ASSESSMENT OF STEELHEAD HABITAT

IN UPPER MATILIJA CREEK BASIN

Stage One: Qualitative Stream Survey

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INTRODUCTION

The upper Matilija Creek watershed and the Coyote/ Santa Anna Creek watershed have both provided historic steelhead spawning and rearing habitats in the Ventura River system. The Matilija Dam was constructed in 1947 on lower Matilija Creek for the purpose of supplying water storage and flood control, but reservoir sedimentation and construction of newer projects has reduced the necessity of the dam (Figure 1). When built, the Matilija Dam blocked access of anadromous steelhead (*Oncorhynchus mykiss*) to upstream spawning areas. In subsequent years, the Robles Diversion Dam was constructed downstream of Matilija Dam and further blocked access. Declines in local steelhead populations led to a federal listing of steelhead as "endangered" in the Southern California Steelhead ESU. In attempts to help restore the Ventura Basin steelhead population, efforts are underway to provide access across Robles Diversion Dam, which would again allow migratory fish to reach Matilija Dam as well as the Lower North Fork Matilija. Because of Matilija Dam's limited function, an Ecosystem Restoration Feasibility Study was conducted by a multidisciplinary team to determine the ecological benefits of removing Matilija Dam for steelhead and other riverine dependent species. One recommendation of the feasibility study was to acquire additional data assessing the habitat quality of the Matilija Basin above the existing dam for spawning and rearing steelhead.

STUDY OBJECTIVES

In recent years, information has been assembled indicating that Matilija Creek above the dam may provide an abundance of high quality habitat if access is provided to upstream migrant steelhead (Chubb 1997). This first stage survey will provide a qualitative assessment of habitat characteristics and quality that can be compared to previous studies.

The first-stage survey will be used to accomplish four principal goals:

1) to provide detailed first-hand knowledge of the entire study area
2) to provide qualitative evaluations of habitat characteristics and quality for comparison with earlier work (e.g., Chubb 1997)
3) to fully describe the length of habitat accessible to anadromous steelhead, and
4) to adequately describe the sampling "universe" for the second-stage survey; from this information, efficient habitat stratifications can be employed to accurately estimate stream habitat characteristics in a statistically rigorous manner (i.e., to produce valid and comparable total and mean values with minimal variances)

The first-stage survey encompassed the entire length of stream accessible to anadromous steelhead, from the lower reaches upstream to the first naturally occurring absolute (or,

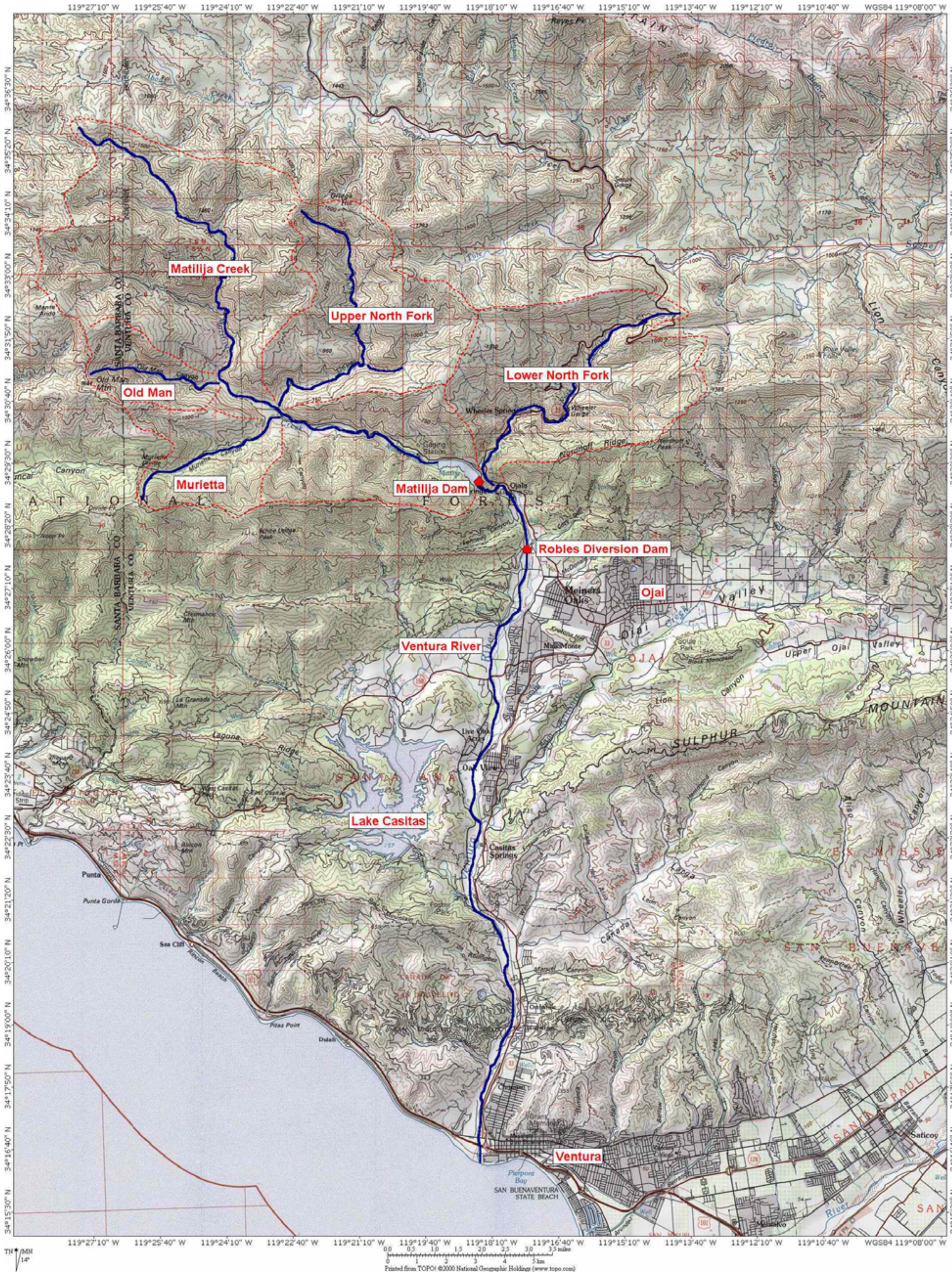

Figure 1. Map of upper Matilija Basin showing sub-watersheds and significant geographical features.

"definite") barrier to upstream migrating adult steelhead. The first-stage survey was conducted from March 9th through March 14th, 2003. This survey will be followed by a second-stage survey to collect more quantitative data within discrete reaches that will provide a more detailed assessment of habitat quantity and quality, however this report only describes the methodologies and preliminary results of the first-stage survey. A following report will detail results of the second-stage survey after it is completed, which is anticipated to occur by late-April 2003. Refer to the study proposal (TRPA 2003) for details regarding the methodologies anticipated for use in the second-stage survey.

METHODS

During the first-stage survey two fisheries biologists walked the full length of all targeted stream reaches, including the mainstem Matilija Creek above the reservoir and it's principal tributaries: Murietta Creek, Old Man Creek, the Upper North Fork Matilija Creek, and an unnamed tributary of the Upper North Fork. The Lower North Fork Matilija Creek (below Matilija Dam) was also surveyed in part (that survey will be completed in April 2003). First-stage surveys were used to visually assess the nature of and changes in the following habitat characteristics:

stream flow
water temperature (measured)
pH (measured)
channel type (gradient, confinement, dominant substrate)
riparian type (dominant vegetation type and density)
general appearance of adult steelhead resting pools

In addition to the above variables, the biologists also noted:

number and size range of observed salmonids (and other significant aquatic species such as frogs and turtles)
water diversions or other man-made structures
tributary confluences
average length of individual mesohabitat units

More detailed information was collected for the following habitat components:

frequency, size, and quality of gravel deposits suitable for steelhead spawning
potential barriers to upstream migration for adult steelhead

Each significant change in habitat characteristics or physical feature (i.e., barriers) was geo-referenced by pulling biodegradable hip chain while walking upstream, and by reference to topographical maps and Global Positioning System (GPS) coordinates (where coverage permitted). GPS waypoints and photographs were taken at (approximately) 1,000 ft intervals, which were also marked with a labeled flag. Water temperatures were measured with a hand-held thermometer at frequent intervals. Dissolved oxygen and pH were measured periodically using an YSI meter (model #550) and a Pinpoint pH monitor.

