A CURSORY EVALUATION OF SALMONID SPAWNING AND REARING CONDITIONS ON MATTOLE RIVER, HUMBOLDT COUNTY

by

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EXECUTIVE SUMMARY

This report presents the results of a survey and evaluation of anadromous fish habitat conditions in Mattole River, Humboldt County, in September, 1990 by the California Department of Fish and Game (DFG). Special emphasis was placed on the mainstem Mattole River and its tributaries above Thorn Junction. This evaluation was prepared in response to timber harvest plan (THP) review team concerns regarding the potential cumulative impacts of past, present and proposed logging operations on Mattole River fisheries. Timber harvest plans in the Mattole River are very controversial because of the issues relating to reducing old-growth dependent wildlife habitat and declining salmonid populations.

The Department of Forestry and Fire Protection designated the 11,300 acre area above Anderson Creek (locally known as Ravasoni Creek) to the Mattole headwaters as the Area of Influence (AOI) for THP 1-88-391 and THP 1-88-520. Climate, river morphology, geomorphology, soils, and land use are considered homogeneous in the AOI (Jager, 1989).

The objective of this study was to evaluate salmonid habitat specifically, spawning gravel and pool habitat which is essential for yearling steelhead and coho production.   The AOI is important for the production and survival of steelhead trout, chinook and coho salmon. The life histories and habitat requirements of salmonids varies between species.

Coho salmon and steelhead spend at least one year in fresh water before entering the ocean and they require cool pools for summer rearing. Coho prefer cover structure in the form of woody debris. The lack of pool cover structure often limits natural coho production. Because of a declining trend for coho populations throughout their range, the Department listed coho salmon a species of special concern in May, 1990. Chinook salmon spend a limited time in fresh water and usually enter the ocean in the first six months of life, but some may over-summer in the Mattole River lagoon. The Mattole River lagoon is shallow and aggrading. This condition is considered a bottleneck for chinook salmon production.

The Mattole River salmon escapement has steadily declined over the last decade with the 1991 chinook salmon return being the lowest on record. Specific consideration of this salmon stock was warranted and the Department recommended a zero net sediment policy in the Mattole River Watershed in regards to land use activity.

Temporal and fiscal constraints allowed only a limited sampling regime, but one considered sufficient to make an assessment of salmonid habitat conditions of Mattole River, especially within

the AOI. Portions of the main river, Lost Man Creek (also known as Lost River), Helen Barnum Creek, Stanley Creek, Mill Creek, Van Anken Creek (also known as Van Arken Creek) and all of Baker Creek were surveyed separately as time was available. Sediment samples were also taken on the Mattole River near the Ettersburg and Honeydew bridge crossings. We concentrated our efforts from the headwaters to Thorn Junction in areas adjacent to proposed land use activity, specifically Baker Creek (THP 1-90-188), Helen Barnum Creek (THP 1-90-63), Lost Man Creek (THP 1-90-232 and THP 1-90-165) and Mill Creek (THP 1-90-179).

A McNeil sediment sampler was used with five standard sieve sizes (25.4, 12.5, 4.7, 2.37, and 0.85 mm) to sample spawning gravel quality at eight stations.

Pool cross-sectional transects, and estimates of sediment deposition, percent pool cover and residual pool volume due to sedimentation were made at three stations.

Our observations include:

1 . All Mattole River and Lost Man Creek gravel samples contained at least 15 percent fines (<0.85 mm) except Station MR3 below Shelter Cove-Briceland Road (11.9%) and MR5 below Honeydew Bridge (14.5%).

    Sample means for fine sediment #4.7 mm ranged from 24.9% to 41%.

2. Rearing habitat was reduced by 26.9% at Lost Man Creek (LRR), and 22% and 28.4% at the upper (MP1) and lower (MP2) Mattole Pool Stations, respectively.

3. Water temperature was adequate for salmonid rearing in summer (58-60°F) in the Area of Influence, but Lower Mattole River water temperature was 72°F (air 84°F.) on September 13, 1990 at the Ettersburg Bridge. Reference literature indicates water temperature in the lower river are lethal for salmonids.

4. Shade canopy was greater than 95% on most headwater tributary streams and ranged from 43-87% on the mainstem Mattole River. Reference literature characterizes the lower and middle Mattole as exposed to solar radiation indicating poor shade canopy.

INTRODUCTION

In fulfillment of its responsibility under the Constitution as a trustee agency for fish and wildlife in California, the Department of Fish and Game (DFG) conducted a study to survey and evaluate the fish habitat conditions in Mattole River. The purpose of this investigation was to provide some of the information needed by the timber harvest review team for it to determine if specific conditions should be imposed on the pending THP's to protect and restore Mattole River fish habitat.

Many published documents, old and new, describe the history of land use practices within the Mattole Basin and the effect these activities had on stream conditions; California Fish and Wildlife Plan (DFG, 1965), Fisheries Enhancement Opportunities in the Mattole River Basin, Humboldt and Mendocino Counties, with Special Emphasis on the Potential of a Flow Augmentation Reservoir (DFG, 1973), Hydrologic Analysis of Proposed THP in the Mattole River (Jager, 1989), Official Response to the Director of Forestry and Fire Protection to Significant Environmental Points Raised During the Timber Harvesting Plan Evaluation Process (Imboden, 1989).

Jager (1989) made the most comprehensive hydrologic analysis to date. He addressed the hydrologic impacts and cumulative watershed effects of proposed timber harvest plans in Mattole headwaters in Hydrologic Analysis of Proposed THP in the Mattole River Basin. He reported on page 61, under the heading of Hydrologic Effects of Historic Uses and Abuses in the Basin,

> "The hydrologic integrity of the Mattole Basin has been seriously damaged as a result of inappropriate logging, land conversion and burning coupled with a series of devastating storms and extreme floods that occurred between the end of WWI and 1965. The damage is most evident in the lower and middle reaches of the basin and is evidenced by extensive channel aggradation that has plugged the channel below the Thorn Junction and more particularly, below Bear Creek."

Dr. Jager continues on page 62;

> "Regardless, channel aggradation in the Lower and Middle Mattole has created a wide, shallow river with subsequent destruction of riparian vegetation. The entire lower channel is subject to abnormally high inputs of solar radiation and sediment. The net effect has been a severe and long term reduction in the potential beneficial uses of the lower Mattole River water.

> Whether the observable destabilization of the lower and middle Mattole fits the Congressional meaning of "cumulative effects" is a moot point. The fact is the hydrology has been altered over historic time with consequent effects on beneficial uses. It is quite another matter however to assert that damage was attributable to activities in the Upper Mattole or that proposed logging under current CDF rules will substantially contribute to downstream problems."

The Department of Fish and Game concurs with these observations and conclusions in the context that impacts from headwater sediment would result in unobservable and unmeasurable incremental effects on the lower Mattole reaches or estuary when considering the condition of the entire watershed. However, the effects of proposed timber harvest plans on salmonid habitat conditions in streams adjacent to areas of proposed THP's and within the AOI, which clearly show residual impacts, would contribute measurable incremental impacts unless adequate mitigation measures are implemented. It was for this reason DFG recommended a "zero net sediment" policy for the Mattole River. The reader should note that this policy is recommended for all land use activity within the watershed.

At present most of Mattole River and its tributaries are typically shallow, with barren pools and broad alluvial riffles. Salmonids, especially coho (a species of special concern listed by DFG May, 1990) and steelhead, prefer deep, cool pools for summer rearing, and all species require clean gravel for good spawning success. The estuary of the Mattole is aggraded and is considered a bottleneck in the production of chinook salmon. In some years the estuary may close early, trapping chinook in the estuary and lower river (Busby, 1988). Water temperature in the lower Mattole River is too warm, averaging 23°C, to provide refuge for late salmon emigrants (Young, 1987).

The salmon population in the Mattole River Basin is only a fraction of what once existed. The Department (1973) published the California Fish and Wildlife Plan which stated that about 5,000 chinook salmon, 2,000 silver salmon and 12,000 steelhead spawned in the Mattole River each year. Annual carcass surveys have been conducted on Mattole River from 1978 through 1989 with mean escapements of 408 chinook and 7 coho. DFG personnel, with the assistance of California Conservation Corps members, conducted salmon spawner counts on the Mattole River from the headwaters to approximately 1.5 miles below Thorn Junction and 1/2 mile of Bridge Creek in 1990-91. The total count was one unidentified fish skeleton near Thorn Junction and ten redds above Stanley Creek.

Gary Peterson, Mattole Salmon Group, conducted twelve surveys in the lower river to augment our efforts. Between November 11, 1990 and February 2, 1991 he saw 7 chinook salmon, five silver salmon, eight steelhead, and eight fish he could not identify.

Because of this decline the American Fisheries Society listed the fall chinook salmon as having a high risk of extinction (Nehlsen, 1991), and the Fish and Game Commission banned salmon angling on the Mattole River starting October 1, 1991.

There is no quantifiable data for Mattole River coho salmon populations, but Moyle (1991) reported the coho run in the Mattole River was probably much reduced from historic levels, numbering in the hundreds in recent years.

Because salmon and steelhead runs are dependent upon such variables as in-river flows and water quality conditions, ocean conditions (El Niño), and sport and commercial harvests, it is inappropriate to use escapement as the only measure of stream health. The physical condition of the habitat is a reliable indicator of the general health of a watershed.

The degradation of the instream habitat is considered the nexus for the decline of Mattole River salmon. The seriousness of the hydrologic and "biological" condition of the lower and middle Mattole River makes the AOI far more important, because it remains the best area for salmon spawning. Coho salmon are found primarily in the AOI, in addition to Bear Creek drainage, with small populations supported in lower river tributaries. Habitat protection and enhancement is essential for reversing the declining salmon population trend and meeting the mandate of SB 2261 to double salmon and steelhead populations statewide by the year 2010.

The California Department of Fish and Game expended over $250,000 on thirteen restoration contracts to reduce the sediment yield by stabilizing landslides and other sources of erosion, creating microhabitat with boulder clusters and log and root wad cover, planting riparian vegetation, and propagating chinook and coho salmon. In addition, the California Conservation Corps spent over 43,017 worker-hours modifying barriers, planting riparian cover, and installing weirs to improve both spawning and rearing habitat in the Mattole River.

Sedell et al, (1989) reported stream habitat projects on the west coast improved salmonid spawning and rearing conditions and probably increased fish production, but analysis of enhancement projects shows that substituting other structures for large woody debris can be very expensive. Sedell (1989) cited Lisle (1982) who stated:

> "In many instances, after-the-fact substitution of debris may cost much more than allowing debris to be recruited to the channel naturally. Even where

> structural enhancement is warranted, using native materials, such as logs, to achieve the hydraulic diversity necessary for productive fish habitat may be the most cost-effective means of treating extensive stream reaches."

