

*Juvenile Steelhead Population Monitoring in the
French Creek Watershed
1992 – 2005*



Prepared for the
French Creek Watershed Advisory Group

by

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Abstract

The French Creek watershed was identified as a major contributor of fine sediment to the Scott River. In 1992 the French Creek Watershed Advisory Group formed and developed watershed monitoring programs to assess various habitat restoration efforts. One component of those programs was the establishment of a long term fish monitoring program. Following preliminary surveys in 1990, six survey reaches were established in 1992 and electrofished annually through 2005. Steelhead, *Oncorhynchus mykiss*, were identified as an indicator species, thus abundance and biomass were used as indicators of stream health. Juvenile steelhead abundance was highest in the lower reaches of the watershed. Biomass estimates for all survey reaches combined appear to be relatively stable from 1992-2005. A high degree of inter-annual and inter-reach variability exists in biomass density (grams of steelhead per m³ of stream). Much of that variability is driven by spatial and temporal differences in cohort and size classes within specific habitats of the watershed (i.e. the presence of a few large adults in specific habitats in certain years). Length analysis suggests that larger individuals were often found higher in the watershed where gradient and velocity was greater than the lower reaches. The exception to this was the Miners Creek site where habitat complexity and pool depth provided ample habitat for larger individuals and a broader range of cohorts. In addition to steelhead, juvenile coho salmon, *Oncorhynchus kisutch*, were observed during the surveys. Of particular importance was the discovery of one strong year class with two much weaker cohorts. It also appears that the upstream extent of anadromy for juvenile coho exists between survey reaches FC3 and FC4, approximately 9.6-10.8 km. As with steelhead, instream habitat complexity may allow for relatively high abundance of juvenile coho while accommodating multispecific communities.

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Introduction/Background

French Creek is tributary to the Scott River in Siskiyou County, California (Figure 1). Decomposed granitic soils are a dominant geological feature of the west side of the Scott Valley in which the French Creek watershed is a part. A watershed assessment of fine sediment levels in the substrate of the Scott River and of a number of its major west slope tributaries identified the French Creek Watershed as a major contributor of fine sediments to the Scott River (Sommarstrom *et al.* 1990). Out of concern for this high sediment delivery, the French Creek Watershed Advisory Group (FCWAG) was formed in 1992. This group is comprised of landowners within the French Creek watershed, local, State and Federal agency personnel and a local volunteer (consultant).

After identifying and prioritizing the major drainage related problems within the French Creek watershed, the FCWAG prepared a Road Management Plan, and a Fire and Fuel Management Plan for the French Creek watershed. The primary goal of these plans is to reduce the yield of fine sediment in the watershed and reduce the potential for negative cumulative watershed effects. In order to assess the efficacy of these plans as well as habitat restoration efforts in the watershed, the FCWAG also developed the French Creek Watershed Monitoring Plan. The goal of the monitoring plan is to:

“..assess trends in instream conditions affected by sand-sized sediment which relate to change in, or need for changes in, land use practices in the granitic terrain of the French Creek watershed. Concern is focused on the potential negative effect which sediment can cause to salmon, steelhead, and trout (salmonid) populations by damaging fish habitat” (FCWAG 1992).

The monitoring plan consists primarily of routine measurements of residual pool volume using V* (V-star) methodology (Lisle and Hilton 1991), stream substrate composition sampling using a McNeil core sampler, and monitoring juvenile steelhead populations in specific reaches of the French Creek watershed. Juvenile steelhead were selected as the key indicator species for monitoring the general health of the French Creek watershed and efforts focused primarily on developing estimates of abundance and biomass. This report details the results of the juvenile steelhead population monitoring component of those efforts for the years 1992 through 2005. To the extent available, information regarding coho salmon will also be presented.

Sampling Locations

To monitor French Creek steelhead population response to upslope stabilization efforts and, riparian and instream habitat improvement projects, six survey reaches were established for the French Creek drainage in 1992. Four of those were at various locations in the French Creek mainstem and one survey reach each in the lower ends of two of its tributaries, Miners Creek and Duck Lake Creek (Figure 1). Sampling within those six survey reaches usually occurred during mid-September using backpack electroshockers to capture fish. Except for the 1998 season, the Miners Creek (MC) survey reach in 1996, and the FC-1A survey reach in 2005, sampling has occurred annually at each survey location since 1992.

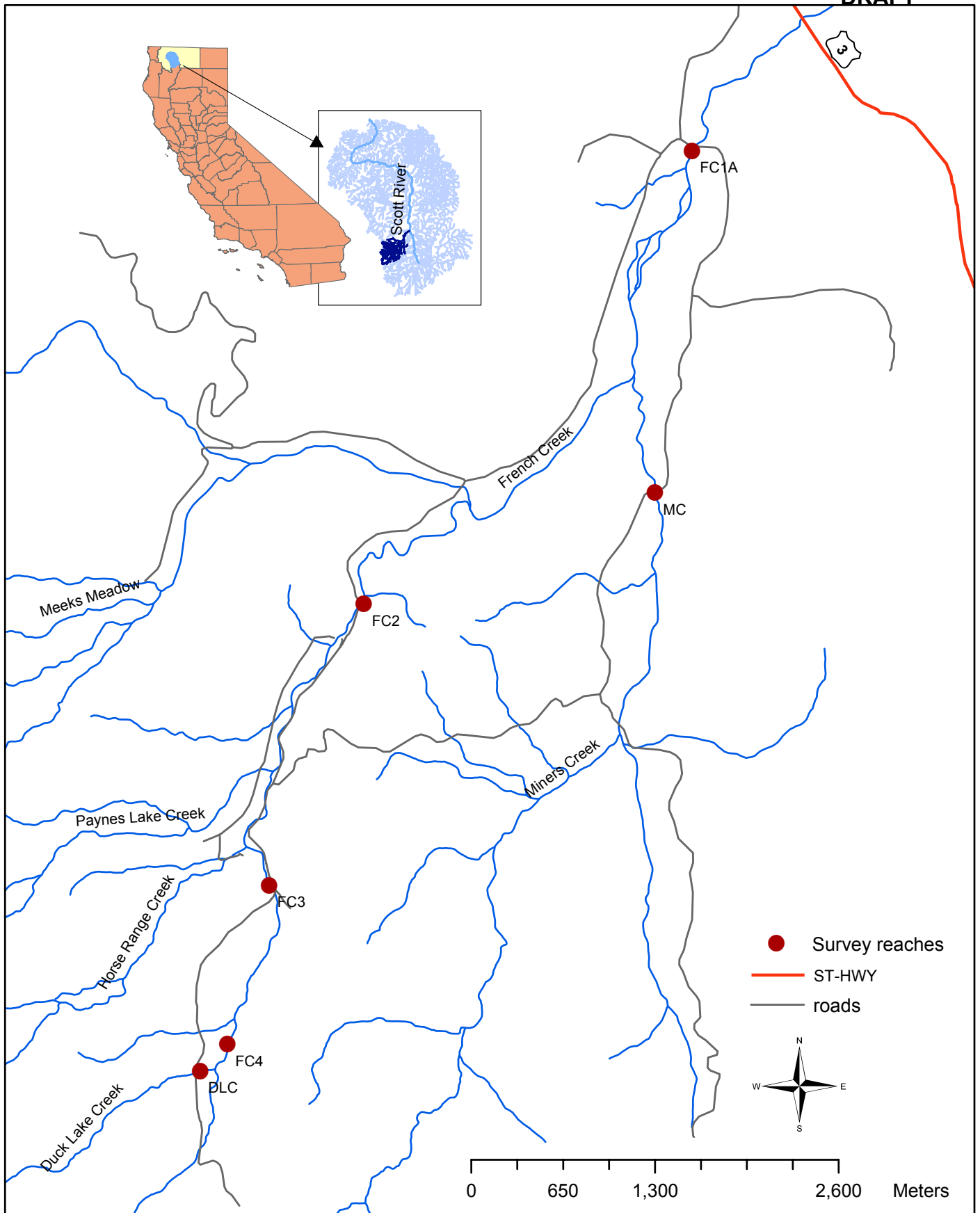


Figure 1. Survey reaches in the French Creek drainage. Insets illustrate location of the French Creek watershed (dark blue) within the Scott River Basin.

Description of Survey Reaches

Except for reach FC-1A, the reaches selected for population sampling were actually reach locations surveyed in 1990 by California Department of Fish and Game personnel working from Sacramento. That sampling strategy was designed to investigate species composition and relative abundance of fish in response to a request by the Department of Water Resources, who at the time was looking for potential water storage (dam) sites within the upper Scott River watershed.

Survey reaches were not randomly selected but instead were chosen based on convenience (i.e., easy access). The length of each reach varied but included at least one riffle, glide or run, and pool habitat type. The length of each survey reach ranged from a minimum of 40.2 m (132 feet) to a maximum of 85.3 m (280 feet). Lengths of some reaches varied from year to year to ensure that all major macro-habitat types were surveyed at each reach location, and/or, to avoid splitting habitat units within a reach.