Channel Type

Channel types were visually classified as A, B, C, or D type channels (Rosgen 1994). The biologists used visual estimates of channel confinement, entrenchment, sinuosity, slope (calibrated with several measurements using a hand-held clinometer), and dominant substrate type to assess channel type.

Riparian Vegetation Type

The dominant vegetation observed along the streambanks was visually assessed using a simplified version of the Cowardin system (Cowardin et al. 1979) that was adapted for the Ventura Watershed (Mertes et al. 1995), by using the following categories:

Freshwater Marsh (FM): Emergents such as cattails, sedges, etc. in perennial/seasonal pools and ponds.

Alluvial Scrub (AS): Composed of drought tolerant chaparral species and scattered herbs in open cobble-dominated stream areas. Few willows and emergents only along water edge.

Riparian Scrub (RS): Composed of willow/mule fat thickets along channel and low flood benches. Most vegetation shorter than 6m (20 feet).

Riparian Forest (RF): Dominant cover of trees along stream with varying degrees of shrub and herbaceous understory. Common trees include cottonwood, alder, oak, bay laurel, maple, and willow.

Spawning Gravel

The approximate patch and particle size, percentage fines, and percentage embeddedness of spawning gravels were visually assessed if:

the dominant particle sizes were ½ to 3 inches in diameter
patches were at least 20 ft^2 in area
the deposit was no greater than (approximately) six inches above the water surface (at the time the survey was conducted)

The criteria for gravel particle and patch sizes were based on steelhead redd studies from a variety of locations (Orcutt et al. 1968, Reiser and White 1981, Raleigh et al. 1984, Hampton 1988, Pearsons et al. 1996), although comparative data was not found from the Southern California ESU. The criteria for gravel being no more than six inches above the water surface was subjectively chosen based on site-specific observations of gravel patch characteristics and professional judgment. Because streamflows in southern California streams are extremely "flashy" during the rainy season, and anadromous fish in general appear to avoid spawning in areas that are prone to dewatering (Shapovalov and Taft 1954), selecting an elevation criteria that is too high would likely result in an overestimation of gravel availability during most years, however a criterion too low would, on average, produce underestimates of gravel availability. Because spawning gravels need to be wetted with flowing water during an extended period of incubation for eggs and sac-fry (typically at least one month or more, Barnhart 1986, Moyle 2002), gravel deposits perched significantly above winter and spring base flow levels for a given year would not likely be usable by spawning steelhead.

A more accurate determination of the "optimal" height criterion would likely require the establishment of stage-discharge relationships in typical spawning areas, or repeated visits to gravel deposits under a variety of spring streamflows. Although neither of these options was feasible for this short-term study, one storm event did occur during data collection that allowed a qualitative evaluation of the stage-discharge relationship. During the March 15th storm event, a temporary gage placed in the Matilija above the reservoir increased from at height of 8 inches (at 12 cfs) to 18 inches (approximately 400 cfs according to the USGS gage), a difference of 10 inches. Thus, an increase of six inches (the gravel height criterion) from the existing base flow would likely result in flows of 200 cfs or more. Tracking the USGS gage data following the March storm event showed that flows dropped to below 200 cfs within one day and below 50 cfs within three days.

Thus, under the dry conditions that existed in the spring of 2003, the six inch criteria would be expected to include the majority of spawning gravels potentially available to steelhead. However, under wetter years, higher base flows during the winter and spring and a more frequent occurrence of storm events could make gravels deposits perched at higher levels available for spawning. Although historical streamflow data shows that mean monthly flows in January, February, and March were less than 20 cfs in 11 to 13 of the 21 years of records, mean monthly statistics are not highly descriptive of the flashy, dynamic nature of streamflows in Southern California steelhead streams. Southern stocks of steelhead are thought to be particularly adapted to take advantage of seasonal and annual cycles of high precipitation, and thus evaluation of gravel deposits using two or more elevation criteria would likely provide more options for assessing gravel availability under a variety of water years.

Many of the gravel patches in the Upper Matilija Basin were "cemented" by mineral deposits. The degree of cementation was qualitatively assessed by dislodging particles in the streambed. Some cemented patches were assessed both before and after the March 15th storm event to determine if such deposits were physically loosened by the high flows.

Barriers to Upstream Migration

Whenever a potential barrier to upstream migration was encountered, the survey paused to conduct a detailed assessment of the barrier characteristics. Each potential barrier was photographed from several angles and sketched to clearly illustrate each barrier component including the barrier materials, the jump pool depth, the vertical and horizontal extent of each required jump or chute, etc. In addition, each barrier was evaluated in terms of its expected likelihood of blockage (e.g., "possible", "probable", or "definite"), while using professional judgment to attempt to account for a range of seasonal streamflows and adult jumping abilities.

All first-stage surveys were terminated at a definite barrier except in two circumstances:

1. the barrier was man-made, in which case it might be removed through future mitigation or enhancement measures, and
2. in the upper mainstem Matilija Creek where we were requested to survey up to the prominent "falls", which were approximately 2,000 ft above an impassable falls 18 ft in height

To assist the evaluation of each potential barrier, the biologists referred to a figure quantifying the relationship between jump height and jump distance for adult steelhead (Figure 2). The figure was a composite of data representing the jumping ability of steelhead in "bright" condition and in "good" condition (Orsborn 1985). It was further assumed that the maximum jumping height of a steelhead was no greater than the depth of the jumping location (for pools less than eight feet deep, Reiser and Peacock 1985). This 1:1 ratio is a liberal estimate compared to the traditional estimate of 0.8:1 from Stuart 1964. We then used the jumping charts for the "good" condition fish to distinguish between passable barriers and possible barriers. The jumping charts for bright steelhead were used to distinguish between possible barriers and definite barriers. Possible barriers were sometimes classified as "probable" barriers if additional factors, such as characteristics of the jumping or landing areas, appeared to reduce the efficiency of a jump.

Several barriers were revisited on 14 and 15 April 2003 immediately after a storm event in order to assess these barriers at a flow higher than observed during the March survey. However, the rapidly dropping flows were not substantially higher than the previous survey and thus were probably not representative of higher flows when steelhead migration would be expected to occur. Physical characters of these barriers were re-measured and photographed. Ideally, all barriers are best evaluated at higher flows, however such flows were so flashy during this survey that a complete reassessment of all barriers could not be accomplished within the scope of this study. Consequently, the ultimate evaluation of passage over "probable" or "possible" barriers will likely be dependent upon further study and the presence of migrating steelhead.

RESULTS

The upper Matilija Basin study area was divided into 22 reaches above the reservoir and two reaches for the Lower North Fork Matilija Creek. Reach boundaries were delineated based on stream channel characteristics, particularly streamflow, channel type, riparian type, and presence of definite barriers (Table 1). Figure 3 shows the upper basin study area with streamflow characteristics (flowing versus dry or intermittent), reach

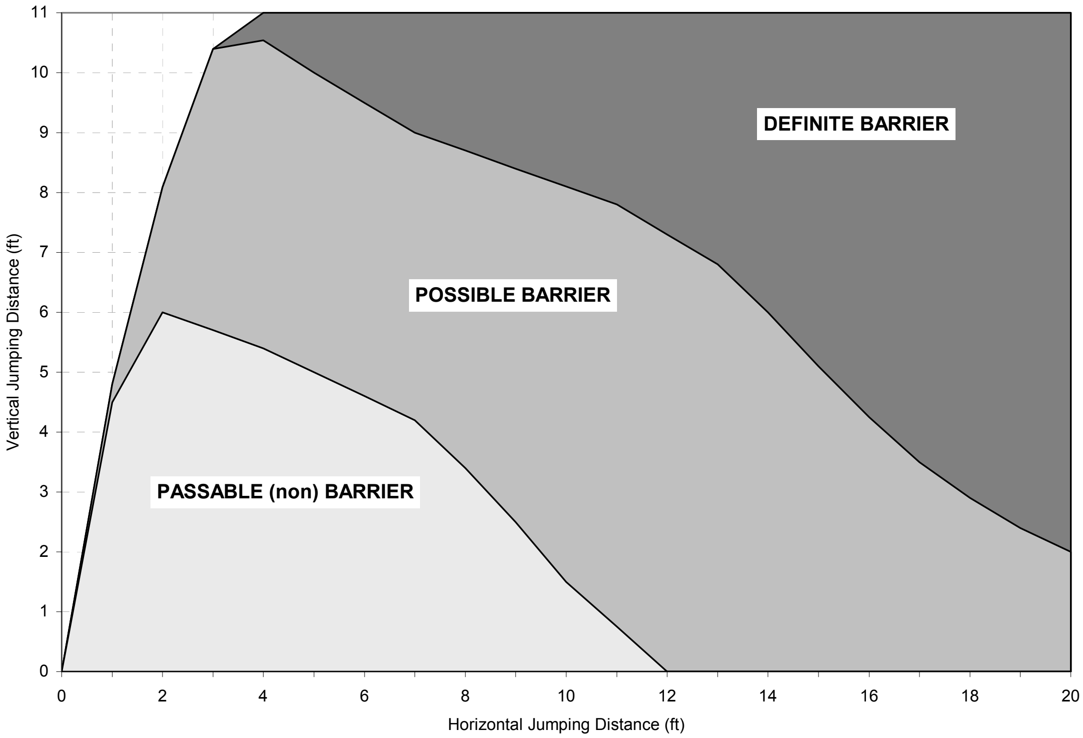

Figure 2. Barrier jumping chart used to assess degree of passage for upstream migrating adult steelhead. Based on data from Orsborn (1985).