Little of the original coniferous stream canopy exists along the Mattole River and its tributaries, and instream large woody material for fish habitat diversity and production is absent. Conifers are important to riparian ecosystems not only for shade, but also as elements of instream large organic debris (LOD). Wood (> 12-inch diameter) in creeks has been identified as maintaining the integrity of aquatic ecosystems, i.e., structural complexity and formation of pools (Sedell et al, 1989). Sedell cited wood recruitment studies by Grette (1982) and David Heinman, Oregon State University (personal communication) who indicated that large coniferous debris do not enter streams in significant amounts until the stand reaches 120 to 150 years.

Shade canopy has regenerated in the AOI, providing protection from the extremely warm summer temperatures and contributing organics (food items) to the stream, but lower Mattole River is exposed to direct solar radiation. Water temperatures are above optimum and approach the upper tolerance level for coho and chinook salmon.

Despite restoration efforts, habitat recovery is slow. This is documented by field surveys and corroborated by literature including William T. Imboden's environmental response for THP 1-90-063 which states:

> "As observed by geologist Sowma, the drainages in the area are recovering. This recovery involves revegetation of banks and movement of old sediment depositions downstream. The length of time necessary for sediment deposition to move out of a stream has been documented by Kelsey et al (1987). This period can be decades. All too frequently, this movement of sediments is mistakenly attributed to current logging activity. Throughout the Redwood region, recovery of stream systems has been documented and occurs in conjunction with current timber harvests conducted in compliance with the Forest Practice Rules. Baker Creek, Helen Barnum Creek, and Lost Man Creek exhibit the long-term effects of past, poor logging practices; and show signs of recovery."

Elsewhere, Imboden states:

> "An examination of Helen Barnum Creek found evidence of sedimentation originating upstream (Jameson, 1990). The stream is cutting through the fill. Revegetation

> by brush, hardwood, and softwood reproduction acts to stabilize sediments and slow their movements downstream (Jameson, 1988). The effects of historic damages within the Mattole basin are discussed on page 61 of the EA" (Jager, 1989).

The Department concurs with the observations and conclusions reported by Mr. Imboden. Considering these observations, it is clear that potential cumulative impacts could arise from proposed THP's.

Section 15355 of the CEQA guidelines defines cumulative impacts as:

> "Cumulative impacts refers to two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts. The individual effects may be changes resulting from a single project or a number of separate projects.
>
> a) The individual effect may be changes resulting from a single project or a number of separate
>
> b) The cumulative impact from several projects is the change in the environment which results from the incremental impact of projects when added to other closely related past present and reasonably foreseeable probable future projects.
>
> Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time."

The following survey objectives were selected as keys to evaluating the condition of salmonid spawning and rearing habitat in Mattole River:

1) Determine the percentage of fine sediment in spawning gravel in the AOI in Mattole River and tributaries.

2) Assess the summer rearing habitat for coho and steelhead in the AOI.

3) Based upon the preceding results, judge whether addition of sediment would cause further degradation.

METHODS

Representative sections of Mattole River and its tributaries within the AOI were selected to assess salmonid spawning and rearing habitat conditions. General information was also obtained including shade canopy, stream temperature and streambank stability. Rearing pool selection was done by first surveying a reach and then choosing a representative site within that reach. Spawning substrate selection was based on knowledge of past spawning at the site or judgment that the site was appropriate for spawning use. Redd and pool sites were flagged and benchmarks placed at pools for future reference, and photographs were taken.

The Mattole River was divided into stream reaches consisting of Mattole River from the headwaters to Lost Man Creek, Mattole River between Lost Man Creek and Baker Creek, and Mattole River between Baker Creek and Thorn Junction. Lost Man Creek and Mattole River headwater tributaries were surveyed separately as time was available. Sediment samples were also taken near Ettersburg and Honeydew bridges (Figure 1.) for a total of eleven samples.

The mainstem Mattole River was walked during the summer from the confluence of Baker to the mouth of Stanley Creek, from Van Anken Creek mouth to 3,516 feet upstream, and from the mouth of Lost Man Creek downstream 500 feet to the county road bridge crossing. DFG and CCC personnel walked mainstem Mattole in January and February 1991 to count salmon spawners from the Hulses' property to the confluence of Stanley Creek and from Thorn Junction to a point approximately 1.5 miles downstream, in addition to, 1/2 mile of Bridge Creek.

All of Baker Creek, 874 feet of Lost Man Creek, 475' of Lost Man Creek, 783 feet of Stanley Creek, approximately 1/4 mile of Mill Creek, 892 feet of Van Anken Creek, and portions of Harris and Gibson creeks were surveyed during this period.

Stream reach surveys, gravel sampling and pool transects were conducted on September 12, 13, 18, and 19, 1990. Baker Creek was surveyed, in its entirety, on September 28, 1991.

Survey members were Larry Preston, Associate Fishery Biologist, Dave Hoopaugh, Associate Fishery Biologist and Dave McLeod, Fishery Biologist. Gary Flosi, Habitat Supervisor II and Larry Preston surveyed Baker Creek on September 28, 1991.

Substrate Sampling

Substrate samples were collected and measured in all reaches of Mattole River using a six-inch diameter McNeil sediment sampler with five standard sieve sizes (25.4 mm, 12.5 mm, 4.7 mm, 2.37 mm, and 0.85 mm). The stations LMR, MR1, MR2, MR2A, MR2B, MR3, MR4, MR5 are labeled in Figure 1. Three samples were taken in a triangular pattern within the thalweg at each station. Field analysis was done for particle sizes greater than 25.4 mm diameter using volumetric displacement in a graduated cylinder and decanted portions of fines sediment   0.85 mm diameter were also analyzed in the field using Imhoff cones, with a settling time of 15 minutes. Remaining portions of the samples were sealed in labeled plastic bags and analyzed in the laboratory using the wet sieve method. All particle sizes greater than 0.85 mm diameter were measured by displacement in a graduated cylinder. The volume of fines less than 0.85 mm was measured following one hour of settling in graduated cylinders or Imhoff cones. Correction factors were then applied to field sample results which had been settled for 15 minutes to adjust for volume reductions in one hour settling periods.

Pool Quality and Rearing Habitat

Three pool stations were selected for measured cross-sections and sediment volumes to represent stream pool habitat conditions. Pools were selected by first surveying a reach, then identifying a pool which was representative of that section. The pool stations are:

Station LMP	Lost Man Creek	475 feet upstream of mouth
Station MP1	Mattole River	1292 feet below Baker Creek
Station MP2	Mattole River	1275 feet below Mill Creek

Pool quality was measured at each of the three selected sample pools using the following procedures:

1) Cross-section profiles.

We measured cross-section profiles in order to quantify channel changes, either filling or scouring, at the time of the survey . Permanent benchmarks were established at each pool to reference water surface elevation. Transects were established perpendicular to the stream channel at 5- to 20- foot intervals from the tail to the head of the pool, depending upon the length of the pool. Vertical measurements of water depth and sediment depth (see item 2, following) were taken at 1 or 2-foot intervals along each transect, depending upon the total wetted width. Transect area was determined using Design CAD (computer aided design).

2) Sediment depth profiles.

The minimum depth of sediment deposits across each pool transect was measured using a three-foot long 3/8 inch diameter rod marked at 0.1 foot intervals. The area of transect filled with sediment was determined using Design CAD. Sediment volumes were estimated by summing the products of the transect areas and the portion of the pool the transect represented.

4)(sic)Photographs.

Photographs were taken from the upper and lower ends of all pool stations. Photographs were also taken of bench marks established in all pools to reference water surface elevations. (Appendix V lists a photographic index. The photographs are available for review at the Eureka DFG office).

RESULTS

General Survey

Mattole River from Lost Man Creek to Mattole Bridge Crossing

A 420-foot section was surveyed beginning at the bridge crossing (about 1.5 miles south of the Humboldt-Mendocino County Line) to Lost Man Creek. Exposed bedrock formed pools and runs and the gravel substrate was predominately material less than one inch diameter. The presence of sands and fines were also noted. Water and air temperature at 1230 p.m. was recorded as 58°F. and 68°F., respectively. The river bars had accumulations of larger gravel and rubble. A site 290 feet above the bridge was selected for a substrate sample.

Stanley Creek

Stanley Creek was surveyed from the mouth to 783 feet upstream. The stream canopy was about 100% and water temperature was 60°F at 3:38pm. At 177 feet from the mouth log weirs were placed to backflood the culvert for fish passage through the road culvert. Exposed bedrock supported pools in lower reaches. Pool depths measured at three random sites were 1.8, 2.1, and 2.1 feet. Stored sediment was observed behind logging slash at 783 feet from the stream mouth.

Lost Man Creek

Lost Man Creek was surveyed from the mouth to 874 feet upstream. The surveyors noted the pool depths were shallow. At 345 feet the stream was low gradient and shallow. Sediment was 1.7 feet, 1.5 feet and 1.3 feet deep in lowermost pools below the first bedrock sill. Bedrock sills were common in Lost Man Creek but most were covered with gravel, sand and fines less than one inch diameter. There was little rubble or instream cover. The stream was typified by pools formed from bedrock outcroppings and aggraded channels.

Shade canopy at 475 and 714 feet from the mouth was measured as 100% and 96%, respectively. Shade canopy at the head of the pool above Station LMP was 97%. Mattole River water temperature was 58°F. immediately below the confluence of Lost Man Creek and Helen Barnum Creeks at 12:30pm on September 12, 1990.

A substrate sample site (LMR) was located at 280 feet above the stream mouth. The site was selected upstream of an active bank slump and below overhanging vegetation. Bank failure was commonplace at this location. Pool station LMP was selected at 475 feet upstream of the mouth.

Juvenile steelhead were observed in Lost man Creek.

Helen Barnum Creek

Helen Barnum Creek was surveyed from the mouth to 120 feet upstream.

Water temperature was 58°F. at 12:30 p.m. and shade canopy was visually estimated at 90-100%. A 1.5-foot deposit of pool sediment was measured. At 120 feet from the mouth the stream was subsurface through aggraded areas which were held in storage by debris jams.

Mattole River Headwaters To Lost Man Creek

A small distance was walked above Lost Man Creek and the remainder of mainstem Mattole was surveyed by driving the adjacent road to four corners. The river was typified by pools formed from bedrock outcrops with some aggraded pools and runs. A gravel sample at Station MR1 was taken at approximately 500 feet above Mendocino Road Marker 1.25. The air temperature and water temperature taken at 3:15 p.m. at this site was 59°F. and 75°F., respectively. While the gravel sample was settling, a spot check for fish was conducted with an electrofisher. A total of 15-20 steelhead up to five inches long were collected along an 80-foot bedrock wall.

