

# **Eagle Lake Rainbow Trout Spawner Migration Study – 2006**

## **Report to the Pine Creek CRMP**

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## Summary

In spring 2006 we PIT tagged a group of Eagle Lake Rainbow Trout (ELRT) spawners to test the efficacy of our tagging protocol, and trained several people in the protocol to make future field work scheduling more flexible. We successfully installed and operated a PIT antenna, and tested the effectiveness of the antenna to detect tagged fish as they swam past. The pilot test allowed us to develop the logistics of installing the antenna, maintaining battery power, and downloading electronic data. A total of 36 fish were PIT tagged at the Pine Creek weir and released upstream of the weir. An additional 10 fish were PIT tagged and released at the Highway 44 culvert. A total of 80 ELRT received a Floy tag, either alone or in conjunction with a PIT tag. Three of the PIT tagged fish released in the vicinity of Highway 44 were later detected as they swam near the antenna. Two Floy tagged ELRT and one PIT tagged ELRT were caught by anglers between 17 August and 11 September 2006. Each of these fish was caught near the end of the Pine Creek system at which it had been released.

## Introduction

The spawning migration of ELRT in Pine Creek has been studied for several years by members of the Pine Creek CRMP group including the California Department of Fish and Game, Eagle Lake Ranger District, Susanville Indian Rancheria, and UC Cooperative Extension. The objective of the migration study has been to test quantitatively whether the CRMP group's habitat improvement and fish passage projects have resulted in suitable passage for spawning trout. The 2006 study was a continuation of the radio-tag tracking project conducted in recent years.

Based on the results of the radio-tracking studies, in 2006 the group decided to switch to tracking the movement of the fish using a new tagging method. Fish were tagged with passive integrated transponder (PIT) tags (Figure 1). Movement of fish may be detected as they swim past a stationary PIT antenna loop placed across the river. The advantages of using PIT tags are that they are much smaller than radio tags (12 – 32 mm; 1/2" – 1 1/4" long), PIT tags can be injected subcutaneously, and the surgery procedure is faster than radio tagging. Fish behavior should be less affected by the PIT tagging procedure than with surgical implantation of a radio tag into the body cavity with a trailing wire antenna. Each PIT tag has a unique code, so each tagged fish is individually identified. Because the tags do not have to contain a battery, but get their charge from passing through the charged antennas loop, the tags last the life of the fish.

The goals of the study for 2006 were to:

- 1) PIT tag a group of ELRT to test the efficacy of our tagging protocol.
- 2) Train several people in the protocol to make future field work scheduling more flexible.
- 3) Install and test one PIT antenna.
- 4) Release the PIT tagged fish to see if they would be detected as they swam past the antenna.

## Methods

Water and air temperature loggers (Onset Optic Stowaway ®) were installed along the length of Pine Creek and operated between 31 March and 30 July 2006.

We tagged ELRT that had arrived at the Spaulding fish trap on Pine Creek (Figure 2). Each fish was transferred in a bucket of stream water from the fish trap to a cooler containing carbon dioxide anesthetic. On 21 April 2006 the anesthetic solution was produced by adding 27 g NaCO<sub>3</sub> (sodium bicarbonate) and 10 mL glacial acetic acid to 10 L water (Peake 1998). On subsequent dates MS-222 was used. Swimming capabilities and opercular movement were monitored. Once the fish reached stage 4 anesthesia (total loss of swimming motion with weak opercular movement) it was removed from the bucket and placed on a measuring board to have its length measured, and on a scale to measure weight. Measuring boards and researchers' hands were kept wet to minimize stress to fish.

We used 32 mm long half duplex PIT tags (Allflex, 860010-001 ISO RFID PIT Needle assy – sterile 32mm HDX; RI-TRP-RR2B), each supplied in an injection needle in a sterile package. Tags were injected subcutaneously on the left side about 3 cm from the dorsal line, near the posterior end of the dorsal fin. A handheld stainless steel injection gun was used to inject the tag in a posterior to anterior direction so that the posterior end of the tag was 1 cm from the injection site. Because each tag came packaged in a fresh, sharp needle it was not necessary to make an incision with a scalpel blade prior to injecting the needle. A drop of Nexaband ® veterinary glue was used to seal the injection site. Each tag's identification number had been printed on a sticker at manufacture, and this sticker was placed on the data sheet. After injection into the fish the tag identification was cross-checked with an Allflex handheld reader (RS-601).