FC-1A. Lowermost French Creek survey reach (Township 41N, Range 9 West, Section 15)

This reach is located immediately upstream of the Miners Creek Road bridge crossing (see Figure 1 & Photo 1) and is the lowermost and longest reach surveyed. Because of the overall width of the creek's channel at this location, it was necessary to utilize two electrofishing units during sampling to prevent fish escaping around the fish capture crew. The stream channel in this reach has changed dramatically since it was first surveyed in 1992.

Photo 1. Reach "FC-1A" looking upstream from Miners Creek Road bridge.



Reach FC-1A Channel Characteristics:

- Widest channel reach (Avg. 15.4' - 26.7' wide)
- Lowest Gradient Reach (1-1.5%)

- Most exposed reach (relatively the sparsest riparian canopy, approx. 10% shade cover) of any of the six survey reaches.
- Majority of the reach length is comprised of glide/run habitat.
- Most difficult to survey (i.e., relatively very wide which allows fish to more easily get past surveyors & very open, lacks cover, so fish panic and swim in all directions rather than into cover elements where they can be captured easily).

FC-2. French Creek survey reach (Township 41N, Range 9 West, Section 28/29)

This reach is located on French Creek a couple of miles upstream of survey reach FC-1A. The reach is located immediately upstream of the French Creek Road bridge crossing (see Figure 1 & Photo 2). In most years, this reach tended to have a higher abundance of Pacific Giant Salamanders compared to the other survey reaches that were sampled.

Photo 2. Reach “FC-2” looking immediately upstream from French Creek Road bridge crossing (Note the block net, at the downstream end of this survey reach, that prevents fish from escaping the survey reach during electroshocking activities.)



Reach FC-2 Channel Characteristics:

- Channel Avg. Width. Range - 15.7' - 21.1' wide.
- Reach Gradient (2 - 3 %).
- Riparian Canopy (approx. 65-70%).
- Majority of reach length is comprised of shallow riffle habitat.
- Numerous shallow pool or pocket water habitat formed by large cobble & small boulders.

FC-3. French Creek survey reach (Township 41N, Range 1 West, Section 32)

This reach is located on French Creek approximately 1 mile upstream of survey reach FC-2. The reach is located immediately upstream of a second bridge crossing of French Creek Road (see Figure 1 & Photo 3). This reach is noted for being the uppermost survey reach on French Creek where juvenile coho were found during sampling in four years since 1992.

Photo 3. Reach “FC-3” looking immediately upstream from the 2nd French Creek Road bridge crossing located approximately one-mile upstream of the J.H. Ranch.



Reach FC-3 Channel Characteristics:

- Active channel has ranged from 9.5' to 13.0' in width (narrowest of the four mainstem French Creek survey reaches).
- Reach Gradient (approx. 3 %).
- Riparian Canopy (approx. 75%).
- Majority of reach length is comprised of shallow riffle habitat.
- Numerous shallow pool or pocket water habitat formed by large cobble & small boulders.
- Most upstream survey reach in French Creek where juvenile coho have been found (15 coho in 1996, 2 coho in 1999, 21 coho in 2002, and 5 in 2005)

FC-4. French Creek survey reach (Township 41N, Range 9 West, Section 5).

This reach is located on French Creek approximately 1-mile upstream of survey reach FC-3. The reach is located approximately 100 yards downstream of the mouth of Duck Lake Creek.

(see Figure 1 & Photo 4). This reach is the uppermost survey reach established on French Creek proper. Juvenile coho have not been found in this reach. This reach has the steepest gradient of the four French Creek reaches. A possible barrier to coho may be present between this reach and survey reach FC-3 further downstream. A stream survey between reaches FC-3 and FC-4 is needed to confirm the presence of a fish barrier.

Photo 4. Reach FC-4 looking upstream.



Reach FC-4 Channel Characteristics:

- Active channel has ranged from 11.0' to 15.7' in average width.
- Reach gradient highest of all French Creek survey sites (approx. 3 to 4 %).
- Riparian Canopy (approx. 65%).
- Majority of reach length is comprised of shallow riffle habitat.
- Numerous shallow pool or pocket water habitat formed by large cobble & small boulders.
- Most upstream survey reach in French Creek.

DLC. Duck Lake Creek survey reach (Township 41N, Range 9 West, Section 5).

The Duck Lake Creek reach is the highest reach in the French Creek drainage (Figure 1). It is the steepest of all the reaches (see Photo 5) and is considered close to the upper extent of anadromy for steelhead. Only a relatively small number of steelhead have been found in this

reach and no coho have ever been observed. The substrate is not dominated by decomposed granite except in a few of the deeper pools.

Photo 5. Duck Lake Creek (DLC) reach looking immediately downstream from French Creek road bridge crossing.



Reach DLC Channel Characteristics:

- Active channel width an avg. of 8.8' – 11.5' wide (relatively narrow steep reach).
- Reach Gradient (approx. 5% - highest gradient reach).
- Riparian Canopy (approx. 75%).
- Much of reach length is comprised of high gradient riffle habitat.
- Numerous shallow pool or pocket water habitat formed by large cobble & large and small boulders.
- Most of instream cover consists of cobble and boulders.
- Consistently produces the fewest juvenile steelhead of any survey reach.
- Coho have never been observed or captured at this location.

MC. Miners Creek survey reach (Township 41N, Range 9 West, Section 22).

The lower end of the Miners Creek reach begins at the upstream side of the Miners Creek road crossing. It is the only survey reach in Miners Creek and is low in the watershed (Figure 1). This reach contains the largest amount of woody debris (Photo 6) of all the reaches sampled and the substrate is dominated by fine sands.

Photo 6. Reach at Miners Creek (MC) looking immediately downstream from Miners Creek Road bridge crossing.



Reach MC Channel Characteristics

- Active channel width an avg. of 9.5' – 13.0' wide.
- Reach Gradient (approx. 1.5 - 2 %)
- Riparian Canopy (approx. 85-90%)
- Majority of reach length is comprised of shallow riffle habitat. One relatively large pool at lower end of reach provides most of the preferred coho habitat.
- No cobble/boulder habitat. Most cover in form of small woody debris, undercut banks, and aquatic vegetation.
- Juvenile coho have been found during six of the past seven annual surveys.

Methodology

Prior to sampling, block nets were set at the upstream and downstream boundary of the reach to be surveyed. This was done to prevent fish from leaving or entering the sample area during fish capture activities. Each reach was no less than 40.2 m (132 feet) in length and contained at least one pool/riffle/run complex in order to ensure that all preferential habitat types were sampled. On occasion it was necessary to adjust the length of a particular reach from one season to the

next to account for changes in the length of habitats. For example, in reach FC-1A changes in reach length were most often required due to the seasonal changes in the length of the only run type habitat contained in that reach.

Fish were captured using a backpack electroshocker unit (Smith-Root Model 12 or Model VII). A survey crew consisting of three or more individuals electrofished from the downstream end of the reach (i.e., from the downstream block net) working upstream to the upstream block net. A second, and usually third pass, was similarly made in each survey reach depending on the number of steelhead captured during the second pass in relation to the first pass. The methodology is commonly known as the Multiple Pass-Deletion method and is widely used to estimate the total number of salmonids in small streams (for examples see Niemela *et al.* 2000; Wildman and Neumann 2003; Peterson *et al.* 2004; Rosenberger and Dunham 2005). Standing stock estimates of juvenile steelhead were generated using MicroFish 3.0 (Van Deventer and Platts 1989), a computer statistics program.

Fish that were temporarily immobilized by the electroshocker, were netted and held in a 5-gallon bucket of water. Once a single pass was made all of the fish captured during that pass were processed and released unharmed back to the stream outside of the sampling reach. Fish from the final pass were released within the sampling reach. Processing included anesthetizing the fish prior to handling. Anesthetized fish were identified to species and counted. Length measurements were recorded from all steelhead and coho salmon and weight of these fish were determined primarily by using the volumetric displacement method (assumption: one (1) milliliter of water displaced by juvenile salmonids is equal to approximately one (1) gram of juvenile steelhead tissue). In 2005, an electronic scale was used to weigh fish individually. Non-target (i.e., non-salmonids) fish species and amphibians that were captured were only counted.

Each season, length, numerous width (usually 10), and depth measurements (usually 30 to 50) were taken within each survey reach. This information was used to determine total surface area and volume of each survey reach. Surface area and volume were used in conjunction with estimated steelhead numbers and biomass to generate densities for comparison between reaches in a particular season or to make abundance and biomass density comparisons within a reach from one season to another. The estimated biomass was determined by multiplying the average weight of a fish to the standing stock estimates derived by the MicroFish 3.0 program. A visual estimate of the amount (percent) of exposed stream substrate in each survey reach was also made each year. The estimate of exposed substrate was used to refine stream surface area and volume measurements from each survey site.

Results and Discussion

Since surveys began in 1992, monitoring has only occurred across two full generations of steelhead (assuming a 6-year life history) and nearly five full generations of coho salmon (3-year life history) within the French Creek watershed. This is certainly not enough time to make conclusive findings with regard to population trends; however, there are some interesting observations which have come out of this monitoring effort.