boundaries, approximate river miles, and all identified barriers (possible or definite). Barriers are identified by the GPS waypoint number associated with each barrier (Table 2). See Appendix A for a list of waypoint information, Appendix B for stage-one mapping data, and Appendix C for photos of barriers. Approximate boundaries of channel types and riparian types in the upper basin are shown in Figures 4 and 5, respectively. Data pertaining to the Lower North Fork is shown in Figure 6. Physical and biological characteristics of each reach will be described individually. All data (except for the upper portion of the Lower North Fork) were collected during March 2003 following one of the driest water years in the past 100 years, consequently the following descriptions of streamflows, barrier dimensions, and fish populations should be interpreted in light of the existing drought conditions.

Upper Matilija Creek (mainstem)

The mainstem Matilija was mapped for 8.60 miles on 9, 10, and 13 March 2003, by two biologists. Water temperatures measured throughout the day ranged from 59-66°F in the lower mainstem (above the reservoir) and 53-58°F in the upper mainstem (above the Upper North Fork). Dissolved oxygen (D.O.) and pH were measured in the lower mainstem at 10.2 mg/l and 8.25, respectively. In the upper mainstem, D.O. was 8.4 mg/l. Measured streamflows during the survey were 12.4 cfs in the lower mainstem, 0.9 cfs above the Upper North Fork confluence, and approximately 5 cfs (eye-estimated) in the upper mainstem above Old Man Creek.

Table 1. Physical characteristics of reaches in the upper Matilija Basin and the Lower North Fork Matilija Creek based on first-stage surveys, March 2003 (April for LNF 2). Gravel density is in ft^2/1,000 lineal feet, and only includes deposits within six inches of the March/ April water surface elevation. Refer to map for reach and barrier locations. Reaches not included for selection of HSI study sites are shown with an asterisk, the reason for exclusion is given in the notes (additional HSI details will be in a following report). Riparian types are FM=freshwater marsh, AS=alluvial scrub, RS=riparian scrub, RF=riparian forest. Fish are NGF=non-game fry, RBT=rainbow trout.

Stream	Reach	Waypoints	River Mile	Reach Length (ft)	Flow Status	Barrier ID #'s poss / definite	Channel Type	Riparian Type	Gravel Density	Gravel Cementation	Fish Observed	Notes
Matilija (mainstem)	* MAT 1	1-4	0.00-0.36	1,900	flowing	- / -	C - D	RS, FM	372.1	low	0	1
	* MAT 2	4-11	0.36-1.14	4,100	flowing	- / -	C - D	RS	0	high	10 NGF	2
	MAT 3	11-22	1.14-2.80	8,779	flowing	- / -	C	RS	14.2	medium	~ 900 NGF	3,4
	* MAT 4	22, 500	2.80-4.10	6,860	n/a	n/a	n/a	n/a	n/a	n/a	n/a	5
	MAT 5	500-517	4.10-5.01	4,826	flowing	- / -	B	AS,RS,RF	50.6	high	0	
	MAT 6	517-535	5.01-6.48	7,731	flowing	- / -	B	AS, RS	67.8	low	0	
	MAT 7	535-550	6.48-8.18	9,018	flowing	"steepchut",544 / 550	B	RF	67.2	low	4 RBT	
	* MAT 8	550-"Falls"	8.18-8.60	2,171	flowing	552 / "falls"	B - A	RF	0	low	0	6
Old Man	* OLD 1	64-70	0.00-0.37	1,960	intermittent/dry	65 / -	A - B	AS	0	high	0	7
	OLD 2	70-79	0.37-1.16	4,146	flowing	74 / -	B	RF	50.7	medium	2 RBT	
	* OLD 3	79-85	1.16-1.67	2,737	dry	- / -	A - B	AS	135.9	medium	0	7
	* OLD 4	85-90	1.67-2.15	2,532	flowing	- / -	A	RF	11.1	medium	0	8
	* OLD 5	90-91+	2.15-2.29 *	710	dry	91 / -	A	AS	n/a	n/a	0	7,12
Upper NF Matilija	UNF 1	23-34	0.00-1.26	6,649	flowing	- / -	B	RF	81.1	medium	5+ RBT	9
	UNF 2	34-39	1.26-1.99	3,851	flowing	- / -	C	AS	0	high	1 RBT	
	UNF 3	39-47	1.99-2.70	3,743	flowing	45 / -	B	RF	17.6	medium	1 "fish"	9
	UNF 4	47-63	2.70-4.08	7,291	flowing	49,51,62 / 63	B - A	RF	15.9	medium	12 RBT	10
Upper NF Trib	UNFT 1	92-99	0.00-0.82	4,318	flowing	- / 100	B	RF,AS	42.6	low	5 RBT	10
Murietta	* MUR 1	600-601	0.00-0.17	909	flowing	- / -	B	RF,RS	0	none	1 RBT	11
	* MUR 2	601-602	0.17-0.26	467	dry	- / -	B	RS	0	none	0	7
	MUR 3	602-620	0.26-1.62	7,154	flowing	611,612,613,617 / -	B	RF	82.9	none	1 RBT	
	* MUR 4	620-627+	1.62-2.13 *	2,700	intermittent/dry	622 / 625	B	RF	0	none	0	7,12
Lower NF Matilija	LNF 1	101-123,701-710	0.00-4.26	22,493	flowing	- / 710	B	RF	416.1	medium	26 RBT, redds	
	LNF 2	710-728	4.26-6.85	13,675	flowing	721,722	B-A	RF,RS	0.02	medium	7 RBT	13

Notes:
1 reach appeared to be backwater (lake) influenced
2 most of reach w/in historic lake zone and thus likely to be modified after dam removal
3 4,909 ft of this mapped reach is private, HSI study site selection restricted to remaining 3,870 ft
4 HSI study site will be approximately 3,000 ft long due to longer habitat unit lengths (all other sites are ~2,000 ft long)
5 private land, not mapped, reach length estimated from map
6 reach above definite barrier, will not provide steelhead habitat
7 channel dry or intermittent during spring survey, therefore not expected to provide summer rearing habitat
8 flow minimal during spring survey, therefore not expected to provide summer rearing habitat
9 reaches 1 and 3 similar, therefore combined prior to selection of HSI study site
10 5,870 ft of UNF above a highly probable barrier, therefore HSI site selected from lower 1,421 ft and UNFT 1 (tributary) combined
11 flowing section short, therefore excluded from selection of HSI study site
12 reach length includes additional dry channel above last WP
13 LNF 2 survey completed in April 2003

Table 2. Physical characteristics of potential barriers in the upper Matilija Basin and the Lower North Fork Matilija Creek. See Figures 3 and 6 for barrier locations.