Following tagging the each was placed in a cooler of stream water to recover. For each fish we recorded the time to reach stage 4 anesthesia, time to measure length and weight, time to tag, and time to recover. A fish was considered to be recovered when it was able to voluntarily move its body and tail in a swimming motion. Fish were allowed to remain in the cooler for approximately 5 to 10 minutes after recovery, and then they were released into Pine Creek just upstream of the trap facility. Unmarked "companion" fish were released along with the tagged fish in order to encourage the tagged fish to swim upstream.

In order to increase our sample size of marked fish, and to make it possible for members of the public to detect marked fish, we also tagged a group of ELRT with green Floy ® tags. Handling and anesthetic procedures were the same as for PIT tagging, and in some cases an individual fish received both a PIT tag and a Floy tag. Lengths, weights, and tagging times were also recorded for a sub-sample of these fish. Unmarked "companion" fish were also released along with these tagged fish.

Slime samples were collected from some of the PIT tagged and Floy tagged ELRT as part of a study to examine the impact of ultraviolet light exposure on mycosporine-like amino acid (MAA) levels in the surface slime of fish, and to relate this to environmental conditions at each sampling location, such as latitude, elevation, and cover. MAAs are a suite of "chemical sunscreens" that absorb potentially damaging UV light in organisms such as phytoplankton,

zooplankton, corals, sea urchins, and gastropods. MAAs have also been detected in fish slime by our collaborator on this project, Dr. Peter Nelson (California Sea Grant Marine Advisor). A dull scalpel blade was used to scrape a small sample of mucus from the side of the fish, working in a nose-to-tail direction to minimize scale loss.

We installed a PIT antenna with an Allflex receiver on the mainstem of Pine Creek between the Highway 44 Bridge and the railway bridge on 2 May 2006 (Figure 3). The antenna was 3 m wide and 0.9 m high and spanned the channel (Figure 4). It was powered by two deep cycle marine batteries and recorded data onto a handheld Palm m130 datalogger with an SD memory card. The antenna was manufactured by Mauro Engineering, Mount Shasta, CA. We made approximately weekly visits to the antenna site to substitute charged batteries, and to check for fish detections.

A second group of ELRT were transported by truck and released in upper Pine Creek near the Highway 44 culvert, upstream of the PIT antenna, on 8 May 2006. A sub-sample of these fish was PIT tagged and Floy tagged (orange) and the remainder were released as companion fish.

## Results

A key part of the procedure in 2006 was training of people in tagging techniques in order to expand the number of people available for field work in the future. Lisa Thompson trained Teresa Pustejovsky in PIT tagging. Melanie McFarland trained D. Burton, David Lile, Teresa Pustejovsky, Lisa Thompson, and Karen Vandersall in Floy tagging. Terry Pearson Ramirez, Paul Chappell, and Len Griswold also assisted with field work.

On 21 April 2006 a total of 55 ELRT were tagged (28 male, 27 female), 30 with a PIT tag only, 6 with both a PIT tag and a Floy tag, and 19 with a Floy tag only (Table 1). Green Floy tags were used on all Floy-tagged fish released just upstream of the Spaulding trap. Seventy-nine male companion fish were released this day.

On 26 April 2006 an additional 45 ELRT were Floy tagged (green) and released into Pine Creek just upstream of the trap facility (23 male, 22 female). These fish were anesthetized with MS-222 following standard CDFG methods. Lengths and weights were recorded for these fish. A total of 61 companion fish (37 male, 24 female) were released.

On 8 May 2006 another 10 ELRT were PIT tagged, and also Floy tagged with orange tags. These fish were released into Pine Creek downstream of the Highway 44 culvert, but upstream of the PIT antenna. These fish were anesthetized with MS-222 following standard CDFG methods. Lengths were recorded for these fish, but weights and tagging times were not recorded. Approximately 200 companion fish of unknown sex were released. Prior to 8 May additional ELRT spawners were transported and released into the upper Pine Creek watershed upstream of Highway 44.

In total 30 ELRT received a PIT tag only, 16 received a PIT tag and a Floy tag, and 64 received a Floy tag only. Including companion fish and ELRT released upstream of Highway 44 a grand

total of over 450 ELRT were released into Pine Creek at some point upstream of the Spaulding trap.

Male ELRT had an average length of 0.44 m on 21 and 22 April, and 0.43 m on 8 May (Table 2). Female ELRT had an average length of 0.47 m on 21 and 22 April, and 0.48 m on 8 May. On average males weighed 910 g, and females weighed 1226 g.

