

**Sawmill Creek Fisheries Survey Annual Report
For 2002 Studies**

**Blue Lake Project, Federal Energy Regulatory Commission (FERC) No.
2230**

City and Borough of Sitka, Licensee

**Prepared By:
Karl Wolfe, Sitka AK.**

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INTRODUCTION AND BACKGROUND

This report documents results of fisheries surveys conducted during 2002 on Sawmill Creek near Sitka, Alaska. The studies of which this report is a part are in support of the relicensing of the Blue Lake hydroelectric project (Project, FERC No. 2230). The City and Borough of Sitka (City) holds the project's FERC license which will expire on March 31, 2008. Relicensing the project requires an environmental data base sufficient to allow FERC, as lead agency under the National Environmental Policy Act (NEPA), to evaluate existing environments, potential impacts, and mitigation measures associated with reauthorization of the project.

This is the second in a series of relicensing fisheries reports. The first (Wolfe, 2002) was issued in February 2002, and documented fisheries studies conducted during summer, fall and early winter, 2001.

During 2001, the City consulted with Alaska Department of Fish and Game (ADF&G), Sitka Tribe of Alaska (STA) and US Forest Service (USFS) to develop a study plan for 2002. A final study plan was developed and approved by the consulting parties, with the following objectives:

1. Develop fish survey methods to fulfill the needs for 1) NEPA analyses in the FERC relicensing process, and 2) ongoing ADF&G stream surveys and the USFS and STA information needs;
2. Gather data useful to extend the information base on species composition, distribution, periodicity, stream life, and habitat use:
and

3. Develop a protocol for sharing of fish survey manpower among the City, ADF&G, STA and USFS.

METHODS

The 2002 Sawmill Creek fish studies were based primarily on streamside or instream observations and fish captures using minnow traps and hook and line, as described in the following:

1. **Frequent general abundance surveys ("Index Surveys")**, at a single point, to determine estimates of run-strength and timing, to be used both for general information and to determine times when the Stream surveys, described below, would best be conducted;
2. **Periodic stream surveys ("Stream Surveys")** at various observation sites, conducted as needed to determine anadromous fish distribution, abundance, and habitat utilization throughout the potentially occupied sections of the stream;
3. **Juvenile fish captures**, to determine the presence of anadromous fish in various stream reaches and to evaluate fish too small to readily observe;
4. **Hook and line sampling**, conducted throughout the stream in order to capture fish too large to be captured by juvenile fish capture techniques.
5. **Snorkel surveys**, within accessible areas in which stream hydraulic and water conditions offered suitable observation conditions;

In this report, locations of surveys are discussed relative to Stream Mile (SM), or distance upstream from high tide line on Sawmill Creek. A base map of the stream was annotated during each survey to show stream mile (to the nearest 0.1 mile, if possible) and specific observation points within the channel. Notes were made of species composition, spawning activity, and habitat conditions and utilization.

SAMPLING LOCATIONS

For the purposes of fishery studies and other references during relicensing, six stream reaches, developed according to differences in fish habitat type, stream gradient or access considerations were developed (Figure 1, Appendix 1, Table 1). Several project features referenced in this report are more fully described in the Initial Consultation Document (ICD) issued by the City on December 3, 2002 (City and Borough of Sitka, 2002). Readers are encouraged to review the Project Description and Project Operations

sections of this document in association with these and other resource-related reports.

The "Falls" referenced in the Reach designations is at SM 0.84 and is a major stream feature at least 15 feet high. The "Slot", an area in which Sawmill Creek passes through an extremely narrow canyon constriction, is located at SM 1.06, and the "Fish Valve Unit" is the instillation at SM 1.75 at which minimum stream flows are released to Sawmill Creek. The Pulp Mill Feeder Unit Outflow is another project-related feature, which formerly drained water into Sawmill Creek at SM 0.53.

Table 1. Sawmill Creek Reach Numbering, from Bridge near Lower Powerhouse Upstream to Base of Blue Lake Project Dam.

Stream Reach and Location (Name)	Identifying Aquatic Habitats and Stream Characteristics
Reach 1 (Index Survey Area). Point at Powerhouse Bin Inlet (SM 0.35) upstream to top of Index Area. (SM 0.44)	Reach 1 consists of a run, a small but abrupt gradient increase leading to a tailout, and a pool/run. Substrate is primarily sand, cobble and boulder; finer substrate is found only at the head of the pool and among large boulders.
Reach 2. Inlet of Index area pool to the Pulp Mill Feeder Pool (SM 0.53) (Includes Concrete Area)	In Reach 2 the gradient increases with areas of deep pocket water and a typical tailout-pool-run-inlet between. The gradient increases are rapid with the associated large cobble/boulder/bedrock substrate. The deeper areas contain sand/gravel and exposed bedrock. The tailouts are a fairly coarse sand gravel and small cobble mixture. The off-channel habitat adjacent to the main channel limited to crevices within bedrock. There are two man-made concrete structures and some Large Woody Debris (LWD).
Reach 3. Pulp Mill Feeder Outflow pool to the base of the Falls (SM 0.84)	Reach 3 consists of three slower water habitats with pocket water between. Substrate is primarily sand/gravel/cobble with some boulder and bedrock. The deeper water areas have some silt, but the only area of detritus and fine organic accumulation is a shallow shelf. There is no off-

	stream habitat and all off-channel structure consists of adjacent large boulders, or undercut bedrock.
Reach 4. From the top of the Falls to the Slot outflow (SM 1.06)	Reach 4 extends from a short area of pocket water carved onto bedrock at the top of the Falls, to a long shallow riffle extending for a quarter mile which ends in an extremely deep run and a tailout. Adjacent to the run is a large pool area. The riffle and run areas are primarily gravel/cobble/boulder substrate with sand appearing in a few larger eddies created by LWD and large boulders. The pool area substrate is silt and sand and has a large area of detritus accumulation as well as a substantial pile of LWD.
Reach 5. From Slot outflow to Fish Valve Unit (SM 1.75)	The Slot is a narrow canyon constriction containing a series of drops with runs and rapid water between the drops. At SM 1.36 the canyon opens up and there is an area of pocket water for another tenth of a mile, a riffle, and then an extended tailout leading to Long Pool. Above Long Pool there is a series of riffles and short drops and pocket water that lead to a short pool area at the Campground Footbridge. The substrate through this reach is primarily gravel and cobble with boulder in faster flowing areas. Sand appears only in the slowest areas such as: The Long Pool, the Boom Log area, and directly underneath the footbridge. Most of Reach 5's structure is concentrated at a large boulder in the Long Pool, LWD in the Boom Log area, and Bridge footings and keystone rock at the Footbridge. The off-stream habitat at SM 1.13 is referred to as Spring Creek.
Reach 6. From the Fish Valve Unit to the	The area from the Fish Valve Unit to

base of the Project dam (SM 2.16)	the project dam consists primarily of deep pools and runs connected by cascades and pocket water. The area has numerous large boulders and much of the bedrock is exposed. The substrate is primarily bedrock, cobble and boulder.
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Other features were named over the course of studies to describe areas or features in which fish were routinely observed, or which offered unique habitats (Table 2). These were:

Table 2. Specific Sampling Areas Within Reaches

Name of Observation/Sampling Area	Description
Bridge Hold (Index Area)	A small hold located under and directly below the Pump House car bridge at SM 0.38
Concrete Area (Reach 2)	A long run, pool, and tail out in Reach 2 at SM 0.49
Pulp Mill Outflow Pool (Reach 3)	A deep pool just downstream of the Pulp Mill Feeder Outflow.
Pipe Fitting Area (Reach 3)	A deep run directly upstream of the Pulp Mill Feeder Pool in Reach 3.
Falls Hole (Reach 3)	A large deep pool located at the base of the Falls at SM 0.84.
Wild Bill's Pool (Reach 3)	A short run, pool, and tail out in Reach 3 at SM 0.79
Long Pool (Reach 5)	A long run, pool, and tail out in Reach 5 at SM 1.37

Detailed maps of each reach were developed during the 2001 sampling season and details were added during the 2002 sampling season (Appendix 1). These maps were annotated with fish locations, habitat utilization, and aquatic and riparian habitat descriptions. Details will be added to these maps in future reports as features change, as more data is collected, and after aerial photographs are taken in 2003.

FISH OBSERVATIONS.

Index Surveys

Index surveys were conducted in the vicinity of the powerhouse bridge (SM 0.41) about once per week. This location was chosen because of its ease of

access and because of the resting habitat visible from the bridge which usually held fish on the day of their immigration to Sawmill Creek. Index surveys were conducted from April 1 to December 9, 2002.

Stream surveys.

Stream surveys were conducted at several locations along Sawmill Creek, to include all representative habitats and reaches. Stream surveys in 2002 were begun on April 1, just prior to expected in-migration of the earliest anadromous species, steelhead trout (*Oncorhynchus mykiss*), and continued until the end of the coho salmon (*O. kisutch*) run in early December. Stream surveys were conducted about once per week.

