude of expected changes is derived from model results. The Project is modeled in its entirety; therefore, PE's that may have an effect on these indicators have a common analysis.

### *Harvest / Yarding / Fuels Treatment / Road Work*

**Proximity –** See appropriate proximity descriptions in water temperature section (above).

**Probability –**Activities proposed in the Project directly affect conditions (compacted soils, increased drainage network) that change peak/base flow. There is high likelihood that some change will occur as a result of this project.

**Magnitude –** Harvest, Yarding, and Fuels Treatment will result in minor negative effects to Peak/Base flow through increases in compaction and increasing the drainage network.

Modeling of the post project subwatershed condition (Table 7) shows a watershed condition class change in the Ditch Gulch subwatershed as a result of this project. This subwatershed is very near a condition class 2 currently due to an extensive current road network. Road Work will result in improved drainage for better water disbursement, resulting in less concentrated flow and lower peak flows.

**Table 7: CWE model results**

| 7th Field HUC Watershed Name | Drainage Area (acres) | Forest Plan TOC (%) | WCC (existing) | WCC (post project) |
|---|---|---|---|---|
| Upper Salt Creek- Hayfork Creek | 9760 | 16 | 1 | 1 |
| Ditch Gulch – Salt Gulch | 948 | 16 | 1 | 2 |

**Element Summary -** Hydrological modeling shows that the Project will have some limited negative effects (-) on peak/base flow and drainage network from harvest, yarding, and fuels treatment; and insignificant long-term positive effects (+) from road work.

### *Hauling*

There is no causal mechanism by which Hauling can affect Change in Peak/Base flow and Increase in Drainage Network indicators. No new permanent roads will be built

**Element summary -** Hauling will have neutral (0) effects on Increase in Peak/base Flow and Increase in Drainage Network indicators because there is no causal mechanism.

### *Change in Peak/Base Flow and Increase in Drainage Network Indicator Summary*

Hydrological modeling shows that the Project will have insignificant short-term negative effects (-) on peak/base flow and drainage network from harvest, yarding and fuels treatment. All positive and negative effects to peak flows are too small to be measurable where critical habitat is found and are therefore insignificant with respect to this analysis.

### *Road Density & Location*

The Project does not include permanent road construction. Temporary roads will be used to access several units. These temporary roads are located well away from critical habitat and will be obliterated after use. Temporary roads are not included in road density or ERA calculations

because they are used only for a single dry season and obliteration includes decompaction that restores the natural infiltration and drainage patterns.

### *Road Density & Location Indicator Summary*

The Project will have neutral effects (0) to road density for all subwatersheds.

### *Disturbance History*

Cumulative watershed effects modeling (above table) shows that all subwatersheds are at or near a Watershed Condition Class 1 (properly functioning). The Ditch Gulch –Salt Gulch subwatershed is very near a condition class 2 currently due to the extensive road network and will become a condition class 2 (functioning at risk) after project implementation. The actual differences in pre- and post-project values are very small.

### *Disturbance History Indicator Summary*

CWE modeling shows that the project maintains at or near, properly functioning condition in the long term but has short term increases in condition class, resulting in insignificant negative (-) effects to critical habitat.

### *Riparian Reserves*

The Project will directly affect Riparian Reserves by thinning conifer trees within the Riparian Reserves of intermittent streams in several units. Project design criteria will minimize negative effects to Riparian Reserves by limiting wet weather operations, maintaining ground cover, designating all crossings and limiting grade of crossings to minimize disturbance that may result from harvest and yarding. Harvest, yarding and temporary road use will have some insignificant negative effects related to ground disturbance on the Riparian Reserves. Long-term positive effects will occur because thinned timber stands in the Riparian Reserve will be healthier and have increased growth. Riparian Reserves outside of Riparian Reserve thinning units will not be affected (neutral effects) by the Project.

### *Riparian Reserves Indicator Summary*

The Project will have insignificant negative (-) short-term effects due to physical disturbance from Riparian Reserve thinning and insignificant long-term positive (+) effects on Riparian Reserve tree growth.

# ELEMENT SUMMARY

## *Harvest*

Harvest will have a neutral (0) effect on Water Temperature, Turbidity, Substrate, Large Woody Debris, Physical Barriers, Pool Frequency, Off-Channel Habitat, Refugia, Width/Depth Ratio, Floodplain Connectivity, and Road Density and Location.