The average total time taken to anesthetize with the buffered CO<sub>2</sub> solution, measure length and weight, PIT tag, and recover a fish was 5 min 18 s (Table 3). Floy tagging took an average of 5 min 25 s. Fish took an average of about 1 min 50 s to reach stage 4 anesthesia. PIT tag surgery alone took an average of 43 s. Measurement of length and weight plus tagging took an average of 1 min 3 s for PIT tagging, and 31 s for Floy tagging. Timing data were incomplete for some fish, so these data were omitted from these calculations. Recovery from anesthesia took approximately 2 min 45 s.

Time taken for PIT tag injection did not appear to decrease as additional fish were tagged by the same person (Figure 5). Similarly, time taken for length and weight measurement plus PIT tagging did not appear to decrease with increased experience (Figure 6). Slime samples were taken from fish 5, 7-10, and 22-26. Slime sampling appeared to add approximately 10-30 s to the overall procedure. The time taken for length and weight measurement plus Floy tagging did not change markedly during the day, but several people practiced tagging a few fish each so practice effects were probably negligible (Figure 7).

The time to reach stage 4 anesthesia did not show any clear trends during 21 April (Figure 8). Fish 54 and 55 took longer to anesthetize and it may be that the CO<sub>2</sub> solution was diluted by the time these fish were placed in the solution. The time taken to reach stage 4 anesthesia at first appears to decrease with increasing fish weight (Figure 9). However if the two longest times (Fish 54 and 55, tagged at the end of the day) are removed the decreasing trend is not apparent.

The length of time taken for measurement of length and weight plus tag insertion does not appear to influence recovery time (Figure 10). Fishes 42, 1, and 44 had the longest recovery times. However, because multiple fish were being processed simultaneously it is possible that some fish had recovered prior to our detecting the recovered status of the fish. Sometimes a fish appeared to be immobile, but when lightly touched it would begin to tail beat.

Three PIT tagged ELRT were detected at the PIT antenna (Table 4). All of these fish were from the group that was tagged on 8 May and released in the vicinity of the antenna. The first fish detected was a female, and was detected four times on 11 May, 3 days after release. The second fish detected was also female, and was first detected on 24 May, sixteen days after release. This fish was also detected three and four days later. The third fish was a male and was detected once on 25 May. Most detections were of short duration (1 s) and fish appeared to be swimming through the antenna. However, the first fish stayed at the antenna for 15 s and for 4 min 35 s on two occasions. There was an undercut bank on river left at the antenna site and this fish may have stayed under the bank for cover.

Another three ELRT from this study were captured by anglers. One ELRT with a green Floy tag was caught on 17 August 2006 in Eagle Lake at the breakwater north of the marina (Floy tag number 01-06978). This fish was a male that had been tagged and released at the Spaulding trap on 26 April. On 31 August 2006 a PIT tagged ELRT was caught in Eagle Lake between the Eagle Campground and the marina (PIT tag number 982 0001994 5980). This fish was a male that had been tagged and released at the Spaulding trap on 21 April. On 11 September 2006 a male ELRT with an orange Floy tag was caught and released 0.25 miles above the pond upstream of Highway 44 in Pine Creek (Floy tag number unknown). This fish was tagged on 8 May and released near Highway 44. The angler that caught this fish reported the he saw another Floy tagged fish that was caught in Pine Creek and kept by another angler earlier in the year. He reported that he was not certain about the Floy tag color, but that it was probably orange. Each of these fish was caught in the end of the Pine Creek system in which it was released.

Water temperature data were available for 2004, 2005, and 2006 (Figure 11), beginning in late March and running until 5 May, 2 June, and 30 July, respectively. Temperatures patterns and trends in 2006 were generally similar to those observed in 2004 and 2005. Daily average temperatures at the upper sites were approximately 10 to 25 °F cooler than the lower stations. In 2004 and 2006 temperatures were greater than 60 °F in lower Pine Creek by early May, but slightly cooler during this period in 2005. In 2005 and 2006 temperatures were over 70 °F in lower Pine Creek by the end of May. In July 2006 temperatures were less than 60 °F at the Bogard site, less than 70 °F in the other upstream sites, and over 70 °F in lower Pine Creek.

## **Discussion**

Three of the ten PIT tagged fish released near Highway 44 were detected at the PIT antenna, indicating that the fish had retained their tags, and that the antenna was operating properly. However, none of the fish released just upstream of the trap on 21 and 26 April were detected further upstream. Since the antenna was installed on 2 May it is possible that these fish swam upstream past the antenna location, spawned, and swam back to Eagle Lake prior to the installation of the antenna. However, based on migration rates of radio tagged fish in recent years this rate of migration seems unlikely.