The observer noted the following on the dates of each Index and Stream Survey:

- Number of fish by species
- Time of day
- General weather condition
- Water temperature
- Relation of observation time to tide status
- Water transparency
- Activity (actively moving upstream, milling, exhibiting spawning behavior, etc.)
- Location of fish in the stream (i.e., are they concentrated in a pool or run, or are they spread evenly through out the stream). Notations included locations of fish both across and up and down the channel.

FISH CAPTURES

Minnow Trapping

Baited minnow traps were placed in areas selected to optimize capture efficiency for all expected species. Minnow traps were baited with salmon eggs and soaked overnight. To minimize mortality, traps were checked immediately the next day. MS-222 or a clove oil and grain alcohol solution was used when fish were too active to otherwise handle. Anesthetized fish were allowed to fully recover in a five-gallon bucket while all others were returned immediately to the water. Minnow traps were set in all Reaches, and also in the areas of Reach 5 referenced as "Spring Creek" and the adjacent ephemeral channels.

Minnow trapping was begun in early April in order to ensure that coho salmon juveniles would be sampled prior to smoltification and out migration, and was continued throughout the summer.

The reference for species identification was Pollard, 1997. Fork length of fish caught and exact trap location were noted for each trapping episode and location.

Hook and Line Captures

Hook and line methods were used to sample fish too large to be captured in traps. Three main tackle types with an assortment of lures were used to effectively cover all habitat types and depth levels. Ultra light and light action spin rods with four and twelve pound-test fluorocarbon line respectively were used for the majority of the sampling. Jigs, spoons, spinners, and yarn fly rigs were all utilized depending on habitat and conditions. A four-weight fly rod with a five-weight floating line was used during aquatic insect hatches and in areas such as riffles where it was superior to spin casting due to habitat conditions. A variety of surface and subsurface flies were used alone and as part of a dropper system according to conditions and insect species present. Location, species caught, and fork length were recorded for each fish captured, and all fish were released immediately.

SAMPLING DATES

Sampling dates for the various observation techniques varied, as shown in Table 3. Generally, surveys began on April 1, with the earliest Index Survey, and ended about December 9, when the last of the coho salmon observations occurred.

Table 3. Dates of sampling by various observation techniques, Sawmill Creek Fisheries Surveys, 2002.

Index Surveys, 2002.

April 1
April 7
April 15
April 22
April 29
May 5,
May 14 Snorkel Survey
May 16
May 23
May 30
June 7
June 14
June 20
June 28

July 2
July 6
July 13
July 19
July 26
August 2
August 5
August 16
August 23
August 31
September 6
September 11
September 16
September 25
October 9
October 18
October 27
October 30
November 5
November 8
November 18
November 22
November 25
December 3
December 9

Stream Surveys, 2002.

Date	Survey Area	Survey Type
April 1	Reaches 1-6	Foot
April 7	Reaches 1-6	Foot
April 15	Reaches 1-6	Foot
April 22	Reaches 1-3	Foot
April 29	Reaches 1-3	Foot
May 5	Reaches 1-6	Foot
May 14	Reaches 1-6	Snorkel
May 16	Reaches 1-3	Foot
May 23	Reaches 1-3	Foot
May 30	Reaches 1-3	Foot
June 7	Reaches 1-3	Foot
June 14	Reaches 1-6	Foot
June 20	Reaches 1-3	Foot
June 28	Reaches 1-3	Foot
July 2	Reaches 1-6	Foot
July 6	Reaches 1-6	Foot
July 19	Reaches 1-6	Foot
July 26	Reaches 1-6	Foot
August 2	Reaches 1, 2,4,5,6,	Foot
September 6	Reaches 1-6	Foot
September 25	Reaches 1-6	Foot

October 27	Reaches 1-2	Foot
October 30	Reaches 3-6	Foot
October 24	Reaches 1-6	Foot
November 5	Reaches 1-6	Foot
November 8	Reaches 1-6	Foot
November 9	Reaches 1-6	snorkel
November 13	Reaches 1-3	Foot
November 18	Reaches 1-6	Foot
November 22	Reaches 1-6	Foot
November 25	Reaches 1-6	Foot
December 3	Reaches 1-6	Foot
December 9	Reaches 1-6	Foot

Minnow Trapping, 2002.

Date	Location
April 7	Reach 5 Spring Creek Area
April 15	Reach 5 SM 1.37 to Slot (SM 1.06)
May 5	Reach 4
May 6	Reach 4
May 13	Reach 5
May 14	Reach 5
May 16	Reach 1 -2
May 23	Reach 3
May 24	Reach 6
May 25	Reach 4
May 26	Reach 6
May 30	Reach 6
June 7	Reach 5
June 14	Reach 5 (SM 1.36 to footbridge SM 1.62)
July 20	Reach 2
August 25	Reach 5

Hook and Line Sampling, 2002.

Date	Location
May 24	Reaches 1,2,3,
May 26	Reaches 2,6,
May 29	Reach 2
June 6	Reaches 1,2,3,
June 7	Reach 5
June 10	Reach 5
June 14	Reaches 1,2,3,4,5,
June 29	Reaches 1,2,3,
July 23	Reaches 1,2,3,

August 16	Reach 2
August 30	Reach 4
September 6	Reach 5
October 30	Reaches 1, 2 3, 4,
November 5	Reach 4
November 8	Reaches 2,3,
November 9	Reach 6

RESULTS

General. Sawmill Creek surveys in 2002 resulted in the observation of seven anadromous species. These were:

Dolly Varden char (*Salvelinus malma*);
 Steelhead trout (*Oncorhynchus mykiss*);
 Chum salmon (*O. keta*);
 King salmon (*O. tshawytscha*);
 Pink salmon (*O. gorbuscha*);
 Coho salmon (*O. kisutch*); and
 Sockeye salmon (*O. nerka*).

All anadromous species except Dolly Varden char and sockeye salmon were found in all Reaches below the Falls at SM 0.84. Dolly Varden char were only observed at the Pulp Mill Outflow at SM 0.53, and only one sockeye salmon was observed at the Pipefitting Area at SM 0.55.

Two resident species were observed or collected, resident rainbow trout, (considered resident if less than about 450 mm in length, and staghorn sculpin.

Conditions during the surveys are summarized in table form in Appendix 2. Due to the loss of a thermograph during an flood episode, stream temperature data is incomplete.

Steelhead.

Index Surveys.

Very few steelhead were seen at the index survey site because they appeared not to prefer the habitat in the areas observable from the Bridge. At most, one steelhead was seen at the Bridge Hold (Table 4, Appendix 3). Stream survey results were utilized more to define steelhead run timing than were Index Survey results.

Stream Surveys.

Stream surveys began on April 1, 2002 and the first steelhead was observed on April 7. Steelhead numbers peaked on May 23, 2002 and the last sighting was on June 20, 2000 (Table 4, Figure 2). All steelhead were observed in Reaches 1 through 3 (below the Falls at SM 0.84) with the majority of fish and all evidence of spawning seen in Reaches 2 and 3.

Table 4. Steelhead numbers observed during stream surveys, 2002.

Date	Number of Steelhead Observed	Comments
April 1	0	breezy
April 7	1	at bridge hold
April 15	4	two anglers
April 22	2	fresh snow
April 29	8	redd activity at Falls Hole tailout
May 5	17	redds at Falls hole and Pulp Mill Feeder Hole
May 14	21	new redd at Pipe Fitting area
May 16	24	18 at Falls Hole
May 23	26	small redd at Pipe Fitting Area
May 30	18	
June 7	11	two fishermen, mayfly hatch
June 14	7	
June 20	2	
June 29	0	

Number Of Steelhead Observed During 2002 Stream Foot Surveys

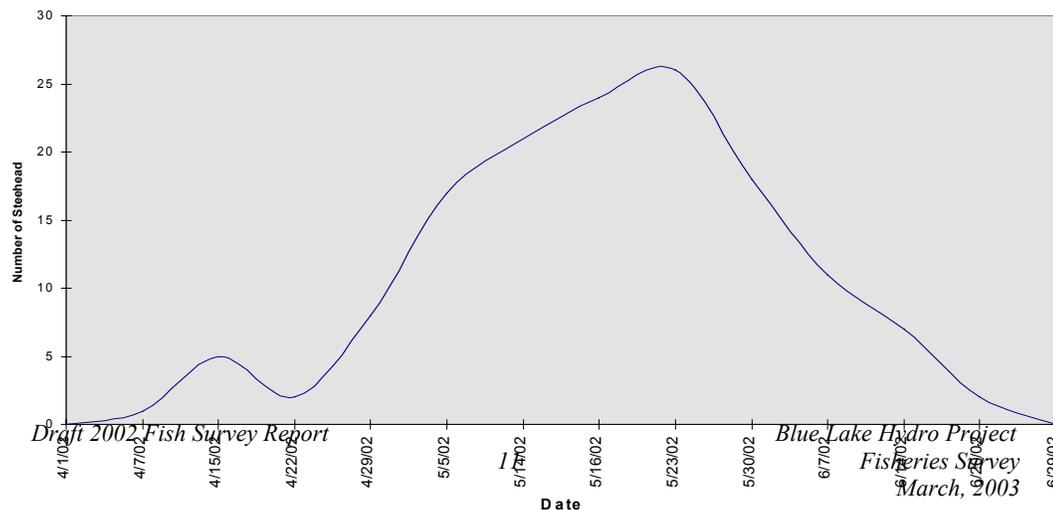


Figure 2. Steelhead observed during stream surveys, 2002.

