DOCUMENTATION OF COHO SALMON (*ONCORHYNCHUS KISUTCH)* IN PINE GULCH CREEK, MARIN COUNTY, CA.

Sandy Dierks

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A report from the
Coho Salmon and Steelhead Trout Restoration Project

February 2002

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February 2002

Documentation of Coho Salmon in Pine Gulch, 2001

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ABSTRACT

Pine Gulch is a 19.8 square km watershed in coastal Marin County, California, and is the primary freshwater input to Bolinas Lagoon. The watershed supports a population of steelhead trout (*Oncorhynchus mykiss*) and it is generally accepted that the watershed supported a native self-sustaining population of coho salmon (*O. kisutch*) into the 1970's. Numerous fish surveys performed by the California Department of Fish and Game, National Park Service (NPS), and others had not detected coho in Pine Gulch since 1968, and it had been presumed extirpated, possibly due to a combination of drought and in-stream damming during the mid 70's.

NPS biologists have conducted comprehensive surveys for juvenile and adult salmonids on Pine Gulch since 1997. During electrofishing surveys in August 2001, several juvenile coho were captured from four locations on the lower 7.5 km of the 12 km mainstem. A follow-up Hankin Reeves type survey was conducted to determine distribution and approximate numbers of coho. Results indicate approximately 538 juvenile coho distributed in two clusters, suggesting they may have originated from more than one redd. Collected tissue samples will be genetically analyzed and may indicate genetic variability of the coho in Pine Gulch Creek, as well as relatedness to coho in adjacent watersheds and other watersheds within the Central California Coast Evolutionarily Significant Unit.

ACKNOWLEDGEMENTS

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esearch conducted under Permit #1046 authori ation by the National arine isheries Service.

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Appendix B – Electrofishing Log

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BACKGROUND

Pine Gulch is a 19.8 square km watershed in coastal Marin County, California, and is the primary freshwater input to Bolinas Lagoon (map 1). The upper portion (75%) is contained within Point Reyes National Seashore (PRNS) and the Golden Gate National Recreation Area (GGNRA). The lower portion (25%) is privately owned, with organic agriculture the primary land use.

The watershed supports a population of steelhead trout (*Oncorhynchus kisutch*) and it is generally accepted that the watershed supported a native self-sustaining population of coho salmon (*O. mykiss*) into the 1970's. The last documented observation of coho salmon is on file at the Yountville office of the California Department of Fish and Game (CDFG). This visual survey conducted in July of 1968 reads, "coho salmon, 20 fish per 100 foot length of stream." The reasons for extirpation of coho salmon in Pine Gulch are uncertain. It is likely, however, that the drought of the late 1970's coupled with in-stream damming during this period severely depleted multiple year classes and led to unsuitable conditions for continued survival of the species within the Pine Gulch watershed.

National Park Service biologists from PRNS and GGNRA have performed numerous fish surveys on the 12 km mainstem of Pine Gulch since 1997. We conducted a Hankin Reeves survey (Dollof et al, 1993) on the lower 8 km in the fall of 1997, and spawner surveys during the winters of 1997-98 and 2000-01. A downstream migrant pipe trap was run during spring 1999, and in spring 2000 we snorkeled 75 pools along the lower 8.5 km. In summer 2000, 8 index sites were established throughout the lower 8 km of the mainstem for yearly monitoring (table 1). No coho salmon were detected in any of these surveys (with the exception of a partial carcass tentatively identified as an adult female coho in winter 2000-01).

During electrofishing surveys of the index sites in August 2001, several juvenile coho were captured in index sites 2, 3 and 5, and a single coho was captured in index site 1b. To further determine the distribution of juvenile coho in Pine Gulch, and develop a rough population estimate, a modified Hankin-Reeves type survey was conducted in September 2001 (map 2).

Table 1. Index sites on Pine Gulch.

Index Site #	Name/Location	Stream Km	Total Length (m)	# habitat units (2001)
1a	MCOSD (Open Space)	0.3	28	4 pools, 3 riffles
1b	Murch's	0.4	84	2 pools, 2 flatwater, 1 riffle
1c	Weber's	0.7	61	4 pools, 2 riffles
2	Paradise Valley	2.8	83	3 pools, 1 flatwater, 1 riffle
3	Gorge	3.9	74	4 pools, 1 riffle
4	BPUD pasture	5.1	51	2 pools, 1 riffle
5	lower Teixeira	6.8	67	4 pools, 2 riffles
6	upper Teixeira	7.8	78	4 pools, 1 riffle

METHODS

We surveyed approximately 7 km of the Pine Gulch mainstem starting at the top of the dredge pool on Marin County Open Space District land (MCOSD) at stream km 0.3, and continuing upstream to the McCurdy creek confluence at km 7.3. The coho survey was intended to encompass the downstream (index site 1b at km 0.4) and upstream (index site 5 at km 6.8) extents of coho detected during index site surveys. We habitat typed the entire reach and conducted snorkel counts in a subset of the pool units. All index site pools (which had already been electrofished) within the coho survey area were also snorkeled, and the electrofishing results used to calibrate the snorkel counts.

Habitat Typing

Starting at the bottom of the coho survey area and working upstream, we numbered, classified, measured the length, and estimated the average width of each habitat unit. Units were classified as pool (scour pool, backwater pool, plunge pool, or mid-channel pool), flatwater, or riffle. Every fifth pool unit was flagged for snorkeling and several measured widths taken to calibrate the estimated width.

Snorkel Counts

We sampled each of the previously determined pools with a single pass snorkel count, using a dive light to search under vegetation, woody debris, and undercut banks. Only coho were counted but the presence of steelhead and non-salmonid fish were noted, as well as cover, habitat complexity, and general survey conditions.

Electrofishing

Prior to this coho survey, the index sites within the coho survey area had already been sampled using standard multiple-pass depletion electrofishing methods. We isolated each habitat unit with block seine nets, electrofished, and counted, measured, and weighed all fish captured. Population estimates for each unit were made using the computer program *Microfish* (VanDeventer and Platts 1989).

Data Analysis

Survey data were entered into a Microsoft Acces database, and from there imported into Microsoft Excel for processing and analysis (Appendix A). All calculations and population estimates were made using methods outlined in Dollof et al (1993).

RESULTS

Habitat Survey

A total of 520 habitat units were identified (248 pool, 83 flatwater, and 189 riffle units). By length, pools comprised 53%, flatwater units 20%, and riffles 27% of the coho survey area (table 2). Habitat composition of the index sites is shown in table 3 for comparison. Correlation between visually estimated and measured surface area of 40 pools was high (R^2=0.96) and a calibration ratio of 1.02 was used to correct the estimated surface area of all units (figure 1).

Table 2. Habitat composition of Pine Gulch coho survey area, September 2001

Unit type	total number	%	total length (m)	%	total surface area (m^2)	%
pool	248	48	3755	53	12436	62
flatwater	83	16	1381	20	3927	19
riffle	189	36	1873	27	3884	19
All units	520	100	7009	100	20247	100

Table 3. Habitat composition of Pine Gulch index sites, August 2001.

Unit type	total number	%	total length (m)	%	total surface area (m^2)	%
pool	27	64	414	79	1286	83
flatwater	3	7	43	8	119	8
riffle	12	29	69	13	148	9
All units	42	100	526	100	1553	100

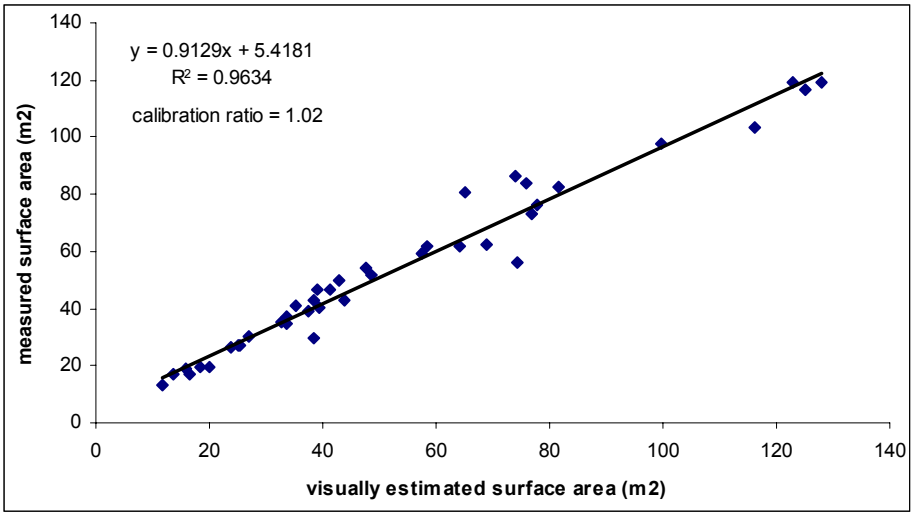

Figure 1. Measured vs. visually estimated surface area of 40 pools; Pine Gulch, September 2001

Snorkel counts

We dove a total of 68 pools, and counted a total of 152 coho in 28 of the pools. Seventeen of the 68 pools had been electrofished in the previous two weeks (Appendix B). *Microfish* population estimates for the electrofished pools were used to calibrate the snorkel counts. Correlation between electrofishing and snorkel counts was low but acceptable (R^2=0.69) and a calibration ratio of 1.0625 was used to correct the snorkel counts for all pools (figure 2). Coho densities (by both pool length and surface area), population estimate, and 95% confidence interval were calculated for the coho survey area as a whole (table 4).