If PIT tag methods are used in future the study would be improved by the installation of additional antennas, particularly further downstream in Pine Creek. This would allow us to determine relative migration rates in different sections of the creek (and to estimate habitat suitability for migration). It would also allow the detection of ELRT that migrate only part way up the creek. We had a 30 foot antenna available in spring 2006, but high flows made it too dangerous to install the antenna in lower Pine Creek. However, it would be possible to install the wire antenna loop in the fall prior to a spring study, when flows are lower and less dangerous. The receiver unit and batteries could then be transported to the antenna site and connected in spring at the start of the study.

## **References**

Peake, S. 1998. Sodium bicarbonate and clove oil as potential anesthetics for non-salmonid fishes. *North American Journal of Fisheries Management* 18:919-924.

## TABLES

Table 1. Numbers of ELRT tagged by tag type, date, and sex. The number and sex (if known) of companion fish released into Pine Creek in conjunction with each tagging event are also listed. Fish tagged on 21 and 26 April were released into Pine Creek just upstream of the Spaulding fish trap. Fish tagged on 8 May were released at the Highway 44 culvert.

Tag Type	Number Tagged									
	21-Apr			26-Apr			8-May			All Dates
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Total, both sexes
<b>PIT only</b>	18	12	30							30
<b>PIT + Floy</b>		6	6				6	4	10	16
<b>Floy only</b>	10	9	19	23	22	45				64
<b>Companion</b>	79		79	37	24	61			200	340

Table 2. Length (m) and weights (g) of tagged ELRT. Fish marked on 21 and 22 April were PIT tagged, Floy tagged, or both. Fish marked on 8 May were PIT tagged.

Tagging date	Statistic	Male		Female		Both sexes	
		Length	Weight	Length	Weight	Length	Weight
<b>21 &amp; 22 April</b>	<b>Average</b>	0.44	910.52	0.47	1225.97	0.45	1065.09
	<b>St. dev.</b>	0.05	269.52	0.03	258.25	0.04	306.83
	<b>n</b>	51	51	49	49	100	100
<b>8-May</b>	<b>Average</b>	0.43		0.48		0.45	
	<b>St. dev.</b>	0.06		0.01		0.06	
	<b>n</b>	6		4		10	

Table 3. Tagging times for fish marked with PIT and/or Floy tags on 21 April. The PIT tag category includes six fish that were also Floy tagged. The Floy tag category includes fish that received only a Floy tag.

Tag Type	Statistic	Time (mm:ss)				
		Anesthesia	Surgery	Measure + Surgery	Recovery	Total
<b>PIT</b>	<b>Average</b>	01:47	00:43	01:03	02:28	05:18
	<b>St. dev.</b>	00:27	00:14	00:16	01:01	01:12
	<b>n</b>	29	29	29	29	29
<b>Floy</b>	<b>Average</b>	01:50		00:31	03:04	05:25
	<b>St. dev.</b>	00:54		00:11	01:20	01:17
	<b>n</b>	13		13	13	13

Table 4. PIT tagged fish detected at the PIT antenna.

Fish number	PIT tag number	Sex	Length (m)	Date	Time (h:mm)	
					Arrived at antenna	Stayed at antenna
104	982000019945776	F	0.48	11-May	1:06	0:15
				11-May	2:07	0:01
				11-May	6:30	4:35
				11-May	15:29	0:01
110	982000019945741	F	0.49	24-May	23:23	0:01
				27-May	22:54	0:01
				28-May	21:39	0:01
107	982000019945863	M	0.51	25-May	9:51	0:01

FIGURES



Figure 1. PIT tag (32 mm) shown with a dime coin for size comparison.



Figure 2. PIT tagging equipment set up at the Spaulding fish trap.



Figure 3. Teresa Pustejovsky, David Lile, Karen Vandersall, Ken Weaver, and Kerry Mauro at the Pine Creek PIT antenna site on 2 May 2006.