Reach FC-1A was the longest and widest reach surveyed. Its length ranged from 53.9 m to 85.3 m (177 to 280 feet) with average widths ranging from 4.7 m (15.4 feet) the first year surveyed (1992) to a maximum average width of 8.1 m (26.7 feet) in 2004 (Table 1). Average stream depth in reach FC-1A ranged from 14.6 cm (0.48 feet) in 1994 to 32.6 cm (1.07 feet) in 2001 (Table 1). The relatively low stream gradient coupled with depths that were substantially deeper than the five other surveyed reaches and lower overall velocities made for greater preferred steelhead and coho habitat. The consistently higher steelhead and coho numbers found in FC-1A, each season, can be attributed in large part to the “preferred” stream conditions that existed there.

Steelhead Observations

A considerable amount of variability in steelhead abundance existed across years and among survey reaches (Table 2; Figure 2). The estimated number of steelhead was consistently high in the three lowermost reaches (i.e., FC-1A, FC-2 and Miners Creek respectively, Table 2; Figure 2). Survey reach DLC, the highest survey reach in the French Creek drainage, yielded the lowest estimates over time (Table 2; Figure 2). The fact that in general, the three lowest reaches (FC-1A, FC2, and MC) contained more woody debris associated with deeper pools and/or more quiet “pocket water” (a factor of lower stream gradient) was likely a key factor contributing to steelhead abundance at these locations. Combining the results of all the survey reaches by year, the highest number of estimated juvenile steelhead were noted in the year 2000 (988) and the least in year 1993 (164, see Figure 3). In fact, estimated steelhead numbers were substantially higher between 1999 through 2003 than in all other years surveyed. It should be noted however, that permission was not granted to sample FC-1A in 2005. Thus, the cumulative total is likely artificially low in 2005.

As with abundance, the total estimated juvenile steelhead biomass was also highest in 2000 with 4,828 grams followed by 1999 with 2,986 grams (Figure 4). Except for 2000 when the cumulative biomass was exceptionally high, the estimated cumulative biomass was relatively stable with minor inter-annual variability (Figure 4). Again it should be noted that the lowest estimated cumulative biomass was recorded in 2005 when FC-1A was not surveyed. It is likely that if FC-1A were sampled the total estimated biomass would approximate previous years.

It must be kept in mind that because reaches varied in length and width from year to year, biomass and fish abundance estimates from reach to reach or comparing the same reach over time can be misleading. A more appropriate comparison may be achieved by expressing estimates of steelhead abundance and biomass in terms of area or volume (i.e., number of steelhead or biomass per unit of area). Estimates of surface area and volume for each reach were determined during the time of survey to facilitate this. The total estimated biomass per m³ for all reaches combined was greatest in 1993 with 14.51 grams of steelhead per m³ (Figure 5). No strong trend is discernable, however. Similarly, when viewed by reach the same measure, biomass by volume of stream (grams of steelhead per m³), shows no obvious trends (Figure 6). Interestingly, the reach that consistently yielded the highest catch (FC-1A) was also among the lowest annual biomass per m³ (Figure 6). As one might expect a high degree of inter-annual variability exists in the biomass of steelhead per m³ of stream, particularly within the two reaches showing the highest biomass density, Duck Lake Creek and Miners Creek. In 1993 steelhead biomass density was 130.8 grams of steelhead per m³ of stream at the MC site while in other

years it was considerably lower (Table 2 and Figure 6). This effect was likely due to the presence of a few large adult steelhead in 1993. The range of fork lengths for steelhead at the MC site in 1993 was 62 -271 mm with a mean FL of 101.3 mm, suggesting there was one or more large individuals which may have driven up the biomass. In 1992 scales taken from 4 large individuals in Miners Creek indicate ages between 2-4 years (internal memo with data from DFG Natural Stocks Unit to Fishery Biologist, Siskiyou Unit dated February 20, 1996) supporting the notion that a few large and older individuals may have been responsible for the high biomass density in 1993. Since depth was not recorded in 1992 it is difficult to determine, but not unlikely, if the same would have held true for 1992 when the scales were collected.

Fork lengths of juvenile steelhead ranged between 30 to 271 millimeters (Table 3) with the vast majority (>90%) of those being less than 100 mm in length. Steelhead less than 100 mm were believed to be primarily age 0+. Steelhead size (fork length) appears to increase further up the watershed (Table 4 and Figure 7). The lowest site in the watershed, FC-1A, consistently had the highest estimates of juvenile steelhead (Figure 2) while also having the smallest 6-year average fork length, when utilizing the mean from 2000-2005 for each site (Table 4 and Figure 7). It should be noted that since permission was not granted to sample FC-1A in 2005 a 5-year average was used for that site. Duck Lake Creek (DLC) usually contained the fewest numbers of juvenile steelhead (Table 2; Figure 2) however, the fish found there were generally larger in size (Figure 7). The exception to this observed pattern is Miners Creek (MC). Miners Creek exhibited the largest 6-year mean length, 80.9 mm FL (Figure 7). The pattern of smaller juveniles occurring lower in the watershed probably correlates to proximity to natal areas and to the slower velocities in those reaches. Fish that were larger and thus more capable of exploiting habitats with higher velocities were found further up the watershed. On the contrary, it is likely that at the MC site the large pool, woody debris, and undercut banks provided habitat complexity adequate for the survival of adult and juvenile steelhead as well as a large number of juvenile coho.

Coho Observations

The discovery of coho in French Creek and Miners Creek, although not totally unexpected, did provide some interesting insight about coho in the French Creek drainage. One important discovery was the observation that there is one relatively strong year class with two much weaker year classes (Table 2; Figure 8). This observation has been further supported by adult coho surveys conducted throughout the Scott River watershed since December 2002 (Mauer 2002, 2003; SiskiyouRCD 2004; Quigley 2005) and juvenile outmigration trapping efforts by DFG since 2000 (Chesney 2000; Chesney and Yokel 2003; Chesney *et al.* 2004) in the lower canyon reach of the Scott River. It should be pointed out that catch estimates presented in Figure 8 for the 2005 season do not include FC-1A since that reach was not sampled that year. While it appears the strongest cohort is improving over time, we feel there is insufficient data to say with any certainty this is the case.

Coho have been found to range as far upstream as reach FC-3. No coho have been observed further up in FC-4 or in the DLC reach. Lack of instream woody debris and higher gradient (3-5%) in these reaches may account for their apparent absence. Based on the fact that coho have been observed in Miners Creek, a heavily degraded stream (i.e., extremely high levels of decomposed granitic sand) suggests that abundant instream cover consisting of complex woody

debris appears to compensate for very poor (highly imbedded) substrate conditions generally not preferred by coho. Coho have been observed in the Miners Creek reach in six of the past seven years (Table 2).

Other fish and amphibian species observed

Non-target fish species observed during these surveys included lamprey ammocetes (*Lampetra* spp.), brook stickleback (*Culaea inconstans*), speckled dace (*Rhinichthys osculus*), and sculpin (c.f. *Cottus klamathensis*). Amphibians encountered in these surveys included Pacific Giant Salamander (*Dicamptodon tenebrosus*), tailed frog (*Ascaphus truei*), Pacific treefrog (*Pseudacris regilla*), and bullfrog (*Rana catesbeiana*).

Comments/Recommendations

Steelhead abundance trends within individual reaches are not clearly discernable and it will likely take another 20-25 years before more reliable conclusions about steelhead abundance in the survey reaches of the French Creek watershed can be made. Similarly, identifying trends in coho salmon populations will require many more years of monitoring. However, it must be kept in mind that because the survey sites were not randomly selected and the lengths of the reaches are relatively small, the data set collected from these reaches results in less than robust data and therefore will lead to conclusions that may or may not be accurate nor reliable and certainly will not stand up to a peer review among the scientific community. Nevertheless, the information gathered over the past 14 years does provide some indication of the relative abundance and size ranges of steelhead and coho and about the presence of other miscellaneous aquatic species found in the French Creek watershed.

- It is recommended that future surveys incorporate the use of a digital scale (± 0.1 g) to achieve more accurate fish weights for generating biomass estimates and to allow for an accurate and more reliable assessment of condition factors of steelhead and coho.
- It appears that complex instream habitat can be an overriding factor in a stream's ability to support relatively high numbers of anadromous salmonids, as appears at the Miners Creek site. Consequently, an improved method of measuring instream habitat complexity is needed to more accurately assess increases in fish numbers owing to even small changes in instream structure and instream habitat complexity within a reach (e.g. type, number and size of instream structures or the percentage of woody and non-woody structures within each reach existing at the time of the survey).
- Secure funding to hire a dedicated survey crew to continue annual surveys and ensure that the surveys have the necessary personnel to complete the tasks or even expand and improve the monitoring effort.
- Above all, efforts should be directed towards establishing a more scientifically robust (i.e., statistically valid) monitoring/assessment program that will stand up to peer review. This will require that survey locations be randomly selected and that survey reaches be of adequate length to better ensure that these survey locations are truly representative of the entire anadromous range of habitat being evaluated.

Table 1. French Creek watershed survey reach characteristics (1992-2005).