Van Anken Creek (also known as Van Arken Creek)

Van Anken Creek was surveyed from Thorn-Whitethorn Road crossing to its confluence with Mattole River to 892 feet upstream. Shade canopy at 200 and 397 feet was 98% and 95%, respectively. The canopy was mature alder and tanoaks. The surveyors noted bedrock outcrops at 397 feet from the mouth. In the lower gradients there were deposits of unconsolidated gravel and silt in the pools, but it was very low compared to the available pool habitat. The upper reach of the survey area had pool habitat six to eight inches deep, with isolated deposits of sediment, low levels of fines, rubble and some large organic debris (logs) for instream cover. The Department and California Conservation Corps has constructed a boulder and log weir jump pool below a road culvert about 1.5 mile upstream which provides passage for steelhead but not coho salmon. Coho were electrofished below the culvert in May 1988.

Mattole River from Van Anken Creek to 3576 feet upstream)

The Mattole River was surveyed from the mouth of Van Anken Creek to 3575 feet upstream. Water temperature was suitable for salmonids (60°F. at 9:00 a.m.), in fact, a 24 inch steelhead was observed in a pool about half way through the survey area.

The stream contained wide bedrock pools about four to six feet deep. There was a noticeable absence of rubble, boulders and log instream cover. The nature of Mattole River changed about 852 feet upstream of Van Anken Creek, from 50 to 60-foot wide to a narrow, shallow wetted channel about 20 feet wide. The gradient was slightly steeper and the deposition of small unconsolidated gravel was apparent. The river's pool habitat changed from long, deep (8-foot pools) to areas of aggradation. At 1313 feet a 2.25-foot deep "wedge" of unconsolidated bedload material aggraded the channel and reduced pool volume. At 1659 feet, young alders established on a sediment deposit were recently cut by local resident(s). Water diversions were also noted in this area. Shade canopy was recorded at the head of each pool every 500 feet and ranged from 40-85% with an average of 63%.

Baker Creek

Baker Creek was partially surveyed from the mouth to the road culvert about 833 feet upstream, by Dave Mcleod and Larry Preston on 9-19-90. The entire stream was surveyed on September 28, 1991 by Larry Preston and Gary Flosi, Habitat Supervisor II. Shade canopy was adequate to provide water temperatures of 60°F. at 10:30 am and noon. Bank stability was good and undercut banks were common, however there are several sites of bank scour along the creek. At 5,946 feet from the mouth, the stream was severely headcut, which may be the primary sediment source sediment in the creek. This headcut was not mentioned in earlier Departmental reports and is believed to be a new sediment source. The quarry is also a potential sediment source.

Baker Creek tributaries, especially the North Fork, are impacted by sediment. Baker Creek continues to store sediment and is an example of a stream with diminished habitat volume and quality. The following observations illustrate this:

At 2,016 feet from the mouth a 3-foot diameter log was perched on bedrock and backfilled with sediment comprised of gravel, sand and fines. Departmental surveys in 1982 and California Conservation Corps surveys 1986 did not mention this site, which indicates it is a recent event. The log was influencing about 500 feet of stream.

At 2,619, 2,722, 4,523 feet from the mouth were point source erosion sites.

At 3,543 the rip rap that was placed in the stream to armor the toe of a slump below the haul road was broadcast into the channel pinching the creek. It will erode the opposite bank at high flows.

A 1986 survey stated that a four-foot falls provided a four-foot pool at 4,239 feet from the mouth. This jam was blown out and the pool was filled with sediment.

At 5,670 feet from the mouth, just above the North Fork is an old log stringer bridge which was reported as not retaining gravel in an earlier report but now contains 3.5 feet of sediment and presents a potential barrier.

At least one new log jam and several old sites which were reported as retaining gravel had been modified naturally and only woody debris remained.

Barnum Timber Company provided a habitat evaluation of Baker Creek by A. A. Rich and Associates (1990) entitled Salmonid Habitat Conditions in Baker Creek, Humboldt County. The data provided by the document indicates that 61% of the available riffles/glides provided coho spawning habitat. Baker Creek could support coho if fish passage is provided. Coho were reported spawning near the mouth in January, 1973.

Mill Creek

We walked Mill Creek from the road access bridge to about 1/4 mile upstream. The stream was primarily bedrock substrate overlain with large cobble and some sediment was evident. Water and air temperature were 60°F and 78°F, respectively at 4:30 p.m. The stream was 13-18 feet wide with stable banks and pools 1-1.5 feet deep.

Mattole River from Mill Creek to 2000 feet downstream Stream channel width ranged from 39 to 52 feet and averaged 44.5 feet. Wetted width was 27-28 feet at 1500 feet and 2000 feet and about half that width in the first half. The stream was aggraded in the first half but bedrock outcroppings were common.

Pool depths were about 2.2 feet at 500 feet to 6 feet deep at 2000 feet. Instream pool cover was absent.

Spawning Gravel Analysis

Individual samples of percent fines less than 0.85 mm ranged from 10.5 to 33.6 percent (Table 1). Sample means for each station ranged from 15.0 to 25.7 percent.

Total percent fines less than 4.7 mm in separate samples ranged from 23.4% to 53.2% (Table 1). Sample means for each station ranged from 30.8% to 42.0%.

Data sheets for volumes and percentages of size categories in substrate samples are found in Appendix I.

Rearing Pool Evaluation

The cross-sectional profiles of station LMP, MR1 and MP2 are included in appendices II through IV, respectively. The differences between the existing pool volumes and percent pool volume lost to sediment are as follows:

	Pool Volume		Lost Volume (ft^3)	Percent Reduction
	Existing (ft^3)	Without Sediment (ft^3)		
Station LMP	222.8	304.9	82.1	26.9
MR1	5468.9	7007.3	1538.4	22.0
MR2	5644.6	7884.2	2239.6	28.4

DISCUSSION

SPAWNING GRAVEL

The effects of sediment in gravel are well documented for salmonid spawning, egg incubation and fry emergence. Iwamoto et al (1970), Raiser et al (1985), and Raiser et al (1979) referenced many investigators who found inverse relationships between the quantity of fines and egg survival and fry emergence. Deposited sediments can smother incubating eggs as well as entomb alevins and fry, thereby precluding emergence (Bjornn, 1969).

Female salmonids remove fine sediments from the gravel during redd construction. Clean gravel increases the flow of water through the redd pocket, supplying adequate oxygen to the eggs and removing waste metabolites. Streams in unstable geologic areas or activities within a watershed which introduce sediment to the watercourse may render the original gravel cleaning ineffective (Reiser et al, 1985).

Researchers have used a variety of fine sediment criteria for correlating percent egg and fry survival. Reduced survival has been related to sediment sizes ranging from <6.4 mm diameter (Reiser, 1979) to <0.85 mm diameter (McNeil and Ahnell, 1964). In addition, there does not appear to be universal consensus on the percentage of sediment which should be allowed to enter a stream before egg survival is impacted, even though all fisheries researchers agree that excessive sediment is inversely related to egg survival and fry emergence (Iwamoto et al, 1978, Chapman 1988, Reiser et al 1985, Phillips 1971, McNeil and Ahnell 1964, Bjornn 1979 (see Figure 2). The equipment available to us warranted limiting our analyses of fines to less than 4.7 mm and less than 0.85 mm.

Chapman (1988) and Platts et al (1979) do not recommend equating egg survival to habitat quality conditions measured solely by McNeil samples, unless those samples were taken directly in the egg pocket. They concluded that only egg pocket gravels are cleaned and sorted during nest construction and therefore represent egg survival. Egg survival can only be inferred from substrate samples taken outside of the egg pocket.

Iwamoto et al (1978) suggested a rationale for setting a level of sediment impact to stream systems;

> The *"amount of sediment that should be allowed to enter a stream before detrimental effects will occur on an aquatic habitat will depend on the amount of fines already contained within the stream channel. The amount that can enter a stream is the difference between the present level and the allowable plus the amount transported."*

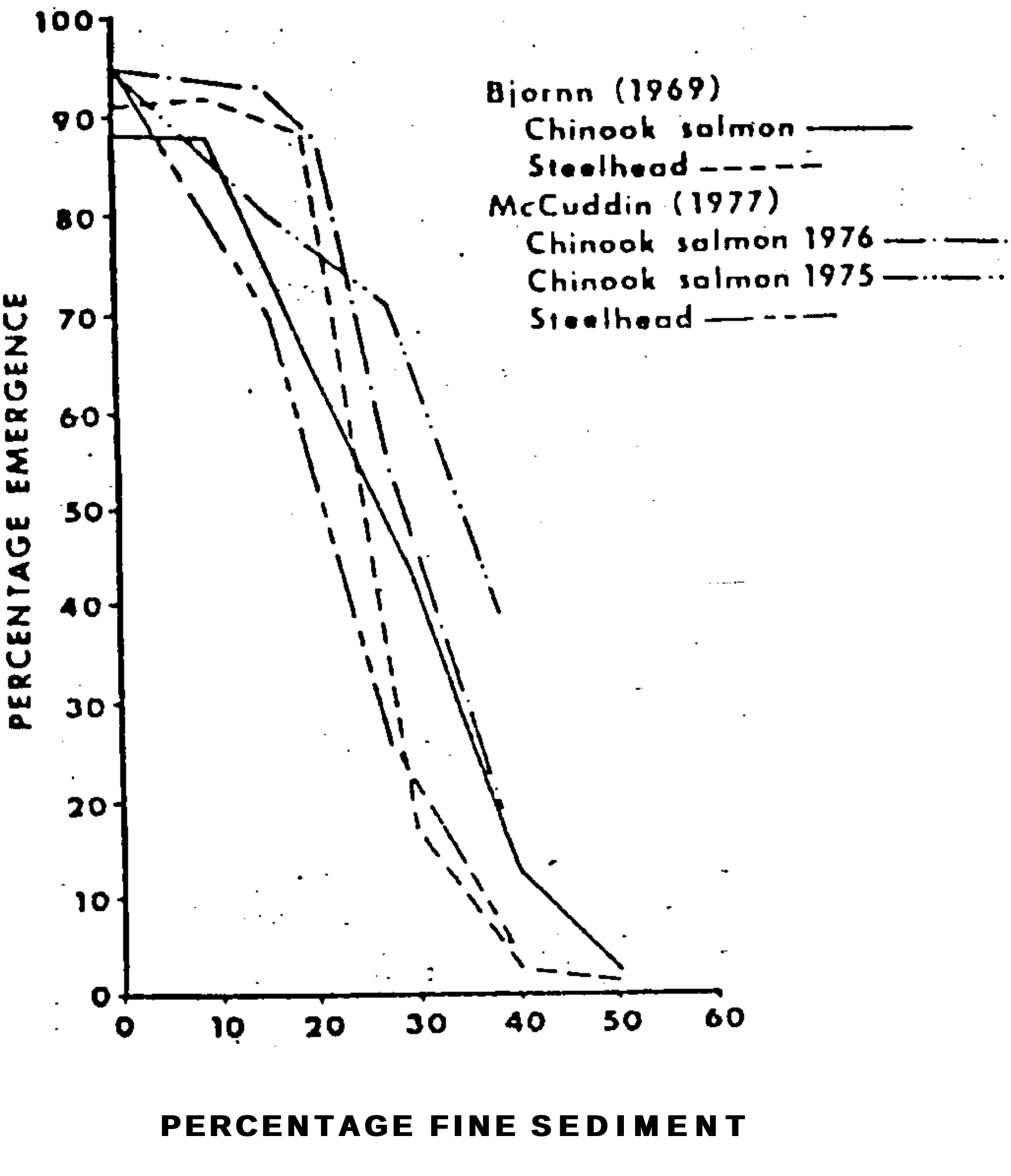


Figure 2. Percentage emergence of fry from newly fertilized eggs in gravel-sand mixtures. Fine sediment was granitic sand with particles less than 6.4 mm. (from Reiser and Bjornn, 1979)

The variables of this sediment transport equation are often intangible and various amounts of percent fines have been suggested by fisheries biologists and hydrologists, which could be allowed before productivity would be impacted. After reviewing the available literature, Iwamoto et al (1978) suggested a limit of 10-20% for sediment less than 0.85 mm diameter. All studies indicate that when fines 0.85 mm diameter exceed 15% of the total sample volume, there is a reduction in egg survival and fry emergence. A level of 15% fines is generally accepted as the maximum threshold for fish egg and alevin mortalities. Mattole River sample means ranged from 11.9 to 22.5 percent with a combined sample mean of 18.1 percent.