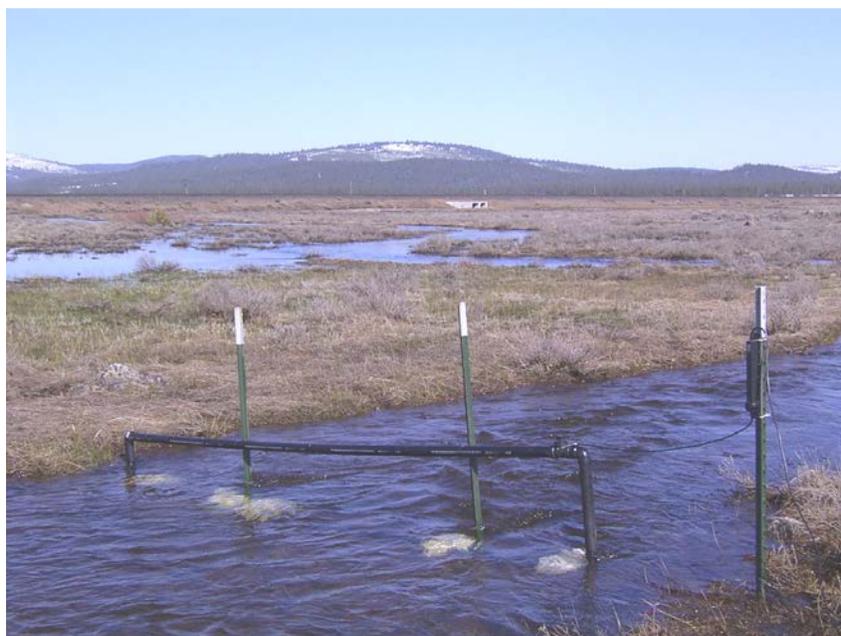


Figure 4. PIT antenna operating in Pine Creek.

Eagle Lake Rainbow Trout Spawner Migration Study – 2006

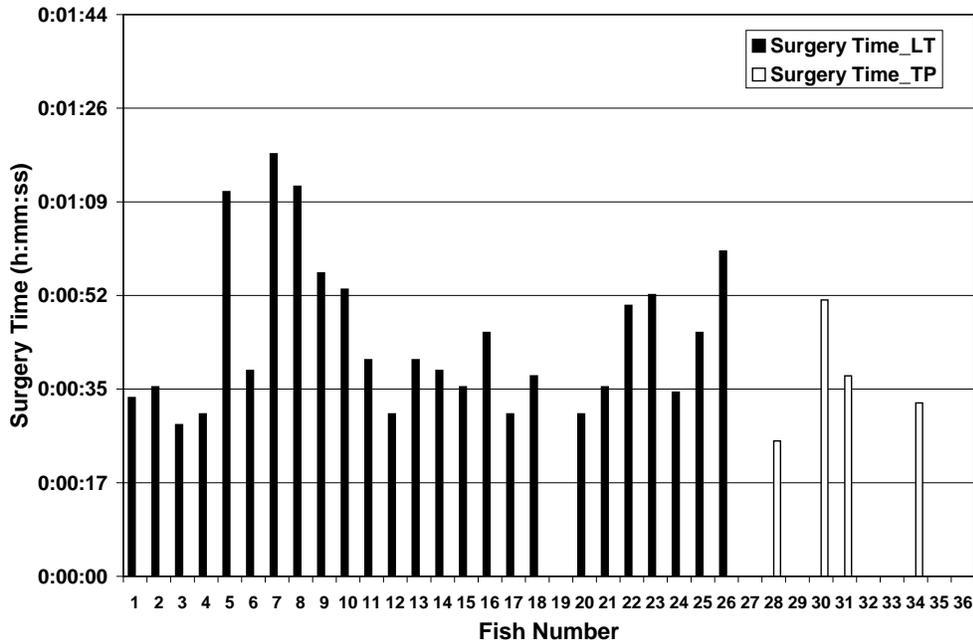


Figure 5. Time taken for PIT tag injection by two taggers, Lisa Thompson, and Teresa Pustejovsky. Fish 11-16 received both a PIT tag and a Floy tag. Slime samples were taken from fish 5, 7-10, and 22-26.