Steelhead holding and spawning activity was concentrated in Reaches 2 and 3. The Falls Pool and the Pulp Mill Outflow Pool had the majority of sightings with the fish holding in deep water with underwater structure and spawning in the adjacent tailouts. The Pipe Fitting area was next in importance, and at the Concrete Area at least one pair spawned off a small bar formed by the angled concrete at the Inlet.

Spawning behavior was observed at the Concrete Area, the Pulp Mill Out Flow Pool, the Pipe Fitting Pool, and the Falls Pool. The largest redds and the majority of fish were located in the Pulp Mill Outflow Pool and the Falls Pool. In all four areas, undisturbed fish held in deep water cover with an overhead current seam.

Chum Salmon

Index Surveys

Chum salmon were observed from July 13 until September 25 (Table 5). Index surveys showed two distinct peaks in the chum run and a smaller secondary peak between (Figure 3). During the first peak on August 2, 27 chum were observed and during the second on September 11, 29 chum were observed.

Table 5. Chum salmon observed during index surveys, 2002

Date	Number of Chum Salmon Observed	Comments
July 6	0	
July 13	3	at bridge hold
July 19	4	two bright pairs
July 26	14	two redds apparent
August 2	27	
August 5	21	spawning in shallower areas
August 16	11	high discharge.
August 23	13	glacial flour limiting visibility
August 31	5	
September 6	28	spawning activity
September 11	29	
September 16	15	

September 25	3	
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Chum Salmon Observed at Index Site

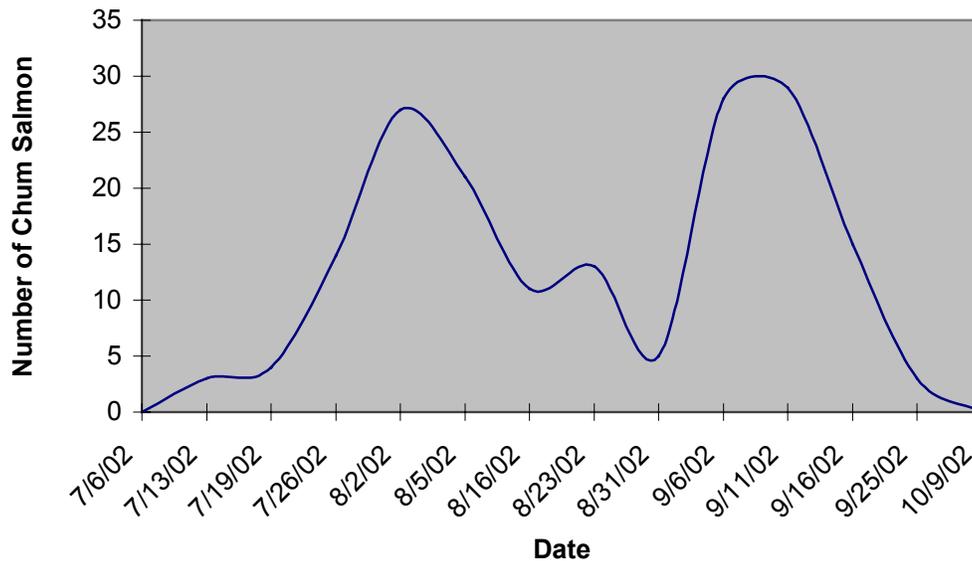


Figure 3. Chum salmon observed during index area surveys, 2002.

Stream Surveys.

The first stream survey to observe chum occurred on July 13, 2002 and the last occurred on September 25 (Table 6). The highest count occurred on September 6 with 190 chum being observed. This survey corresponds with the second peak in the Index data (Table 5, Figure 2).

Table 6. Chum salmon observed during stream surveys, 2002.

Date	Number of Chum Salmon Observed	Comments
July 6	0	
July 13	3	All observed in index area
July 19	27	15 at Falls Hole
August 2	61	Area Above Pulp Mill Feeder not accessible
September 6	190	

September 25	19	
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King Salmon

Index Surveys

Kings were first observed during 2002 Index Surveys on July 26, 2002. The number of kings increased through August 23 with a peak count of 34 fish. After this peak count, king observations decreased rapidly (Table 7, Figure 4.)

Table 7. King salmon observed during index surveys, 2002.

Date	Number of Kings	Comments
July 6	0	
July 13	0	Holding below bridge.
July 19	0	
July 26	8	
August 2	14	Spawning activity
August 5	34	
August 16	25	
August 23	34	Bad visibility in all but the shallowest areas
August 31	12	Poor Visibility in deeper areas
September 6	4	
September 11	0	

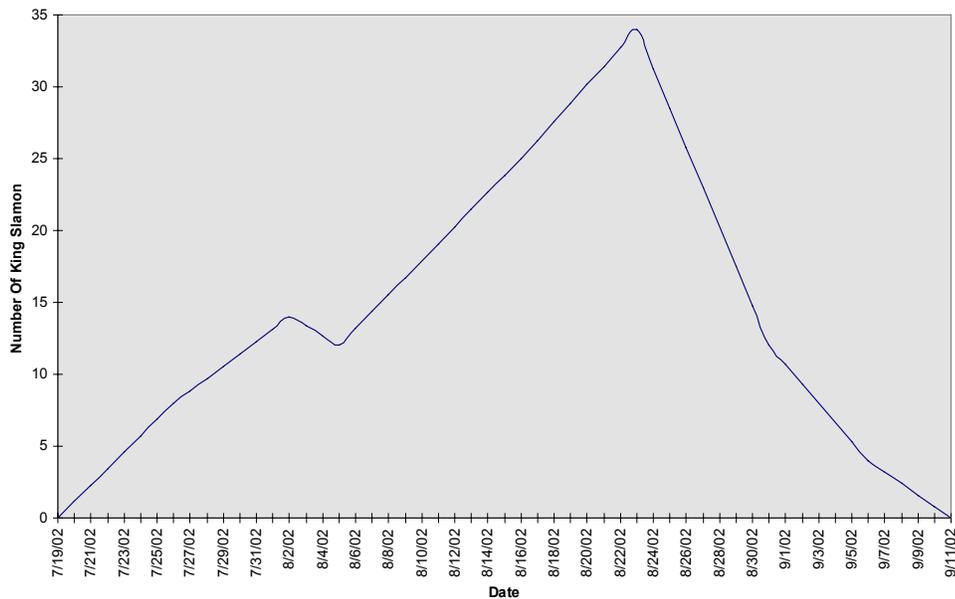


Figure 4. King salmon observed during index surveys, 2002.

Stream Surveys

King salmon were first spotted during 2002 Stream Surveys on July 19, at the Falls Hole (Table 8). The peak stream survey count occurred on August 2, 2002 with 33 fish. The area below the Falls at SM 0.84 and above Reach 2 was inaccessible from mid-August until early September, which was the period concurrent with the peak index count. The last stream survey with king salmon present was on September 6, 2002.

Table. 8 King salmon observed during stream surveys, 2002.

Date	Number	Comments
July 6, 2002	0	
July 19, 2002	4	All at Falls Pool
August 2, 2002	33	
August 5, 2002	34	
August 16, 2002	25	Reach 2, 3 Not accessible
September 6, 2002	8	

Pink Salmon

Index Surveys

Pink Salmon were observed during Index surveys from August 5 until October 9, with a peak count of 1400 occurring on September 16 (Table 9, Figure 5).

Table 9. Number of pink salmon observed during index surveys, 2002.

Date	Number of Pinks
August 5	4
August 16	32
August 23	39
August 31	215
September 6	425
September 11	690
September 16	1400
September 25	690
October 9	360
October 18	0

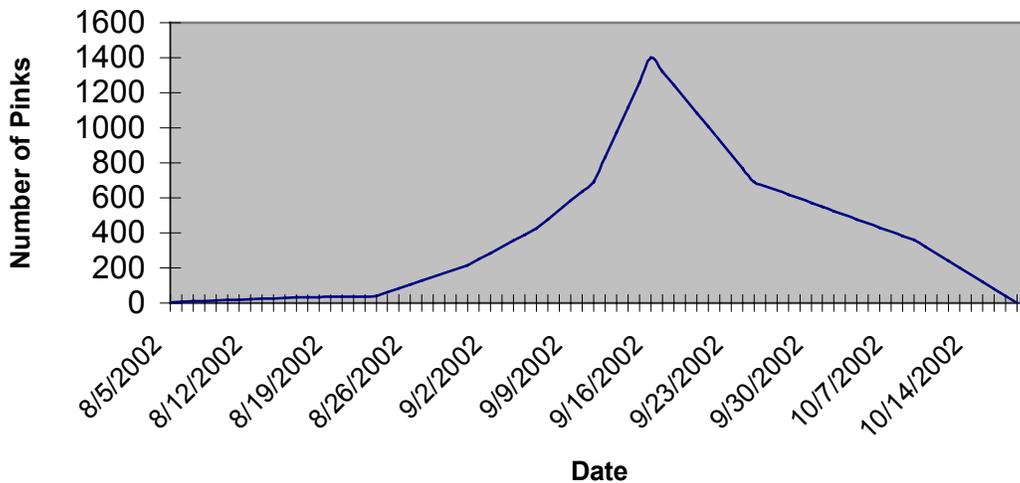


Figure 5. Pink salmon observed during index surveys, 2002.