Chapman (1987) also addressed the concern for acceptable sediment levels in the absence of technical information, after a review of the available literature. He stated;

> *"We acknowledge that our inability to find and develop quantitative functional relationships that can be used as regulatory tools will disappoint some readers and please others. Among the latter may be some who have vested interest in logging and road construction. Our failure may also please those who have contended that best management practices should be sufficient protection for aquatic communities, or that protective criteria must have quantitative tools before they can be justified. We direct the following comments to advocates of best management practices.*
>
> *The interface between water and air is, to a very real degree, the interface between relatively easy and very difficult ecological assessments. Too often, it is also the interface below which research funding has been insufficient. Even after 35 years of intensive work on the effects of fine sediments on the intragavel environment, we are only now focusing on that which directly influences survival of embryos to emergence. Only now have researchers begun to realize the importance of habitat for overwintering by salmonids in the northern rockies.*
>
> *Quantitative tools for evaluation of effects of fines will not supplant scientific judgement. The complexity and variety of stream systems in the northern Rockies will make it impossible to broadcast fixed criteria. We suggest that every stream system and subsystem must be evaluated as a discrete unit; that conservatism in favor of the fishery resource is prudent, especially in the case of high-value fisheries, and should be quite amply justified simply on the grounds that unforeseen externalities are easy to cause but hard to rectify; and, finally that informed judgement should drive the.*

system rather than any arbitrary set of best management practices. We feel that best management practices can too easily be interpreted to mean economical practices. While "economical" in this sense serves the timber or mining interests well, it totally neglects consideration of the state of knowledge in stream ecology and hidden costs passed on to the general public in the form of deteriorated fishery resources and future rehabilitation requirements."

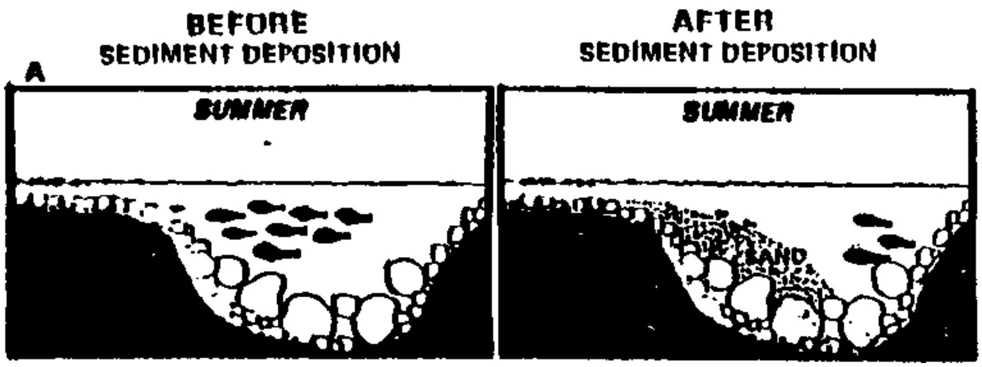
POOL REARING HABITAT

Reiser et al (1985) reported many investigators had studied and related increased sediment in pools to reduced fish habitat (Figure 3). Grouse (1961), as well as other researchers, found that sediment added to natural and laboratory pools decreased juvenile salmonid abundance in almost direct proportion to the amount of pool volume lost to sediments.

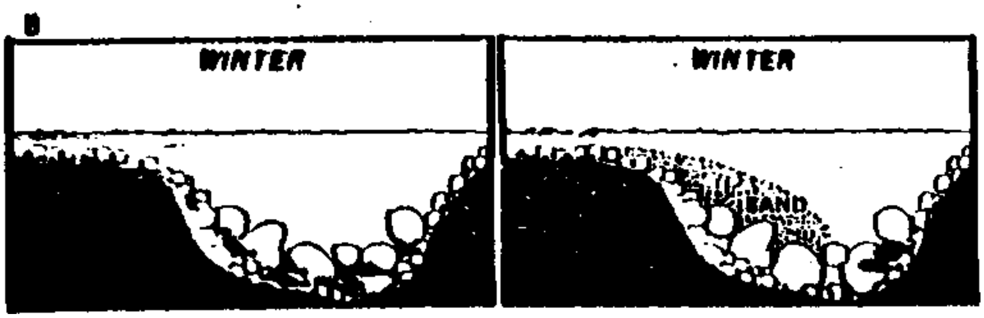
Bjornn (1977) recommended using the percentage of fine sediment material in a riffle as an index for monitoring "sediment health" of a stream. The percentage of fine sediment in the riffles not only provided a measure of gravel suitability for egg survival, but also an index of pool sediment deposition. He concluded that if riffles had negligible amounts of sediment then the pools would also have small amounts of sediment. Crouse et al (1981) concluded that habitat for juvenile salmonids, as well as spawning gravel, required protection from excessive fine sediment.

Pool stations samples showed a successional downstream increase in pool sediment and reduction in pool habitat. As expected, Station MR2, (the lowermost station) showed the largest decrease in pool volume (28.4%), compared to Station MR1 (22.0%). This would be expected because the higher gradient stream reaches can transport sediment at lower flows than can lower gradient reaches. Therefore the greatest effect would occur with distance as the stream gradient decreases. Volume of the pool sampled on Lost Man Creek was reduced by 26.9%.

The estimates of reduced pool volume from sedimentation should be considered minimal. Our ability to drive the sediment probe is limited to recent unconsolidated material. We suspect there are substantial buried deposits of unconsolidated material that we were unable to detect and measure without excavation.



A) IN SUMMER, FISH REAR WITHIN THE WATER COLUMN. SEDIMENT DEPOSITION DECREASES POOL VOLUME AND AVAILABLE REARING SPACE



B) IN WINTER. FISH HOLD IN GRAVEL INTERSTITIAL SPACES WITHIN POOLS. SEDIMENT DEPOSITION "FILLS IN" THE SPACES REDUCING HOLDING AREA

FIGURE 3. SUMMER REARING (TOP) AND WINTER HOLDING (BOTTOM) HABITAT BEFORE (LEFT) AND AFTER SEDIMENT DEPOSITION MODIFIED FROM BJORNN ET AL (1977)

WATER TEMPERATURE

Salmonids require cool water temperatures. Increased water temperatures decrease the water's dissolved oxygen content which affects the fish's growth, swimming ability, disease susceptibility, and the ability to catch food (Reiser and Bjornn, 1979). Reiser et al (1975) cited Brett (1952) who reported the upper lethal water temperature for salmon was 25.8°C (77.2°F) and Bell (1973) who reported that coldwater fish stop growing at temperatures above 20.3°C (68.5°F).

Although average daily temperatures throughout the growing season are unknown, our spot measurements indicate that temperatures are adequate in Upper Mattole River. Lower Mattole River water temperatures are warm and generally unsuitable for salmon. (Young, 1987; DFG, 1973).

CONCLUSIONS

Mattole River salmonid habitat was impacted by sediment in September, 1990. Sediment can limit spawning success and the volume of rearing pool habitat for salmonids.

DFG recommends a policy of zero net sediment, that is, no sediment-producing activity should be permitted unless its impact is limited to the minimum possible and is accompanied by a comprehensive effort to correct the existing source, or equivalent.

DFG also recommends retaining mature conifers along stream courses to reestablish the potential for instream wood recruitment.

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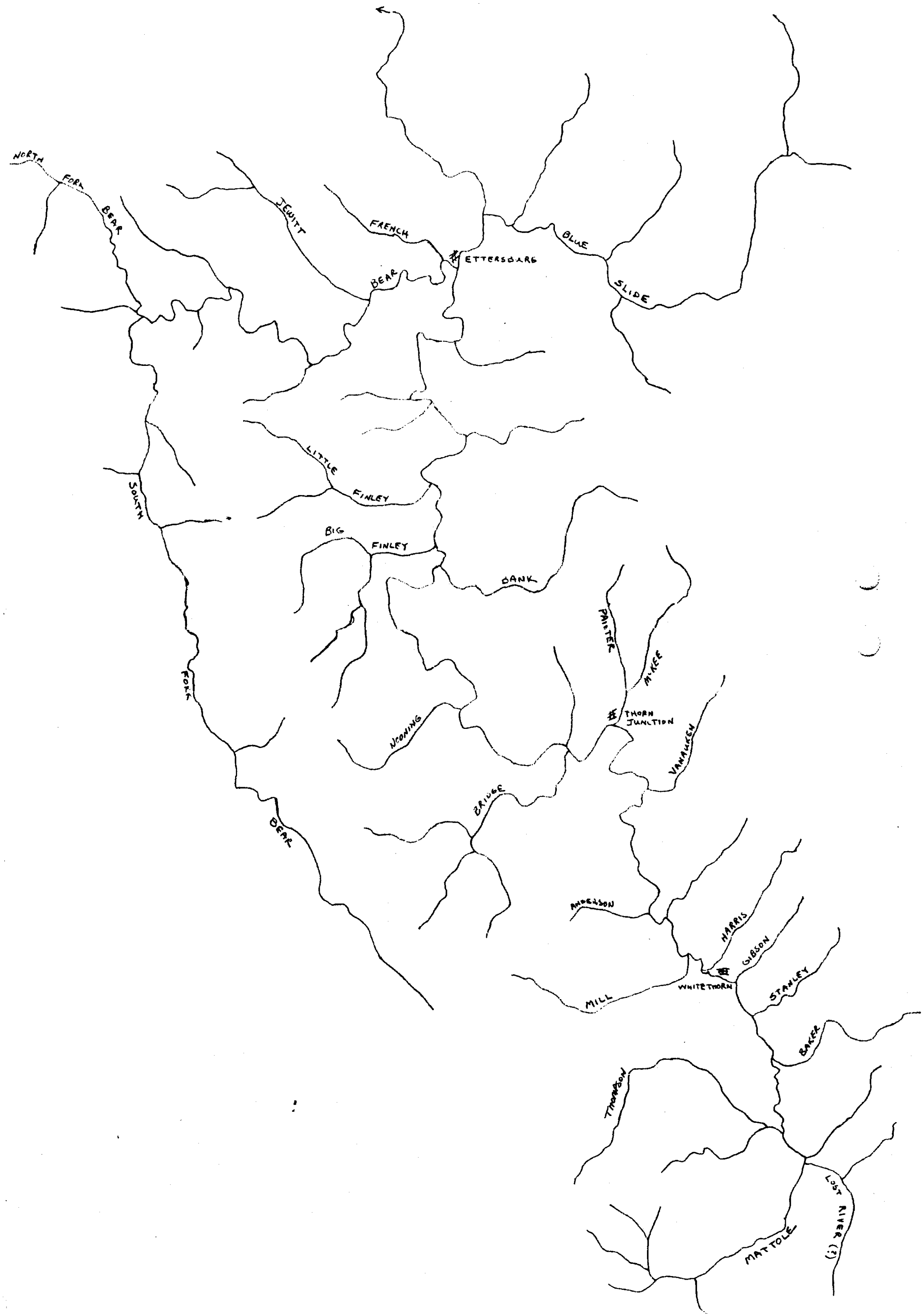