Reach	Barrier ID#	River Mile	Barrier Type	Barrier Composition	Jump Pool Depth (ft)	Jump Distances (ft) Vertical	Jump Distances (ft) Horizontal	Barrier Category	Notes
MAT 7	"steepchut"	7.09	chute	bedrock	n/a	n/a	n/a	possible	45 ft long chute at 30 deg.; 2 ft wide, 3-4 in deep
MAT 7	544	7.51	chute	bedrock	n/a	n/a	n/a	probable	50+15 ft long chutes at 30-50 deg.; 3 ft wide, 2-3 in deep
MAT 7	550	8.18	falls	bedrock	4	18	40	definite	
MAT 8	552	8.38	falls	bedrock	3	10	5	probable	
MAT 8	"falls"	8.6	falls	bedrock	n/a	50*	n/a	definite	* visual estimate
OLD 1	65	0.02	falls	boulder	3*	7.5*	8*	possible	* dry channel; possible side channel at high flows
OLD 2	74	0.66	falls	boulder	2.5	6	12	possible	
OLD 5	91	2.14	falls	bedrock	1.2 / 1.2	4.5 / 3.8	11 / 7.5	probable	two distinct jumps at current flow
UNF 3	45	2.43	falls	bedrock	5	5	12	possible	
UNF4	49	2.85	falls	bedrock	2.0 / 2.0	8.5 / 3.5	22 / 10	probable	two distinct jumps at current flow
UNF4	51	2.97	falls	bedrock	2	5.7	29	probable	
UNF4	62	4.00	falls	bed/bldr	5	7.5	14	probable	
UNF4	63	4.08	falls	bedrock	5	11	16	definite	
UNFT	100	0.82	falls	bedrock	5	100*	190*	definite	* visual estimate of several large drops combined
MUR 3	611	0.89	falls	boulder	2	4	8	possible	
MUR 3	612	0.94	falls	boulder	2	5	12	possible	
MUR 3	613	1.01	falls	boulder	4	7	7	probable	
MUR 3	617	1.5	falls	boulder	4.5	4	8	possible	
MUR 4	622	1.74	falls	boulder	1	5	6	possible	
MUR 4	625	1.94	falls	boulder	1.5	11	10	definite	after rain distance was 7.3' vert & 15' horiz, depth 4.3'
LNF 1	710	4.26	road Xing	concrete	2.5	11	18	definite	man made
LNF 2	721	~6.00	cascade	boulder	1.3	8	13	probable	
LNF 2	722	6.07	falls	boulder	2.6	6.5	28	probable	

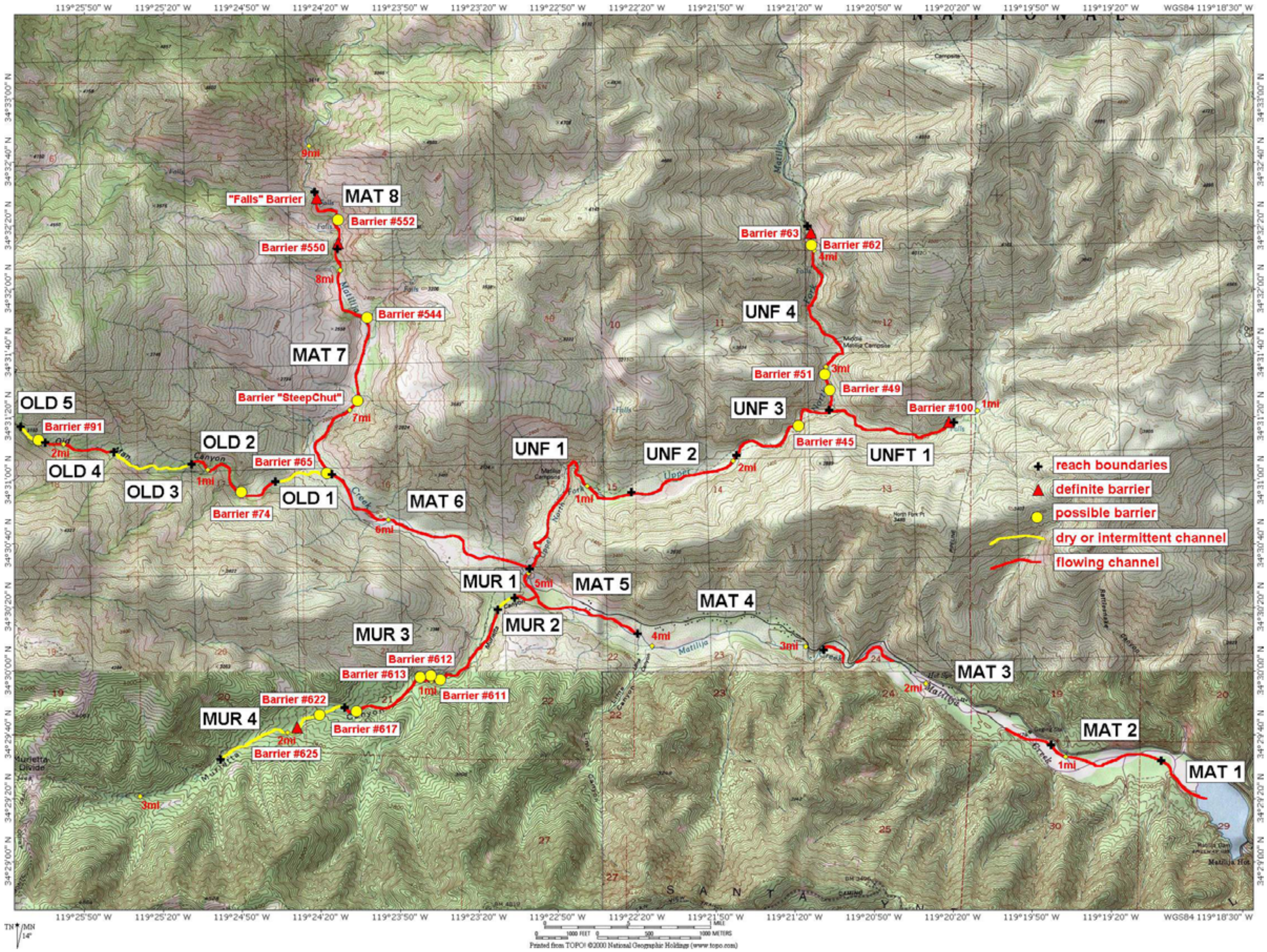

Figure 3. Map of the upper Matilija Basin showing reach boundaries, dominant streamflow characteristics (colored lines), and barrier locations. Channels not outlined were not mapped.

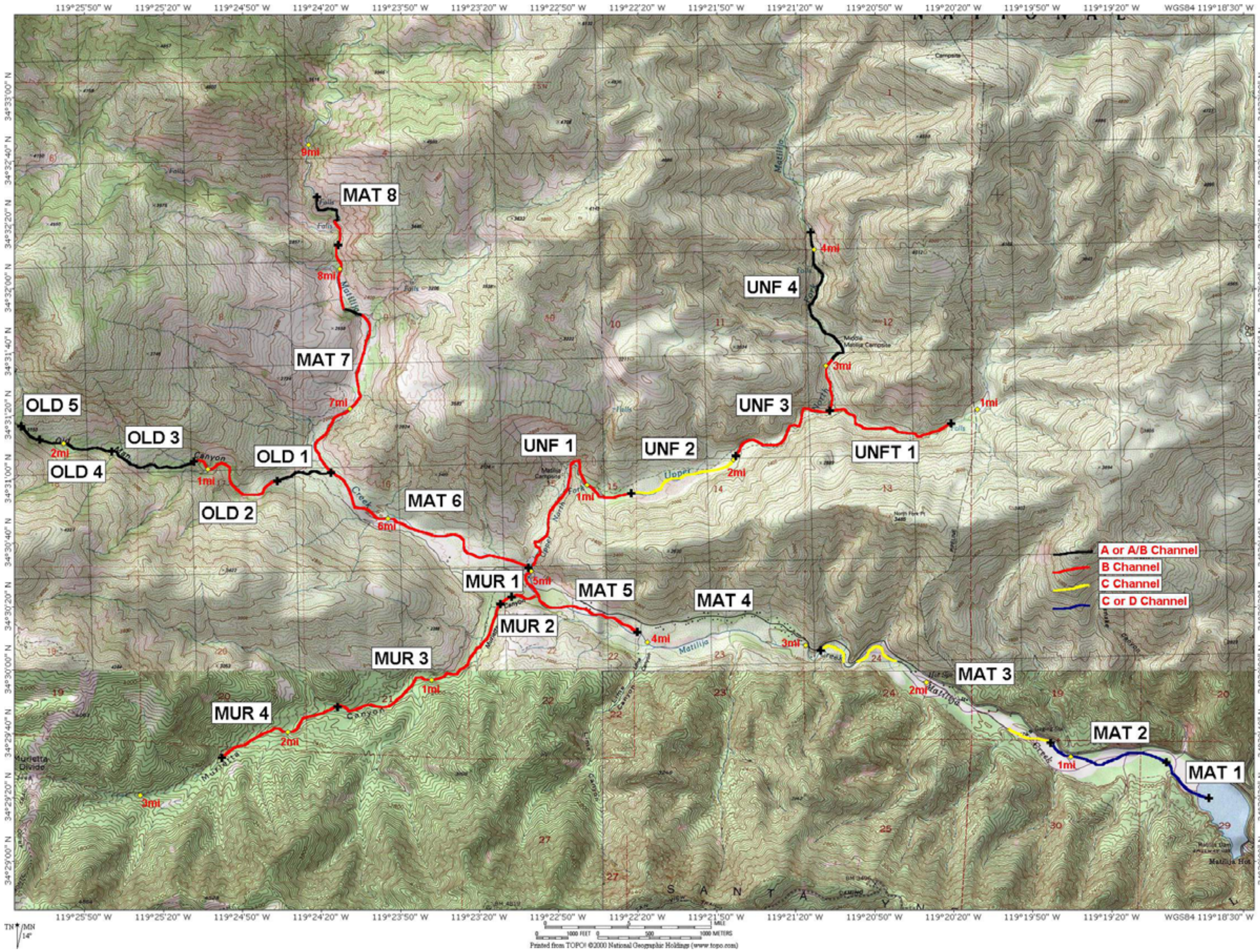

Figure 4. Map of the upper Matilija Basin showing reach boundaries and dominant channel types (colored lines). Channels not outlined were not mapped.