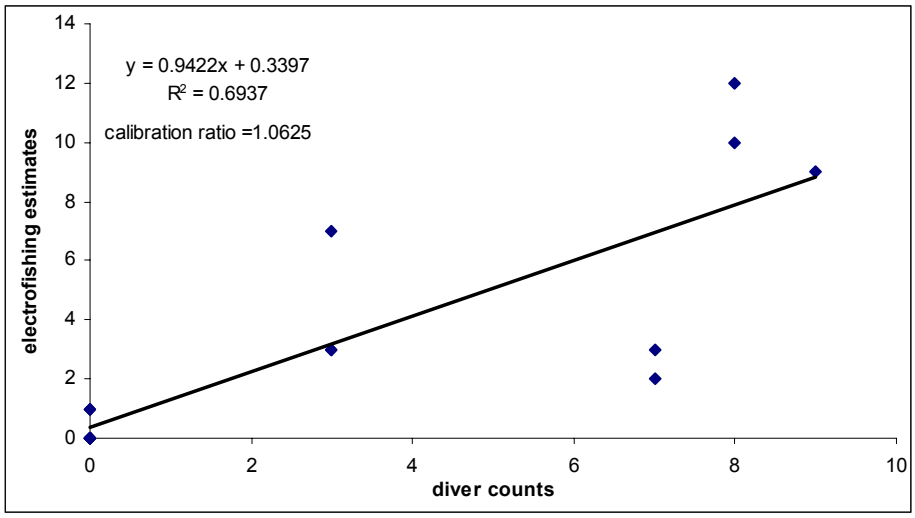

Figure 2. Electrofishing estimates vs. snorkel counts for 17 pools, Pine Gulch, September 2001

Table 4. Coho density and population estimates (assuming continuous distribution); Pine Gulch coho survey area, September 2001

Reach	Avg Coho per pool		Density		Population Estimate	Variance	95% conf. interval
	Original	Calibrated	coho/m	coho/m^2			
All	2.24	2.38	.1475	.0452	589	24104	± 329

Coho observed in the snorkel surveys appeared to be distributed in two clusters, from unit 183 to 293 and from unit 384 to 519 (stream km 2.7 - 4.3 and km 5.7 - 7.3), with a gap in between (figure 3). Based on the uneven distribution of coho in the snorkeled pools, we divided the surveyed area into 4 reaches (table 5) and calculated separate coho densities, population estimates, and 95% confidence intervals for the two reaches in which they were detected (table 6). Using this method we estimated an overall population of 538 (± 349) coho (compared to 589 ± 329 assuming continuous distribution), with most of those occuring in the upper 1.5 km of the surveyed area. Coho densities from snorkeled pools where they were observed ranged from 0.017 to 0.161 coho/m^2 in reach 2 and from 0.025 to 0.358 coho/m^2 in reach 4 (based on calibrated surface area and fish #'s). For comparison, coho densities for pools from the index sites where they were found are given in table 7.

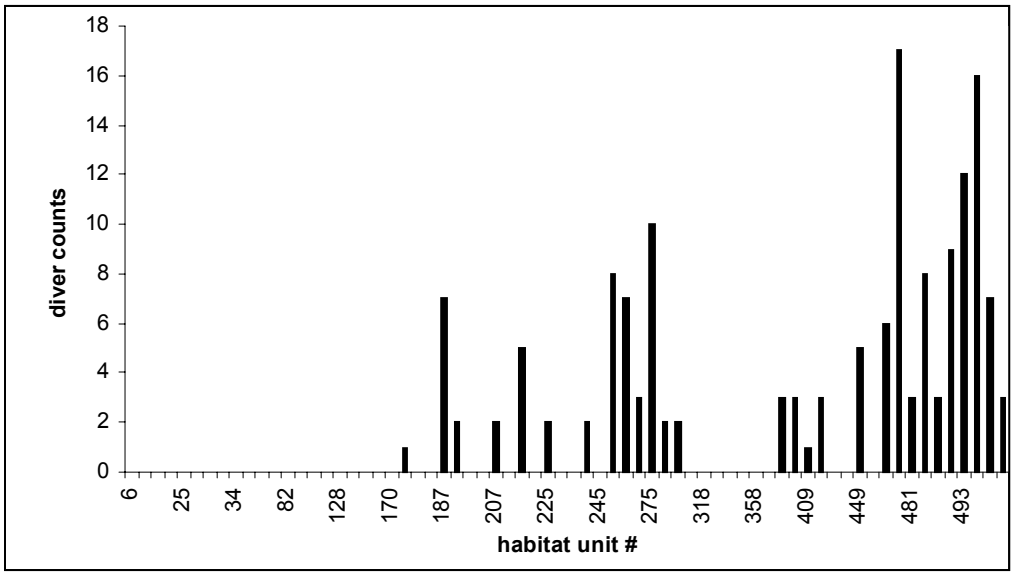

Figure 3. Distribution of coho in snorkeled pools on Pine Gulch, September 2001

Table 5. Summary of coho snorkel counts on Pine Gulch, September 2001

Reach	Habitat Unit #	Location (stream km)	# of Pools			Coho Counted
			Total	Snorkeled	w/ Coho	
1	1-182	0.3 to 2.7	89	21	0	0
2	183-293	2.7 to 4.3	55	22	13	53
3	294-383	4.3 to 5.7	36	7	0	0
4	384-519	5.7 to 7.3	68	18	15	99
			248	68	28	152

Table 6. Coho density and population estimates (assuming clustered distribution); Pine Gulch coho survey area, September 2001

Reach	Avg Coho per pool		Density		Population Estimate	Variance	95% conf. interval
	Original	Calibrated	coho/m	coho/m^2			
2	2.41	2.56	.1482	0.0485	141	4191	± 166
4	5.50	5.84	.4061	0.1186	397	14205	± 379
					538	18396	± 349

Table 7. Coho population estimates and densities from Pine Gulch index sites; August 2001.

Index Site	Unit	Unit Type	Length (m)	Surface Area (m^2)	# Coho	Density	
						co/m	co/m^2
1b	5	scour pool	20.0	64.98	1	0.0500	0.0154
2	1	scour pool	15.6	53.35	1	0.0641	0.0187
	5	scour pool	31.0	104.16	3	0.0968	0.0288
3	2	scour pool	17.5	70.00	10	0.5714	0.1429
	4	scour pool	19.8	83.16	2	0.1010	0.0241
	5	scour pool	19.5	60.06	3	0.1538	0.0500
5	1	scour pool	14.2	30.35	7	0.4930	0.2306
	3	scour pool	18.2	63.70	12	0.6593	0.1884
	4	scour pool	11.6	26.97	3	0.2586	0.1112
	6	scour pool	11.7	48.85	9	0.7692	0.1842

DISCUSSION

The clustered distribution of the juvenile coho observed during snorkel surveys suggests that they may have originated from more than one redd. The partial carcass of an adult female salmonid tentatively indentified as a coho was found at km 4.6 during routine spawner surveys in January 2001, just upstream of the lower cluster of juvenile coho observed in reach 2. Tissue samples from this carcass and the juvenile coho captured during electrofishing are undergoing genetic analysis and will hopefully indicate the degree of relatedness among the juveniles, the carcass, and coho from adjacent watersheds (Appendix C).

The observed "gap" in distribution, from km 4.3 to 5.7, coincides with an area affected by cattle grazing in an unfenced pasture adjacent to the creek from km 4.8 to 5.7. There is a noticeable increase in bank erosion and substrate embeddedness, and decrease in riparian cover, adjacent to and downstream of the pasture section. Cattle exclusion through land acquisition is proposed for this area. In cooperation with the Save-the Redwoods League, Point Reyes National Seashore is working to raise the funds for acquisition and protection of 73 acres currently within the Seashore boundary, but owned and managed by the Bolinas Community Public Utilities District. Conversion to NPS ownership would precipitate restoration and management as part of the Natural Zone. Livestock grazing would be eliminated from the property.

Several theories could explain the occurrence of coho in Pine Gulch after so many years of apparent absence:

- Strays: The winter of 2000-01appeared to be a productive year for a relatively strong year class, and the coho spawning runs in this area were the highest in several years. It is possible that some strays from the adjacent Olema/ Lagunitas or Redwood Creek watersheds managed to successfully spawn in Pine Gulch. If this were the case, then genetic analysis would presumably show a close relation between the carcass and coho from one of the adjacent watersheds. Since any strays involved in spawning may not all have come from the same watershed, the juvenile coho (as offspring of parents from two different watersheds) might show less relatedness to a particular watershed.

- Relict year class: This year class may have survived in Pine Gulch at levels too low for detection, and started to rebound during this favorable year. If so, the year class would have been present as spawners during the winter of 1994-95 and 1997-98, as juveniles during the summer/fall of 1995 and 1998, and as outmigrating smolts during the spring of 1996 and 1999. There have been some unconfirmed anecdotal sightings of coho over the years (winter of 1993-94 and 1996-97) but these would have represented different year classes. At any rate, it seems unlikely that the numerous surveys conducted by NPS since 1997 (including spawner surveys winter 1997-98 and smolt trap spring 1999) would have missed any coho that might have been present. Genetic analysis in this case would probably show less relatedness between the Pine Gulch coho and those from adjacent watersheds.

- Planted coho: We can't discount the possibility that some juvenile coho were planted in Pine Gulch three years ago, and enough survived to return and spawn this year. Any planted coho would likely have come from a limited area within a single watershed, so the Pine Gulch

coho, as their offspring, would show much less genetic diversity than the other two scenarios. Assuming at least two redds and two different spawning pairs in winter 2000-01, at least 4 adult coho would have had to survive and return to spawn. Based on coho survival rates in Sandercock (1991), we can roughly estimate a 1% survival rate for any planted juveniles, so at least 400 young-of-year coho would have to be planted to yield 4 returning adults. The difficulty in capturing and transporting this many fish in an unsanctioned planting effort makes this a much less likely scenario.