<i>Location</i>	<i>Year</i>	<i>Length (ft.)</i>	<i>Avg. Width (ft.)</i>	<i>Avg. Depth (ft.)</i>	<i>Percent Exposed Substrate</i>	<i>Surface Area (ft²)</i>	<i>Reach Volume (ft³)</i>	<i>Surface Area (m²)</i>	<i>Reach Volume (m³)</i>
French Creek (FC-1A)	1992	177	15.4	N.A.	N.A.	2726	N.A.	253	N.A.
	1993	186	16.3	0.60	1%	3001	1801	279	51.0
	1994	177	16.2	0.48	1%	2839	1363	264	38.6
	1995	177	19.1	0.68	0%	3386	2303	315	65.2
	1996	177	22.8	0.62	1%	3995	2477	371	70.1
	1997	209	19.1	0.66	1%	5318	5342	494	151.0
	1998	---- No	survey	conducted	this year	-----	-----	-----	-----
	1999	177	26.7	0.96	9.6%	4272	4101	397	116.1
	2000	271	26.3	0.65	5.5%	7138	8958	663	253.7
	2001	177	18.3	1.07	2%	3174	3492	295	98.9
	2002	280	19.5	0.50	8.8%	5145	4014	478	113.7
	2003	266	26.7	0.91	7%	6656	6861	618	194.3
	2004	271	24.8	0.90	5%	6382	5967	593	169.0
	2005	----- No	survey	conducted	this year	in this	reach	only ----	-----
French Creek (FC-2)	1992	150	18.8	N.A.	N.A.	2820	N.A.	262	N.A.
	1993	157	20.6	0.62	10%	2911	1805	270	51.1
	1994	164	17.9	0.87	10%	2642	2299	245	65.1
	1995	156	21	0.53	10%	2948	1562	274	44.2
	1996	179	21.1	0.68	10%	3399	2243	316	63.5
	1997	160	17.9	0.24	10%	2578	619	239	18.0
	1998	----- No	survey	conducted	this year	-----	-----	-----	-----
	1999	160	19.8	0.26	15%	2693	808	250	22.9
	2000	160	17.3	0.74	15%	2353	1741	219	49.3
	2001	166	18.2	0.63	25%	2266	1428	211	40.4
	2002	160	18.2	0.85	25%	2184	1856	203	52.7
	2003	164	15.7	0.80	25%	1936	1543	180	43.7
	2004	160	19.5	0.70	25%	2339	1628	217	46.1
	2005	150	17.8	N.A.	N.A.	2675	N.A.	249	N.A.
French Creek (FC-3)	1992	160	12.2	N.A.	N.A.	1952	N.A.	181	N.A.
	1993	155	12.5	0.54	10%	1744	942	162	26.7
	1994	157	9.5	0.54	10%	1342	725	125	20.5
	1995	156	13.0	0.62	10%	1825	1132	170	32.1
	1996	160	12.9	0.88	10%	1858	1635	173	46.3
	1997	157	12.7	0.20	10%	1795	359	167	10.2
	1998	----- No	survey	conducted	this year	-----	-----	-----	-----
	1999	161	12.2	0.75	25%	1473	1105	137	31.3
	2000	160	10.5	0.67	25%	1256	842	117	23.6
	2001	160	11.2	0.56	25%	1344	753	125	21.3
	2002	160	10.6	0.69	35%	1153	796	107	21.6
	2003	140	12.6	0.65	30%	1231	796	114	22.5
	2004	160	12.5	0.74	25%	1499	1114	139	31.6
	2005	150	12.1	N.A.	N.A.	1810	N.A.	168	N.A.

Table 1 cont'd. French Creek watershed survey reach characteristics (1992-2005)

<i>Location</i>	<i>Year</i>	<i>Length (ft.)</i>	<i>Avg. Width (ft.)</i>	<i>Avg. Depth (ft.)</i>	<i>Percent Exposed Substrate</i>	<i>Surface Area (ft²)</i>	<i>Reach Volume (ft³)</i>	<i>Surface Area (m²)</i>	<i>Reach Volume (m³)</i>
French Creek (FC-4)	1992	134	11.0	N.A.	N.A.	1474	N.A.	137	N.A.
	1993	132	13.6	0.67	20%	1436	962	133	27.2
	1994	132	13.5	0.89	20%	1425	1269	132	35.9
	1995	132	15.7	0.79	20%	1658	1310	154	37.1
	1996	132	15.0	0.68	20%	1584	1140	147	32.3
	1997	132	11.7	0.63	20%	1236	742	115	21.0
	1998	-----No	survey	conducted	this year	-----	-----	-----	-----
	1999	132	13.4	0.71	20%	1413	997	131	28.2
	2000	132	11.3	0.67	20%	1202	805	112	22.8
	2001	132	13.8	0.52	40%	1093	568	102	16.0
	2002	132	10.0	0.83	25%	990	822	92	23.3
	2003	132	14.1	0.59	40%	1113	661	103	18.9
	2004	132	10.6	0.81	40%	843	682	78	19.3
	2005	150	10.3	N.A.	N.A.	1545	N.A.	144	N.A.
Duck Lake Creek (DLC)	1992	132	8.8	N.A.	N.A.	1162	N.A.	108	N.A.
	1993	132	9.6	0.47	30%	887	417	82	11.8
	1994	132	9.3	0.65	30%	859	559	80	15.8
	1995	132	10.2	0.6	27.5%	974	585	90	16.6
	1996	132	10.3	0.6	30%	952	571	88	16.2
	1997	132	10.2	0.2	30%	942	188	88	17.6
	1998	----- No	survey	conducted	this year	-----	-----	-----	-----
	1999	132	10.4	0.63	25%	1030	649	96	10.4
	2000	132	11.5	0.62	30%	1058	656	98	18.6
	2001	132	9.5	0.59	30%	878	518	82	14.7
	2002	132	9.4	0.61	40%	745	454	69	13.0
	2003	132	10.5	0.70	30%	967	675	90	19.6
	2004	132	9.3	0.60	30%	859	515	80	14.6
	2005	150	13	N.A.	N.A.	1916	N.A.	178	N.A.
Miners Creek (MC)	1992	132	6.3	N.A.	N.A.	832	N.A.	77	N.A.
	1993	132	7.3	0.41	5%	915	375	85	10.6
	1994	132	6.1	0.32	5%	765	245	71	6.9
	1995	132	11.4	1.23	1.5%	1482	1823	138	51.6
	1996	----- No	survey	conducted	this year	in this	reach	only ---	-----
	1997	132	10.1	0.40	2%	1307	523	121	14.8
	1998	-----No	survey	conducted	this year	-----	-----	-----	-----
	1999	132	11.1	0.61	4%	1400	854	130	24.2
	2000	132	10.0	0.61	10%	1186	723	110	20.5
	2001	132	10.8	0.54	1%	1411	762	131	21.6
	2002	132	9.6	0.82	15%	1077	883	100	25.0
	2003	132	9.6	1.07	7.5%	1167	1251	108	34.4
	2004	132	11.4	0.84	5%	1428	1193	133	33.8
	2005	150	7.3	N.A.	N.A.	1100	N.A.	102	N.A.

Table 2. Summary of total catch, population estimates(standard error) when available, densities and biomass in French Creek, Duck Lake Creek and Miners Creek, 1990-2005.

<i>Location</i>	<i>Year</i>	<i>Total SH Catch</i>	<i>Total Estimated SH(error)</i>	<i>Estimated Total SH Biomass (g)</i>	<i>Estimated SH Density (no./m³)</i>	<i>Estimated SH Biomass Density (g./m³)</i>	<i>Mean SH Biomass (g./SH)</i>	<i>Estimated SH Biomass Density (g. SH/m²)</i>	<i>Total Catch Coho</i>	<i>Total estimated Coho(error)</i>
FC-1A	1992	38	39(1.8)	133	N.A.	N.A.	3.4	0.5	0	0
	1993	61	61(0.8)	201	1.2	3.9	3.3	0.7	0	0
	1994	56	83	382	2.2	9.9	4.6	1.4	0	0
	1995	48	53	498	0.8	7.6	9.4	1.6	0	0
	1996	34	35(1.6)	557	0.5	7.9	15.9	1.5	6	6
	1997	155	171(7.5)	858	1.1	5.7	5.0	1.7	0	0
	1998	No	survey	conducted	this year	-----	-----	-----	-----	-----
	1999	123	141(9.1)	419	1.2	3.6	2.97	1.1	27	28(1.8)
	2000	301	495(71.7)	2163	2.0	8.5	4.37	3.3	2	2
	2001	136	147(6.3)	389	1.5	3.9	2.7	1.3	3	3
	2002	219	334(51.1) [†]	688	2.9	6.1	2.1	1.4	484	500
	2003	270	347(25.7)	1202	1.8	6.2	3.5	1.9	9	9
	2004	174*	N.A.	N.A.	N.A.	N.A.	2.4	N.A.	15*	N.A.
	2005	No	survey	conducted	this year	in this	reach	only----	-----	-----
FC-2	1990	107	128	811	N.A.	N.A.	N.A.	3.1	0	0
	1992	141	142(1.0)	753	N.A.	N.A.	5.3	2.9	0	0
	1993	12	12(1.2)	330	0.2	6.5	27.5	1.2	0	0
	1994	155	172	740	2.6	11.4	4.3	3.0	0	0
	1995	32	32	336	0.7	7.6	10.5	1.2	0	0
	1996	51	54(3.0)	540	0.9	8.5	10.0	1.7	29	29
	1997	34	34(1.0)	254	1.9	14.1	7.5	1.1	0	0
	1998	No	survey	conducted	this year	-----	-----	-----	-----	-----
	1999	98	102(3.0)	703	4.5	30.7	6.9	2.8	46	46(0.8)
	2000	181	197(7.1)	736	4.0	14.9	3.7	0.9	0	0
	2001	197	206(4.9)	858	5.1	21.2	4.2	4.1	0	0
	2002	75	86(7.2)	522	1.6	9.9	6.1	2.6	10	12
	2003	59	60(1.9)	498	1.4	11.4	8.3	2.8	0	0
	2004	31	31(0.9)	315	0.7	6.8	10.2	1.5	0	0
	2005	121	139 (8.9)	417.5	N.A.	N.A.	3.0	1.7	32	47(15.6)

* - Due to sampling difficulties, only one pass was made in reach FC-1A in 2004.