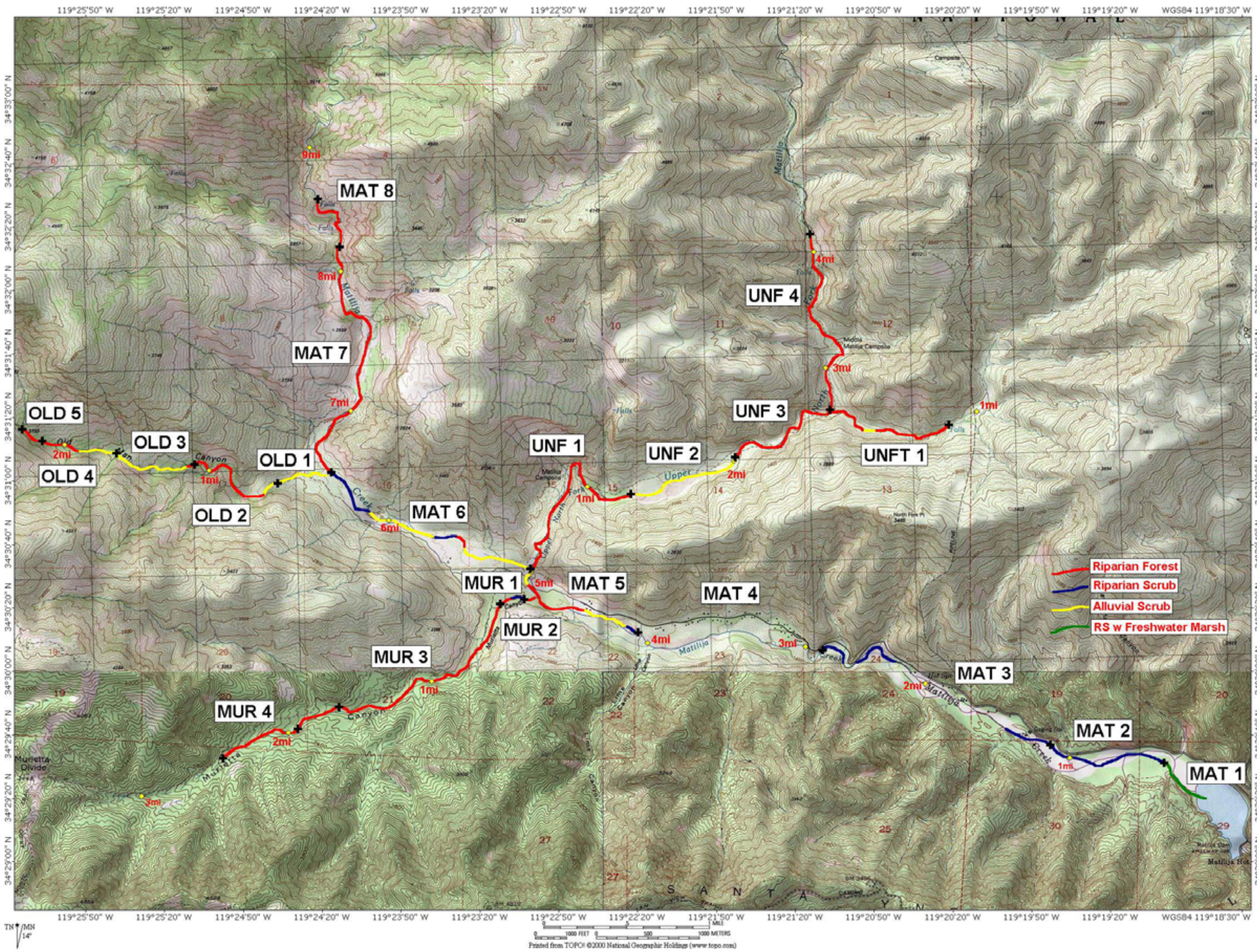

Figure 5. Map of the upper Matilija Basin showing reach boundaries and dominant riparian types (colored lines). Channels not outlined were not mapped.

MAT 1

This portion of the Matilija is probably under the direct effect of the reservoir, becoming inundated at higher flows. Consequently, finer substrates including gravel were relatively abundant within this section of the stream. The relative density and quality of gravel in this reach was exceeded only in the Lower North Fork (Table 1). The stream channel was frequently braided, and many were lined with *Arundo*, willow, mule-fat, and some marsh species such as cattails (Figure 5). Algae and other aquatic vegetation were common. No fish or potential barriers were observed. Overall, the spawning habitat in this reach was good, but the rearing habitat was judged to be fair to good.

MAT 2

Older topographic maps (i.e., Figure 1) and personal communications with Water Department personnel have indicated that much of this reach is within the historical lake level (Table 1). Consequently, channel characteristics in this section could change considerably following removal of the dam. The flood plain was wide with some split channels. The riparian vegetation was dominated by *Arundo*, mule fat, and willow (Figure 5). There were several good holding pools in this reach. Substrate was cobble dominated, and no spawning gravel was observed in this section. Mineral deposits were beginning to be more evident in this section. The surfaces of gravel, cobbles, and boulders were physically gritty due to the deposits, which effectively "cemented" the particles together. These deposits appeared to significantly reduce substrate quality for spawning, and benthic invertebrate production appeared to be very low. However, it is unknown to what degree these depositions are removed or if gravels are significantly loosened during winter and spring high-flow events. Several gravel deposits were revisited in April following the March 15th storm event, but such deposits showed little evidence of becoming significantly loosened following that event. This mineral cementation is seen throughout most of the basin. There were about 10 non-game fry observed in this section, but no trout were observed. No potential barriers were encountered. Despite the mineral effects and paucity of fish, the overall physical appearance of this reach was fair to good.

MAT 3

This reach was mapped in its entirety, however further access will be restricted to small, disjunct portions of this reach due to private property (Table 1). In this section of the river the slope increased slightly, and there were more boulders. The flood plain alternately widened and then narrowed, but the overall channel character of the stream was similar (Figure 4). There was much less *Arundo* through this reach where mule fat and willow dominated (Figure 5). There were good holding pools, and no barriers, but good spawning gravel was rare. Several hundred non-game fry (probably arroyo chub, *Gila orcutti*, and/or stickleback, *Gasterosteus aculeatus*) were observed throughout this reach, however no rainbow trout were observed. This reach would probably not be a significant spawning area, but for rearing it appeared to provide fair to good habitat.

MAT 4

This reach was not surveyed due to private property. It is unlikely that barriers to upstream migration exist in this reach due to the channel's low gradient.

MAT 5

The first portion of this reach was visually characterized as a C channel type, however after 800 ft the creek transitioned into a more confined B channel and remained that way throughout the remainder of the reach (Table 1, Figure 4). Riparian forest species dominate the banks, although short areas of riparian scrub and alluvial scrub also occurred (Figure 5). There were few holding pools in this reach, and streambanks appeared highly unstable in some locations. No barriers were observed, although the road crossing would prevent passage during periods of low flow. At the time of this survey, Murietta Creek, which enters the mainstem in the upper portion of this reach, and the Upper North Fork, which enters at the upper reach boundary, contributed a significant portion of the streamflow within this reach. There were also numerous sulfur springs contributing flow to this reach approximately 500-1,000 ft below Murietta Creek, and the few spawning gravels available were highly cemented. There were no trout observations in this reach. The overall rating for rearing habitat in this reach is fair.