Recent spawner surveys conducted this winter have detected a second coho year class in Pine Gulch, represented by a single spawning pair seen in December, 2001. Coincidentally, this pair and their associated redds were located at stream km 6.7, in the same area where the highest densities of juvenile coho were seen the previous summer. At the very least, this indicates the presence of good spawning habitat in this area.

Whether the Pine Gulch coho are the result of spawners straying from the Lagunitas/Olema Creek or Redwood Creek watersheds, or one or more surviving year classes that have managed to escape detection, their presence is significant and will definitely affect future monitoring and management of the watershed.

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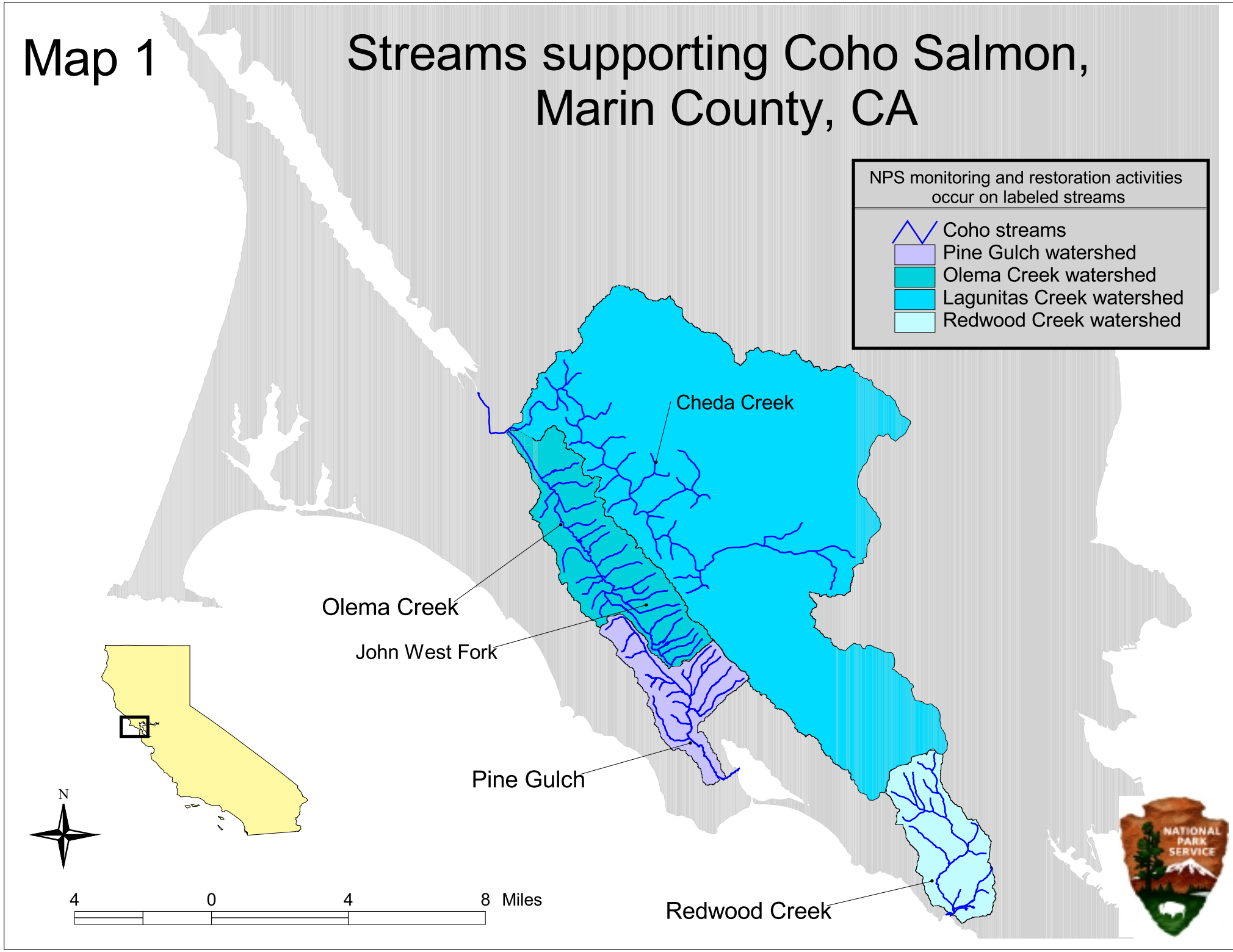
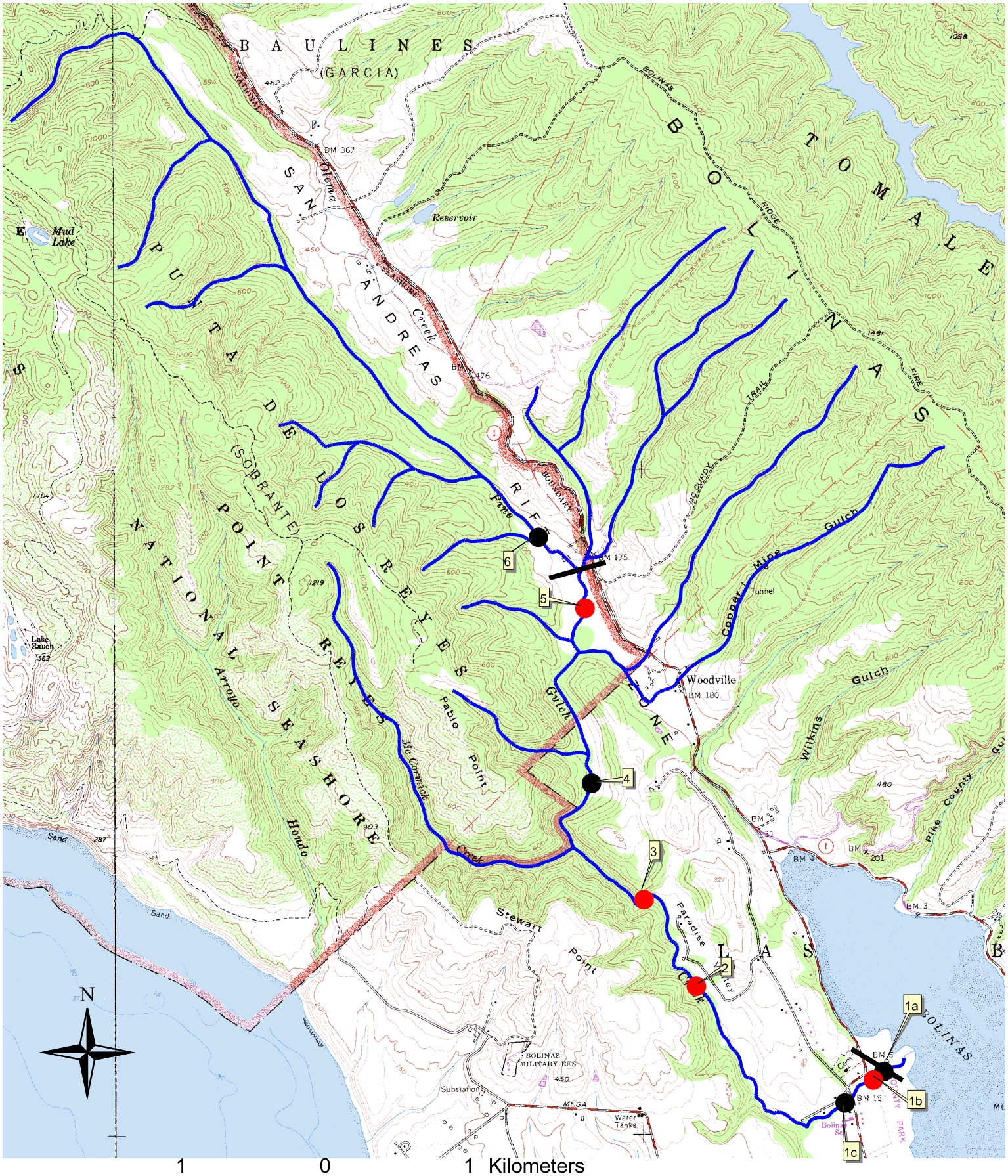
Map 1

Streams supporting Coho Salmon, Marin County, CA





Map 2. Index site and survey area locations on Pine Gulch; Aug-Sept 2001. (Bolinas 7.5' quad)

- Index sample site - no coho
- Index sample site - w/ coho
- Survey area boundary