[†] - Only 2 passes were made.

Table 2 cont'd. Summary of total catch, population estimates(standard error) when available, densities and biomass in French Creek, Duck Lake Creek and Miners Creek, 1990-2005.

<i>Location</i>	<i>Year</i>	<i>Total SH Catch</i>	<i>Total Estimated SH(error)</i>	<i>Estimated Total SH Biomass (g)</i>	<i>Estimated SH Density (no./m³)</i>	<i>Estimated SH Biomass Density (g./m³)</i>	<i>Mean SH Biomass (g./SH)</i>	<i>Estimated SH Biomass Density (g. SH/m²)</i>	<i>Total Catch Coho</i>	<i>Total estimated Coho(error)</i>
FC-3	1990	33	35	531	N.A.	N.A.	N.A.	3.4	0	0
	1992	47	49(2.4)	436	N.A.	N.A.	8.9	2.4	0	0
	1993	13	13(0.3)	185	0.5	6.9	14.2	1.1	0	0
	1994	30	32	224	1.6	10.9	7.0	1.7	0	0
	1995	16	17	425	0.5	13.2	25.0	2.5	0	0
	1996	30	30(0.3)	201	0.6	4.3	6.7	1.2	15	15
	1997	14	14(0.8)	83	1.7	8.1	5.9	0.5	0	0
	1998	No	survey	conducted	this year	-----	-----	-----	-----	-----
	1999	53	54(1.6)	586	1.7	18.7	10.9	4.3	2	2
	2000	92	96(3.3)	355	4.0	14.9	3.7	3.0	0	0
	2001	14	14(1.0)	151	0.7	7.1	10.8	1.2	0	0
	2002	27	28(1.8)	218	1.3	10.1	7.8	2.1	21	21
	2003	31	35(4.3)	213	1.6	9.5	6.1	1.9	0	0
	2004	19	19(0.5)	203	0.6	6.4	10.7	1.5	0	0
	2005	19	19(0.9)	164.9	N.A.	N.A.	8.7	0.1	5	5(0.2)
FC-4	1990	46	50	512	N.A.	N.A.	N.A.	2.5	0	0
	1992	41	41(0.9)	480	N.A.	N.A.	11.7	3.5	0	0
	1993	10	10(0.7)	239	0.4	8.8	23.9	1.8	0	0
	1994	42	42	227	1.2	6.3	5.4	1.7	0	0
	1995	12	19	268	0.5	7.2	14.1	1.7	0	0
	1996	32	45(13.6)	410	1.4	12.7	9.1	2.8	0	0
	1997	49	51(2.3)	181	2.4	8.6	3.5	1.6	0	0
	1998	No	survey	conducted	this year	-----	-----	-----	-----	-----
	1999	35	35(0.8)	360	1.2	12.8	10.3	2.7	0	0
	2000	32	32(1.1)	305	1.4	13.4	9.5	2.7	0	0
	2001	50	54(3.6)	291	3.4	18.2	5.4	2.9	0	0
	2002	37	39(2.6)	411	1.7	17.6	10.5	4.5	0	0
	2003	16	19(4.8)	152	1.0	8.0	8.0	1.5	0	0
	2004	35	38(3.2)	395	2.0	20.4	10.4	5.0	0	0
	2005	34	46(11.9)	130.3	N.A.	N.A.	2.8	0.9	0	0

Table 2 cont'd. Summary of total catch, population estimates(standard error) when available, densities and biomass in French Creek, Duck Lake Creek and Miners Creek, 1990-2005.

<i>Location</i>	<i>Year</i>	<i>Total SH Catch</i>	<i>Total Estimated SH(error)</i>	<i>Estimated Total SH Biomass (g)</i>	<i>Estimated SH Density (no./m³)</i>	<i>Estimated SH Biomass Density (g./m³)</i>	<i>Mean SH Biomass (g./SH)</i>	<i>Estimated SH Biomass Density (g. SH/m²)</i>	<i>Total Catch Coho</i>	<i>Total estimated Coho(error)</i>
DLC	1990	21	21	777	N.A.	N.A.	N.A.	6.7	0	0
	1992	17	17(0.4)	218	N.A.	N.A.	12.8	2.0	0	0
	1993	10	10(0.3)	247	0.8	20.9	24.7	3.0	0	0
	1994	8	8	118	0.5	7.5	14.8	1.5	0	0
	1995	7	7	57	0.4	3.4	8.1	0.6	0	0
	1996	10	10(1.1)	211	0.6	13.0	21.1	2.4	0	0
	1997	10	11(2.4)	254	0.6	14.4	23.1	2.9	0	0
	1998	No	survey	conducted	this year	-----	-----	-----	-----	-----
	1999	10	10(0.9)	257	1.0	24.7	25.7	2.7	0	0
	2000	51	51(1.1)	768	2.8	41.3	15.1	7.8	0	0
	2001	29	29(1.0)	266	2.0	18.1	9.2	3.3	0	0
	2002	13	13(0.7)	192	1.0	14.8	14.8	2.8	0	0
	2003	8	8(0.3)	155	0.4	7.9	19.4	1.7	0	0
	2004	7	7(0.9)	91.5	0.5	6.3	13.1	1.2	0	0
	2005	18	18(0.2)	184.7	N.A.	N.A.	10.3	1.0	0	0
MC	1990	192	233	1010	N.A.	N.A.	N.A.	7.4	0	0
	1992	4	4(0.2)	290	N.A.	N.A.	72.5	3.8	0	0
	1993	57	58(1.7)	1386	5.5	130.8	23.9	16.3	7	7(0.6)
	1994	43	43	374	6.2	54.2	8.7	5.3	0	0
	1995	43	52	952	1.0	18.4	18.3	6.9	0	0
	1996	No	survey	conducted	this year	in this	reach	only-----	-----	-----
	1997	89	89(0.8)	334	6.0	22.6	3.8	2.8	0	0
	1998	No	survey	conducted	this year	-----	-----	-----	-----	-----
	1999	172	182(5.1)	661	7.5	27.3	3.6	5.1	130	139
	2000	109	117(4.8)	501	5.7	24.4	4.3	4.6	0	0
	2001	52	59(5.6)	624	2.7	28.9	10.6	4.8	12	12
	2002	7	7(0.9)	150	0.3	6.0	21.4	1.5	91	95
	2003	25	25(0.7)	N.A.	0.7	N.A.	N.A.	N.A.	18	30(19.2)
	2004	58	63(4.2)	887	1.9	26.2	14.1	0.5	4	4
	2005	24	24(0.8)	320.6	N.A.	N.A.	13.4	3.1	186	216(12.2)

Table 3. Steelhead and coho length frequency data 1992-2005 for all reaches combined.

(Capture Total (n), Sum of Fork Lengths, Size Range, & Mean Fork Length)

<i><u>Year</u></i>	<i><u>-----Steelhead-----</u></i>				<i><u>-----Coho-----</u></i>			
	<i><u>n</u></i>	<i><u>Sum of FL</u></i>	<i><u>Size Range</u></i>	<i><u>Mean FL</u></i>	<i><u>n</u></i>	<i><u>Sum of FL</u></i>	<i><u>Size Range</u></i>	<i><u>Mean FL</u></i>
1992	288	19094	49-225 mm	66.2 mm	0	N.A.	N.A.	N.A.
1993	163	11639	38-271 mm	71.4 mm	7	2860	58-84	74.6 mm
1994	334	22645	33-228 mm	67.8 mm	0	N.A.	N.A.	N.A.
1995	158	11044	35-221 mm	69.9 mm	0	N.A.	N.A.	N.A.
1996	157	12968	37-224 mm	82.6 mm	50	3652	57-90 mm	73 mm
1997	351	24086	30-199 mm	68.6 mm	0	N.A.	N.A.	N.A.
1998	No surveys were conducted in 1998.							
1999	491	34440	38-239 mm	70.1 mm	205	15460	55-94 mm	75.4 mm
2000	866	47691	41-193 mm	55.1 mm	2	156	76-80 mm	78.0 mm
2001	478	32892	47-244 mm	68.8 mm	15	1098	68-79 mm	73.2 mm
2002	378	24218	39-230 mm	64.1 mm	122*	7145	44-81 mm	58.6 mm
2003	409	29427	49-220 mm	71.9 mm	27	2195	69-110 mm	81.3 mm
2004	324**	22307	39-215 mm	68.8 mm	15**	1443	67-91 mm	75.9 mm
2005	216†	16865	41-240 mm	78.1 mm	223†	14839	54-89 mm	66.5 mm

* Randomly measured 122 of 606 coho captured in 2002.