MAT 6

During this survey the streamflow in the mainstem decreased significantly above the Upper North Fork confluence (0.9 cfs versus 12.4 cfs in the lower reaches), and local landowners indicated that this portion of the channel frequently goes dry or intermittent during periods of low flow. However, this reach contained many holding pools and good spawning gravels, with some occasional light cementing (Table 1). Boulders were the dominant substrate type in this B channel (Figure 4). Alluvial scrub dominated most of this reach but the upper end transitions into riparian scrub then riparian forest (Figure 5). No barriers were encountered in this reach. The overall habitat rating was judged as good.

MAT 7

This long reach contained good spawning gravels and numerous deep holding pools (Table 1). Large boulders dominated the substrate with short sections of bedrock canyon with low and high-angled bedrock ledges. Riparian forest species dominated the bank and contributed more woody debris than was observed in lower reaches (Figure 5). There were four rainbow trout, five western pond turtles, and a few frogs observed in this reach. However, access for steelhead will be difficult in the upper portion of this reach due to two probable barriers (barriers "steepchut" and #544) before the definite barrier (barrier #550) at the top of the reach (Table 2, Figure 3, Appendix C). Overall, the spawning and rearing habitat rating for this reach was judged as good.

MAT 8

This reach is believed to be inaccessible to steelhead because of barrier #550, which is an 18 ft bedrock falls at the downstream boundary (Table 2, Figure 3). In this steep, confined reach the weathered bedrock walls contributed lots of gravel-sized rock that were noticeably sharper and more angular than the downstream gravels. Riparian forest dominated this B and A channel reach (Table 1, Figures 4 and 5). In addition to a significant 10 ft falls halfway up this reach (barrier #552), the reach was terminated by a spectacular 50 ft waterfall (Table 2, Appendix C). This waterfall is a frequent destination for local hikers, which has a highly distinctive appearance due to the bedrock geology and heavy mineral deposition.

Upper North Fork Matilija Creek

The Upper North Fork Matilija was mapped for 4.08 miles by one biologist on 10 and 11 March 2003, and 0.82 miles of an unnamed tributary was mapped on 13 March. Streamflow measured at the mouth was 3.2 cfs on 7 March, and was eye-estimated at approximately 1½ cfs in both the mainstem and the unnamed tributary at that confluence. Water temperatures ranged from 50-58^{o}F, and the D.O. and pH measured near the confluence with the Matilija were 8.4 mg/l and 8.23, respectively.

UNF 1

Good spawning gravel was observed throughout this reach with some patches of excellent gravel, although some cementing was evident (Table 1). Overall, the substrate in this B channel was boulder dominated and the riparian vegetation was dominated by alder (Figures 4 and 5). Good holding pools were present with some large woody debris. No barriers were observed. Five rainbow trout were observed in this reach, as well as many non-game fish. Overall rating for spawning and rearing in this reach was judged as good to excellent.

UNF 2

This reach abruptly opened up into a C channel with a much wider flood plain, some split channels, and a relatively low slope (Table 1, Figure 4). Very little canopy cover was present in this reach, the dominant vegetation was sparse mule fat and willow (Figure 5). Despite the lower gradient, there was virtually no spawning gravel, but more silt in this reach than in UNF 1. Cobble substrates were highly cemented. There were some good holding pools in this reach, however only one rainbow trout was observed. No barriers were observed in this reach. Overall the habitat rating for rearing was judged as fair to good, with little spawning habitat.

UNF 3

In this reach the flood plain narrowed and the riparian forest returned (Table 1, Figures 4 and 5). The substrate was dominated by boulders and bedrock, but slack water areas frequently contained fine silt. Although there was some good spawning gravel throughout this reach, the cementing of some gravel was still evident. Access was good with one possible barrier (barrier #46, Table 2, Figure 3, Appendix C). One unidentified fish was observed in this reach. Overall, the habitat rating for this reach was good.

UNF 4

This reach begins immediately above the confluence with the unnamed tributary (Figure 3). Here, the stream channel became narrower and steeper, and transitioned from a B channel to an A channel (Figure 4). In this reach several potential barriers were encountered (barriers #49, #51, #62, and #63). Barrier #63 was judged as a definite barrier to upstream migrant steelhead, but barrier #49 also appeared formidable (Table 2, Appendix C). The substrate was dominated by boulders and bedrock, with fine silt in deep pools. Overhead, the channel was enclosed by thick riparian forest (Figure 5). There were 12 positive rainbow trout observations in this reach. The overall habitat quality appeared good, but access may be restricted to a short length below barrier #49.

UNFT 1

This is an unnamed tributary entering the Upper North Fork from the east approximately 2.7 miles upstream from its mouth (Table 1). With an estimated 1.5 cfs of flow, this stream was very similar to reach UNF 4. The channel was largely a B type with a dominant substrate of boulders, and a riparian forest dominated by alders (Figures 4 and 5). There were holding pools throughout the reach with good patches of spawning gravel having fairly little cementation. Five rainbow trout were observed in this reach. This reach terminated at a definite barrier (#100) composed of several waterfalls with a combined vertical drop of approximately 100 ft (Table 2, Figure 3, Appendix C). Overall the habitat quality rating for this tributary was judged as good.

Murietta Creek

Murietta Creek was mapped for 2.13 miles by one biologist on 11-12 March 2003. Streamflow on 7 March was 1.2 cfs at the mouth, but surface flow varied considerably along the mapped length. D.O. and pH measured at the mouth were 9.2 mg/l and 7.5, respectively (the pH value is approximate). Water temperatures ranged from 53-58^{o}F.

MUR 1

The lower 900 ft of Murietta Creek contained flowing water to its confluence with Matilija Creek (Table 1, Figure 3). On March 7th this flow was measured at 1.2 cfs. No barriers or spawning gravels were observed in this reach, and boulders dominated the substrate. Riparian scrub dominated the vegetation but riparian forest species (alder and oak) were present on upper flood terraces and they provided some woody debris in the stream channel (Figure 5). One rainbow trout was observed. The rearing habitat in this reach appeared good, but the stability of surface flow during summer months is unknown.

MUR 2

This reach consisted of approximately 500 ft of dry B channel (Table 1, Figure 4). Stream channel was less confined than downstream and contained a large split channel. Riparian forest species dominated banks on the upper flood terrace but riparian scrub dominated the channel margins (Figure 5). Because of the dry channel it is doubtful that this reach provides much rearing habitat, except during intermittent periods of higher flow. No barriers were observed, although assessment of barriers is difficult in the absence of surface flow.

MUR 3

Steelhead access to this long reach could be difficult given the periodically dry channel downstream and the presence of several possible barriers (barriers #611, #612, #613, #617, Table 2, Appendix C). At approximately 5,900 ft upstream, an unnamed tributary adds significant flow. Gradient in this B channel varies between 2 to 4% with small to medium boulders (and occasional large boulders) dominating substrate (Table 1, Figure 4). Spawning gravels were numerous and showed none of the mineral cementing found in most other sub-basins. Riparian forest was dense throughout most of the reach and woody debris was plentiful. Although many excellent holding pools were present, only one rainbow trout was observed. Overall the spawning and rearing habitat in this reach was judged as good, although the access and stability of streamflows remains questionable.

MUR 4

This upper reach had intermittent flow or was dry. Occasional holding pools were found to have water, but they were stagnant and choked with algae and surface flow was inconsistent. One possible barrier (barrier #622) exists halfway up this reach and a barrier initially classified as definite (barrier #625) was located near the top boundary (Figure 3, Table 2, Appendix C). The channel remained dry for approximately one-half mile above the last barrier. The dry or intermittent nature of flow in this reach suggests very poor habitat potential in most normal or dry water years. When originally evaluated barrier #625 occurred in a dry channel, however when re-visited under flowing conditions the barrier exhibited less severe passage characteristics (Table 2, Appendix C).

Old Man Creek

Old man Creek was mapped for 2.29 miles by one biologist on 12 March 2003. Surface flow was absent at the confluence with the mainstem Matilija and in some upstream reaches, in other reaches flows were eye estimated at ½ to 1 cfs. Water temperatures in flowing reaches ranged from 55-62^{o}F. D.O. and pH were not measured.