Harvest will have neutral (0) effects on Chemical Contamination and insignificant, short-term positive (+) effects to Nutrients in the stream channels.

Harvest will have insignificant negative effects (-) on Peak/Base Flow, Increase in Drainage Network, Disturbance History, and Riparian Reserves due to physical disturbance.

Harvest will have discountable negative effects (-) on Streambank Condition due to harvesting within Riparian Reserves.

## Yarding

Yarding will have neutral (0) effect on Chemical Contamination/Nutrients, Physical Barriers, Large Woody Debris, Off-Channel Habitat, Refugia, Width/Depth Ratio, Streambank Condition, Floodplain Connectivity, and Road Density and Location.

Yarding will have insignificant negative (-) effects on Water Temperature due to possible increases in water surface area from changes in stream channel configuration due to slight increases in sediment.

Yarding will have insignificant negative (-) effects on Turbidity and Substrate due to ground disturbance and subsequent erosion due to yarding of trees.

Yarding will have insignificant negative (-) effects on Pool Frequency due to some erosion from ground disturbance by tractor yarding.

Hydrological modeling shows that the Project will have insignificant negative effects (-) on Peak/Base Flow, Drainage Network, Disturbance History and, Riparian Reserves due to yarding.

## Fuels Treatment

Fuels Treatment will have neutral (0) effect on Physical Barriers, Large Woody Debris, Off-Channel Habitat, Refugia, Width/Depth Ratio, Streambank Condition, Floodplain Connectivity, and Road Density and Location.

Fuels treatment will have insignificant negative (-) effects on Water Temperature due to possible increases in water surface area from changes in stream channel configuration.

Fuels treatment will have insignificant negative (-) effects on Turbidity and Substrate from ground disturbance and subsequent erosion.

Fuels treatment will have neutral (0) effects on Chemical Contamination and insignificant, short-term positive (+) effects to Nutrients in the stream channels.

Fuels Treatment will have insignificant negative (-) effects on Pool Frequency due to sediment from ground disturbance.

Hydrological modeling shows that the Project will have insignificant negative effects (-) on Peak/Base Flow, Drainage Network, Disturbance History and, Riparian Reserves from harvest, yarding, and fuels treatment.

## Hauling

Hauling will have neutral (0) effect on Chemical Contamination/Nutrients, Physical Barriers, Large Woody Debris, Off-Channel Habitat, Refugia, Width/Depth Ratio, Streambank Condition, Floodplain Connectivity, Increase in Peak/base Flow, Drainage Network, Road Density and Location, Disturbance History, and Riparian Reserves.

Hauling will have insignificant negative (-) effects on Water Temperature due to possible increases in water surface area from changes in stream channel configuration.

Hauling will have insignificant negative (-) effects on Turbidity and Substrate as a result of hauling on native and aggregate surfaced roads.

Hauling will have insignificant negative (-) effects on pool frequency as a result of sediment due to hauling on native and aggregate surfaced roads.

### *Road Work*

Road Work will have neutral (0) effect on Chemical Contamination/Nutrients, Physical Barriers, LWD, Off-Channel Habitat, Refugia, Width/Depth Ratio, Floodplain Connectivity, and Road Density and Location.

Road Work will have insignificant negative (-) effects on Water Temperature due to possible increases in water surface area from changes in stream channel configuration.

Road Work will have insignificant short-term negative (-) effects to Turbidity and Substrate due to soil disturbance and long-term positive (+) effects resulting from better road drainage.

Road Work will have insignificant short-term negative (-) effects as a result of ground disturbance during reconstruction and long-term positive (+) effects to Pool Frequency due to better road drainage.

Road Work will have insignificant negative (-) effects on Streambank Condition in critical habitat due to physical disturbance at several sites.

Road Work will have insignificant long-term positive (+) effects on Increase in Peak/base Flow, Drainage Network, Disturbance History, and Riparian Reserves.

## INDICATOR SUMMARY

"Population Characteristics" and "Species and Habitat" Pathway indicators are not addressed in this document, since insufficient information exists to allow for their evaluation. A species recovery plan has not been drafted for SONCC coho salmon.

### *Water Temperature Indicator Summary*

Several Project elements have insignificant negative (-) effects on water temperature. The additive effects are still expected to be insignificant because decreases in stream shade are too small to be measured and will not result in any measurable increases in solar radiation reaching the stream channel. Channel changes of a magnitude that would increase the surface area of the stream exposed to solar radiation are not possible in the well-confined channels common in the project area.