** Due to sampling difficulties, only one pass was made in reach FC-1A in 2004.

† No survey was conducted in FC1A in 2005.

Table 4. Mean fork length, mm, (standard deviation) and range for each site from 2000-2005. The six year average is the mean fork length over the six years listed for each site. Sites are listed in order from bottom of the watershed to the top of the watershed.

	2000	2001	2002	2003	2004	2005	6-yr avg.
<i>Site</i>	<i>FL $\bar{x}$ (stdev) range</i>	<i>FL $\bar{x}$ (stdev) range</i>	<i>FL $\bar{x}$ (stdev) Range</i>	<i>FL $\bar{x}$ (stdev) range</i>	<i>FL $\bar{x}$ (stdev) range</i>	<i>FL $\bar{x}$ (stdev) range</i>	<i>FL $\bar{x}$ (stdev) range</i>
FC-1A	63.8 (12.6) 47-156	78.1 (25.6) 55-215	54.8 (9.8) 39-134	67.4 (8.7) 50-108	54.5 (9.6) 41-145	not surveyed	62.9 (14.9) 39-215
MC	64.2 (20.9) 42-193	77.8 (37.9) 48-244	106.3 (60.0) 59-230	85.4 (26.7) 63-179	88.3 (31.9) 55-215	134.1 (33.0) 91-210	80.9 (35.7) 42-244
FC2	60.8 (18.4) 42-159	64.5 (13.4) 48-137	73.2 (29.5) 53-195	80.4 (25.9) 54-220	88.7 (24.5) 64-139	59.5 (20.4) 45-208	66.1 (21.6) 42-220
FC3	62.2 (16.9) 42-128	94.6 (21.2) 61-136	78.0 (24.0) 52-130	75.0 (25.0) 49-146	88.4 (32.4) 61-152	80.2 (28.2) 43-123	72.7 (24.7) 42-152
FC4	66.9 (34.8) 30-190	64.2 (27.7) 47-200	72.8 (41.3) 44-207	76.3 (24.5) 52-132	72.3 (42.1) 39-204	96.4 (59.3) 42-240	73.9 (41.3) 30-240
DLC	61.5 (28.2) 41-183	82.6 (30.0) 53-172	90.7 (40.3) 51-182	100.6 (44.2) 57-187	107.0 (31.1) 55-150	91.6 (36.2) 41-164	78.7 (35.3) 41-187

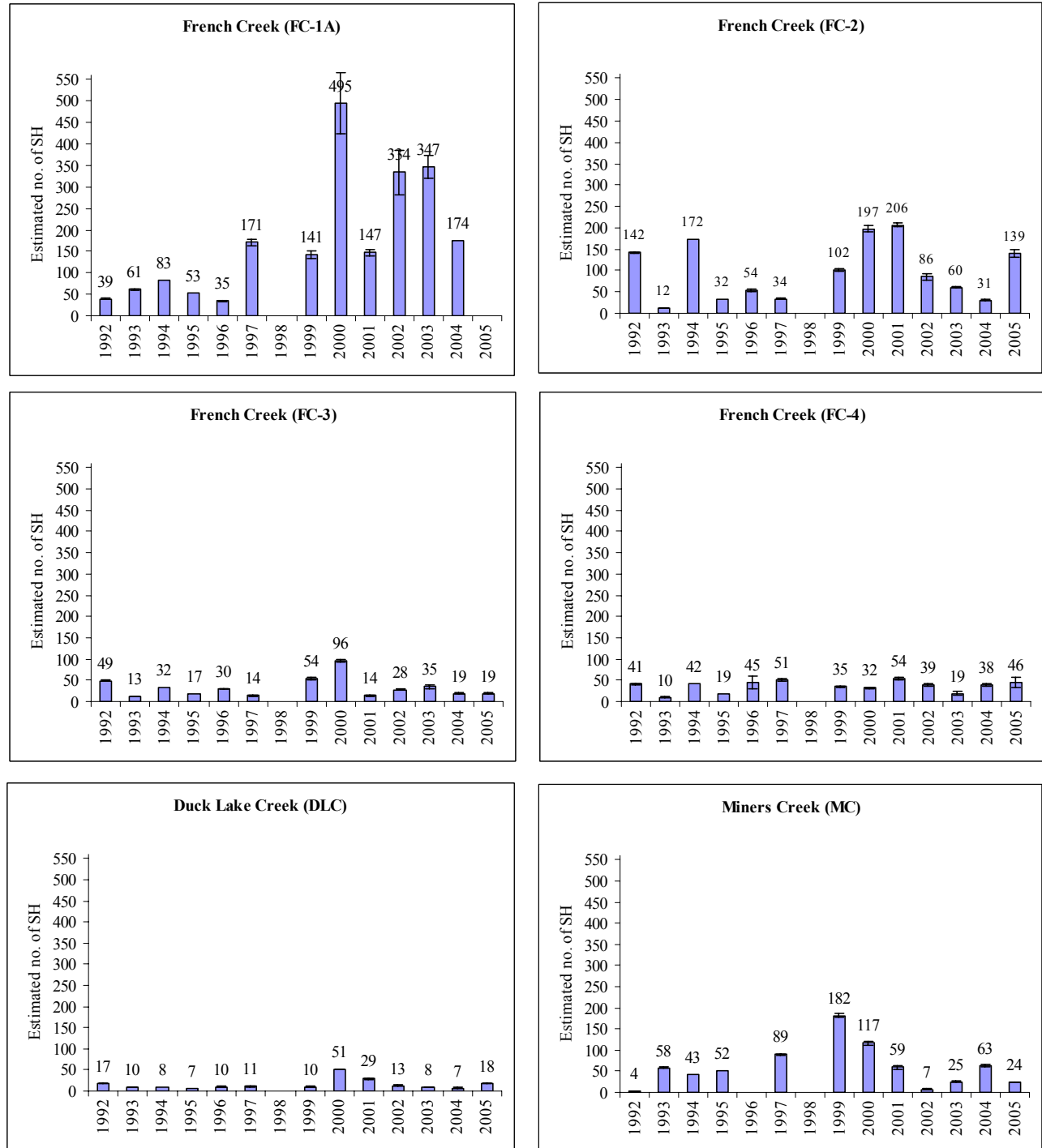


Figure 2. Total estimated number of juvenile steelhead (by reach). No surveys were conducted in 1998 and in 2005 reach FC-1A was not surveyed. Error bars are one standard error for years where data was available.

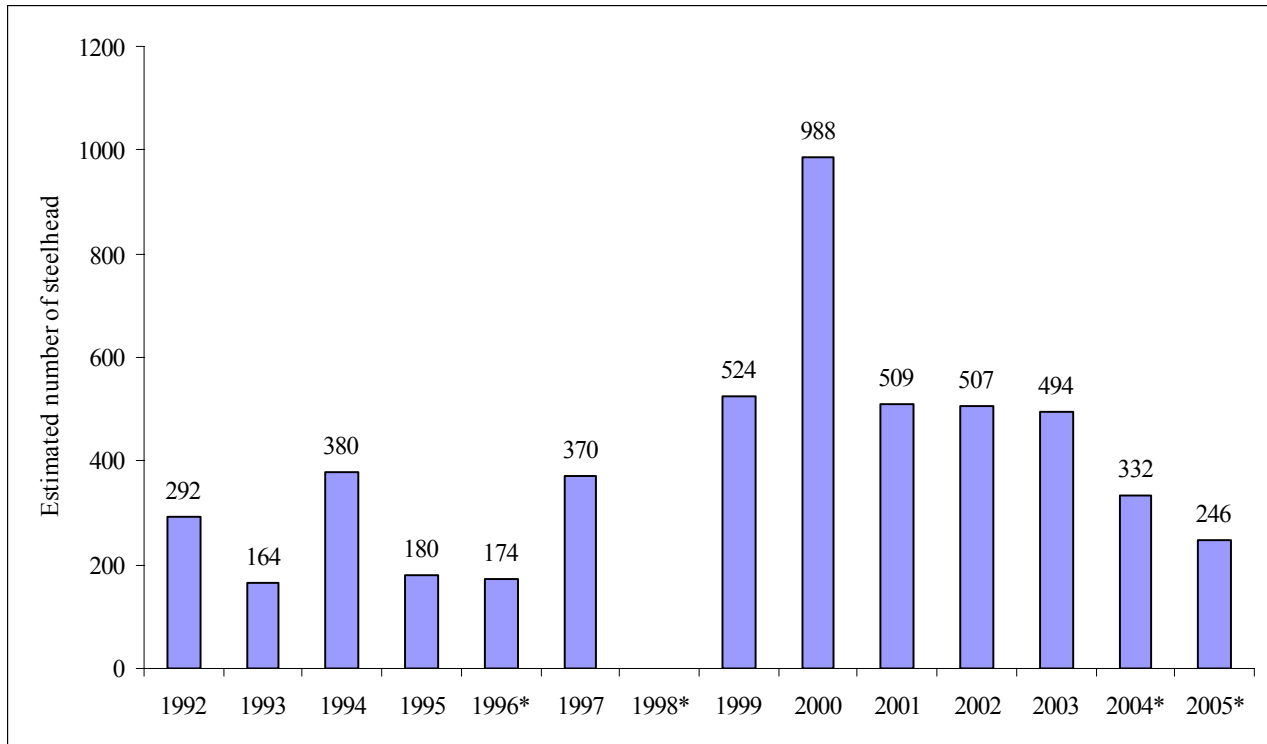


Figure 3. Cumulative estimates of steelhead for all reaches combined.