Appendix A
Habitat, Snorkel, and Electrofishing Survey Results

Unit	Unit		Estimated	Measured Widths				Surface Area			Depth			Snorkel Counts							Electrofishing				
Number	Type	Length	Width	1	2	3	4	Estimated	Measured	Corrected	Crest	Max	Residual	Date	Diver	CO	calibrated CO	CO/m2	SH YOY	SH 1+	Date	# Passes	CO	SH YOY	SH 1+
1	FW	15.9	2.1					33.39		33.90															
2	R	9.3	0.9					8.37		8.50															
3	SC	24	4					96		97.47															
4	FW	23.2	2.5					58		58.89															
5	SC	18.4	3					55.2		56.05															
6	SC	11	3.5	2.3	2.9	2.8		38.5	29.33	39.09				09/05/01	Brown	0	0	0							
7	R	6.7	2					13.4		13.61															
8	FW	26.8	3.25					87.1		88.44	0.07	0.17	0.1	09/05/01	Brown	0	0	0			08/28/01	2	0	11	0
9	FW	25.6	3	2.86				76.8	73.22	77.98	0.06	0.32	0.26	09/05/01	Brown	0	0	0			08/28/01	2	0	21	0
10	SC	20	3.2	3.08				64	61.6	64.98	0.1	0.57	0.47	09/05/01	Brown	0	0	0			08/28/01	2	1	23	11
11	R	3	1					3		3.05															
12	FW	11.3	2.8					31.64		32.13															
13	R	9.6	3					28.8		29.24															
14	FW	6.1	3.7					22.57		22.92															
15	R	12.9	1.8					23.22		23.58															
16	MC	11.7	6					70.2		71.28															
17	FW	10.9	2.2					23.98		24.35															
18	SC	11.5	4.5					51.75		52.54															
19	SC	21.7	3.5					75.95		77.12															
20	R	14.4	2					28.8		29.24															
21	SC	22.1	3					66.3		67.32															
22	FW	17.6	1.5					26.4		26.81															
23	FW	20.2	3.1					62.62		63.58															
24	R	6	0.9					5.4		5.48															
25	SC	14.3		2.81					40.18	40.18	0.05	0.75	0.7	09/05/01	Brown	0	0	0			08/16/01	2	0	23	4
26	R	5.2		1.4	1.2	1.4			6.93	6.93											08/16/01	1	0	0	0
27	SC	17.2		3.44					59.17	59.17	0.06	0.85	0.79	09/05/01	Brown	0	0	0			08/16/01	2	0	18	11
28	SC	12.6		2.6	2.6	3.1	2.66		34.52	34.52	0.19	0.46	0.27	09/05/01	Brown	0	0	0			08/16/01	2	0	17	4
29	R	4		1.05	1.15	1.55			5	5.00											08/16/01	1	0	0	0
30	SC	7.6		4.1	4.4	4.7	3.6		31.92	31.92	0.04	0.74	0.7	09/05/01	Brown	0	0	0			08/16/01	2	0	6	3
31	FW	20.2	2.1					42.42		43.07															
32	SC	16.8	2.1					35.28		35.82															
33	SC	16.2	1.8					29.16		29.61															
34	SC	17.3	2.8	3.3	2.6	3.1		48.44	51.9	49.18	0.06	0.61	0.55	09/05/01	Brown	0	0	0							
35	R	17.7	2.3					40.71		41.34															
36	FW	22.8	4					91.2		92.60															
37	SC	11.2	3					33.6		34.12															
38	SC	14.1	2.5					35.25		35.79															
39	SC	6.5	5					32.5		33.00															
40	R	4.2	0.7					2.94		2.99															
41	SC	16.4	4					65.6		66.61															
42	FW	17	0.5					8.5		8.63															
43	SC	11.5	3.8					43.7		44.37															
44	R	7.1	2.5					17.75		18.02															
45	FW	17.6	2.5					44		44.68															
46	FW	23	3					69		70.06															
47	R	5.6	2.2					12.32		12.51															
48	FW	14.9	3.2					47.68		48.41															
49	SC	14.6	2.3	2.5	2.1	3		33.58	36.99	34.10	0.05	0.47	0.42	09/05/01	Brown	0	0	0							
50	SC	19.3	2.5					48.25		48.99															
51	R	5.2	0.9					4.68		4.75															
52	SC	18.4	2.9					53.36		54.18															
53	R	9.9	3					29.7		30.16															
54	SC	24.1	3.5					84.35		85.65															
55	SC	4.8	2					9.6		9.75															
56	R	10.8	0.6					6.48		6.58															
57	SC	12.2	5					61		61.94															
58	R	6	4					24		24.37															
59	SC	30.6	3.8	2.65	3	3.8	4.1	116.28	103.66	118.07	0.08	0.55	0.47	09/05/01	Brown	0	0	0							
60	R	15.2	3.5					53.2		54.02															

all units of measure in meters (linear) and square meters (surface area)

Unit	Unit		Estimated	Measured Widths				Surface Area			Depth			Snorkel Counts							Electrofishing				
Number	Type	Length	Width	1	2	3	4	Estimated	Measured	Corrected	Crest	Max	Residual	Date	Diver	CO	calibrated CO	CO/m2	SH YOY	SH 1+	Date	# Passes	CO	SH YOY	SH 1+
61	SC	16.6	5.5					91.3		92.70															
62	R	7.2	1.8					12.96		13.16															
63	SC	23.4	4.8					112.32		114.05															
64	R	5	1.7					8.5		8.63															
65	SC	17.6	3.9					68.64		69.69															
66	R	3	1					3		3.05															
67	SC	18	2.5					45		45.69															
68	R	3	1					3		3.05															
69	SC	12.2	2.2					26.84		27.25															
70	R	12.4	1					12.4		12.59															
71	SC	6.8	3.5					23.8		24.17															
72	R	5.6	0.8					4.48		4.55															
73	SC	15.6	2.1	1.5	1.7	2.4	3.4	32.76	35.1	33.26	0.05	0.4	0.35	09/05/01	Brown	0	0	0							
74	R	16.7	1.2					20.04		20.35															
75	SC	11.1	3.4					37.74		38.32															
76	R	11.5	2.1					24.15		24.52															
77	SC	22.1	3					66.3		67.32															
78	R	3.2	1.5					4.8		4.87															
79	SC	9.5	3					28.5		28.94															
80	FW	40.8	3.5					142.8		144.99															
81	R	8	2.5					20		20.31															
82	SC	11.2	3	2.7	3.3	3.2	3.1	33.6	34.44	34.12	0.04	0.76	0.72	09/05/01	Brown	0	0	0							
83	FW	24.7	2					49.4		50.16															
84	SC	18.2	3					54.6		55.44															
85	FW	24.2	2.5					60.5		61.43															
86	SC	23.1	3.5					80.85		82.09															
87	FW	4.7	0.5					2.35		2.39															
88	SC	11.1	4					44.4		45.08															
89	R	28.9	1					28.9		29.34															
90	SC	8	3					24		24.37															
91	SC	11.4	4					45.6		46.30															
92	R	12.8	1					12.8		13.00															
93	SC	17.2	4	3.2	4.2	4.1	3	68.8	62.35	69.86	0.05	0.57	0.52	09/05/01	Brown	0	0	0							
94	R	1.6	0.5					0.8		0.81															
95	SC	9.6	2.5					24		24.37															
96	R	4.4	1.5					6.6		6.70															
97	SC	5.4	3					16.2		16.45															
98	R	5.3	1					5.3		5.38															
99	SC	5.1	5					25.5		25.89															
100	FW	17.4	2.5					43.5		44.17															
101	SC	9.6	2.5					24		24.37															
102	R	5	0.5					2.5		2.54															
103	SC	10.2	4					40.8		41.43															
104	R	10.8	0.6					6.48		6.58															
105	SC	7.4	2.5	2.3	3	2.6		18.5	19.49	18.78	0.09	0.31	0.22	09/05/01	Brown	0	0	0							
106	MC	8.8	2					17.6		17.87															
107	FW	19.8	1.5					29.7		30.16															
108	SC	10.1	4.5					45.45		46.15															
109	R	7.3	2.5					18.25		18.53															
110	FW	14.9	3					44.7		45.39															
111	R	4	0.6					2.4		2.44															
112	SC	13.5	2.5					33.75		34.27															
113	FW	18.6	2					37.2		37.77															
114	R	7.7	1					7.7		7.82															
115	SC	10.7	2					21.4		21.73															
116	R	18.5	3					55.5		56.35															
117	SC	18.1	4.5	5.9	4	3.8		81.45	82.66	82.70	0.07	0.96	0.89	09/05/01	Brown	0	0	0							
118	SC	13.7	3.5					47.95		48.69															
119	SC	11	2.5					27.5		27.92															
120	R	12.5	2.5					31.25		31.73															

all units of measure in meters (linear) and square meters (surface area)

Unit	Unit		Estimated	Measured Widths				Surface Area			Depth			Snorkel Counts							Electrofishing				
Number	Type	Length	Width	1	2	3	4	Estimated	Measured	Corrected	Crest	Max	Residual	Date	Diver	CO	calibrated CO	CO/m2	SH YOY	SH 1+	Date	# Passes	CO	SH YOY	SH 1+
121	FW	22.7	2.5					56.75		57.62															
122	FW	24.3	3					72.9		74.02															
123	R	26	2.5					65		66.00															
124	FW	35.5	6.5					230.75		234.29															
125	SC	13	5					65		66.00															
126	R	6.1	2					12.2		12.39															
127	SC	24.3	3					72.9		74.02															
128	SC	12.5	3.5	3.8	3.5	3		43.75	42.92	44.42	0.15	0.89	0.74	09/05/01	Brown	0	0	0							
129	SC	14.7	3					44.1		44.78															
130	R	48	5					240		243.69															
131	FW	20	3					60		60.92															
132	R	15.5	2.5					38.75		39.35															
133	SC	12.8	3.5					44.8		45.49															
134	SC	9.2	3					27.6		28.02															
135	R	16.7	2.5					41.75		42.39															
136	FW	16.1	3					48.3		49.04															
137	BW	10	2					20		20.31															
138	R	16.5	4					66		67.01															
139	SC	8.2	6					49.2		49.96															
140	FW	51.8	5.5					284.9		289.28															
141	FW	20.8	5.5					114.4		116.16															
142	R	8	1.5					12		12.18															
143	SC	13.5	2	2	2.4	2.3		27	30.15	27.41	0.07	0.33	0.26	09/05/01	Brown	0	0	0							
144	SC	6.4	7					44.8		45.49															
145	SC	8.7	3					26.1		26.50															
146	R	15	1.5					22.5		22.85															
147	SC	6.8	7					47.6		48.33															
148	FW	11.9	3					35.7		36.25															
149	SC	10.4	4					41.6		42.24															
150	R	4.2	2					8.4		8.53															
151	SC	13	2.5					32.5		33.00															
152	R	20.2	1.5					30.3		30.77															
153	SC	9	1.5	2	1.9	1.7		13.5	16.8	13.71	0.09	0.3	0.21	09/05/01	Brown	0	0	0							
154	SC	8	1.5					12		12.18															
155	SC	7.1	3					21.3		21.63															
156	R	26.1	1					26.1		26.50															
157	SC	6.5	2.5					16.25		16.50															
158	FW	26	5.5					143		145.20															
159	SC	17.6	4.5					79.2		80.42															
160	SC	21.2	3.5	2.3	2.1	3.5		74.2	55.83	75.34	0.15	0.45	0.3	09/05/01	Brown	0	0	0							
161	R	5.4	1					5.4		5.48															
162	SC	18.8	3.5					65.8		66.81															
163	FW	18.6	1.5					27.9		28.33															
164	SC	19.4	4.5					87.3		88.64															
165	SC	21	4					84		85.29															
166	R	5.8	2					11.6		11.78															
167	SC	9.1	4.5					40.95		41.58															
168	R	5	2					10		10.15															
169	SC	10	3.5					35		35.54															
170	SC	8	2.5	2.7	2.3	2.4		20	19.73	20.31	0.22	0.65	0.43	09/05/01	Brown	0	0	0							
171	R	18.2	1					18.2		18.48															
172	SC	12.7	3					38.1		38.69															
173	R	6.8	3					20.4		20.71															
174	SC	25.5	4					102		103.57															
175	R	5	0.7					3.5		3.55															
176	SC	5.3	6					31.8		32.29															
177	R	7.4	1					7.4		7.51															
178	SC	30	2.5					75		76.15															
179	SC	9.9	4					39.6		40.21															
180	R	4.8	0.6					2.88		2.92															