### *Turbidity and Substrate Indicator Summary*

The Project would have insignificant negative (-) effects on turbidity and substrate from several project elements. The additive effects are still expected to be insignificant because effects will be spatially and temporally separated. Any turbidity or sediment that is generated from the Project will be distributed over several thousand acres of watershed this will result in significant dilution of any local effect and because of different drainage patterns and stream lengths effects will not be concentrated at any single time.

### *Chemical Contamination/Nutrients Indicator Summary*

The Project will have neutral (0) effects on Chemical Contamination and insignificant, short-term Positive (+) effects to Nutrients in the stream channels.

### *Physical Barriers Indicator Summary*

The Project will have neutral (0) effects on Physical Barriers.

### *Large Woody Debris Indicator Summary*

The Project will have neutral (0) effects on LWD.

### *Pool Frequency Indicator Summary*

The Project will have short-term negative (-) effects on pool frequency and depth by slightly increasing sediment supply due to ground disturbance. The Project is also expected to have long-term positive (+) effects to pool frequency through a reduction in sediment supply through better road drainage and surfaces.

### *Off-Channel Habitat Indicator Summary*

Due the lack of off-channel habitat in the action area, the Project will have neutral (0) effects on this indicator.

### *Refugia Indicator and Element Summary*

Due the lack of refugia habitat in the action area, the Project will have neutral (0) effects on this indicator.

### *Width/Depth Ratio Indicator Summary*

Due the nature of the stream channels in the action area the Project will have neutral (0) effects on this indicator.

### *Streambank Indicator Summary*

The Project will have insignificant negative (-) effects on streambank condition in critical habitat due to physical disturbance at several sites as a result of water drafting for Road Work.

### *Floodplain Connectivity Indicator Summary*

Due the nature of the stream channels in the action area the Project will have neutral (0) effects on this indicator.

### *Change in Peak/Base Flow and Increase in Drainage Network Indicator Summary*

Hydrological modeling shows that the Project will have insignificant short-term negative effects (-) on peak/base flow and drainage network from harvest, yarding and fuels treatment. Hauling will have neutral (0) effects on Increase in Peak/base Flow and Increase in Drainage Network indicators because there is no causal mechanism. All positive and negative effects to peak flows are so small as to be immeasurable where critical habitat is found and are therefore insignificant.

### *Road Density & Location Indicator Summary*

The Project will have neutral effects (0) to road density for all subwatersheds.

### *Disturbance History Indicator Summary*

CWE modeling shows that the project maintains the properly functioning condition but has slight increases in ERA, resulting in insignificant negative (-) effects.

### *Riparian Reserves Indicator Summary*

The Project will have insignificant negative (-) short-term effects due to physical disturbance from Riparian Reserve thinning and insignificant long-term positive (+) effects on Riparian Reserve tree growth.

## PRIMARY CONSTITUENT ELEMENTS

In designating critical habitat, NMFS considers the following requirements of the species: (1) Space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, or rearing offspring; and, generally, (5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of this species (see 50 CFR 424.12(b)). In addition to these factors, NMFS also focuses on the known physical and biological features (primary constituent elements) within the designated area that are essential to the conservation of the species and that may require special management considerations or protection. These essential features may include, but are not limited to, spawning sites, food resources, water quality and quantity, and riparian vegetation.

Since NMFS did not list specific PCE's during it's listing of critical habitat for SONCC coho salmon (64 FR 24049) the PCE's specifically listed in the September 2, 2005 critical habitat rule for 12 ESU's of west coast salmon (70 FR 52630) will be used since they were deemed appropriate for several species of listed salmonids over the range of several states. The specific PCE's include:

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development.

2. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams, and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

3. Freshwater migration corridors free of obstructions with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

4. Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and adult and juvenile forage, including aquatic invertebrates and fishes supporting growth and maturation.

5. Near shore marine areas free of obstruction and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders.

6. Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Estuarine and saltwater habitats are not found on the Shasta-Trinity National Forest nor are they expected to be within the action area of any project that is undertaken by the STNF, therefore primary constituent elements 4, 5, and 6 will not be addressed in this BA. Freshwater habitats (PCE 1-3) are found on the STNF and will be addressed. Table 8 relates the PCE's to the habitat indicators as modified for the STNF.