* Note that no survey was conducted in MC in 1996. No surveys were conducted in 1998. Only one pass was made in FC1A in 2004. FC1A was not surveyed in 2005.

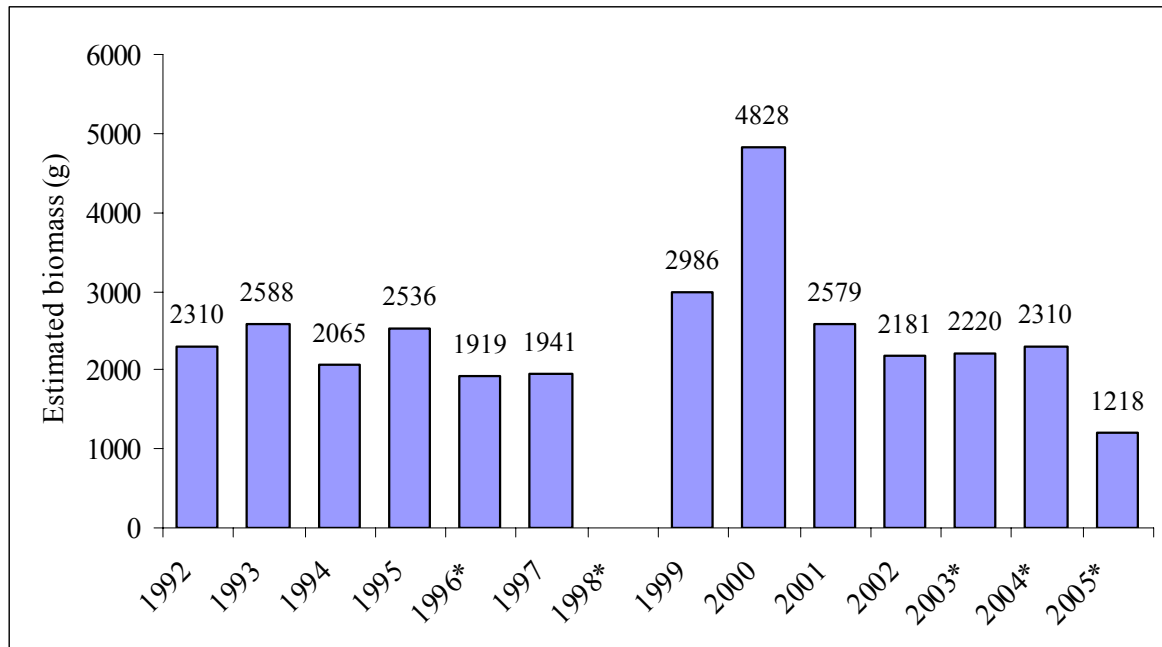


Figure 4. Cumulative estimated biomass (grams) of steelhead for all reaches combined.

* No survey in reach MC in 1996. No survey in 1998. No weights taken in reach MC in 2003. In 2004, biomass estimate includes all locations with only a single pass made in reach FC-1A. In 2005 FC-1A was not surveyed.

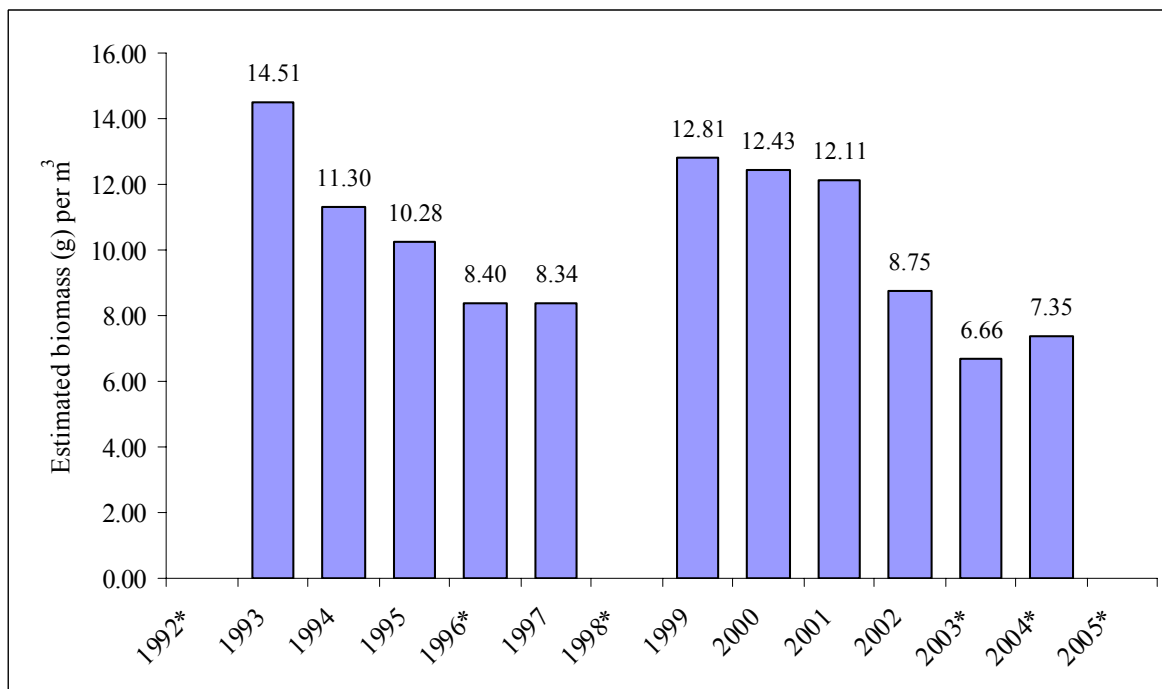


Figure 5. Cumulative estimated biomass (grams) of steelhead per m³ of stream for all reaches combined.

* Depth was not measured in 1992. No survey in reach MC in 1996. No survey in 1998. No weights taken in reach MC in 2003. In 2004, biomass estimate includes all locations with only a single pass made in reach FC-1A. In 2005 depth was not measured.