Stream Surveys

Pink Salmon were counted in Reaches 1-3 on September 6 and September 25, with 9075 and 10,740 fish respectively. During earlier and later stream surveys no pink salmon were seen.

Sockeye Salmon.

Index Surveys

No sockeye were observed during Index surveys. Sockeye apparently moved past the Index site rapidly. Also, the sockeye run was quite small, reducing the chance of observing them at a single point.

Stream Surveys

One sockeye salmon was observed during a stream survey on November 15, 2002, at the inlet of the Pipe Fitting Area.

Coho Salmon.

Index Surveys

No adult coho salmon were observed during Index surveys. It is presumed that coho are passing through the Index Area and heading directly upstream where the pool water velocities are slower.

Stream Surveys

Three coho were observed during a stream survey on September 25, 2002. The last two coho were observed on December 3, 2002 (Table 10). The number of fish observed between these two dates ranged between two and six fish. The majority of fish were located in the Falls Pool and The Pulp Mill Outflow Pool. From September 25 until November 5 the clarity of the water was poor with a blue/gray hue due to fine sediment transport (glacial flour) greatly reducing the ability to spot fish in Sawmill Creek.

Table 10. Number of coho salmon observed during index surveys, 2002.

Date	Number of Coho	Comments
September 25	3	Difficult to see in deeper holes
October 30	5	Fish holding in deep areas near tailouts
November 5	6	Head of Falls hole not visible.
November 8	5	
November 9	8	Snorkel survey
November 13	7	Bear at Falls, couldn't count pool
November 15	4	
November 18	4	
November 22	3	
November 25	5	
December 3	2	One dark fish at both Falls Hole and Pulp Mill Outflow

December 9	0	
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No coho were observed above the Falls during stream surveys or during the snorkel survey. No coho spawning was documented at any location.

Dolly Varden.

Index Surveys.

No Dolly Varden were seen during index surveys. This is probably due to the availability of more preferable habitat upstream.

Stream Surveys

On April 29, 2002 two Dolly Varden fry were observed in Reach 2 in the boulders below the Pulp Mill Outflow Area. One Dolly Varden was positively identified on October 30, 2002 among king salmon jacks and Resident sized rainbow trout. Other Dolly Varden were sampled during Hook and Line sampling.

Resident Rainbow Trout.

For the purposes of this study resident rainbow trout less than about 450mm were considered residents.

Index Surveys.

No resident rainbow trout were observed during index surveys. Rainbow trout in the index area prefer to hold along the cliff wall at the inlet and in other areas that would make viewing them unlikely.

Stream Surveys.

Resident sized rainbow trout observed during stream surveys are summarized in Table 11.

Table 11. Resident rainbow trout observed during stream surveys, 2002.

Date	Reach	Location	Number	Comment
5/14	3	Pulp Mill Out flow	2	Spawning in Tail out
5/16	3	Pulp Mill Out flow	2	Together in Tail out
5/23	3	Rainbow Hole	1	On redd in Tail out
6/14	3	Pulp Mill Out flow	6	One feeding
6/20	3	Pulp Mill Out flow	2	
6/28	3	Pulp Mill Out flow	2	

10/30	3	Pulp Mill Out flow	?	Mixed in with jacks
11/5	3	Pulp Mill Out flow	6	Hanging behind coho
11/9	5	Beaver Falls Run	12	Feeding
11/9	5	Damn Pool	5	Cruising
11/13	3	Pulp Mill Out flow	?	Numerous milling at tail out

Minnow Trapping.

212 rainbow trout, one staghorn sculpin (*Leptocottus armatus*), and three juvenile coho were captured using minnow traps (Table 12.)

Table 12. Results of minnow trapping, 2002.

Date	Species		
	Rainbow	Coho	Staghorn Sculpin
April 7	8		
April 15	24		
May 5	11		
May 6	11		
May 9	9		
May 13	9		
May 14	8		
May 16	8	3	
May 23	29		1
May 24	6		1
May 25	7		
June 7	13		
June 14	10		
June 15	29		
July 20	10		
August 25	12		

Coho Salmon.

Three juvenile coho salmon were captured in the Concrete Area of Reach 2 on May 16, 2002. A 66mm coho was captured at the downstream concrete structure, and a 64mm coho and 84mm coho were captured in the upstream left log structure in the same area.

Rainbow Trout

Rainbow trout were captured in all Reaches and areas except the tributaries leading to the Spring Creek. Lengths ranged from 47mm to 331mm. The four fish greater than 200mm were lodged in the opening of the trap.

Hook and line sampling.

Dolly Varden

Dolly Varden char were caught during hook and line sampling sessions on July 23, 2002 and on August 16, 2002. The length of the char sampled ranged from a minimum of 178mm to a maximum of 246mm. Dolly Varden were not caught during any trapping sessions or during other hook and line sampling sessions.

Table 12. Dolly Varden char sampled during hook and line sampling, 2002

Date	Location	Length (mm)
July 23	Outflow Pool	178
July 23	Outflow Pool	246
July 23	Outflow Pool	217
August 16	Outflow Pool	215
August 16	Outflow Pool	192

Rainbow Trout.

Rainbow trout were captured in all Reaches using hook and line sampling techniques. 89 rainbows were caught ranging in fork length from 84mm. to 475mm (Table 13).

Table 13. Rainbow trout caught during hook and line sampling, 2002

Date	Rainbows Caught
May 24	9
May 26	5
May 29	3
June 6	3
June 7	13

June 10	18
June 14	16
June 29	1
July 23	1
August 30	4
September 6	2
October 30	6
November 6	1
November 9	6

King Salmon.

Three king salmon were captured on hook and line, 3 each on July 23 and August 16, 2002. All of these salmon were considered “jacks” or immature males which accompany the adult fish spawning run.

DISCUSSION

OVERALL SPECIES REPRESENTATION

Sawmill Creek fish surveys during 2002 resulted in observations or capture of five pacific salmon species (pink, chum, coho, king, and sockeye) and two other anadromous species, Dolly Varden char and steelhead trout. Two resident species, rainbow trout and staghorn sculpin . No anadromous fish were observed upstream of the Falls at SM 0.84.

Generally, the 2002 survey differed from the 2001 surveys in the following:

- Steelhead were noted, whereas they were not seen in 2001 because surveys began too late (September 8) to observe their activities;
- The entire pink, chum and king salmon runs were observed, whereas certain instream activities of these species were not observed in 2001 due to the late survey start date;
- Staghorn sculpin and resident-sized rainbow trout (O. mykiss less than about 450 mm in length) were observed;

The 2002 anadromous fish observation and capture results differ from information in the Alaska Department of Fish and Game (ADF&G) Catalogue and Atlas of anadromous fish distribution Alaska ADF&G 1993a and b). These publications indicate that pink, chum, king, coho, and steelhead are found in Sawmill Creek to the base of Blue Lake dam (ADF&G 1993 a and b).

The absence of anadromous fish upstream of the Falls may be due to the Falls' height and the cascades within the Slot area which present a second barrier to upstream access, particularly during high flows.

The Falls area was observed during high flows in late summer, 2002, but not measured due to high flows and access limitation. Low water clarity during this high flow period made spotting fish difficult in all reaches. More detailed evaluations of the Falls as well as juvenile fish sampling in 2003 will help determine if anadromous fish currently occur upstream of the Falls.

In the following discussions of the various Sawmill Creek salmon species, it is important to note that numbers of fish counted at the index site and upstream are meant to give insights into run timing and relative abundance. The numbers are not population estimates, and are not to be compared directly to ADF&G escapement counts, which estimate the entire number of fish escaping to Sawmill Creek. Index and stream survey counts will be compared year to year, and may be compared to ADF&G escapement counts to see if relationships exist.

STEELHEAD

The first steelhead was observed on April 7, 2002. A peak count was observed on May 23, with 26 fish, and the last fish was observed on June 20, 2002. The 2001 fish surveys began after the steelhead run; therefore no year-to-year comparisons are possible in this report. ADF&G survey counts for May 9, 1994 and May 9, 1995 showed 17 and 31 steelhead, respectively. Given that the stream surveys during April, May and June, 2002, were done during reasonable viewing conditions (affording observation of the entire stream downstream of the Falls), it may be broadly concluded that the steelhead run in Sawmill Creek has averaged less than 50 fish per year over the three years for which data are available. Most streams in Southeast Alaska noted for large steelhead runs have access to a lake down stream of spawning areas and watersheds without lakes are known for their comparatively small runs.