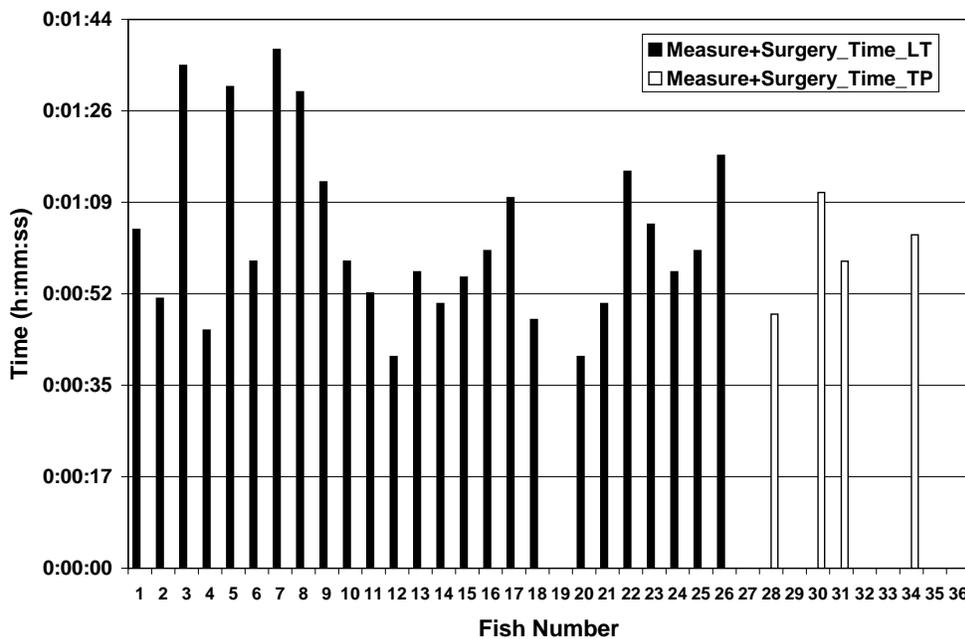


Figure 6. Time taken for length and weight measurement and PIT tag injection by two taggers, Lisa Thompson, and Teresa Pustejovsky on 21 April 2006. Fish 11-16 received both a PIT tag and a Floy tag. Slime samples were taken from fish 5, 7-10, and 22-26.

Eagle Lake Rainbow Trout Spawner Migration Study – 2006

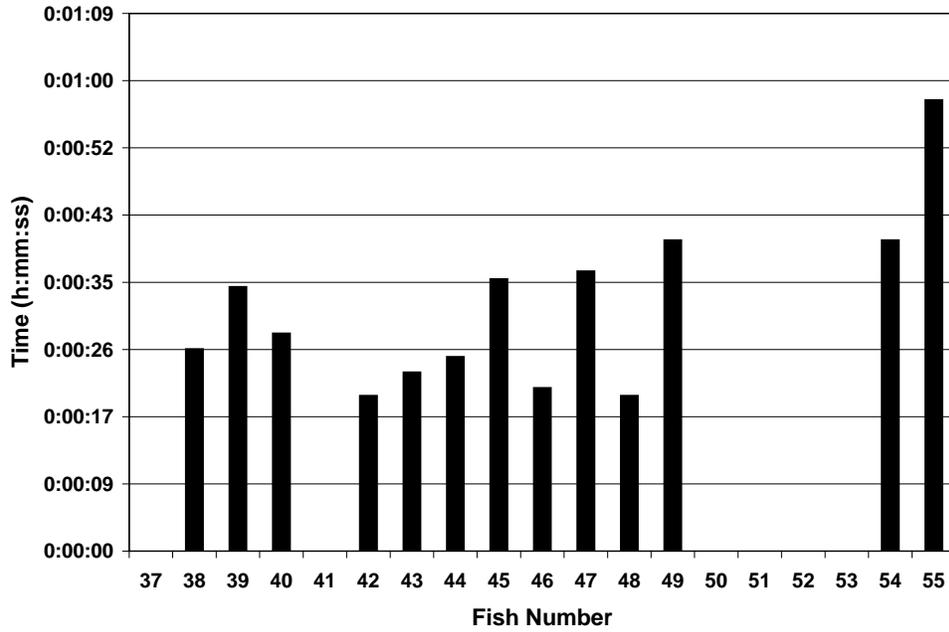


Figure 7. Time taken for length and weight measurement and Floy tag injection on 21 April 2006. Tagging was performed by three different people.