NORTH FORK BEAR
JEWITT
FRENCH
ETTERSBURG
BLUE SLIDE
BEAR
LITTLE FINLEY
SOUTH FORK BEAR
BIG FINLEY
BANK
PAINTER
McKEE
THORN JUNCTION
VANAUKEN
NOONING
BRIDGE
ANDERSON
HARRIS
GIBSON
WHITETHORN
MILL
STANLEY
BAKER
THOMPSON
LOST RIVER (?)
MATTOLE

MATTOLE RIVER

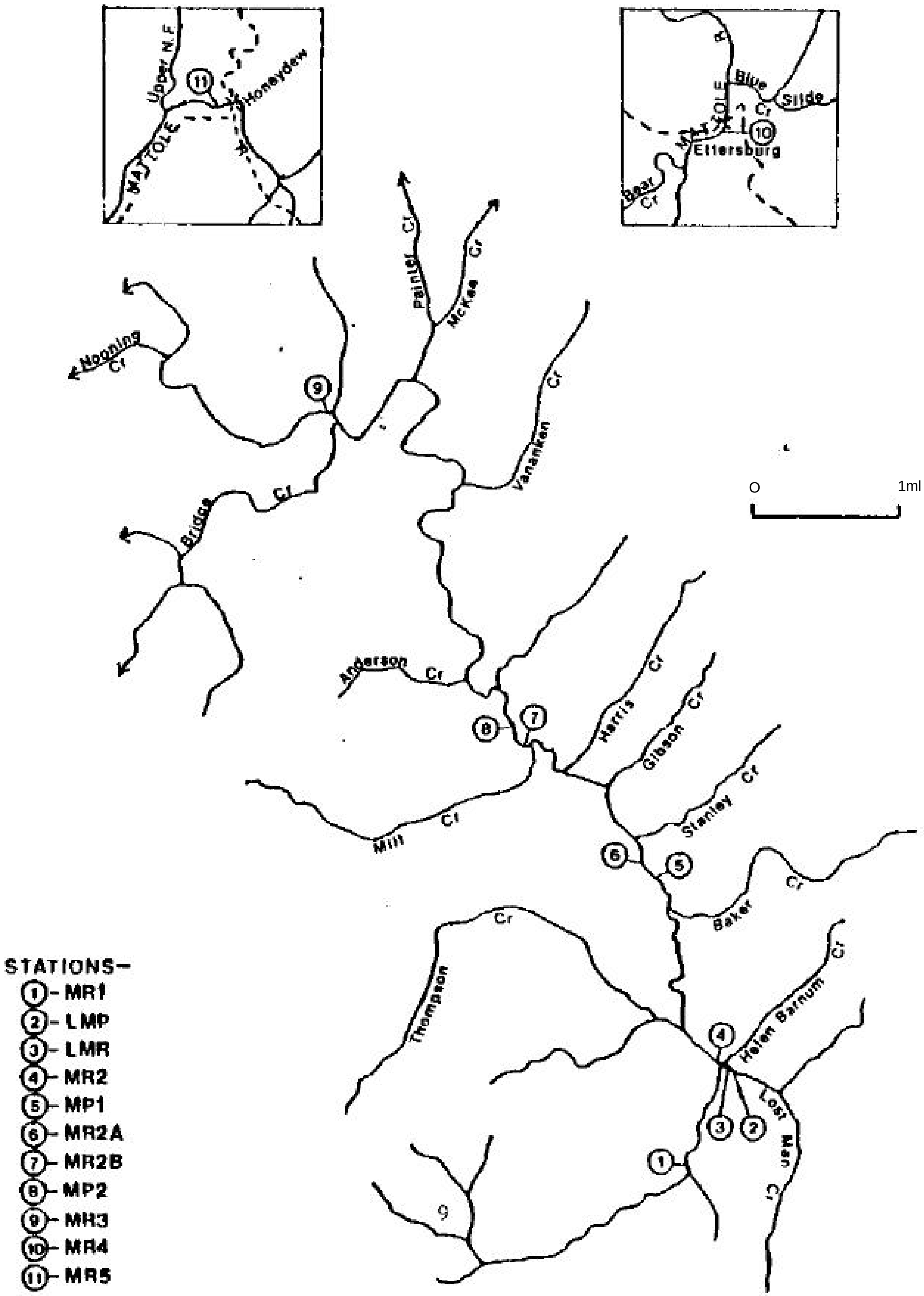


Table 1 Percent Fines in Mattole River Sediment Samples

		<4.7 mm and >2.37 mm	<2.38 mm and >0.85 mm	<0.86 mm	Total <4.7 mm
Station LRR					
	Sample 1	9.8	8.7	22.5	41.0
	2	8.4	8.4	19.1	36.9
	3	9.2	5.4	20.6	37.3
	Mean	9.1	7.5	20.6	37.3
	Stan. dev.	0.7	1.8	1.7	3.3
Station MR1					
	Sample 1	8.1	5.0	16.4	29.5
	2	6.3	6.8	19.1	32.2
	3	7.0	7.5	20.4	34.9
	Mean	7.1	6.4	18.6	32.2
	Stan. dev.	0.9	1.3	2.0	2.7
Station MR2					
	Sample 1	1.3	4.8	20.8	26.9
	2	1.8	2.6	18.6	23.0
	3	2.5	4.4	18.0	24.9
	Mean	1.9	3.9	19.1	24.9
	Stan. dev.	0.6	1.2	1.5	2.0
Station MR2A					
	Sample 1	7.9	7.7	19.0	34.6
	2	7.2	6.9	26.7	40.8
	3	7.8	8.2	21.7	37.7
	Mean	7.6	7.6	22.5	37.7
	Stan. dev.	0.4	0.7	3.9	3.1
Station MR2B					
	Sample 1	8.1	8.9	19.6	36.3
	2	6.4	6.3	18.8	31.5
	3	6.8	5.0	18.0	29.8
	Mean	7.1	6.7	18.8	32.6
	Stan. dev.	0.9	2.0	0.8	3.5
Station 3					
	Sample 1	4.9	7.6	10.6	23.1
	2	3.2	3.5	6.3	13.0
	3	16.6	21.0	18.8	56.4
	Mean	8.2	10.7	11.9	30.8
	Stan. dev.	7.3	9.2	6.4	22.7
Station 4					
	Sample 1	10.0	5.5	21.3	36.8
	2	11.9	10.4	18.8	41.1
	3	14.7	13.2	16.1	44.0
	Mean	12.2	9.7	18.7	40.6
	Stan. dev.	2.4	3.9	2.6	3.6
Station MR5					
	Sample 1	10.2	16.9	14.7	41.8
	2	9.2	17.3	16.1	42.6
	3	9.2	16.6	12.7	38.5
	Mean	9.5	16.9	14.5	41.0
	Stan. dev.	0.6	0.4	1.7	2.2
Combined sam. Mean		7.8	8.7	18.1	34.6
Combined sam. S.D.		2.9	3.9	3.4	5.5

Appendix I

Table No. _____ Volumes and Percentages of Size Categories in Substrate Samples[1]						
Location: Station LRR - Mattole River					Date: 9/13/90 McLeod	
Sieve Size[2]	Sample #1		Sample #2		Sample #3	
	Vol.	%	Vol.	%	Vol.	%
>1 inch (25.4 mm)	796	25.0	918	30.6	700	24.1
> 1/2 inch (12.5 mm)	511	16.1	530	17.6	705	24.3
> No. 4 (4.7 mm)	569	17.9	477	15.9	483	16.7
>No. 8 (2.37 mm)	310	9.8	253	8.4	268	9.2
Subtotal	2186	68.8	2178	72.5	2156	74.3
Fines						
>No. 20 (0.85 mm)	275	8.7	252	8.4	157	5.4
< No. 20 (0.85 mm)	716	22.5	575	19.1	590	20.3
Subtotal Fines	991	31.2	827	27.5	747	25.7
Total	3177	100	3005	100	2903	100

[1] Figures In Table represent averages for 3 samples.

[2] Greater than > Less than <

Table No. _____ Volumes and Percentages of Size Categories in Substrate Samples[1]						
Location: Station MR1 - Mattole River					Date: 9/12/90 McLeod	
Sieve Size[2]	Sample #1		Sample #2		Sample #3	
	Vol.	%	Vol.	%	Vol.	%
>1 inch (25.4 mm)	866	37.7	856	34.1	820	29.2
> 1/2 inch (12.5 mm)	412	17.9	448	17.8	561	20.0
> No. 4 (4.7 mm)	341	14.9	400	15.9	445	15.9
>No. 8 (2.37 mm)	186	8.1	158	6.3	197	7.0
Subtotal	1805	78.6	1862	74.1	2023	72.1
Fines						
>No. 20 (0.85 mm)	114	5.0	171	6.8	210	7.5
< No. 20 (0.85 mm)	377	16.4	481	19.1	574	20.4
Subtotal Fines	491	21.4	652	25.9	784	27.9
Total	2296	100	2514	100	2807	100

[1] Figures In Table represent averages for 3 samples.