Steelhead were concentrated in the Falls Hole and the Pulp Mill Feeder pool, and appeared to favor deeper water which presumably offered more cover. All spawning behavior was noted in Reaches 2 and 3 in pool tailout areas near deep waters. Juvenile rainbow were caught in sufficient quantities in the trapping and hook and line surveys to indicate successful rainbow spawning and rearing Reaches 2 and 3.

Although flow rates were comparatively low (60 to 75 cfs) during the 2002 steelhead run, the fish appeared to have little difficulty migrating to the base of the Falls. No passage restrictions were observed in shallow riffles or runs where impediments might be expected during low flows. The areas where

spawning was noted appear to have sufficient streamflow, depth and upwelling for incubation during flows of this magnitude. There is also enough deep-water habitat near large rocks to provide for sufficient juvenile winter rearing habitat.

It is not known whether rainbow trout were native to Sawmill Creek watershed prior to stocking by the U.S. Forest Service in 1938 and 1939. (Der Hovanisian 1994) During this period 9,000 fry, 200 adult rainbow trout, and 50,000 steelhead eggs from Sashin Lake were planted in Blue Lake (Der Hovanisian 1994). After this initial planting, 8,800 rainbow trout from The Willamette River in Oregon were released in Blue Lake. (Der Hovanisian 1994) It is assumed that fish from these plantings spilled over the dam creating resident and anadromous populations in Saw Mill Creek. (ADF&G Sitka Sport fish Summary).

CHUM SALMON

The two peaks in the chum salmon index counts may indicate the existence of early and late runs. The peak counts occurred on August 2 with 27 chum and on September 11 with 29 chum. A small secondary peak occurred during the August 20-30 period perhaps because of overlap between the two peaks, from members of both “runs” being present at the same time.

During the 2001 survey season, the run peak was observed at the index area on September 26. In 2002, the peak occurred almost two weeks earlier on September 11. In 2001, however, surveys did not start until September 8, eliminating the possibility for comparisons with the earlier “August” run component. Salmon runs in the area during 2001 were considered early, perhaps because of oceanic conditions, or due to streamflow conditions. Future Sawmill Creek surveys should yield valuable data on the range of dates

ADF&G aerial surveys on August 6 and August 8, 2001, showed 300 and 500 fish, respectively. No ADF&G survey data is available for periods corresponding our index area second peak count (around September 11).

Stream survey data do not directly correspond to the index counts, perhaps because high flows limited access to all Reaches downstream of the Falls. The August 2 stream survey noted 61 fish, but was stopped at the top of the Pulp Mill Outflow pool because access was restricted due to high flows. The stream survey count on September 6 of 190 chum covered areas that were inaccessible due to high flows last year and on the August 2 stream survey. On this date, 120 of the 190 chum counted were in areas above the Pulp Mill Outflow pool.

Chum Salmon ripened in deeper water then spawned throughout Reaches 1-3. Chum spawning was concentrated in the larger pools and adjacent bars and tailouts of Reaches 1-3.

Although chum salmon have probably always been present in Sawmill Creek, it is likely that chum numbers and run timing are affected by its location between Medeveje hatchery and the Deep Inlet terminal fisheries area. Future chum surveys will focus on the timing during the August-September period.

KING SALMON

The King salmon run in Sawmill Creek started on July 19 and the peak index count of 34 fish was on August 23. During this time Reaches above the index area were not accessible and stream surveys were limited in scope.

King Salmon utilized deep-water habitats, holding there until they were ready to spawn in adjacent upwelling areas. King salmon were found in these habitats throughout Reaches 1, 2, and 3.

The current Sawmill Creek king salmon run is probably not a naturalized run, but may consist primarily of strays from nearby hatchery stocks. As with steelhead and coho salmon, king salmon populations may be limited in Sawmill Creek because of a lack of suitable rearing habitat. Future surveys will address issues related to king salmon abundance in Sawmill Creek.

PINK SALMON

During the 2002 survey season, pink salmon were present in the index area from August 5 until October 9. A peak index count of 1400 pinks occurred on September 16, 2002. 2001 index surveys began on September 8 with a peak count of 825, decreasing until the last pink was observed on October 14. As the 2001 pink return was considered early, the 2002 timing is likely more typical. The 2002 pink counts dropped off earlier than in 2001, perhaps because increased flows removed spawned out fish from the population.

The 2001 and 2002 stream survey data suggest that the Sawmill Creek pink salmon run is an “even year” run, with larger escapements occurring in even numbered years. This corresponds to other similar streams in the area (INPFC Statistical Yearbooks 1961-1963).

It is difficult to evaluate Sawmill Creek pink salmon escapement numbers based on this report’s index and stream survey counts because 1) it was difficult to survey pinks because of high flow conditions in 2002, and 2) it is likely that most pinks spawn in the intertidal reaches of the stream and not in the upstream reaches we surveyed.

ADF&G pink salmon index counts are done from the air, and focus on the downstream-most areas of the stream. Recent ADF&G counts have placed peak pink salmon escapement numbers at about 40,000 fish, indicating that, if our stream survey counts for 2002 are representative of upstream escapement numbers, about ¼ of the population uses upstream areas. In comparison, Indian River, in Sitka, known as a large producer of pink salmon, has about 100,000 pinks in the larger escapement years, according to ADF&G index survey data. Indian River, however, is thought to have more spawnable area than Sawmill Creek.

Pink salmon utilized all areas throughout Reaches 1, 2 and 3, often ripening in deep water and utilizing tailouts and bars for spawning.

COHO SALMON

During both 2001 and 2002 the first coho was observed in Sawmill Creek on September 25. The peak 2001 index count occurred on October 6, and the peak stream count for 2002 also occurred on this date. During the 2002 sampling season, no coho were observed at the index site. Peak numbers of coho during both years were quite small, however, totaling no more than six fish at any observation.

Sawmill Creek coho populations are quite small compared to similar streams in southeast Alaska. The observation of only six fish during what is normally their prime in-migration time and the juvenile sampling of only three coho is unusual. Coho, unlike pink and chum salmon, require instream rearing habitat for one to three years after emergence. During that resident time period, coho salmon prefer the slow back waters and side channel habitat. The relative absence of this habitat below the Falls at SM 0.84, as well as the absence of a lake downstream of the spawning areas, may explain the low numbers of coho salmon.

Coho were most often found in Reach 3 with the Falls Pool and the Pulp Mill Feeder Pool being the most utilized areas. Coho were also commonly observed at the Pipe Fitting Area and the Concrete Area. As for other salmon species, these appeared to be the preferred areas for holding. No inference about coho spawning may be drawn because none were seen either building redds or spawning, but this result was influenced by poor visibility from September through November, the usual time for coho spawning.

SOCKEYE SALMON

Only one sockeye salmon was observed during the 2002 survey season, and no sockeye salmon were observed during the 2001 survey season. Sockeye are known to require an accessible lake system for rearing. The sockeye

salmon seen in Sawmill Creek in 2002 was likely a stray from a nearby system.

DOLLY VARDEN

Anadromous Dolly Varden populations in southeast Alaska have been shown to have complex migrations (Armstrong 1984). In spring the spawning portions of Dolly Varden populations leave lake wintering areas and migrate directly to their resident spawning streams. Non-spawning portions of the population leave either their resident streams as smelts or lake wintering areas and travel in and out of nearby watersheds until a watershed with a accessible lake is found.

The absence of pre-smolt Dolly Varden in the trapping data, the absence of spawning Dolly Varden, and the size the six char caught seem to indicate that they were strays from a nearby system. However, the presence of two Dolly Varden fry indicates that at least a limited amount of successful spawning takes place. Juvenile Dolly Varden, like juvenile coho salmon, prefer slower back waters and side channel habitat for winter residency and Sawmill Creek has limited areas of this habitat type.

RESIDENT RAINBOW TROUT

Readers should note that the term “resident” applied to Sawmill Creek rainbow trout is primarily a size convention, and may not always imply a difference between “rainbow” and “steelhead”. Particularly in the smaller size classes, fish included under “resident” rainbow in our sample may or may not be steelhead. Larger fish, particularly those in excess of about 250 mm. are probably resident rainbow because steelhead would normally have outmigrated prior to reaching this size. Future studies will seek attributes which more accurately distinguish resident rainbow from steelhead in Sawmill Creek.

Resident rainbow trout were present in all reaches and areas and were either captured using minnow traps or hook and line, or observed during index or stream surveys. Fork lengths of resident rainbow ranged from 47mm to 475mm. Qualitatively, the condition factors of rainbows were highest in Reaches 1-3 below the Falls at SM 0.84.