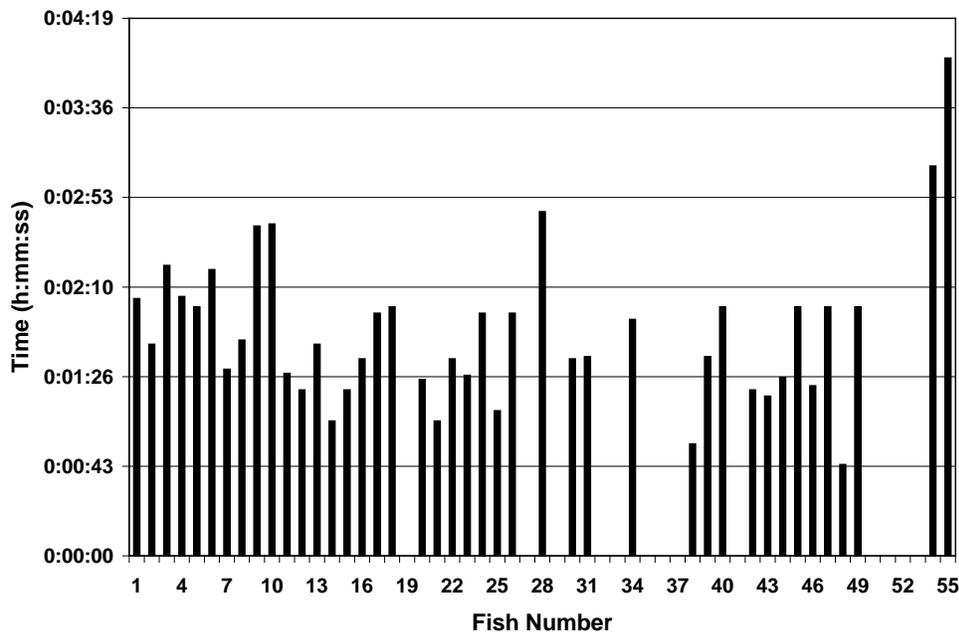


Figure 8. Time to reach stage 4 anesthesia for fish PIT and/or Floy tagged on 21 April.

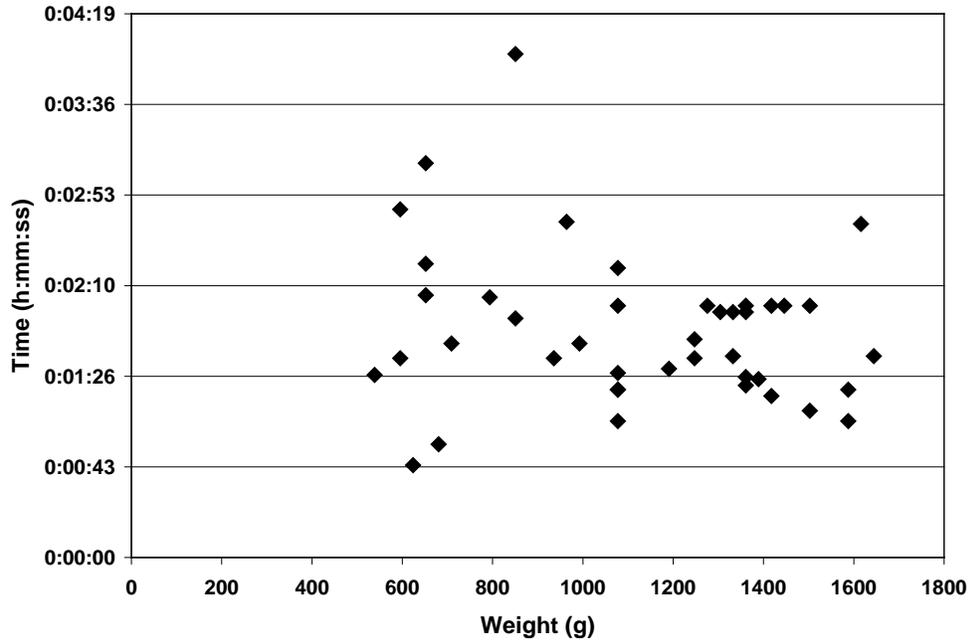


Figure 9. Relationship between fish weight and time to reach stage 4 anesthesia for fish PIT and/or Floy tagged on 21 April.

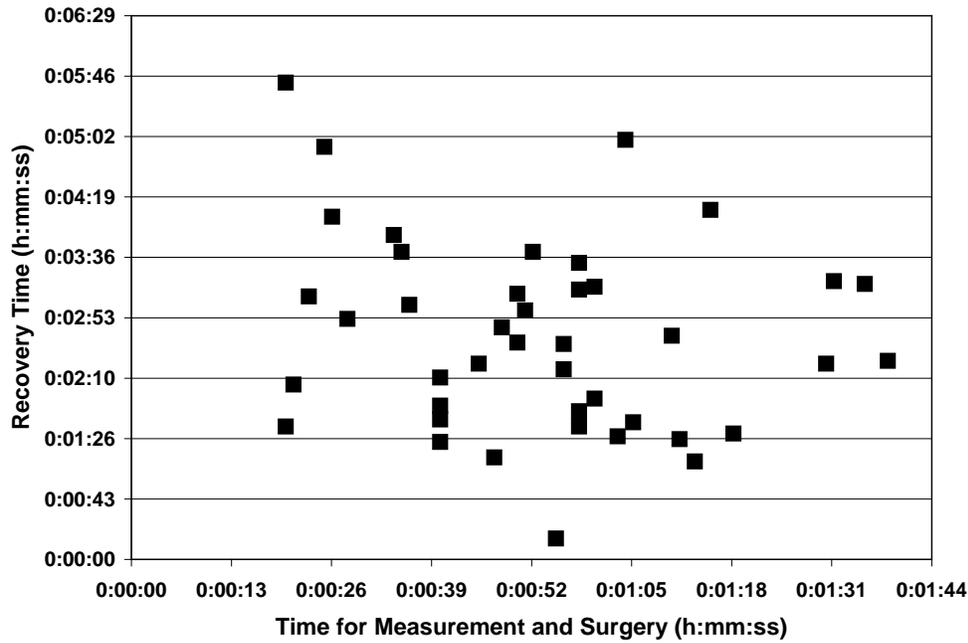


Figure 10. Recovery time as a function of time for length and weight measurement and surgery.