[2] Greater than > Less than <

Table No. _____ Volumes and Percentages of Size Categories in Substrate Samples[1]

Location: Station MR2 - Mattole River						Date: 9/13/90 McLeod
Sieve Size[2]	Sample #1		Sample #2		Sample #3	
	Vol.	%	Vol.	%	Vol.	%
>1 inch (25.4 mm)	608	23.8	1024	44.4	1252	43.8
> 1/2 inch (12.5 mm)	860	33.7	439	19.0	468	16.4
> No. 4 (4.7 mm)	398	15.6	313	13.6	426	14.9
>No. 8 (2.37 mm)	34	1.3	42	1.8	72	2.5
Subtotal	1900	74.4	1818	78.8	2218	77.6
Fines						
>No. 20 (0.85 mm)	122	4.8	59	2.6	125	4.4
< No. 20 (0.85 mm)	531	20.8	430	18.6	514	18.0
Subtotal Fines	653	25.6	489	21.2	639	22.4
Total	2553	100	2307	100	2857	100

[1] Figures In Table represent averages for 3 samples.

[2] Greater than > Less than <

Table No. _____ Volumes and Percentages of Size Categories in Substrate Samples[1]

Location: Station MRR2A - Mattole River						Date: 9/13/90
Sieve Size[2]	Sample #1		Sample #2		Sample #3	
	Vol.	%	Vol.	%	Vol.	%
>1 inch (25.4 mm)	434	30.1	627	20.3	868	30.4
> 1/2 inch (12.5 mm)	472	16.9	618	20.1	455	15.9
> No. 4 (4.7 mm)	203	18.4	578	18.8	457	16.0
>No. 8 (2.37 mm)	203	7.9	222	7.2	223	7.8
Subtotal	1880	73.3	2045	66.4	2003	70.1
Fines						
>No. 20 (0.85 mm)	197	7.7	212	6.9	235	8.2
< No. 20 (0.85 mm)	487	19.0	823	26.7	620	21.7
Subtotal Fines	684	26.7	1035	33.6	855	29.9
Total	2564	100	3080	100	2858	100

[1] Figures In Table represent averages for 3 samples.

[2] Greater than > Less than <

Table No. _____ Volumes and Percentages of Size Categories in Substrate Samples[1]

Location: Station MR2B - Mattole River						Date: 9/20/90 McLeod
Sieve Size[2]	Sample #1		Sample #2		Sample #3	
	Vol.	%	Vol.	%	Vol.	%
>1 inch (25.4 mm)	742	26.5	748	25.7	659	24.6
> 1/2 inch (12.5 mm)	467	16.7	717	24.6	590	22.1
> No. 4 (4.7 mm)	567	20.2	529	18.2	628	23.5
>No. 8 (2.37 mm)	226	8.1	187	6.4	182	6.8
Subtotal	2002	71.5	2181	74.9	2059	77.0
Fines						
>No. 20 (0.85 mm)	250	8.9	183	6.3	134	5.0
< No. 20 (0.85 mm)	548	19.6	547	18.8	482	18.0
Subtotal Fines	798	28.5	730	25.1	616	23.0
Total	2800	100	2911	100	2675	100

[1] Figures In Table represent averages for 3 samples.

[2] Greater than >   Less than <

Table No. _____ Volumes and Percentages of Size Categories in Substrate Samples[1]

Location: Station MR3 - Mattole River						Date: 9/12/90 McLeod
Sieve Size[2]	Sample #1		Sample #2		Sample #3	
	Vol.	%	Vol.	%	Vol.	%
>1 inch (25.4 mm)	1385	50.7	753	28.9	870	29.1
> 1/2 inch (12.5 mm)	347	12.7	492	18.9	426	14.3
> No. 4 (4.7 mm)	324	11.9	522	20.1	624	20.9
>No. 8 (2.37 mm)	133	4.9	197	7.6	316	10.6
Subtotal	2189	80.2	1964	75.5	2236	74.9
Fines						
>No. 20 (0.85 mm)	88	3.2	91	3.5	188	6.3
< No. 20 (0.85 mm)	453	16.6	548	21.0	560	18.8
Subtotal Fines	541	19.8	639	24.5	748	25.1
Total	2730	100	2603	100	2984	100

[1] Figures In Table represent averages for 3 samples.

[2] Greater than >   Less than <

Table No. _____ Volumes and Percentages of Size Categories in Substrate Samples[1]						
Location: Station MR4 - Mattole River					Date: 9/18/90 McLeod	
Sieve Size[2]	Sample #1		Sample #2		Sample #3	
	Vol.	%	Vol.	%	Vol.	%
>1 inch (25.4 mm)	656	19.6	689	24.7	494	20.2
> 1/2 inch (12.5 mm)	716	21.4	367	13.2	369	15.1
> No. 4 (4.7 mm)	742	22.2	585	21.0	507	20.7
>No. 8 (2.37 mm)	334	10.0	333	11.9	358	14.7
Subtotal	2448	73.2	1974	70.8	1728	70.7
Fines						
>No. 20 (0.85 mm)	183	5.5	289	10.4	323	13.2
< No. 20 (0.85 mm)	714	21.3	524	18.8	392	16.1
Subtotal Fines	897	26.8	813	29.2	715	29.3
Total	3345	100	2787	100	2443	100

[1] Figures In Table represent averages for 3 samples.

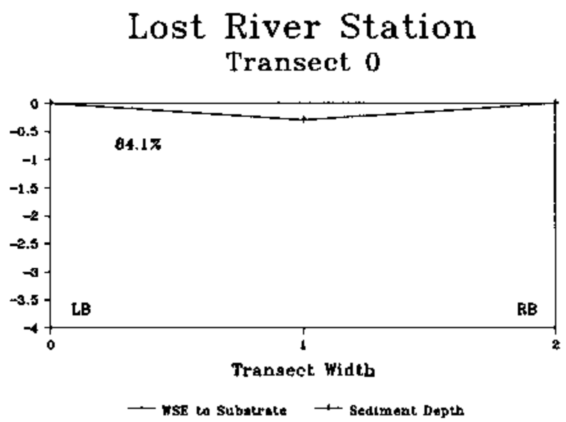
[2] Greater than > Less than <

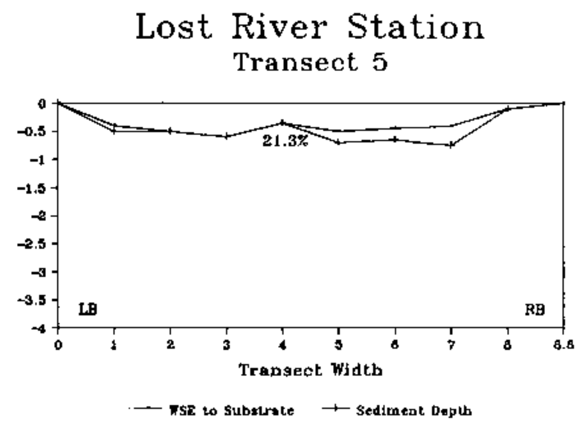
Table No. _____ Volumes and Percentages of Size Categories in Substrate Samples[1]						
Location: Station MR5 - Mattole River					Date: 9/18/90 McLeod	
Sieve Size[2]	Sample #1		Sample #2		Sample #3	
	Vol.	%	Vol.	%	Vol.	%
>1 inch (25.4 mm)	471	16.5	513	24.2	844	33.4
> 1/2 inch (12.5 mm)	457	16.0	315	14.9	344	13.6
> No. 4 (4.7 mm)	736	25.7	388	18.3	366	14.5
>No. 8 (2.37 mm)	292	10.2	194	9.2	234	9.2
Subtotal	1956	68.4	1410	66.6	1788	70.7
Fines						
>No. 20 (0.85 mm)	484	16.9	365	17.3	420	16.6
< No. 20 (0.85 mm)	420	14.7	341	16.1	320	12.7
Subtotal Fines	904	31.6	706	33.4	740	29.3
Total	2860	100	2116	100	2528	100

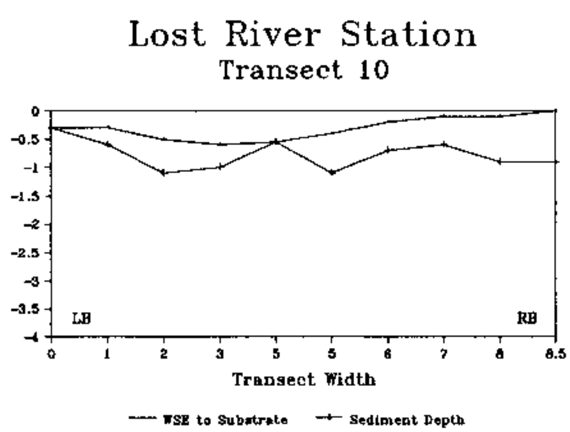
[1] Figures In Table represent averages for 3 samples.

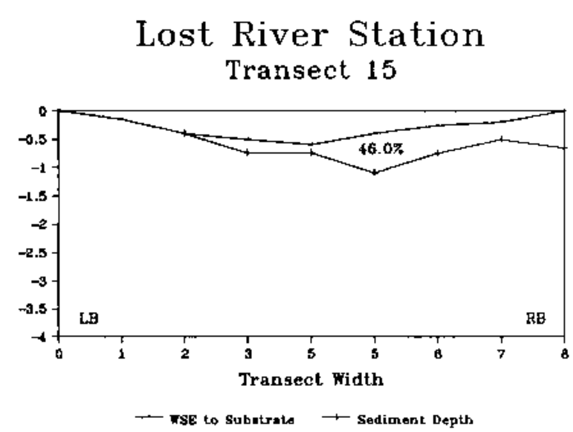
[2] Greater than > Less than <

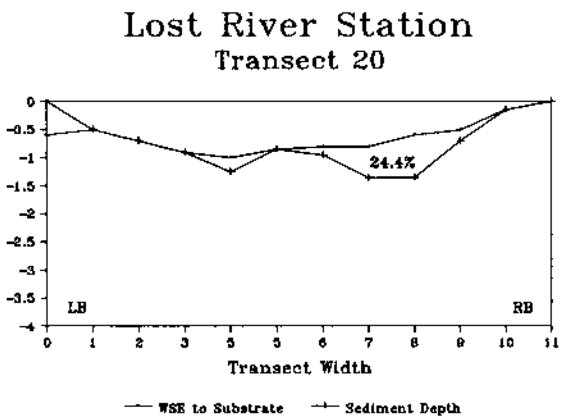
Appendix II

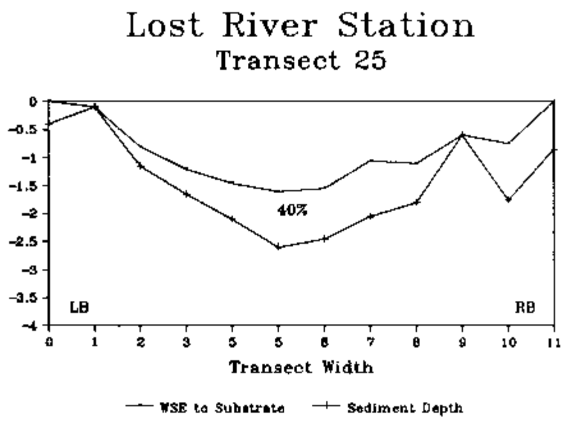

Lost River Station
Transect 0
84.1%
LB
RB
Transect Width
WSE to Substrate
Sediment Depth