**Table 8: Primary constituent elements, Pathways and Indicators**

| **Primary Constituent Element** | **Pathway** | **Habitat Indicator** |
|---|---|---|
| Spawning (Freshwater) | Flow/ Hydrology | Change in Peak/Base Flow |
| | Water Quality | Suspended Sediment/Intergravel DO/Turbidity |
| | | Chemical Contaminants |
| | Habitat Elements | Substrate Character/Embeddedness |
| Rearing (Freshwater) | Water Quality | Temperature |
| | | Suspended Sediment/Turbidity |
| | | Chemical Contaminants/Nutrients |
| | Habitat Elements | Substrate Character/Embeddedness |
| | | Large Woody Debris |
| | | Pool Frequency and Quality |
| | | Large Pools |
| | | Off-channel Habitat |
| | Channel Condition & Dynamics | Streambank Condition |
| | | Floodplain Connectivity |
| | Flow/Hydrology | Change in Peak/Base Flow |
| | Watershed Conditions | Riparian Reserves |
| **Migration (Freshwater)** | Water Quality | Temperature |
| | | Suspended Sediment/Turbidity |
| | | Chemical Contaminants/Nutrients |
| | Habitat Access | Physical Barriers |
| | Habitat Elements | Substrate Character/Embeddedness |
| | | Large Woody Debris |
| | | Off-channel Habitat |
| | Channel Condition & Dynamics | Streambank Condition |
| | Flow/Hydrology | Change in Peak/Base Flow |
| | Watershed Conditions | Riparian Reserves |

### *Effects on Primary Constituent Elements*

**Spawning**

The Salt project is expected to have insignificant negative effects on several indicators that relate to the spawning PCE. Short-term increases in peak flow may result as an effect of compacted and disturbed ground. These increases are modeled to be well within the threshold of concern for these watersheds resulting in no changes that would affect the fish's ability to spawn. Turbidity may have some short term increase during runoff events that would result in changes to substrate; however these changes are not expected to be great enough to change the suitability of spawning substrate.

**Rearing**

Pools with good cover are necessary for successful rearing of coho salmon. The Project will have short-term negative effects on pool frequency and depth by slightly increasing sediment supply due to ground disturbance. Water temperatures within the action area are well within the properly functioning range and are not expected to measurably increase. Riparian Reserves and stream banks necessary for cover during rearing will Salt project will be outside of fish bearing areas. The project may lead to slightly increased turbidity during the winter rearing period, increases are not expected to be great enough, or of long enough duration to affect foraging and growth during the late fall and winter period.

**Migration**

Adult migration occurs during high flow events between October and December; several indicators that relate to this activity may be affected by the Salt project. Short-term increases in peak flow may result as an effect of compacted and disturbed ground. These increases are modeled to be well within the threshold of concern for these watersheds resulting in no changes that would affect the fish's ability to migrate. Turbidity may have some short term increase during runoff events that would result in changes to a fish's ability to navigate however these changes are not expected to be great enough to change the migration pattern of any fish that may be present.

Juvenile migration occurs primarily in the March to July time period. During the latter portions of the migration period proper water temperatures are necessary to maintain the health of out migrating juveniles. Water temperatures within the action area are well within the properly functioning range and are not expected to measurably increase. The project is not expected to increase turbidity during the out migration period because increases in turbidity will be small and will occur primarily during the late fall and winter period. Riparian Reserves and stream banks necessary for cover during out migration will not be affected by this project because the limited streambank disturbance that may occur during the Salt project will be outside of fish bearing areas.

# ESA EFFECT DETERMINATION

## *Project Effects Determination Key for Species and Designated Critical Habitat*

1) Do any of the indicator summaries have a positive (+) or negative (-) conclusion?

Yes – Go to 2

No – No Effect

2) Are the indicator summary results only positive?

Yes – NLAA

No – Go to 3

3) If any of the indicator summary results are negative, are the effects insignificant or discountable?

Yes – NLAA

No – LAA, fill out Adverse Effects Form

Direct effects to coho salmon are not expected to occur. There are no aspects of the Project that will occur where fish are present

Analysis of the effects of the Project Elements on the habitat indicators has found that negative effects that are of sufficient probability (discountable) and magnitude (insignificant) to affect SONCCC coho salmon's critical habitat. This Project will have no effect on SONCCC coho salmon but **May Affect, but is not likely to adversely affect** its critical habitat.