all units of measure in meters (linear) and square meters (surface area)

Unit	Unit		Estimated	Measured Widths				Surface Area			Depth			Snorkel Counts								Electrofishing				
Number	Type	Length	Width	1	2	3	4	Estimated	Measured	Corrected	Crest	Max	Residual	Date	Diver	CO	calibrated CO	CO/m2	SH YOY	SH 1+	Date	# Passes	CO	SH YOY	SH 1+
181	SC	11.7	3	3.8	3.2	3.5		35.1	40.95	35.64	0.08	0.65	0.57	09/05/01	Brown	1	1.25	0.035							
182	R	6.8	2					13.6		13.81															
183	SC	15.6		3.42					53.35	53.35	0.06	0.75	0.69	08/29/01	Fong	0	0	0	18	2	08/21/01	2	1	13	14
184	SC	23		2.24					51.52	51.52	0.08	0.38	0.3	08/29/01	Fong	0	0	0	5	0	08/21/01	2	0	11	5
185	FW	5.3		1.5					7.95	7.95	0.1	0.24	0.14								08/21/01	1	0	2	2
186	R	8.6		1.3	1.3	1.6			12.04	12.04											08/21/01	1	0	2	0
187	SC	31		3.36					104.16	104.16	0.07	0.89	0.82	08/29/01	Fong	7	8.75	0.084			08/21/01	2	3	27	25
188	R	21	2					42		42.65															
189	FW	19.8	2.5					49.5		50.26															
190	SC	42	2.75					115.5		117.27				08/29/01	Fong	2	2.5	0.021	15	5					
191	SC	13.6	1					13.6		13.81															
192	R	13.3	0.75					9.98		10.13															
193	SC	27.5	3					82.5		83.77															
194	R	4.1	0.75					3.08		3.12															
195	SC	14	2.4					33.6		34.12				08/29/01	Fong	0	0	0	8	0					
196	FW	18.4	2.5					46		46.71															
197	R	14.1	1.5					21.15		21.47															
198	SC	23.2	3.5					81.2		82.45															
199	R	3.7	0.75					2.78		2.82															
200	SC	21	3					63		63.97															
201	SC	20	1.75					35		35.54				08/29/01	Fong	0	0	0	20	4					
202	R	4	1					4		4.06															
203	SC	18.9	3.75					70.88		71.96															
204	R	4	2					8		8.12															
205	FW	8.9	2.5					22.25		22.59															
206	R	17.6	2					35.2		35.74															
207	SC	9	3.1					27.9		28.33				08/29/01	Fong	2	2.5	0.088	18	4					
208	SC	12.8	3					38.4		38.99															
209	R	2.5	1					2.5		2.54															
210	SC	12.7	2.5					31.75		32.24															
211	R	3	1.5					4.5		4.57															
212	FW	12.3	1.75					21.53		21.86															
213	R	4	1					4		4.06															
214	SC	17	2.5					42.5		43.15				08/29/01	Fong	0	0	0	9	0					
215	SC	13.9	3					41.7		42.34				08/29/01	Fong	5	6.25	0.148	20	5					
216	R	9.7	2					19.4		19.70															
217	SC	21.5	3					64.5		65.49															
218	FW	38	3					114		115.75															
219	SC	20	3					60		60.92				08/29/01	Fong	0	0	0	27	2					
220	R	20.4	1.5					30.6		31.07															
221	SC	17.8	2					35.6		36.15															
222	R	3	1.5					4.5		4.57															
223	FW	14.9	2.25					33.53		34.04															
224	SC	25.8	2.5					64.5		65.49															
225	SC	15	2					30		30.46				08/29/01	Fong	2	2.5	0.082	16	1					
226	BW	10	1					10		10.15				08/29/01	Fong	0	0	0	0	2					
227	R	3.5	1					3.5		3.55															
228	SC	8.9	1					8.9		9.04															
229	R	4	0.75					3		3.05															
230	SC	16.5	3					49.5		50.26															
231	FW	30.6	2.5					76.5		77.67															
232	R	24	2.5					60		60.92															
233	SC	7.5	3					22.5		22.85				08/29/01	Fong	0	0	0	2	0					
234	SC	7.1	4					28.4		28.84															
235	SC	23.6	2.75					64.9		65.90															
236	R	10	4.5					45		45.69															
237	SC	28.5	3.5					99.75		101.28															
238	R	4	2					8		8.12															
239	SC	15	3.25					48.75		49.50				08/29/01	Fong	2	2.5	0.051	8	4					
240	R	6.3	3					18.9		19.19															

all units of measure in meters (linear) and square meters (surface area)

Unit	Unit		Estimated	Measured Widths				Surface Area			Depth			Snorkel Counts								Electrofishing				
Number	Type	Length	Width	1	2	3	4	Estimated	Measured	Corrected	Crest	Max	Residual	Date	Diver	CO	calibrated CO	CO/m2	SH YOY	SH 1+	Date	# Passes	CO	SH YOY	SH 1+
241	FW	24	2.5					60		60.92																
242	R	15.3	1.25					19.13		19.42																
243	SC	12.4	4.5					55.8		56.66																
244	FW	5.5	1.25					6.88		6.98																
245	MC	8	2.5					20		20.31				08/29/01	Fong	0	0	0	7	1						
246	R	3	1.5					4.5		4.57																
247	SC	14.9	1.75					26.08		26.48																
248	R	25.4	1.25					31.75		32.24																
249	SC	22.5	3.25					73.13		74.25																
250	FW	20.6	2					41.2		41.83																
251	SC	18.6	4					74.4		75.54																
252	R	8.8	2.75					24.2		24.57																
253	FW	16.2	3					48.6		49.35																
254	SC	18.2	2.5					45.5		46.20																
255	R	10.7	1.5					16.05		16.30																
256	FW	13.1	2					26.2		26.60																
257	R	10.8	2					21.6		21.93																
258	SC	20.3	5					101.5		103.06																
259	R	10.5	1.5					15.75		15.99																
260	SC	7.3	2.75					20.08		20.38																
261	SC	17.5		4					70	70.00	0.04	0.49	0.45	09/06/01	Press	8	10	0.143			08/20/01	2	10	28	3
262	R	9.8		2.1	1.7	1.1			16.01	16.01											08/20/01	1	0	0	0
263	SC	19.8		4.2					83.16	83.16	0.1	0.8	0.7	09/06/01	Press	7	8.75	0.105			08/20/01	2	2	8	13
264	SC	19.5		3.08					60.06	60.06	0.15	0.52	0.37	09/06/01	Press	3	3.75	0.062			08/20/01	2	3	11	4
265	SC	12.8	3					38.4		38.99																
266	R	5.4	1.5					8.1		8.22																
267	FW	11.2	3.5					39.2		39.80																
268	SC	11.2	3					33.6		34.12																
269	R	2.4	0.8					1.92		1.95																
270	FW	6.3	2.5					15.75		15.99																
271	R	39	2					78		79.20																
272	BW	5.9	1					5.9		5.99																
273	SC	18.4	3.5					64.4		65.39																
274	R	11.3	3					33.9		34.42																
275	SC	21.7	3	3	4.5	3.9	3.5	65.1	80.83	66.10	0.08	0.45	0.37	09/06/01	Brown	10	12.5	0.189								
276	MC	15.2	2.5					38		38.58																
277	R	2.9	1					2.9		2.94																
278	SC	9	3					27		27.41																
279	R	12.8	1					12.8		13.00																
280	SC	11.6	3.5					40.6		41.22																
281	R	13.2	1.5					19.8		20.10																
282	SC	18.2	3					54.6		55.44																
283	SC	7.3	4					29.2		29.65																
284	R	6.9	1.5					10.35		10.51																
285	SC	8.2	2	2.1	2.2	2		16.4	17.22	16.65	0.12	0.42	0.3	09/06/01	Brown	2	2.5	0.150								
286	R	54.6	2.5					136.5		138.60																
287	SC	29.2	4					116.8		118.59																
288	R	17.1	2.5					42.75		43.41																
289	SC	39.5	5					197.5		200.53																
290	BW	8.7	2					17.4		17.67																
291	R	20.4	2					40.8		41.43																
292	FW	11	1.5					16.5		16.75																
293	SC	20.5	6	4.7	7	5.5	6	123	118.9	124.89	0.07	0.64	0.57	09/06/01	Press	2	2.5	0.020								
294	FW	9.6	2.5					24		24.37																
295	R	9.7	2.5					24.25		24.62																
296	SC	13.3	3					39.9		40.51																
297	R	5.8	2					11.6		11.78																
298	FW	13.4	2.5					33.5		34.01																
299	SC	31.4	3					94.2		95.65																
300	R	23.2	3					69.6		70.67																

all units of measure in meters (linear) and square meters (surface area)