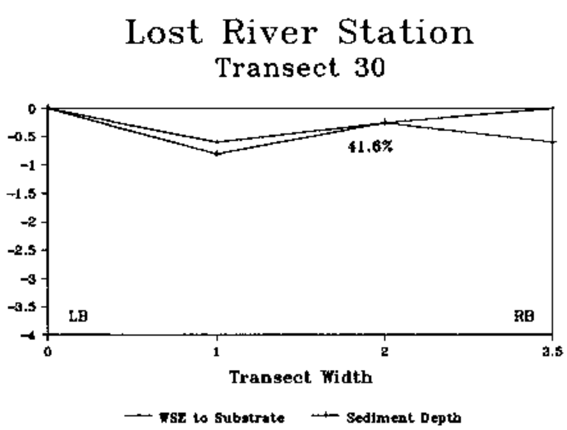

Lost River Station
Transect 5
21.3%
LB
RB
Transect Width
WSE to Substrate
Sediment Depth


Lost River Station
Transect 10
LB
RB
Transect Width
WSE to Substrate
Sediment Depth


Lost River Station
Transect 15
46.0%
LB
RB
Transect Width
WSE to Substrate
Sediment Depth

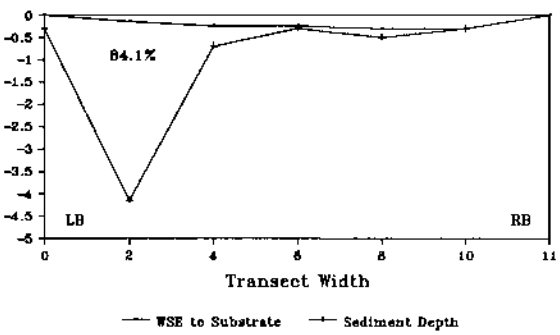

Lost River Station
Transect 20
24.4%
LB
RB
Transect Width
WSE to Substrate
Sediment Depth


Lost River Station
Transect 25
40%
LB
RB
Transect Width
WSE to Substrate
Sediment Depth

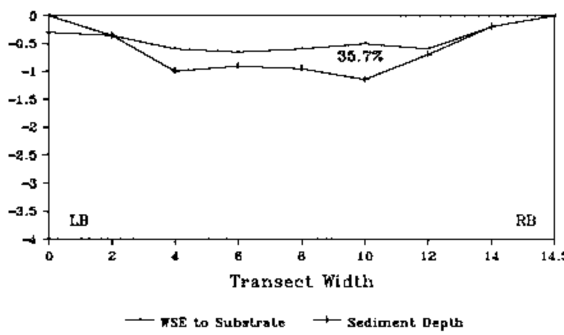

Lost River Station
Transect 30
41.6%
LB
RB
Transect Width
WSE to Substrate
Sediment Depth

Appendix III

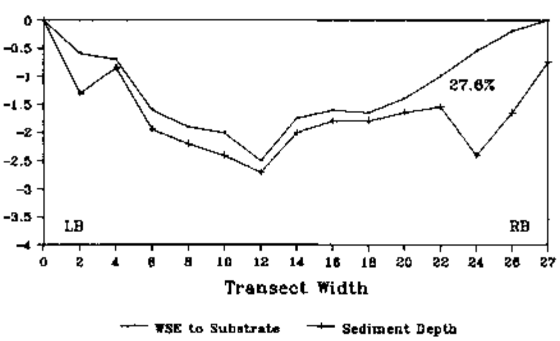
Mattole River Station MP#1
Transect 0



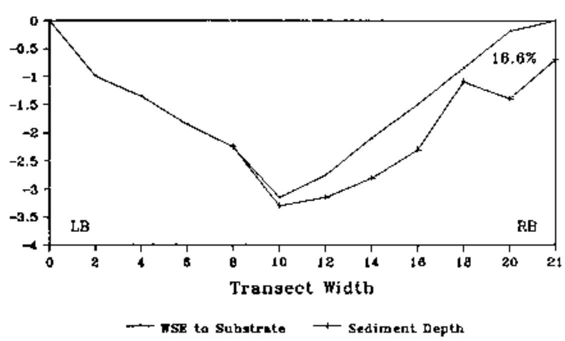
Mattole River Station MP#1
Transect 20

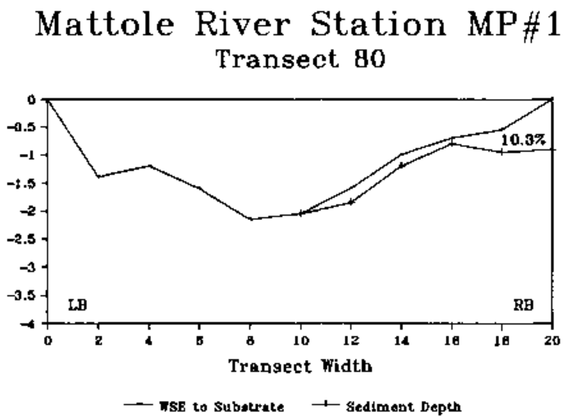


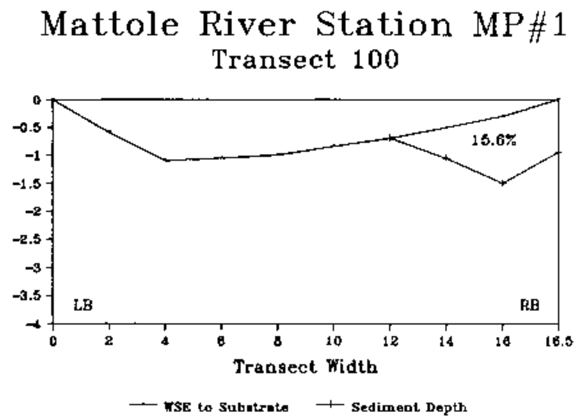
Mattole River Station MP#1
Transect 40

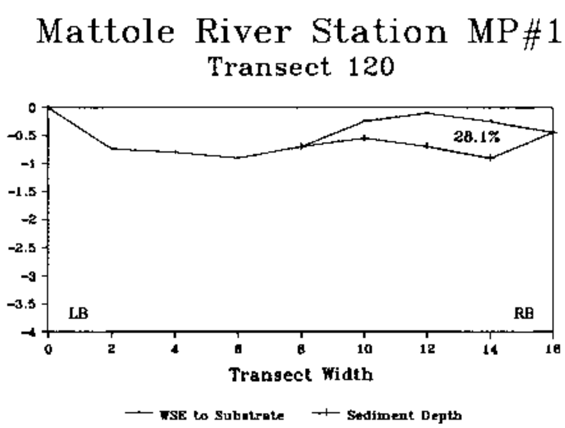


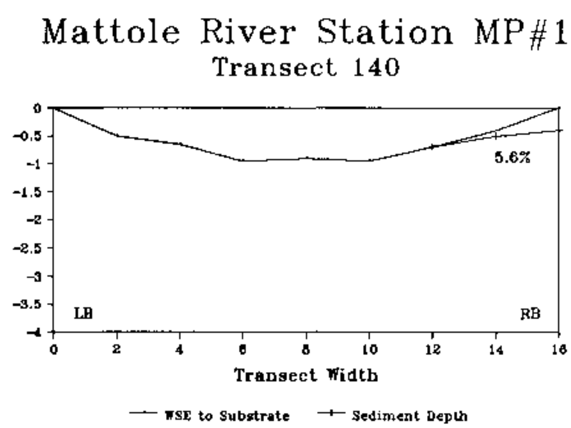
Mattole River Station MP#1
Transect 60



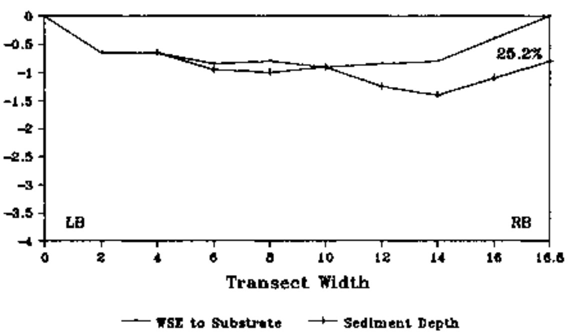

Mattole River Station MP#1
Transect 80
10.3%
LB
RB
Transect Width
WSE to Substrate
Sediment Depth


Mattole River Station MP#1
Transect 100
15.6%
LB
RB
Transect Width
WSE to Substrate
Sediment Depth

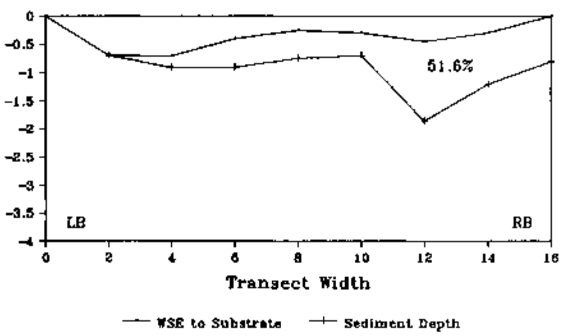

Mattole River Station MP#1
Transect 120
28.1%
LB
RB
Transect Width
WSE to Substrate
Sediment Depth


Mattole River Station MP#1
Transect 140
5.6%
LB
RB
Transect Width
WSE to Substrate
Sediment Depth