# ESA CUMULATIVE EFFECTS

The ESA defines cumulative effects in 50 CFR. § 402.02 as "those effects of future State or private activities, not involving Federal activities that are reasonably certain to occur within the Project area of the Federal action subject to consultation." Available information on past and present Federal, State and Private actions are reflected in the existing condition discussions under each indicator in the previous section of this BA/BE. Future Federal actions will be analyzed through separate section 7 consultations and are not considered in this section. There are no known future State actions planned in the subject watersheds. The Project area includes some private industrial timber lands. In addition, there are scattered private/residential blocks of land. The predominant past land use on private lands was timber harvest, and it is likely that timber harvest will continue to be the predominant land use into the future.

Mining, timber harvest, grazing, and roads have all contributed cumulatively to habitat degradation in addition to natural events including wildland fires and unstable geology. Sediment is the most common indicator determined to be at risk or not properly functioning in the subject watersheds. An insignificant amount of sediment will be input as a result of the Project. The Project would not add measurably or incrementally to cumulative effects.

# ESSENTIAL FISH HABITAT DETERMINATION

A description of the proposed action can be found in the Salt Project EA.

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), in concordance with the Sustainable Fisheries Act of 1996 (Public Law 104-267) designated Essential Fish Habitat (EFH) for coho and Chinook salmon (Federal Register, Vol. 67, No. 12). The MSA defined EFH as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (Federal Register, Vol. 67, No. 12)." EFH for coho salmon and Chinook salmon in the Action Area is identical to coho critical habitat displayed in Figure 2.

Analysis of the effects of the Project Elements on the habitat indicators has found no anticipated negative effects that are of sufficient probability (discountable) and magnitude (insignificant) to affect essential fish habitat. This Project will therefore not adversely affect Essential Fish Habitat.

**Forest Sensitive Species**

It is my determination that the implementation of the Project may have insignificant affects to individuals but is not likely to trend towards Federal listing or loss of viability of Forest Sensitive species.

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### *Literature Search*

The west zone fisheries program, of the Shasta-Trinity National Forest, maintains libraries of relevant scientific literature at the Weaverville Ranger District and Hayfork Ranger District offices. New literature is added as it becomes available. Relevant new literature is searched for on a monthly basis through the Rocky Mountain Research Station's library services monthly alert that summarizes (http://library.rmrs.fs.fed.us/alertindex.htm) new scientific literature of interest to natural resource management. New scientific literature is also searched on google scholar (scholar.google.com) on a project specific basis. No new scientific literature was discovered relevant to the effects of this project.

New scientific literature relating to the effects of land management and anadromous fish use was discussed during the May 4, 2006 Shasta-Trinity National Forest Level 1 team meeting. No new relevant scientific literature was known.

## GLOSSARY OF TERMS COMMONLY USED IN FOREST SERVICE LAND MANAGEMENT

**Activity Fuels**: Fuels generated by any number of timber harvesting methods.

**Adaptive Management Area**: Landscape units designed for development and testing of technical and social approaches to achieving desired ecological, economic, and other social objectives.

**Basal Area**: The area of the cross section of a tree stem including the bark, near its base, generally at breast height, or 4.5 feet above the ground.

**Broadcast Burning**: A type of burning that occurs inside defined boundaries, and may be several acres in size. Broadcast burning would only occur when weather and air quality permits, and a burn plan would be written and approved prior to its implementation. This form of burning under prescribed parameters is beneficial for reducing hazardous fuels, and restoring fire's natural role into the ecosystem.

**Burn Concentrations**: See Jackpot burning.

**Cable Logging (yarding)**: A harvest technology where cut logs are partially or fully suspended above the ground and transported to a landing.

**Canopy**: The more or less continuous cover of leaves and branches collectivity formed by the crowns of adjacent trees in a stand forest.

**Canopy Closure**: The degree to which the canopy (forest layers above ones head) blocks sunlight or obscures the sky. It can only be accurately determined from measurements taken under the canopy, as openings in the branches and crowns must be accounted for.

**Decommissioned Road**: These roads are not needed for future use and are taken off the FS transportation system once the decommissioning activities have been implemented and earth berm barriers installed. However, the roads are still tracked by the database. The goal is to remove those elements of a road that reroute hillslope drainage and present slope stability hazards by re-establishing natural drainage to the extent practicable.

**Dozer Line**: To rearrange, gather and push aside fuels with a bulldozer. This provides a break in the continuity of fuels, which helps prevent fire from spreading outside of the unit. Some fuels and the duff layer would remain on the forest floor in these areas.