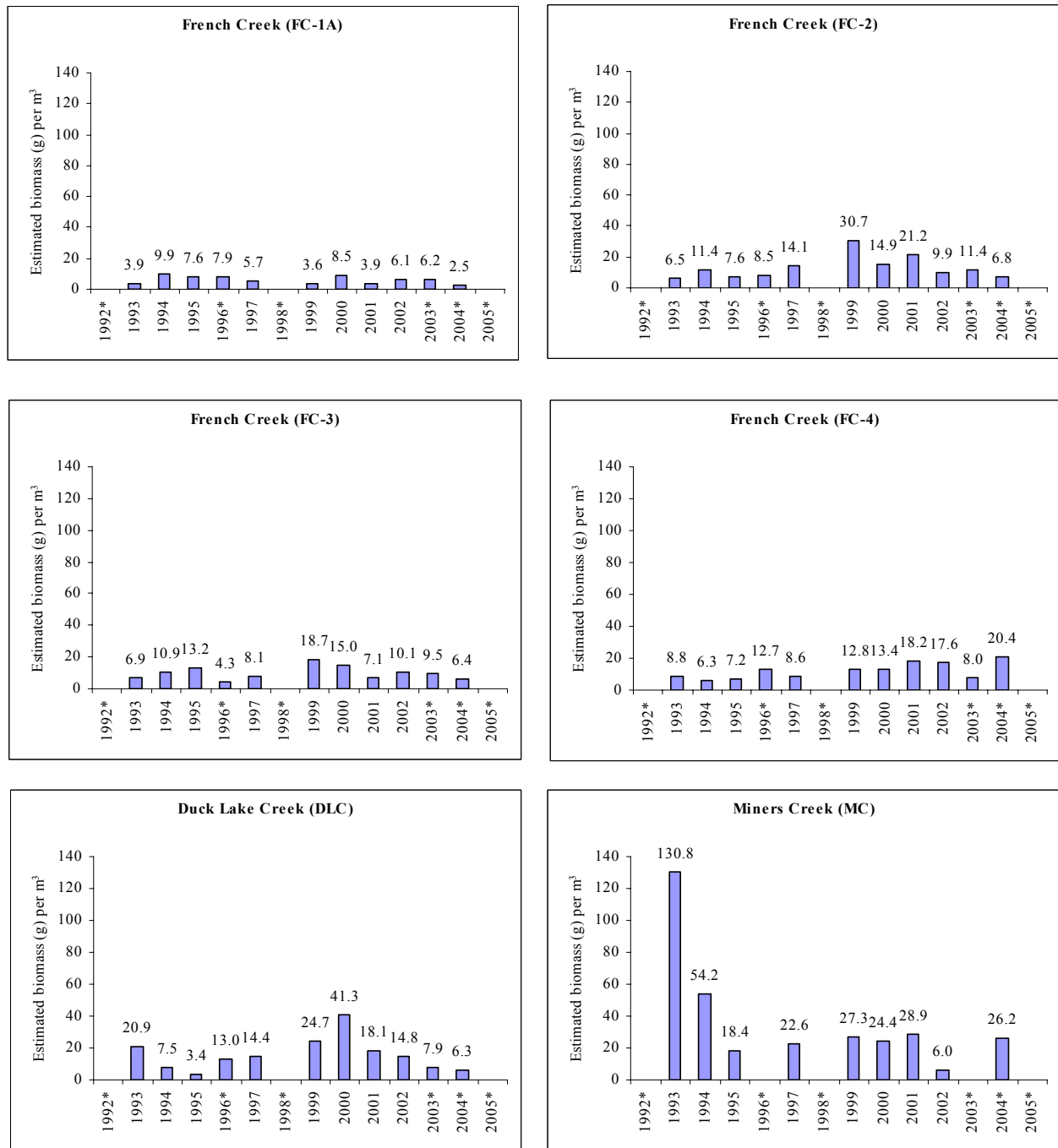


Figure 6. Steelhead biomass (g) per m³ of stream for each reach and year.

*Depth was not measured in 1992. No survey in reach MC in 1996. No survey in 1998. No weights taken in reach MC in 2003. In 2004, biomass estimate includes all locations with only a single pass made in reach FC-1A. In 2005 depth was not measured.

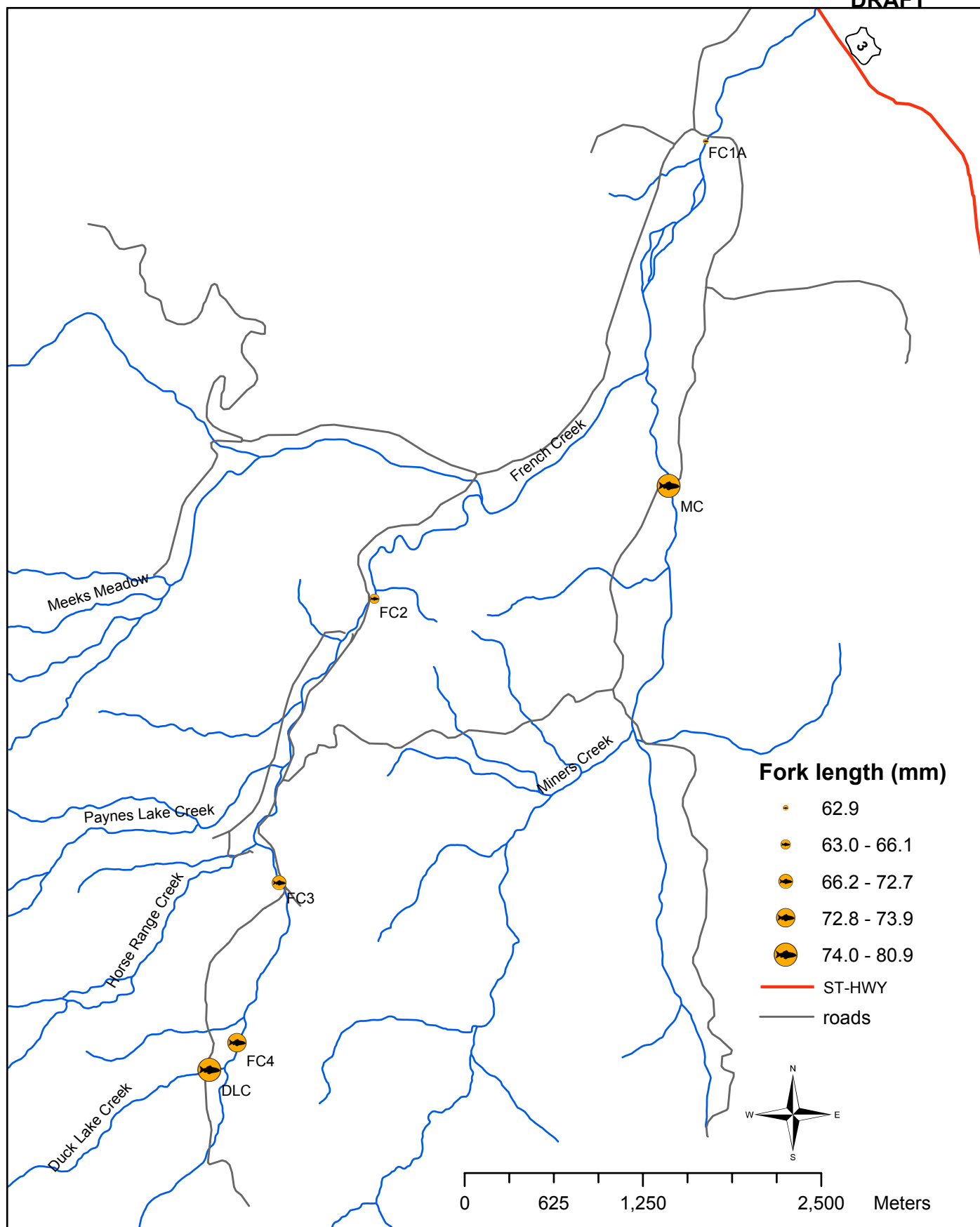


Figure 7. The mean fork length for steelhead based on a six year average from 2000-2005. FC-1A was not surveyed in 2005.

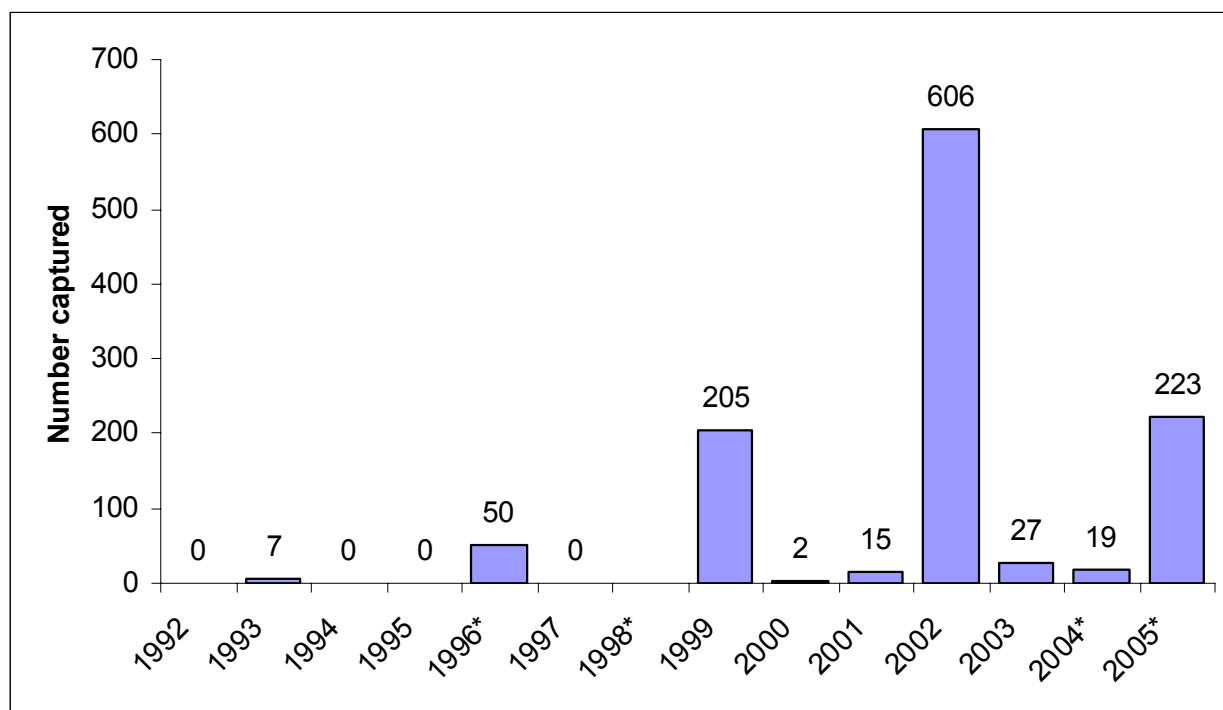


Figure 8. The cumulative catch of coho for all reaches. Note that no survey was conducted in MC in 1996. No surveys were conducted in 1998. Only one pass was made in FC1A in 2004. FC1A was not surveyed in 2005.

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