Unit	Unit		Estimated	Measured Widths				Surface Area			Depth			Snorkel Counts								Electrofishing				
Number	Type	Length	Width	1	2	3	4	Estimated	Measured	Corrected	Crest	Max	Residual	Date	Diver	CO	calibrated CO	CO/m2	SH YOY	SH 1+	Date	# Passes	CO	SH YOY	SH 1+
301	SC	44.7	4.5					201.15		204.24															
302	R	19.3	2					38.6		39.19															
303	MC	20.8	3					62.4		63.36															
304	R	2.9	1.5					4.35		4.42															
305	SC	32	4	3.2	3.7	4.1	3.9	128	119.2	129.97	0.06	0.52	0.46	09/06/01	Brown	0	0	0							
306	R	32	3					96		97.47															
307	SC	18.4	3.5					64.4		65.39															
308	R	16.8	3					50.4		51.17															
309	SC	14.5	3.5					50.75		51.53															
310	R	23.3	2.5					58.25		59.14															
311	FW	12.5	2					25		25.38															
312	R	17.2	2.5					43		43.66															
313	SC	16.6	3					49.8		50.56															
314	FW	8.2	2.5					20.5		20.81															
315	SC	11.2	3					33.6		34.12															
316	FW	29.7	3					89.1		90.47															
317	FW	12.8	1.5					19.2		19.49															
318	SC	13	3	3.6	3.5	3.6		39	46.37	39.60	0.08	0.43	0.35	09/06/01	Press	0	0	0							
319	R	4.3	1.5					6.45		6.55															
320	FW	5.8	2					11.6		11.78															
321	R	13.7	1					13.7		13.91															
322	SC	24.8	4					99.2		100.72															
323	R	6.5	2.5					16.25		16.50															
324	SC	16.6	2.5					41.5		42.14															
325	R	9.7	2					19.4		19.70															
326	SC	42.3	3.5					148.05		150.32															
327	R	9.4	2.5					23.5		23.86															
328	SC	7	3					21		21.32															
329	R	5	2					10		10.15															
330	SC	10	2.5	2.7	2.6	2.8		25	27	25.38	0.09	0.58	0.49	09/06/01	Brown	0	0	0							
331	R	16.6	1.5					24.9		25.28															
332	FW	19.5	3					58.5		59.40															
333	R	15.2	1.5					22.8		23.15															
334	SC	29.5	2.5					73.75		74.88															
335	SC	16.7	3					50.1		50.87															
336	R	12.4	2.5					31		31.48															
337	FW	16.6	2					33.2		33.71															
338	R	6.8	1.5					10.2		10.36															
339	SC	18.6	3					55.8		56.66															
340	FW	18.1	2					36.2		36.76															
341	R	3.4	2					6.8		6.90															
342	SC	16.4	3.5					57.4		58.28															
343	FW	11.6	2					23.2		23.56															
344	SC	6.4	6	8	6	6		38.4	42.67	38.99	0.05	0.91	0.86	09/06/01	Brown/Press	0	0	0	13	11					
345	R	15.8	4					63.2		64.17															
346	SC	28.5	3.5	3.2	3.1	4		99.75	97.85	101.28	0.09	0.53	0.44	09/06/01	Brown/Press	0	0	0	44	4					
347	SC	12	2.5					30		30.46															
348	FW	19.2	3					57.6		58.48															
349	R	4.8	3.5					16.8		17.06															
350	SC	18.6	4					74.4		75.54															
351	R	11.3	3.5					39.55		40.16															
352	SC	20.8	4					83.2		84.48															
353	FW	11.6	2					23.2		23.56															
354	FW	13	2.5					32.5		33.00															
355	R	4.8	1.5					7.2		7.31															
356	SC	16.1	3.5					56.35		57.22															
357	R	10.1	1.5					15.15		15.38															
358	SC	13	4.5	7.6	3.7	3		58.5	61.97	59.40	0.1	0.54	0.44	09/06/01	Press	0	0	0							
359	R	11.2	1.5					16.8		17.06															
360	FW	16	2.5					40		40.61															

all units of measure in meters (linear) and square meters (surface area)

Unit	Unit		Estimated	Measured Widths				Surface Area			Depth			Snorkel Counts							Electrofishing				
Number	Type	Length	Width	1	2	3	4	Estimated	Measured	Corrected	Crest	Max	Residual	Date	Diver	CO	calibrated CO	CO/m2	SH YOY	SH 1+	Date	# Passes	CO	SH YOY	SH 1+
361	R	23.8	2.5					59.5		60.41															
362	SC	7.4	3					22.2		22.54															
363	R	5	3					15		15.23															
364	SC	32.9	4					131.6		133.62															
365	SC	20.4	3.5					71.4		72.50															
366	R	2.6	2.5					6.5		6.60															
367	FW	4.4	3.5					15.4		15.64															
368	R	23.6	2					47.2		47.92															
369	SC	11.8	3					35.4		35.94															
370	R	4.8	2.5					12		12.18															
371	SC	20.3	2					40.6		41.22															
372	R	6.4	3					19.2		19.49															
373	SC	21.7	3.5	3	3.6	5		75.95	83.91	77.12	0.09	1.1	1.01	09/06/01	Brown	0	0	0							
374	R	7.8	1					7.8		7.92															
375	SC	25.7	3.5					89.95		91.33															
376	R	4	1					4		4.06															
377	SC	9.4	3					28.2		28.63															
378	R	7.2	1.5					10.8		10.97															
379	FW	9	3					27		27.41															
380	SC	8.9	5					44.5		45.18															
381	R	4	1					4		4.06															
382	SC	14.1	1.5					21.15		21.47															
383	R	18	1.5					27		27.41															
384	SC	22.2	3.5	3.5	3.2	3.3	3.8	77.7	76.59	78.89	0.11	0.72	0.61	09/06/01	Press	3	3.75	0.048							
385	FW	14.5	3.5					50.75		51.53															
386	R	6.1	1					6.1		6.19															
387	FW	5.2	1.5					7.8		7.92															
388	SC	15.2	3					45.6		46.30															
389	R	7.2	1					7.2		7.31															
390	SC	14.8	3					44.4		45.08															
391	FW	10.5	2					21		21.32															
392	SC	16.9	1.5					25.35		25.74															
393	R	6.8	2.5					17		17.26															
394	SC	11.2	4					44.8		45.49															
395	SC	10.5	3.5					36.75		37.31															
396	R	10.6	2					21.2		21.53															
397	FW	24	1.5					36		36.55															
398	MC	14.3	3	4	3	3.4		42.9	49.57	43.56	0.08	0.64	0.56	09/06/01	Brown	3	3.75	0.086							
399	R	7.2	1					7.2		7.31															
400	SC	8.8	5					44		44.68															
401	R	6.8	2.5					17		17.26															
402	SC	14.1	1.5					21.15		21.47															
403	R	3.9	2					7.8		7.92															
404	FW	30	2.5					75		76.15															
405	R	20.3	2					40.6		41.22															
406	MC	7.2	2					14.4		14.62															
407	R	7.2	0.8					5.76		5.85															
408	FW	6.4	1					6.4		6.50															
409	SC	6.4	2.5	2	3.4	3.6		16	19.2	16.25	0.09	0.42	0.33	09/06/01	Brown	1	1.25	0.077							
410	SC	11.3	1					11.3		11.47															
411	R	8.4	1					8.4		8.53															
412	SC	13	4.5					58.5		59.40															
413	SC	16.5	3					49.5		50.26															
414	R	6.6	1.5					9.9		10.05															
415	SC	19.9	3					59.7		60.62															
416	R	5.9	1					5.9		5.99															
417	SC	25	5	2.6	5.5	5	4.7	125	116.5	126.92	0.08	0.71	0.63	09/06/01	Press	3	3.75	0.030							
418	R	5.7	1					5.7		5.79															
419	SC	7.4	4					29.6		30.05															
420	SC	10	3					30		30.46															

all units of measure in meters (linear) and square meters (surface area)