**Duff Layer**: The layer of loosely compacted debris underlying the litter layer on the forest floor.

**End lining**: Removing harvest trees by winching with a rubber tired or tracked skidder. Often used when trees must be moved a short distance over steep (over 35%) slopes or sensitive areas (Riparian Reserves).

**Equivalent Road Acre (ERA)**: A unit of measure used in cumulative watershed impact analyses, which represents the equivalent disturbance of one acre of roaded area. Disturbances primarily include soil exposure and compaction.

**Erosion Hazard Rating**: A relative rating of the potential for the loss of soil due to sheet and rill erosion from a specific site. Commonly used to address erosion response expected from a given land management activity. Ratings are the result of a cumulative analysis of soil type, topography, climate, and vegetative and protective factors.

**Fuel Break**: A strip of land strategically placed where hazardous fuels have been replaced with less burnable materials. Fuel breaks divide fire-prone areas into smaller parcels for easier fire control and provide access for firefighting.

**Fuel**: Any material capable of sustaining or carrying a forest fire, usually natural material both live and dead.

**Fuel Loading**: The amount of combustible material present per unit of area.

**Fuel Management Zone**: A specified area of land where natural fuels are either removed of manipulated in order to help slow or stop the spread of wildfire.

**Green Tree Retention (GTR)**: The practice of retaining live, growing trees on a site during a regeneration harvest as a future source of trees and snags for wildlife. An average of six to twelve trees per acres that exceed the average stand diameter are retained as biological legacies within the harvest unit to provide habitat components over the next management cycle.

**Hand Line**: To cut and remove understory vegetation to bare mineral soil. This width can be determined on site during a wildfire or during project planning, and is based on current and

expected fire behavior. Trenches are constructed on the down hill side of the unit on steep slopes to prevent rolling material from crossing fire lines.

**Hand pile**: Piling of fuel using only human laborers.

**Helicopter Logging (yarding)**: Use of helicopters to transport logs from where they are felled to a landing.

**Jackpot Burning**: A technique of applying fire to target fuels, which ignites only concentrations of burnable materials within the unit being treated.

**Landing**: Any place on or adjacent to a logging site where logs are assembled for further transport.

**Lop and Scatter**: Cutting, lopping and scattering residual vegetation. Usually to a height of less than 18 inches above the ground.

**Management Direction**: A statement of goals and objectives and the associated management prescriptions and standards and guidelines for attaining them.

**Mass Wasting**: A general term for the dislodgement and downslope transport of soil and rock material under the direct application of gravity.

**Mastication**: To mechanically grind up forest fuels such as brush, branches and small diameter trees into small pieces, which are then left on site. This would occur on slopes < 35% inside plantations and fuel buffers.

**Matrix**: Federal lands outside of reserves, withdrawn areas, managed late-successional reserves, and adaptive areas.

**Obliteration**: Road removal where no presence of the road remains. All drainage structures are removed and the road is returned to the natural slope.

**Overstory**: That portion of trees in a forest, with more than one roughly horizontal layer of foliage, which forms the upper or uppermost layer.

**Overstory Removal**: A timber cutting method applied to stands with two or more distinct age or size classes, the older (or larger) of which is merchantable and is removed. The removal leaves an adequately stocked stand of understory trees.

**Regeneration Harvest**: Applies to the logging stands of rotation age or greater; and of stands below rotation age which cannot economically be held any longer because of poor stocking, health, thrift, quality, or composition. These cuttings are intended to replace the existing stands with a new stand. See also green tree retention.

**Residual Stand**: Trees that remain standing after some event such as thinning.

Riparian Reserve: A land designation where riparian-dependant resources receive primary emphasis and where special standards and regulations apply.

**Sanitation/Salvage**: The removal of dead or damaged trees, or trees susceptible to insect and disease attack such as intermediate and suppressed trees, essentially to prevent the spread of pest or pathogens and to promote forest health.

**Silviculture**: The science of cultivating forest crops.

**Silvicultural Prescription**: A professional plan for controlling the establishment, composition, constitution, and growth of forests.

**Silvicultural System**: Establishing, growing, and tending of forests.

**Skid Trail**: A path created to drag logs to a landing.

**Skyline**: See cable logging.

**Snag**: A standing dead tree from which the leaves and most of the branches have fallen.

**Stand**: A community of trees occupying a specific area sufficiently uniform in composition, age arrangement and condition distinguishable as a silvicultural or management unit.