OLD 1

Most of this reach was completely dry making access to the rest of the stream impossible at the current flow (Table 1). Access at higher flows would probably be difficult, due to some steep cascades and falls (barrier #65, Table 2, Figure 3, Appendix C). Less than 300 ft of this reach contained intermittent flow (<0.5 cfs), and no fish observed in this portion of the stream. No spawning gravel was observed in this reach, and the overall habitat rating for this reach was poor.

OLD 2

This relatively long B reach contained surface flow with good riparian forest cover and good patches of gravel (Table 1, Figures 3, 4, and 5), although some gravels were cemented. Two rainbow trout observed in this reach. Overall, the habitat rating for this reach was judged to be good, although the dry channel downstream and a possible barrier (barrier # 74, Table 2, Appendix C) could restrict access to this habitat.

OLD 3

This reach was dry with a few intermittent pools (Table 1, Figure 3). Although good spawning gravel was abundant in this reach, it is difficult to tell how much would be usable during higher flows. This reach was relatively open with alluvial scrub vegetation and increasing gradient, although no barriers were observed (Figures 4 and 5). Due to the instability of flows in this reach, the habitat potential was judged as poor except perhaps during wet years.

OLD 4

Although surface flow existed in this steep reach, it was very minimal. There was only one patch of spawning gravel noted in this reach, and no fish were observed (Table 1). No barriers were observed. Overall, the habitat quality in this reach was judged as poor.

OLD 5

This reach was relatively steep, open, and dry (Table 1, Figures 4 and 5). The survey ended at a potential barrier (barrier #91, Figure 3, Table 2, Appendix C), but the channel continued dry for at least another 500 ft. The habitat quality in this reach was judged as poor.

Lower North Fork Matilija Creek

The lower 5.12 miles of the Lower North Fork were mapped by two biologists on 14 March 2003, and an additional 1.95 miles was mapped on 13 April 2003. On 9 March, streamflow was measured at 3.9 cfs, and D.O. and pH were 9.15 mg/l and 7.8, respectively. Measured water temperatures ranged from 55-60^{o}F.

LNF 1

The Lower North Fork of the Matilija appeared to contain some of the best habitat for steelhead spawning and rearing within the upper basin. The majority of the channel was type B and was enclosed by riparian forest or, in Wheeler Gorge, by canyon walls (Table 1, Figure 6). Spawning gravels were very abundant and in good condition, although there was some mineral cementation in areas. Rainbow trout were frequently observed, and several redds and spawning adults were also seen during the March survey. Potential access for steelhead was good throughout most of this reach, despite some steep cascades and falls in the lower end that were expected to be passable at higher flows. There was, however, a definite man-made barrier at a road crossing in the Wheeler Gorge Campground (barrier #710, Table 2, Figure 6, Appendix C).

LNF 2

Most of this reach was surveyed on 13 April 2003 during a rainstorm. Streamflow above the confluence with Cannon Creek was approximately one-half of the flow in LNF 1. The flow continued to decrease further upstream and was eye-estimated at 0.5 cfs at waypoint #715, but was dry for a distance of 160 ft between waypoints 724 and 725 (Figure 6). There were two probable barriers in this reach (barrier #'s 721 and 722, Table 2, Appendix C). There was 220 ft^2 of spawning gravel, and one 4 inch trout noted in this reach. Most of the stream channel was type B with some sections of A channel. The vegetation was predominantly riparian forest with some riparian scrub with dense brush. The survey ended approximately 0.45 miles below the Highway 33 barrier at waypoint #728, due to inclement weather and thick brush.

At the Highway 33 crossing a definite barrier exists, however detailed data was not collected at this barrier. It consisted of a long (~100 ft), sloped concrete culvert that dropped 6-8 ft into a shallow plunge pool. It appeared to be impassable to steelhead due to both the vertical jump into the culvert and the extreme velocities that would be expected to occur in the sloped culvert during passage flows. During a preliminary site visit in March the channel was dry above the Highway 33 barrier for a distance of approximately ¼ mile, however perennial surface flow is reported to occur farther upstream where a spring enters the channel (Mark Capelli, NMFS, personal communication). Unless the downstream barriers at the campground and at the Highway 33 crossing were removed, this upper portion of the Lower North Fork would not be available for steelhead rearing.

DISCUSSION

Summary of First-Stage Survey Results

If Matilija Dam is removed and passage is provided past Robles Diversion Dam, steelhead could potentially have access to approximately 8.2 miles of habitat in the mainstem Matilija Creek, 4.9 miles in the Upper North Fork (including the unnamed tributary), at least 2.3 miles in Old Man Creek, 1.9 miles in Murietta Creek, and 4.3 miles in the Lower North Fork (Table 2). Together, approximately 21.6 miles of habitat could

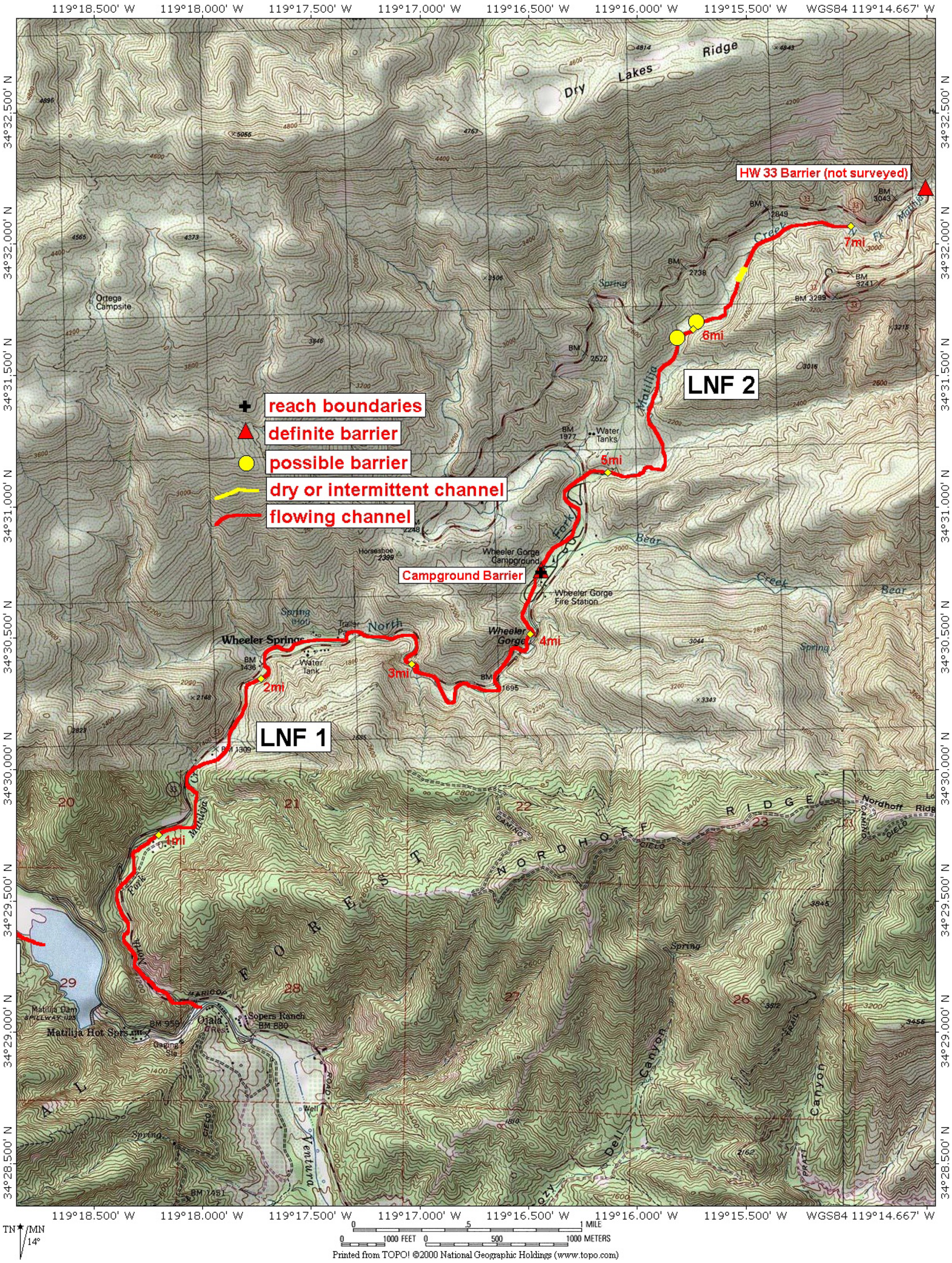

Figure 6. Map of Lower North Fork Matilija Creek showing reach boundaries and barrier locations. Most of the channel was B-type with surface flow and riparian forest. Channels not outlined were not mapped.

be provided, with an additional two to three miles of habitat if the definite barrier at the Wheeler Campground was removed. Of the 21.6 miles, 6.7 miles occur above "possible" barriers to upstream migration (Table 2), and thus such areas may not be accessible to steelhead. Also, 1.5 miles of the potentially accessible habitat were either dry or intermittent during the March survey, and thus such areas would be unlikely to provide summer rearing habitat except during wetter years (Table 1, Figure 3).