Unit	Unit		Estimated	Measured Widths				Surface Area			Depth			Snorkel Counts							Electrofishing				
Number	Type	Length	Width	1	2	3	4	Estimated	Measured	Corrected	Crest	Max	Residual	Date	Diver	CO	calibrated CO	CO/m2	SH YOY	SH 1+	Date	# Passes	CO	SH YOY	SH 1+
421	SC	7.2	3.5					25.2		25.59															
422	FW	12.4	1.5					18.6		18.89															
423	R	6.1	1					6.1		6.19															
424	SC	21.2	4.5					95.4		96.87															
425	R	4.9	0.8					3.92		3.98															
426	PL	9.2	4.5	6	5.1	4.2		41.4	46.92	42.04	0.08	0.99	0.91	09/06/01	Brown	0	0	0							
427	SC	12.7	2					25.4		25.79															
428	R	6.6	3					19.8		20.10															
429	SC	19.7	3					59.1		60.01															
430	R	5.1	0.7					3.57		3.62															
431	SC	21.2	4					84.8		86.10															
432	R	7.4	2.5					18.5		18.78															
433	SC	17.2	5					86		87.32															
434	FW	11	2.5					27.5		27.92															
435	R	5.7	2					11.4		11.58															
436	FW	20.4	3					61.2		62.14															
437	R	12.6	2					25.2		25.59															
438	FW	7.6	2.5					19		19.29															
439	SC	5.8	2	2	2.6	2.3		11.6	13.34	11.78	0.06	0.39	0.33	09/06/01	Brown	0	0	0							
440	FW	3.9	0.7					2.73		2.77															
441	SC	7.7	1.2					9.24		9.38															
442	R	6.5	1					6.5		6.60															
443	SC	16.5	5					82.5		83.77															
444	SC	3.8	3.5					13.3		13.50															
445	R	1.6	0.8					1.28		1.30															
446	SC	15.8	2					31.6		32.09															
447	SC	6.5	3					19.5		19.80															
448	R	3.2	0.7					2.24		2.27															
449	SC	9.5	2.5	2.9	2.3	3.1		23.75	26.28	24.11	0.06	0.67	0.61	09/06/01	Press	5	6.25	0.259							
450	R	4.9	2.5					12.25		12.44															
451	FW	6.5	2.5					16.25		16.50															
452	SC	24.7	3					74.1		75.24															
453	R	3.4	1					3.4		3.45															
454	FW	9.7	2					19.4		19.70															
455	R	2.4	1					2.4		2.44															
456	SC	7.1	1.2					8.52		8.65															
457	R	2.6	0.5					1.3		1.32															
458	SC	5.9	1.5					8.85		8.99															
459	R	9.6	5.5					52.8		53.61															
460	SC	13.3	3					39.9		40.51															
461	R	21.1	2					42.2		42.85															
462	MC	12.5	3	2.7	3.2	3.5		37.5	39.17	38.08	0.07	0.3	0.23	09/06/01	Brown	0	0	0							
463	SC	10.6	3					31.8		32.29															
464	SC	6.7	2					13.4		13.61															
465	R	6.4	2.5					16		16.25															
466	SC	12	4.5					54		54.83															
467	R	5.9	2.5					14.75		14.98															
468	MC	14.3	2					28.6		29.04															
469	SC	15.8	2.5	2	2.4	2.7	3.1	39.5	40.29	40.11	0.07	0.42	0.35	09/06/01	Press	6	7.5	0.187							
470	MC	5.3	4					21.2		21.53															
471	R	13	2					26		26.40															
472	SC	13.8	3					41.4		42.04															
473	SC	15.8	3.5					55.3		56.15															
474	R	14.9	2.5					37.25		37.82															
475	SC	13.6	3					40.8		41.43															
476	R	11.6	3					34.8		35.33															
477	SC	24.7	3	3.6	3	3.4	4	74.1	86.45	75.24	0.1	0.83	0.73	09/06/01	Press	17	21.25	0.282							
478	SC	18.2	3.5					63.7		64.68															
479	SC	16.7	2.5					41.75		42.39															
480	R	2.9	2.5					7.25		7.36															

all units of measure in meters (linear) and square meters (surface area)

Unit	Unit		Estimated	Measured Widths				Surface Area			Depth			Snorkel Counts							Electrofishing				
Number	Type	Length	Width	1	2	3	4	Estimated	Measured	Corrected	Crest	Max	Residual	Date	Diver	CO	calibrated CO	CO/m2	SH YOY	SH 1+	Date	# Passes	CO	SH YOY	SH 1+
481	SC	14.2		2.4	2.3	1.95	1.9		30.35	30.35	0.08	0.37	0.29	09/06/01	Brown	3	3.75	0.124			08/14/01	2	7	6	6
482	R	4.8		2.5					12	12.00											08/14/01	1	0	2	0
483	SC	18.2		3.5					63.7	63.70	0.11	0.8	0.69	09/06/01	Brown	8	10	0.157			08/14/01	2	12	5	9
484	SC	11.6		3.3	2	2.5	1.5		26.97	26.97	0.09	0.51	0.42	09/06/01	Brown	3	3.75	0.139			08/14/01	2	3	4	6
485	R	6.1		1.1					6.71	6.71											08/14/01	1	0	0	0
486	SC	11.7		5.5	3.1	4.3	3.8		48.85	48.85	0.04	0.76	0.72	09/06/01	Brown	9	11.25	0.230			08/14/01	2	9	10	11
487	R	18	3					54		54.83															
488	FW	11.2	3					33.6		34.12															
489	R	2.9	1.5					4.35		4.42															
490	FW	9.2	1.5					13.8		14.01															
491	SC	5	2.5					12.5		12.69															
492	R	4.2	2					8.4		8.53															
493	SC	16.4	3.5	3.7	4.6	3.5	2.6	57.4	59.04	58.28	0.07	0.9	0.83	09/06/01	Press	12	15	0.257							
494	R	3.8	3.5					13.3		13.50															
495	SC	14.9	3					44.7		45.39															
496	SC	12	2					24		24.37															
497	R	2.2	2					4.4		4.47															
498	SC	7.9	2.5					19.75		20.05															
499	R	6.1	1.5					9.15		9.29															
500	FW	10.7	2.25					24.08		24.44															
501	R	6.9	2					13.8		14.01															
502	SC	13.7	2.25					30.83		31.30															
503	SC	17.3	2.75	2.7	4	2.7		47.58	54.21	48.31	0.07	0.72	0.65												
504	R	12	2					24		24.37															
505	SC	25.1	3					75.3		76.46															
506	MC	15.6	3					46.8		47.52				09/06/01	Press	16	20	0.421							
507	R	12	1.75					21		21.32															
508	FW	14.7	2					29.4		29.85															
509	R	6.2	1					6.2		6.30															
510	SC	6.8	1.5					10.2		10.36															
511	R	4.9	1.5					7.35		7.46															
512	SC	17.4	5					87		88.34				09/06/01	Brown	7	8.75	0.099							
513	R	9	1.75					15.75		15.99															
514	SC	14.9	2					29.8		30.26															
515	R	6.8	0.75					5.1		5.18															
516	SC	6	1					6		6.09															
517	R	2.5	2					5		5.08															
518	SC	6.7	3.5					23.45		23.81															
519	SC	8.5	3	3	3.6	3		25.5	27.2	25.89	0.05	0.25	0.2	09/06/01	Brown	3	3.75	0.145							
520	R	5.6	2.25					12.6		12.79															
Totals:		7009						19128.59		20246.93						152	190						51	248	131

all units of measure in meters (linear) and square meters (surface area)

Appendix B
Index Site Electrofishing Log

Point Reyes National Seashore

CSRP Electrofishing Log for Pine Gulch

Site Name Gorge **Site Description** Stream km 3.9 **Electrofishing Date** 8/20/2001

Site Name Gorge **Index Site Number** 3 **Unit Number** 2

Unit Type LSL **Temp °C** 13.4 **Conductivity (µS/cm)** 237

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	627	P16	200	10	28	3
Pass 2	620	P16	200	0	0	0
Pass 3						
Pass 4						

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Gorge **Index Site Number** 3 **Unit Number** 3

Unit Type LGR **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	235	P16	100	0	0	0
Pass 2						
Pass 3						
Pass 4						

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Gorge **Index Site Number** 3 **Unit Number** 4

Unit Type LSBk **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	731	P16	200	1	6	12
Pass 2	677	P16	200	1	2	1
Pass 3						
Pass 4						

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Point Reyes National Seashore

CSRP Electrofishing Log for Pine Gulch

Site Name Gorge **Index Site Number** 3 **Unit Number** 5

Unit Type LSBo **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	618	P16	200	2	8	3
Pass 2	512	P16	200	1	3	1
Pass 3						
Pass 4						

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Point Reyes National Seashore

CSRP Electrofishing Log for Pine Gulch

Site Name Lower Teixeira **Site Description** Stream km 6.8 **Electrofishing Date** 8/14/2001

Site Name Lower Teixeira **Index Site Number** 5 **Unit Number** 1

Unit Type LSR **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	714	P16	200	7	6	6
Pass 2	545	P16	200	0	0	0
Pass 3						
Pass 4						

Total Mortality

CO	0
SH YOY	1
SH 1+	0

Site Name Lower Teixeira **Index Site Number** 5 **Unit Number** 2

Unit Type LGR **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	338	P16	100	0	2	0
Pass 2						
Pass 3						
Pass 4						

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Lower Teixeira **Index Site Number** 5 **Unit Number** 3

Unit Type LSR **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	841	P16	200	11	5	8
Pass 2	735	P16	200	1	0	1
Pass 3						
Pass 4						

Total Mortality

CO	0
SH YOY	1
SH 1+	0

Point Reyes National Seashore

CSRP Electrofishing Log for Pine Gulch

Site Name Lower Teixeira **Index Site Number** 5 **Unit Number** 4

Unit Type LSR **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	559	P16	200	2	4	6
Pass 2	501	P16	200	1	0	0
Pass 3						
Pass 4						

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Lower Teixeira **Index Site Number** 5 **Unit Number** 5

Unit Type LGR **Temp °C** 16.1 **Conductivity (µS/cm)** 231.1

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	112	P16	100	0	0	0
Pass 2						
Pass 3						
Pass 4						

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Lower Teixeira **Index Site Number** 5 **Unit Number** 6

Unit Type LSR **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	639	P16	200	8	9	11
Pass 2	633	P16	200	1	1	0
Pass 3						
Pass 4						

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Point Reyes National Seashore

CSRP Electrofishing Log for Pine Gulch

Site Name Murch **Site Description** Stream km 0.4 **Electrofishing Date** 8/28/2001