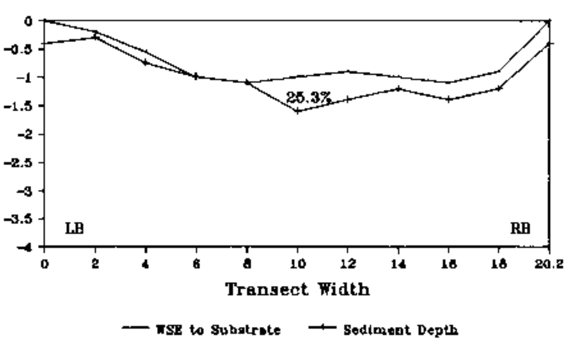
Mattole River Station MP#1
Transect 160



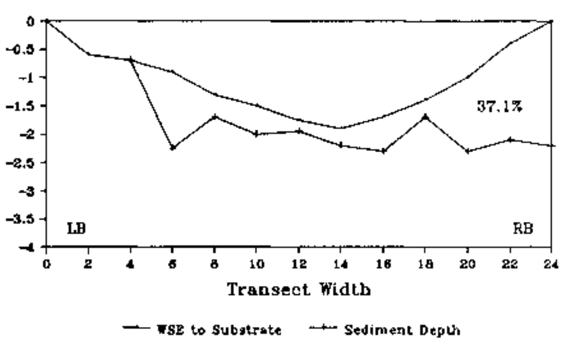
Mattole River Station MP#1
Transect 180



Mattole River Station MP#1
Transect 200

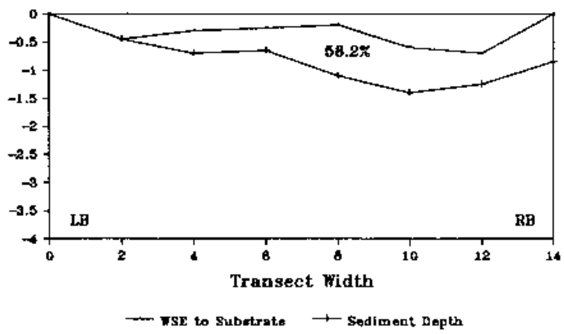


Mattole River Station MP#1
Transect 220



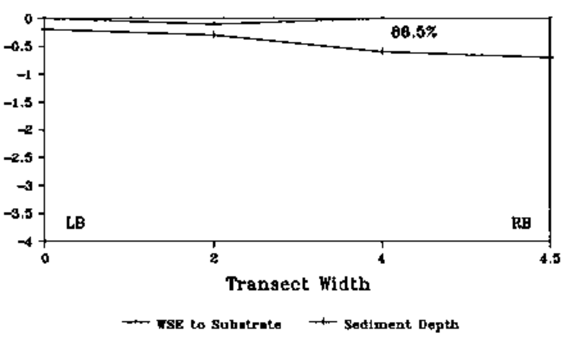
Mattole River Station MP#1

Transect 240

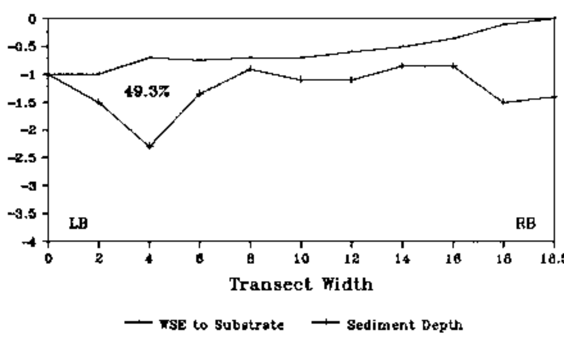


Appendix IV

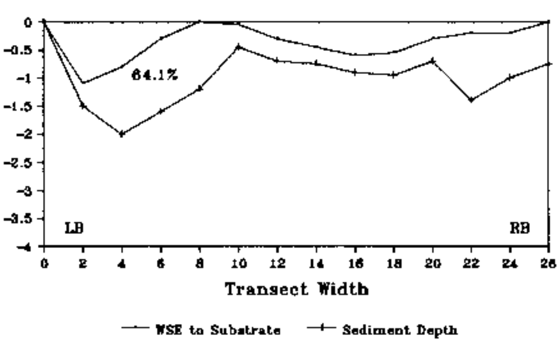
Mattole River Station MP#2
Transect 0



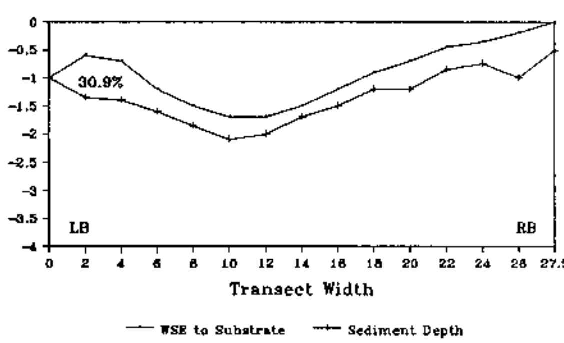
Mattole River Station MP#2
Transect 20



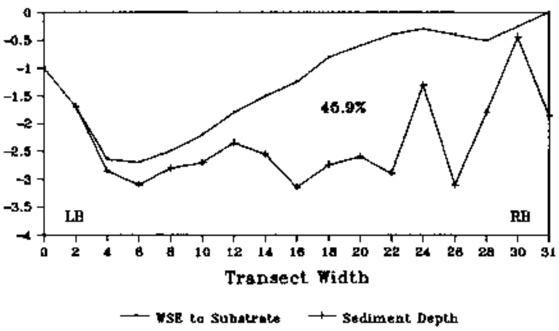
Mattole River Station MP#2
Transect 40



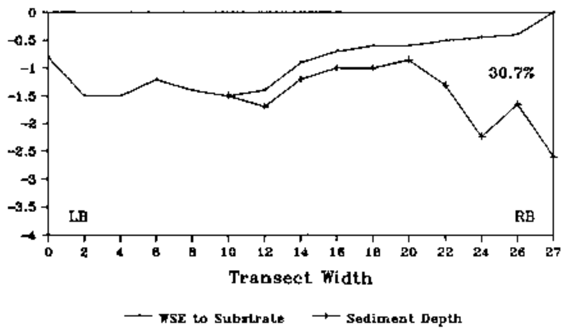
Mattole River Station MP#2
Transect 60



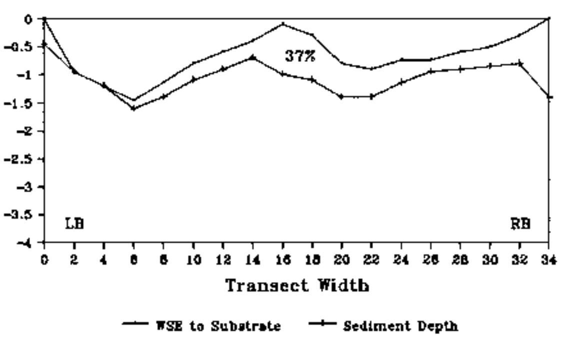
Mattole River Station MP#2
Transect 80



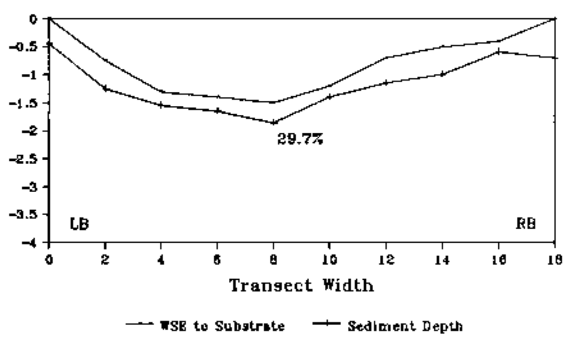
Mattole River Station MP#2
Transect 100

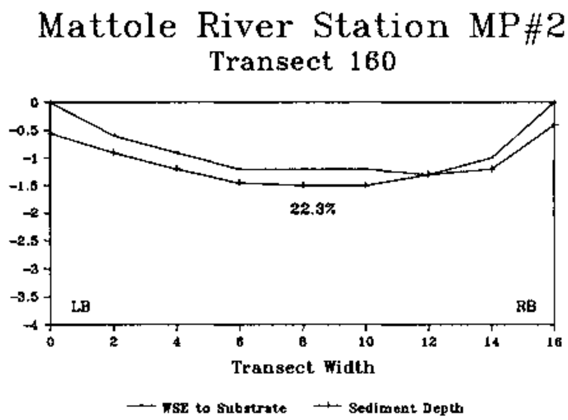


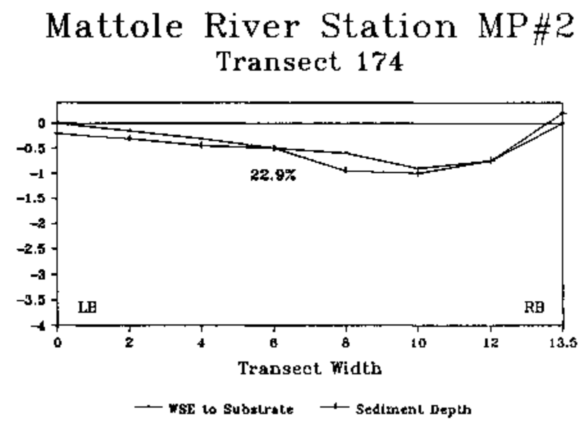
Mattole River Station MP#2
Transect 120



Mattole River Station MP#2
Transect 140




Mattole River Station MP#2
Transect 160
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
22.3%
LB
RB
0
2
4
6
8
10
12
14
16
Transect Width
WSE to Substrate
Sediment Depth


Mattole River Station MP#2
Transect 174
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
22.9%
LB
RB
0
2
4
6
8
10
12
13.5
Transect Width
WSE to Substrate
Sediment Depth

Appendix V

MATTOLE RIVER PHOTOGRAPHIC INDEX			
Photo No.	Stream	Station	Subject
1	Mattole River	MR1	500 feet upstream RM 1.25.
2	Mattole River	MR2	290 feet upstream county line.
3	Mattole River	MR2A	0.18 roadmiles upstream Stanley Creek.
4	Mattole River	MR2B	below Mill Creek mouth.
5	Mattole River	MR2B	below Mill Creek mouth.
6	Mattole River	MR3	below Briceland-Shelter Cove Road
7	Mattole River	MR4	below Ettersburg Bridge
8	Mattole River	MR5	below Honeydew Bridge
9	Lost Man Creek		log debris retaining gravel
10	Lost Man Creek	LMC	pool transect 475 feet from mouth
11	Lost man Creek	LMC	looking downstream at pool transect
12	Lost Man Creek	LMC	pool transect benchmark
13	Lost Man Creek	LMR	gravel sample location - looking DS
14	Lost Man Creek	LMR	gravel sample location - looking US
15	Lost Man Creek	LMR	looking downstream at bank failure
16	Lost Man Creek	LMR	looking upstream at bank failure
17	Lost Man Creek	LMR	pool 345 feet from mouth
18	Helen Barnum Creek		72 feet from the mouth
19	Stanley Creek		783 above mouth
20	Van Anken Creek		600 feet upstream of county road bridge
21	Mattole River		1006 feet downstream from Baker Creek
22	Mattole River	MP1	1292 feet downstream from Baker Creek
23	Mattole River	MP1	
24	Mattole River	MP1	
25	Mattole River		1313 feet upstream from Van Anken Creek.
26	Mattole River		2'3" of sediment
27	Mattole River		2613 feet upstream from Van Anken Creek.
28	Mattole River		1000 feet below Mill Creek
29	Mattole River		rope swing at Mill Creek confluence
30	Mattole River	MP2	1275 feet below Mill Creek
31	Mattole River	MP2	
32	Mattole River	MP2	
33	Mattole River	MP2	

note: These photographs are on file at the Eureka Office of the Department of Fish and Game