Habitat use of resident fish varied with size, time of day, and time of year. Areas with numerous micro-refugia and/or overhead cover close to a current seam held most of the juveniles with fork lengths between 47 and 100mm. The cliff wall on the left hand upstream side of the Index Area, the rocks and LWD of the Concrete Area, the rock in the Long Pool, The Boom Log Area, and the LWD at the inlet to the Spring Creek Pool are examples of this type of habitat.

Fish in the medium size range (100-200mm) were sampled early the year in the same habitats as the smaller fish, and as the season progressed many moved out into more exposed habitats. This movement was particularly pronounced during peak feeding periods such as at twilight, during aquatic insect hatches, and in the presence of spawning salmon. Tailouts, eddies near current, and submerged boulders were utilized in all areas during these periods. Fish in this size range were also found behind larger fish in deep water habitats with submerged large boulders such as the Slot Exit pool tail out, the Pipe Fitting Area, and the Falls Hole.

The largest fish sampled and observed (200-475mm) tended to be in deeper areas with cover, and utilized shallower tailouts only during spawning and feeding behind spawning anadromous fish. Deep-water habitats with concentrations of trout include the Pipe Fitting area, the Falls hole, the Pulp Mill Outflow area, the Beaver Lake Falls area, and the Dam Pool. Fish in these larger classes were also observed in tailout areas of upwelling near reeds.

During mid-April, pairs of resident-sized rainbows were observed building redds in tailouts at the Pulp Mill Outflow and Falls pools. A spent female was captured in Reach 5 at the Campground Footbridge on June 14. Larger rainbow also took advantage of the deeper tailouts such as the Pulp Mill Outflow pool, the Rainbow Hole, and the Concrete area during salmon spawning to feed.

Upstream of the Falls, resident rainbow were both less numerous and apparently less well-fed than downstream. Reach 4 rainbows were concentrated in a small run at the tailout of the Slot Exit pool and were scarce elsewhere in the Reach. Further, rainbows captured in Reach 4 appeared emaciated and snakelike during the salmon runs, while rainbows captured in Reaches 1-3 during the same periods appeared to have significantly greater condition factor.

Sawmill Creek resident rainbows may have been spawned in the creek, or may have come over the Blue Lake project spillway. It is currently not possible to distinguish fish from these origins, but it will be an objective of future studies to find, if possible, ways to determine the extent to which Sawmill Creek rainbow populations are comprised of fish from Blue Lake.

FUTURE STUDIES.

At the time of this report, the City and Borough of Sitka is in the process of developing detailed study plans for the 2003 and future study years, as part of the relicensing for the Blue Lake project. Results of the 2001 and 2002 surveys will influence sampling and analytic techniques in the future years.

Based on the 2001 and 2002 study results, this author sees the need for the following actions:

- Continue index area and stream survey fish observations, from April through December (if possible given access restrictions) for relicensing study period;
- Expand the index surveys downstream to include the intertidal reaches of Sawmill Creek and more accurately determine the relative utilization of up and downstream habitats by pink and chum salmon (this task may be facilitated by cooperation with ADF&G to combine our efforts in these habitats with that agency's yearly pink and chum salmon index surveys);
- Evaluate condition factors of rainbow trout in all Reaches to determine differences in condition which may be due to food supply, habitat availability, competition or other factors;
- Conduct age and growth studies on resident rainbow trout to determine age structure, growth rates and relative abundance;
- Work with ADF&G and other scientists to devise a way to distinguish between resident rainbow and steelhead in Sawmill Creek, and to determine origins (either instream or Blue Lake) of Sawmill Creek rainbow trout. This may be done using genetic, morphometric or meristic analysis.

Other additional study techniques and elements may arise from the ongoing relicensing study planning.

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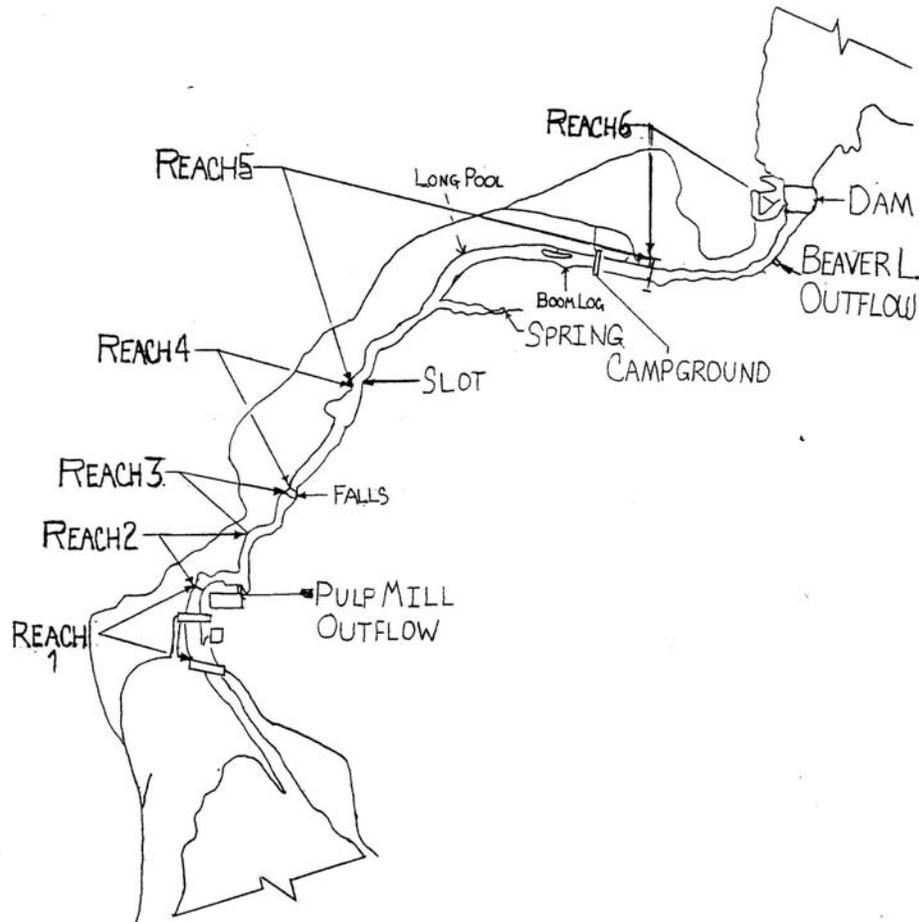
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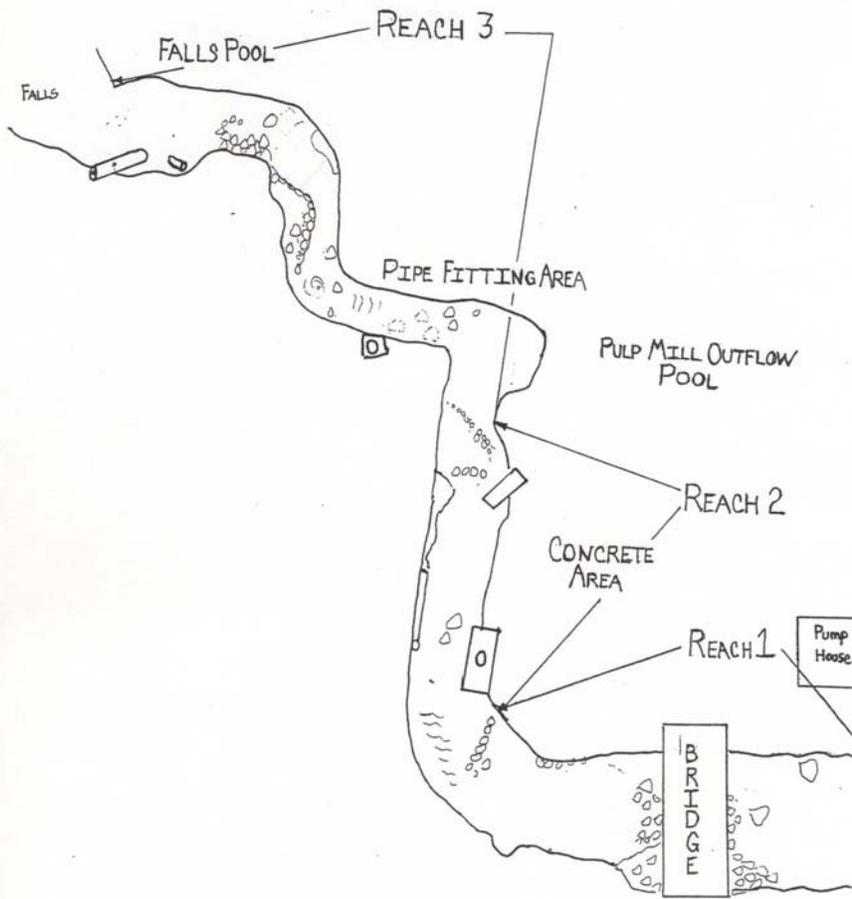
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Appendix 1. Maps of Sawmill Creek Study Reaches and Fish Habitats.