Of the 21.6 miles of potentially accessible habitat, 1.3 miles were visually judged as being "good to excellent" habitat (UNF 1), 12.7 miles were judged as "good" habitat, 3.5 miles were judged as "fair to good" habitat, 0.9 miles was judged as "fair" habitat, and 1.9 miles were judged as "poor" quality habitat, mostly because of unstable flow regimes. The remaining 1.3 miles were not mapped due to private property (Table 1).

Most of the "good" spawning and rearing habitat in the mainstem Matilija was located in the upper portions of the watershed, whereas the lower reaches typically contained little spawning habitat and only "fair" or "fair to good" rearing habitat (the exception being Mat 1, which contained abundant gravels due to the lake influence). In contrast, the smaller tributaries Old Man Creek and Murietta Creek contained the best habitat in their lower or middle reaches. The uppermost reaches of both streams contained very low flows or were already dry during the March surveys. The intermediate-sized tributaries (the Upper North Fork and the Lower North Fork) contained consistently good habitat throughout all of the mapped reaches.

More quantitative habitat measurements will be collected during the second-stage survey in April 2003 and should help to refine these subjective classifications of habitat quality.

Comparison of First-Stage Assessments with Existing Data

The most comprehensive source of previously existing habitat data is from U.S. Forest Service (USFS) reports (Chubb 1997), which gives a good overviews of the Matilija and adjacent basins and the historical land-use activities, and summarizes stream survey information collected in 1979 (Moore 1980). Some data contained in the "Chubb Report" will be more thoroughly evaluated following the second-stage survey in April 2003, which is intended to collect quantitative information on specific habitat parameters. However, some information from the first-stage survey can be compared to data presented in the Chubb Report, although photo replication of the Chubb maps showing barrier locations, streamflow characteristics, fish densities, etc. is inadequate to exactly compare locations between the USFS report and our results. Also, the Chubb Report bases several conclusions on detailed habitat or fisheries information that is not clearly described, hence it is difficult to make direct comparisons without knowledge of the methodologies employed.

Barriers to Upstream Migration

A rough comparison of the number and locations of barriers shows several similarities and dissimilarities. For example, the Chubb Report shows some barriers classified as "complete" that are relatively close to the barriers we classified as "definite" in the upper mainstem Matilija and the Upper North Fork (Figure 3, Table 2). However, the Chubb Report also shows complete barriers in the Lower North Fork that we did not encounter (or, that we judged differently). Also, we identified a number of "possible" barriers in Old Man Creek and in Murietta Creek that were not identified in the Chubb Report. Given the lack of detail in how barriers were assessed for the Chubb Report, it is difficult to give a cause for these differences. Even with the semi-quantitative methodology that we employed, a significant amount of "professional opinion" is ultimately involved in most evaluations, and the streamflow conditions that exist during the survey can also have a large effect on the final assessment. Despite the ambiguities inherent to barrier assessment, the results can clearly have significant effects on the overall estimation of potential steelhead habitat. As previously discussed, a thorough barrier analysis is best performed under flow conditions typical during upstream migration and, ideally, in the presence of migratory steelhead. Neither option was feasible during this short-term study.

Channel Streamflow Characteristics

The Chubb Report's characterizations of channel flow regimes also differed significantly from the conditions that we encountered in the March survey. For example, the Chubb Report appeared to classify the flow regime in Old Man Creek as perennial, whereas we found alternating sections of dry, intermittent, and flowing channels (Table 1). We also suspect that the mainstem Matilija above the Upper North Fork (Mat 6) may become intermittent by late-summer, based on the very low flows measured in March (<1 cfs) prior to the spring rain events, and based on reports from local landowners. Obviously, the assessment of a streams flow regime as dry or intermittent is best done during the summer low flow period, and such conditions will vary annually depending upon preceding rainfall history. However, one might expect that dry or intermittent channels during a March survey would likely be dry during the summer and fall months, despite the occurrence of late-spring rain events as experienced in 2003. Additional details regarding the flow history in the upper Matilija Basin preceding this survey will be discussed in a following report describing the analysis of Habitat Suitability Index (HSI) data.

Availability of Spawning Gravels

The Chubb Report indicated that spawning habitat was most common in the Lower North Fork, the upper reaches of the mainstem, portions of the Upper North Fork, and in Murietta Creek. In general, our assessment of the availability of spawning gravels is similar, with highest densities (>400 ft^2/1,000 ft) of spawnable gravel in the Lower North Fork, and intermediate densities (50-100 ft^2/1,000) in the upper mainstem, the lower portion of the Upper North Fork, and in Murietta Creek. We also found substantial gravels in the lowest reach of the mainstem and in middle reaches of Old Man Creek. The gravels in the lower mainstem may not persist following dam removal, however, and those in Old Man Creek may only be occasionally available during years of adequate streamflows.

Mineral Deposition on Substrate Materials

The Chubb Report describes the mineral depositions found within substrate materials in much of the upper basin. We found lower levels of mineralization in the Lower North Fork, the upper mainstem, and Murietta Creek, than in other portions of the basin. The report suggests that high winter and spring flows will adequately loosen cemented gravel deposits, as has been suggested by other local biologists (Mark Capelli, NMFS, personal communication). We found that gravel cementation was prevalent in most areas of the upper basin during our March survey, which suggests that mineralization may be common during the period of steelhead egg and fry incubation in some years. A number of gravel deposits were revisited in April to assess whether the 15 March storm event did loosen cemented gravels. There appeared to be very little loosening of gravels, however the winter and early spring of 2003 produced very few high flow events and thus the degree of cementation observed during this survey may be significantly greater than in an "average" year.

The Chubb Report also suggested that the mineral content in the surface waters would produce a productive environment for aquatic invertebrates and abundant food supplies for fish. However, our cursory evaluation of the benthic community (i.e., looking under rocks) suggested that invertebrate production was relatively low. Additional work on water quality and benthic production would help to determine if food supplies would be expected to limit growth and survival of juvenile steelhead.

Fish Population Information

As part of our first-stage survey, biologists scanned pool habitats and other rearing areas for the presence of fish. Bankside observation can be expected at best to produce only a rough idea of relative fish distribution and abundance, and should not be assumed to represent fish densities that are representative of the true population. The Chubb Report does not state how trout density estimates were derived, but clearly the densities they reported far exceeded the fish observations we made during our March surveys. Nevertheless, some similarities are evident. For example, the Chubb Report indicated highest densities of trout fry in the Lower North Fork, the upper portion of the Upper North Fork, and the upper mainstem. Likewise, our observations suggested highest abundance of trout in the Lower North Fork and in the Upper North Fork.

Because of the highly unstable nature of streamflows in many areas of the Matilija Basin, it is likely that extreme annual variation will occur in fish population abundance. Consequently, such "snapshot" assessments of fish distribution and abundance can be highly misleading and should be viewed with caution. Additional details regarding the potential effects of drought conditions on fish populations and habitat characteristics in the upper Matilija Basin will be discussed in following report describing the HSI study.

CONCLUSIONS

The upper Matilija Basin (including the Lower North Fork) has the potential to provide significant spawning and rearing habitat for steelhead, if access is provided past Robles Diversion Dam and Matilija Dam. The qualitative first-stage assessment suggested that the "best" habitat, in terms of accessibility, flow characteristics, gravel quality, and instream habitat, was present in the upper mainstem, the Lower North Fork, and the Upper North Fork. Seasonally dry or intermittent channels (during spring incubation and summer rearing periods), barriers to upstream migration, and mineralized cementation of spawning and food production areas are several significant factors that may limit potential production of steelhead in portions of the upper basin, particularly during drought conditions like those existing during this survey in March 2003.

A more quantitative second-stage survey was subsequently conducted in April within specified reaches selected to represent differences in habitat character. Quantitative habitat values (HSI scores) will then be expanded for comparison with qualitative assessments, and to provide overall estimates of habitat quality/habitat area for spawning and rearing steelhead in the upper Matilija Basin. These results will be presented in a following report.

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