Site Name Murch **Index Site Number** 1B **Unit Number** 1

Unit Type GLD **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	614	P16	200	0	9	0
Pass 2	485	P16	200	0	2	0
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Murch **Index Site Number** 1B **Unit Number** 2

Unit Type LGR **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	27	P16	100	0	0	0
Pass 2		P16	200			
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Murch **Index Site Number** 1B **Unit Number** 3

Unit Type GLD **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	372	P16	200	0	19	0
Pass 2	306	P16	200	0	2	0
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	1
SH 1+	0

Point Reyes National Seashore

CSRP Electrofishing Log for Pine Gulch

Site Name Murch **Index Site Number** 1B **Unit Number** 4

Unit Type LSR **Temp °C** 16.1 **Conductivity (µS/cm)** 259.3

General Comments gage = 0.80

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	610	P16	200	1	20	11
Pass 2	523	P16	200	0	3	0
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	1
SH 1+	0

Point Reyes National Seashore

CSRP Electrofishing Log for Pine Gulch

Site Name Open Space **Site Description** Stream km 0.3 **Electrofishing Date** 8/28/2001

Site Name Open Space **Index Site Number** 1A **Unit Number** 1

Unit Type LSR **Temp °C** 15.8 **Conductivity (µS/cm)** 275.4

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	27	P16	200	0	1	0
Pass 2		P16	200			
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Open Space **Index Site Number** 1A **Unit Number** 3

Unit Type LSR **Temp °C** 15.6 **Conductivity (µS/cm)** 272.1

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	83	P16	200	0	0	0
Pass 2		P16	200			
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Open Space **Index Site Number** 1A **Unit Number** 5

Unit Type LSR **Temp °C** 15.9 **Conductivity (µS/cm)** 264.1

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	90	P16	200	0	2	0
Pass 2		P16	200			
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Point Reyes National Seashore

CSRP Electrofishing Log for Pine Gulch

Site Name Open Space **Index Site Number** 1A **Unit Number** 7

Unit Type LSR **Temp °C** 17.2 **Conductivity (µS/cm)** 272.4

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	244	P16	200	0	1	1
Pass 2		P16	200			
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Point Reyes National Seashore

CSRP Electrofishing Log for Pine Gulch

Site Name Paradise Valley **Site Description** Stream km 2.8 **Electrofishing Date** 8/21/2001

Site Name Paradise Valley **Index Site Number** 2 **Unit Number** 1

Unit Type LSR **Temp °C** 15.7 **Conductivity (µS/cm)** 142.3

General Comments Top end blocked by fallen bay. ADULT SH ~50 CM seen in unit but not captured.

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	678	P16	200	1	11	11
Pass 2	599	P16	200	0	2	3
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Paradise Valley **Index Site Number** 2 **Unit Number** 2

Unit Type GLD **Temp °C** **Conductivity (µS/cm)**

General Comments split channel LB unit

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	550	P16	200	0	11	5
Pass 2	437	P16	200	0	0	0
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Paradise Valley **Index Site Number** 2 **Unit Number** 3

Unit Type GLD **Temp °C** **Conductivity (µS/cm)**

General Comments top of unit 1, cut off by fallen bay

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	132	P16	200	0	2	2
Pass 2		P16	200			
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Point Reyes National Seashore

CSRP Electrofishing Log for Pine Gulch

Site Name Paradise Valley **Index Site Number** 2 **Unit Number** 4

Unit Type LGR **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	146	P16	100	0	2	0
Pass 2		P16	200			
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Paradise Valley **Index Site Number** 2 **Unit Number** 5

Unit Type LSL **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	1150	P16	200	3	25	22
Pass 2	1040	P16	200	0	2	3
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	0
SH 1+	1

Point Reyes National Seashore

CSRP Electrofishing Log for Pine Gulch

Site Name Upper Teixeira **Site Description** Stream km 7.8 **Electrofishing Date** 8/9/2001

Site Name Upper Teixeira **Index Site Number** 6 **Unit Number** 1

Unit Type LSR **Temp °C** 14.3 **Conductivity (µS/cm)** 169.2

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	668	P16	200	0	5	8
Pass 2	558	P16	200	0	2	0
Pass 3						
Pass 4						

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Upper Teixeira **Index Site Number** 6 **Unit Number** 2

Unit Type LSR **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	337	P16	200	0	2	3
Pass 2	323	P16	200	0	0	0
Pass 3						
Pass 4						

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Upper Teixeira **Index Site Number** 6 **Unit Number** 3

Unit Type LGR **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	134	P16	100	0	0	0
Pass 2						
Pass 3						
Pass 4						

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Point Reyes National Seashore

CSRP Electrofishing Log for Pine Gulch

Site Name Upper Teixeira **Index Site Number** 6 **Unit Number** 4

Unit Type LSR **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	378	P16	200	0	3	4
Pass 2	419	P16	200	0	0	1
Pass 3						
Pass 4						

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Upper Teixeira **Index Site Number** 6 **Unit Number** 5

Unit Type LSL **Temp °C** **Conductivity (µS/cm)**

General Comments New unit this year--not sampled in 2000

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	492	P16	200	0	3	7
Pass 2	468	P16	200	0	0	0
Pass 3						
Pass 4						

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Point Reyes National Seashore

CSRP Electrofishing Log for Pine Gulch

Site Name Weber **Site Description** Stream km 0.7 **Electrofishing Date** 8/16/2001

Site Name Weber **Index Site Number** 1C **Unit Number** 1

Unit Type LSR **Temp °C** 14.2 **Conductivity (µS/cm)** 248

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	595	P16	200	0	22	4
Pass 2	433	P16	200	0	1	0
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	1
SH 1+	0

Site Name Weber **Index Site Number** 1C **Unit Number** 2

Unit Type LGR **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	72	P16	100	0	0	0
Pass 2		P16	200			
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Weber **Index Site Number** 1C **Unit Number** 3

Unit Type LSR **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	656	P16	200	0	14	11
Pass 2	489	P16	200	0	4	0
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Point Reyes National Seashore

CSRP Electrofishing Log for Pine Gulch

Site Name Weber **Index Site Number** 1C **Unit Number** 4

Unit Type LSR **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	253	P16	200	0	16	4
Pass 2	221	P16	200	0	1	0
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Weber **Index Site Number** 1C **Unit Number** 5

Unit Type LGR **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	11	P16	100	0	0	0
Pass 2		P16	200			
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Site Name Weber **Index Site Number** 1C **Unit Number** 6

Unit Type LSR **Temp °C** **Conductivity (µS/cm)**

General Comments

	Time	Setting	Volts	CO	SH YOY	SH 1+
Pass 1	424	P16	200	0	6	3
Pass 2	439	P16	200	0	0	0
Pass 3		P16	200			
Pass 4		P16	200			

Total Mortality

CO	0
SH YOY	0
SH 1+	0

Appendix C
Genetic Sample Summary Table

Coho tissue samples from Pine Gulch (Marin County, California); August 2001.
Collected by Pt. Reyes Nat'l Seashore staff, (415) 464-5191

Sample ID	Watershed	Stream Name	Reach/Location	Date Collected	Collector	Species	Fork Length (mm)	Weight (g)	Sex	Age	tissue type	# collected
PG01-2	Pine Gulch	Pine Gulch	stream km 6.8	14-Aug-01	JW	CO	65	3.6	Unk	YOY	caudal fin clip	1
PG01-3	Pine Gulch	Pine Gulch	stream km 6.8	14-Aug-01	GB	CO	58	2.1	Unk	YOY	caudal fin clip	1
PG01-4	Pine Gulch	Pine Gulch	stream km 6.8	14-Aug-01	GB	CO	77	5.0	Unk	YOY	caudal fin clip	1
PG01-5	Pine Gulch	Pine Gulch	stream km 6.8	14-Aug-01	GB	CO	76	5.3	Unk	YOY	caudal fin clip	1
PG01-6	Pine Gulch	Pine Gulch	stream km 6.8	14-Aug-01	GB	CO	73	4.3	Unk	YOY	caudal fin clip	1
PG01-7	Pine Gulch	Pine Gulch	stream km 6.8	14-Aug-01	GB	CO	72	3.9	Unk	YOY	caudal fin clip	1
PG01-8	Pine Gulch	Pine Gulch	stream km 6.8	14-Aug-01	JW	CO	76	4.9	Unk	YOY	caudal fin clip	1
PG01-9	Pine Gulch	Pine Gulch	stream km 3.9	21-Aug-01		CO	70	4.2	Unk	YOY	caudal fin clip	1
PG01-10	Pine Gulch	Pine Gulch	stream km 3.9	21-Aug-01		CO	72	4.1	Unk	YOY	caudal fin clip	1
PG01-11	Pine Gulch	Pine Gulch	stream km 3.9	21-Aug-01		CO	72	4.1	Unk	YOY	caudal fin clip	1
PG01-12	Pine Gulch	Pine Gulch	stream km 3.9	21-Aug-01		CO	72	4.4	Unk	YOY	caudal fin clip	1
PG01-13	Pine Gulch	Pine Gulch	stream km 3.9	21-Aug-01		CO	66	3.3	Unk	YOY	caudal fin clip	1
PG01-14	Pine Gulch	Pine Gulch	stream km 3.9	21-Aug-01		CO	68	3.4	Unk	YOY	caudal fin clip	1
PG01-15	Pine Gulch	Pine Gulch	stream km 2.8	22-Aug-01	JW	CO	80	5.9	Unk	YOY	caudal fin clip	1
PG01-16	Pine Gulch	Pine Gulch	stream km 2.8	22-Aug-01		CO	75	4.8	Unk	YOY	caudal fin clip	1
PG01-17	Pine Gulch	Pine Gulch	stream km 2.8	22-Aug-01		CO	70	3.9	Unk	YOY	caudal fin clip	1