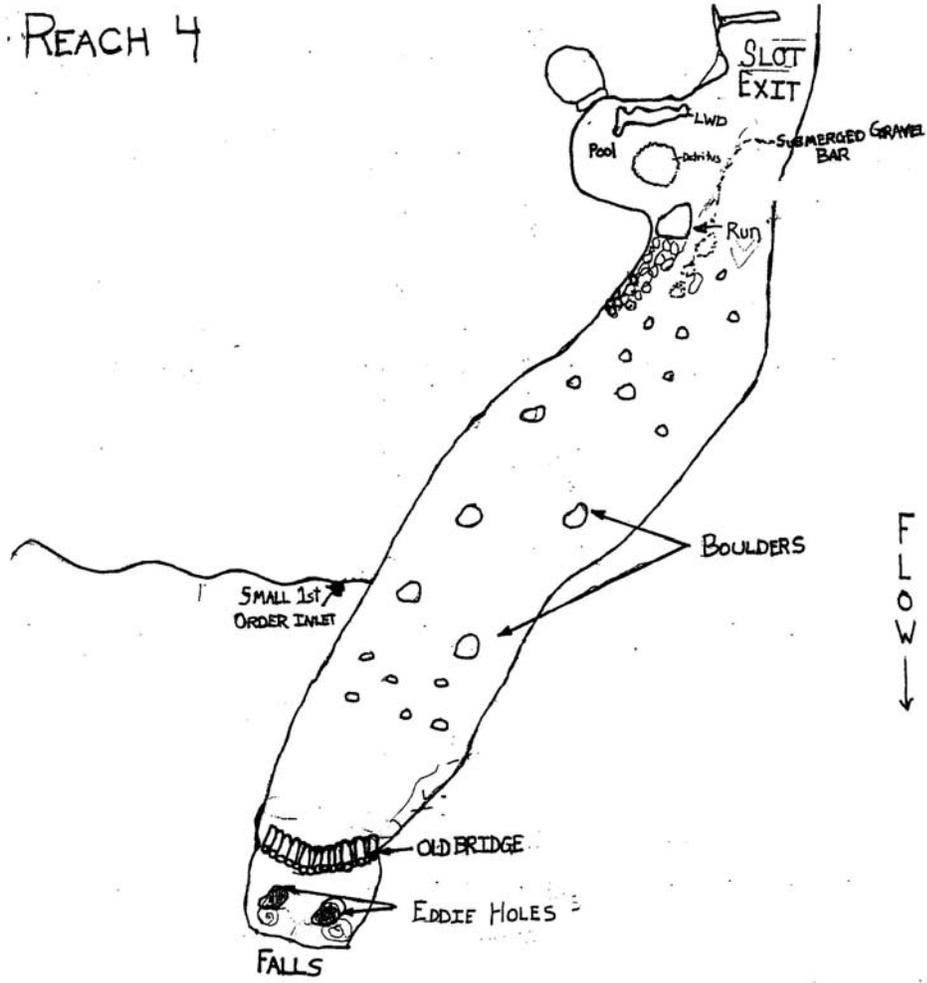
REACH LOCATIONS



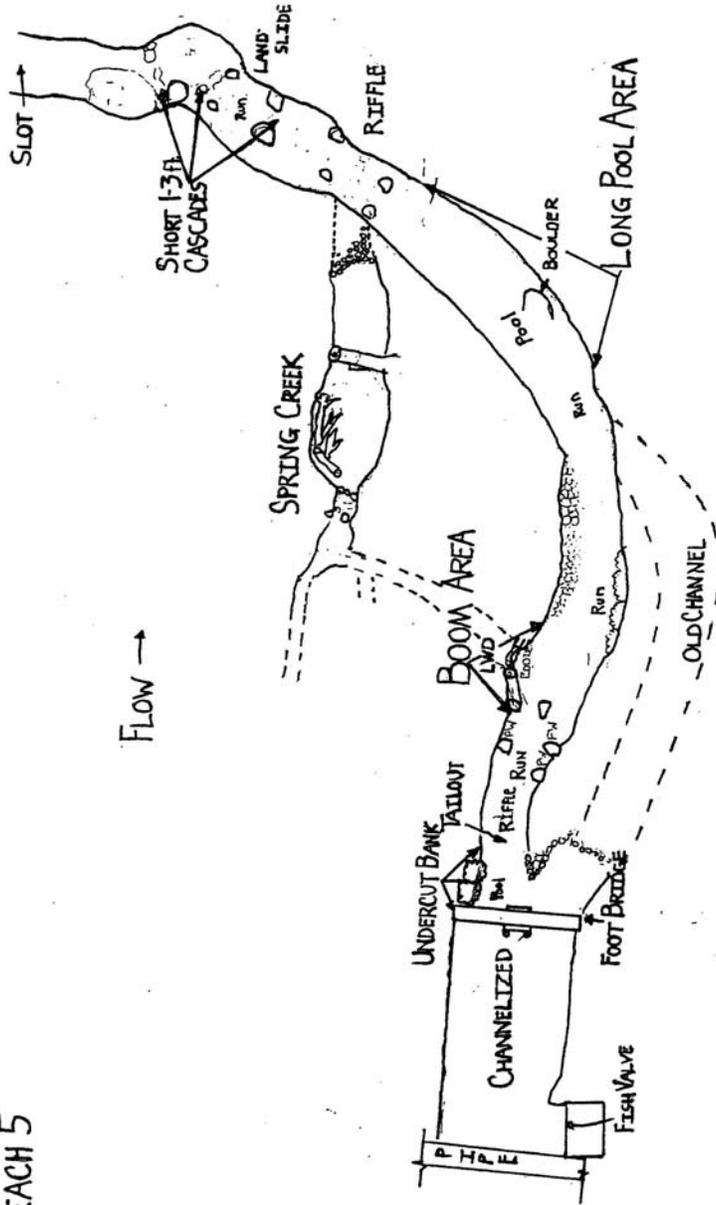
REACHES 1-3



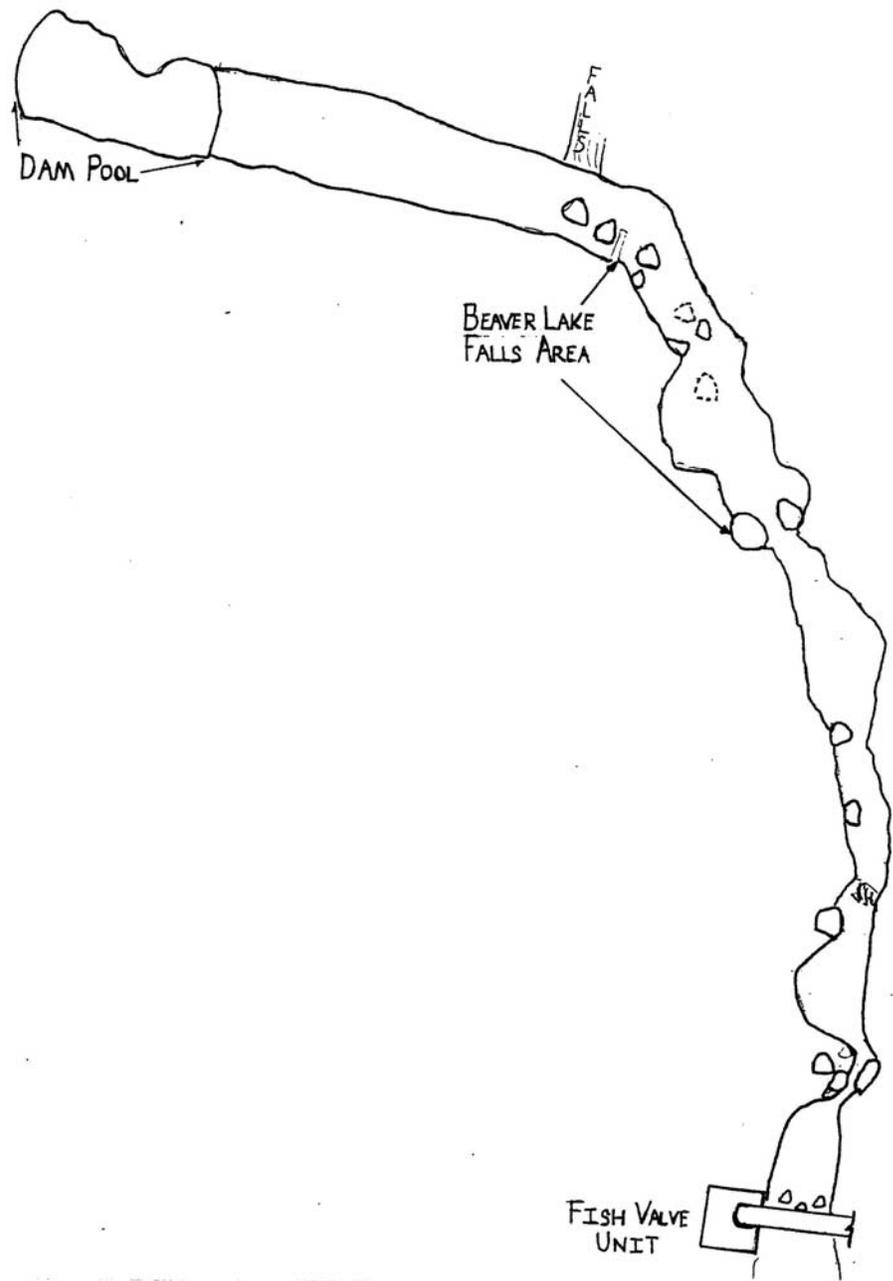
REACH 4



REACH 5



REACH 6



Appendix 2. Summary of Sampling Conditions, 2002 Surveys

Date	Time	Location	Discharge		Temp. C		Water Clarity	Weather	Comments
			stage	cfs.	Air	H2O			
4/1/02	1143	Reach 1	11.87	60.71	4.5	3.5	clear	Clear and breezy	
4/8/02	0900	Spring Creek			4.4	3.8			
4/14/02					7.8				
4/15/02	0800	Spring Creek			7.2	3.9	clear		
4/15/02	1045	Reach 1	11.90	64.44	7.2	3.9	clear	Clear and breezy	
4/22/02	0930	Reach 1	11.98	75.11	-1.1	3.8	clear	Partly cloudy/clear	Fresh snow
4/29/02	1400	Reach 1	11.93	68.32	10.5	3.9			
5/5/02	1718	Reach 1	11.90	64.44	3.9	3.8	normal	cloudy	
5/13/02					10.0				
5/14/02	1740	Reach 1	11.85	58.30	7.8	4.0		Overcast/breezy	
5/16/02	1330	Reach 3	11.90		8.9	4.2		overcast	
5/23/02	1320	Reach 1	11.89			4.5		overcast	
5/23/02	1330	Reach 3	11.89	63.18	8.9	4.8	normal	overcast	
5/24/02	1800	Reach 3	11.86		12.2	5.0			
5/25/02	1830	Reach 4			7.8	5.1			
5/26/02		Reach 6			6.1	6.0	normal		
5/30/02	0900	Reach 1	11.87	60.71	6.1	5.0	normal	partly cloudy	
6/7/02	0900	Reach 1	11.89	63.18	8.3	4.9	normal	Partly cloudy	
	1000	Reach 4				5.1			
6/14/02	1225	Reach 1	11.86	59.50	20	5.0	clear	sunny	
6/20/02	1730	Reach 1	11.98	75.11	16.7		clear		
6/28/02	1100	Reach 1	12.02		13.8		clear	overcast	
7/2/02	1030	Reach 1	12.93		13.32		excellent	Partly cloudy	
7/19/02	1000	Reach 1	12.93	294.5	12.8		normal		

8/02/02	1015	Reach 1	12.95		10.5		normal	Partly cloudy	
8/5/02	1845	Reach 1	12.94		16.1		normal	overcast	
8/16/02	1725	Reach 1	14.04		13.32		Poor	overcast	
8/23/02	1145	Reach 1	14.62		15.5		poor	Overcast/rain	
8/31/02	1100	Reach 1	14.03		12.8		poor	drizzle	
9/6/02	1010	Reach 1	12.61		8.3		poor	Partly cloudy	
9/11/02	1700	Reach 1	13.34		10.0		poor	rain	
9/16/02	1645	Reach 1	12.55		9.4		normal	overcast	Glacial in deeper areas
9/25/02	1715	Reach 1	12.97		11.1		normal	drizzle	Glacial in deeper areas
10/9/02	1125	Reach 1	14.82		4.4		poor	sunny	
10/18/02	0915	Reach 1	14.62		6.7		poor	Partly cloudy	
10/27/02	1500	Reach 1	12.55		10		poor	clear	
10/30/02	0950	Reach 1	12.48		19.4		poor	Partly cloudy	
11/5/02	0915	Reach 1	11.38		6.7	7.5	normal	rain	
11/8/02	0900	Reach 1			10	6.7	Normal	overcast	
		Reach 5	3.8			6.7	Normal		
		Reach 6				7.0	Normal		
11/9/02	0900	Reach 5	3.8			6.7	Normal	overcast	
		Reach 6				7.1	Normal		
11/13/02	1015	Reach 1	11.41		6.7	7.0	normal		
11/22/02	1330	Reach 5	3.01		6.0		normal	overcast	
	1245	Reach 6				7.0	Excellent		
11/25/02	0845	Reach 1					normal	overcast	
		Reach 4				7.0	Excellent		
		Reach 6				7.0			
12/3/02		Reach 1	11.90		1.7	6.5	normal	Clear/Sunny	
12/9/02	1015	Reach 1	11.59		8.3	6.5	Excellent	Drizzle	

Appendix 3. Steelhead Sampling Summary.

Sampling Date	Discharge	Location	Number of Steelhead	Comments
April 1, 2002	60.71 cfs	Index Site	2*	*Two reported seen by angler
April 1, 2002	60.71 cfs	Reaches 1-6	0	windy