**Stocking Level**: In a forest, a subjective indication of the number of existing trees as compared to the desirable number for maximum productivity of wood.

**Temporary Road**: Roads authorized by contract, permit, lease, and/or emergency operation. These roads are not part of the FS transportation system, nor maintained for long-term use. Temporary road removal and site stabilization is required after approved use prior to the rainy season each year or when the facility is no longer needed, whichever is earliest.

**Thinning**: Harvest made in an immature stand in order primarily to maintain or accelerate the diameter increment (annual growth) of the residual trees but also, by suitable selection, to improve the average form of the trees that remain, without damaging the canopy.

**Tractor Pile**: Piling fuels by the use of a bulldozer, most often equipped with a brush rake to minimize the amount soil incorporated into piles.

**Tractor Logging (Yarding)**: Moving cut trees to a landing by dragging behind a ground based rubber tired or tracked skidder equipped with grapples.

**Understory**: The lower layer of trees and shrubs under the forest canopy.

**Unstable or Potentially Unstable Areas**: Lands that need protection to maintain natural disturbance patterns and functions, prevent increased landslide distribution in time and space (rate and frequency), prevent increased delivery of sediment, and maintain landslide–delivered supply of large woody material over several rotations.

**Watershed Condition Class (WCC)**: The Forest Plan LMP established Thresholds of Concern for 5th field watersheds and defines Watershed Condition Class (WCC) (USDA Forest Service, 1994). The WCC are defined as follows:

- *Watershed Condition Class I*: ERA less than 40 percent TOC;
- *Watershed Condition Class II*: ERA between 40 and 80 percent TOC; and
- *Watershed Condition Class III*: ERA greater than 80 percent TOC.

The following summarizes the FSM 2521.1 – Watershed Condition Classes. The ERA evaluates watershed condition and assigns one of the following three classes:

1. Class I Condition. Watersheds exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. The drainage network is generally stable. Physical, chemical, and biologic conditions suggest that soil, aquatic, and riparian systems are predominantly functional in terms of supporting beneficial uses.

2. Class II Condition. Watersheds exhibit moderate geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. Portions of the watershed may exhibit an unstable drainage network. Physical, chemical, and biologic conditions suggest that soil, aquatic, and riparian systems are at risk in being able to support beneficial uses.

3. Class III Condition. Watersheds exhibit low geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. A majority of the drainage network may be unstable. Physical, chemical, and biologic conditions suggest that soil, riparian, and aquatic systems do not support beneficial uses.

**Whole Tree Yard**: The removal of a whole tree (including its bole, limb wood, branches and bark) to the landing, except for where the top of the tree is determined to be 3-inches in diameter, which is lopped off and left on site. Whole tree yarding does not remove broken limb wood, bark sloughing, and broken boles. Once at the landing, the tree is delimbed and cut into logs at specified lengths.

**Yarding**: Moving logs from the stump to a central concentration area or landing.

**Yarding of Unmerchantable Material (YUM)**: Moving unmerchantable portions of trees from the stump to a central location.

# Appendix A: National Fire Plan Project ESA Compliance Statement

Project Compliance with the Endangered Species Act Consultation Requirements, Using the

Counterpart Consultation Regulations

USDA Forest Service

**Project Name**: Salt Project

**State**: California

**Forest Service Region**: Region 5

**National Forest/Grassland**: Shasta-Trinity

**Ranger District**: Hayfork

**Date Of Completed BE or BA/BE**: 12 August 2008

**Name of Journey-Level Biologist who reviewed the BE or BA**:

Donald R. Ratcliff
Fisheries Biologist
Shasta-Trinity National Forest

As proposed the project is within the scope of, and will support, the National Fire Plan, because: Thinning and fuels treatments within the Salt Project area will result in more fire resistant timber stands.

The effects analysis completed and documented in the above BE or BA was done under the Section 7 counterpart regulations of the Endangered Species Act (Federal Register, December 8, 2003), and is in compliance with those regulations and the March 4, 2004 Alternative Consultation Agreement between the Forest Service, FWS and NMFS.

SIGNATURE OF LINE OFFICER: _____

NAME OF LINE OFFICER: **J. Sharon Heywood**

TITLE OF LINE OFFICER: Forest Supervisor

DATE: _____