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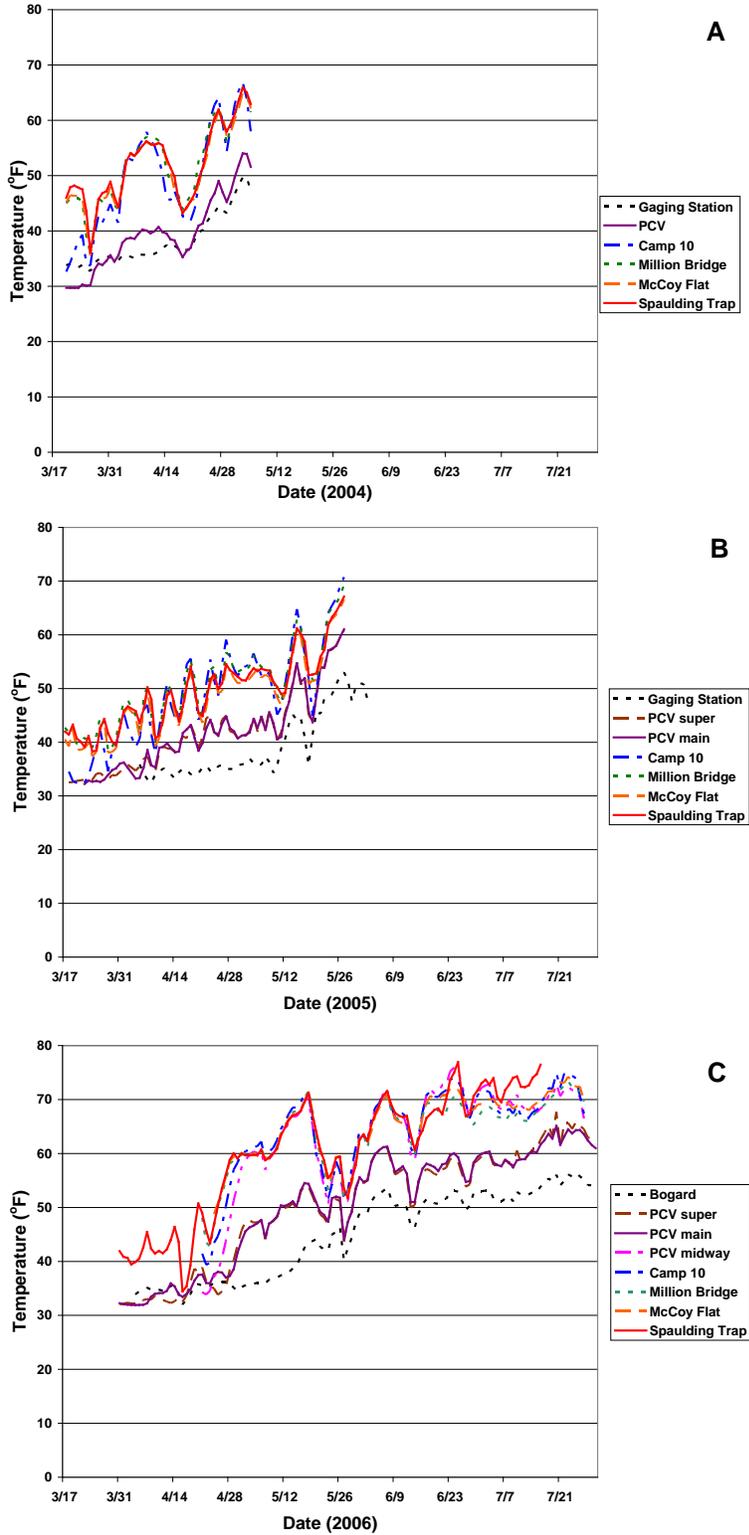


Figure 11. Daily average temperature at stations along the length of Pine Creek between March and July in A) 2004, B) 2005, and C) 2006. Gaging Station/Bogard is the most upstream site, and Spaulding Trap is the most downstream site. PCV indicates Pine Creek Valley.