April 7, 2002	59.50	Index Site	1	holding at Bridge Hold
		Reach 2	0	Large amount of brown filamentous algae and fungal growth
		Reach 3	0	Substrate growth decreases above Cascade
		Reach 4	0	
		Reach 5	0	
		Reach 6	0	
April 15, 2002	64.44 cfs.	Index Site	1	holding at Bridge Hold
		Reach 2	0	
		Reach 3	4	One at pipe fitting, one at Wild Bill's Pool, and two at the Cascade Pool (Rainbow Hole)
		Reach 4	0	
		Reach 5	0	
		Reach 6	0	
April 22, 2002	75.11 cfs.	Index Site	0	Flat Light just after snow shower, water clear but difficult to see into. Mink tracks at fish carcass. Evidence if angling
		Reach 2	1	At Pulp mill Outflow Pool
		Reach 3	1	At Cascade Pool
April 29, 2002	68.32 cfs.	Index Site	1	holding at Bridge Hold
		Reach 2	0	
		Reach 3	4	All Four at Cascade Pool (Rainbow Hole)
May 5, 2002	64.44	Index Site	0	2 holding below Power House Bin
		Reach 2	2	Both at Pulp Mill

				Outflow Pool.
		Reach 3	13	Three at Pipe Fitting Pool. Ten at Cascade Pool,
		Reach 4	0	(Trapping data)
		Reach 5	0	(Trapping data for Spring Creek area)
		Reach 6	0	
May 14, 2002 Snorkel Survey	58.30	Index Site	0	Powerhouse 1
		Reach 2	7	One at concrete hold and six at the Pulp Mill Outflow Pool
		Reach 3	15	One at Pipe Fitting Pool, Two at Wild Bill's Pool, and Twelve at The Cascade Pool.
		Reach 4	0	
		Reach 5	0	Slot not swam. Numerous residents at Boom logs, Boulder and tail out of Boulder pool
		Reach 6	0	
May 16, 2002	61.94	Index Site	0	Two at Power House Bin
		Reach 2	4	All at Pulp Mill Outflow Pool. (Trapping data for)
		Reach 3	18	All at Cascade Pool.
May 23, 2002	63.18	Index Site	0	One fish at Power house
		Reach 2	8	Two at Concrete Area and six at Power House Pool.
		Reach 3	14	Two in Pipe Fitting area, Twelve in Cascade Pool/Rainbow Hole. One other rainbow between resident and anadromous size in Rainbow Hole behind larger fish.

May 30, 2002	60.71	Index Site	0	One fish in Power House area
		Reach 2	4	Four at Pulp Mill Out Flow Pool
		Reach 3	13	Two in Pipe Fitting area, Twelve in Cascade Pool/Rainbow Hole. Two other rainbow between resident and anadromous size in Pipe Fitting area. Both appear to be feeding.
June 7, 2002	63.18	Index Site	1	One at Bridge Hold. Two at Power house area.
		Reach 2	0	
		Reach 3	9	Three at Pipe Fitting area six at the Cascade Pool/Rainbow Hole. Two other rainbow at the Pipe Fitting area Feeding.
June 14, 2002	59.50	Index Site	0	One at Power House.
		Reach 2	0	
		Reach 3	6	Three at Pipe Fitting Area and Three at Cascade Pool/Rainbow Hole. Six rainbow at Pipe Fitting area
		Reach 4	0	
		Reach 5	0	
		Reach 6	0	
June 20, 2002	75.11-55.95	Index Site	0	CFS. dropped while reading.
		Reach 2	0	
		Reach 3	2	One steelhead at Pipe Fitting Area, and one at Cascade/Rainbow Hold. Two other rainbow at Concrete Area
June 28, 2002	80.93	Index Site	0	
		Reach 2	0	Two resident sized rainbow at Pipe Fitting Area.

		Reach 3	0	
July 2, 2002	294.5	Index Site	0	
		Reach 2	0	
		Reach 3	0	
		Reach 4	0	
		Reach 5	0	
		Reach 6	0	