# FINAL FISHERIES INVESTIGATIONS REPORT 2011

## TAKATZ LAKE HYDROELECTRIC PROJECT (FERC No. 13234)

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Prepared for:

**City and Borough of Sitka Electric Department**

**July 2012**

## EXECUTIVE SUMMARY

In February, 2008, the City and Borough of Sitka ("City") received a Preliminary Permit ("Permit") for the Takatz Lake Hydroelectric Project (FERC No. 13234, "Project") from the Federal Energy Regulatory Commission (FERC) in Washington D.C. This Project would potentially affect resources in the Takatz, Sadie, Baranof and Medvejie river basins which fall within the potential project boundaries. During the 2010 field season, studies were conducted primarily in the in the Takatz Creek Drainage with some additional information from the other potentially affected water bodies including, Takatz Bay, Sadie Lake Drainage, Baranof Lake Drainage, and Medvejie Drainage. The results of these studies were documented in a Draft Fisheries Report distributed on March 21, 2011 (Wolfe 2011).

The City conducted an interagency meeting on April 27, 2011, to discuss the report for 2010 fisheries studies and studies for the upcoming 2011 study season. Draft minutes of the interagency meeting were distributed on May 9, 2011.

During the April 27 meeting, attendees agreed on the following priorities for 2011 aquatic resources studies:

- Emphasis during the 2011 field season would be on the Takatz River Basin, with particular focus on Lower Takatz River Reaches 1 and 2, as described in Wolfe, 2011.
- Experimental gill netting would be conducted in Takatz Lake;
- Studies in the Baranof River and Medvejie River Basins would be considerably reduced;
- Further water temperature monitoring would be conducted in the Takatz basin including Takatz Lake, Lower Takatz River and Takatz Bay;
- A Fisheries Workgroup consisting of Karl Wolfe, Shawn Johnson, Patrick Fowler, Troy Tydingco and Roger Harding would be formed to facilitate rapid communication and decision-making during the 2011 field season.

Based on these priorities a draft study plan for 2011 field studies was distributed in May 2011 (CBS 2011). To fulfill one element of the FERC application requirements this report documents the result of fisheries surveys conducted during the 2011 field season. Unless otherwise specified this report documents studies conducted in 2011.

### TAKATZ RIVER BASIN

In the Takatz River Basin fish distribution was primarily limited by two waterfalls in Takatz Creek. Only Dolly Varden char *(Salvelinus malma)* that were presumed to be a barrier isolated resident population were encountered from a large water fall (Upper Falls) at Stream Mile (SM)

1.83 (Reach 2) downstream to a lower waterfall at SM 0.73 (Lower Falls)(Reach 1). Downstream of the Lower Falls pink (*Oncorhynchus gorbuscha*) and chum salmon (*Oncorhynchus keta*) were the primary species encountered. Subject to public review, an update to the Alaska Department of Fish and Game (ADF&G) Anadromous Waters Catalog (AWC) reflecting the barrier presented by the Lower Falls is currently pending.

Dolly Varden data from the 2011 field season suggested a complex life history in Reach 2 and adjacent inflow areas. Spawning and emergent fry were observed in Reach 2 and all adjacent inflow areas, but many of the adult fish and a portion of the juveniles moved out of winter habitats and into habitats adjacent to faster water. Primary winter habitats included: the East Tributary Pond, both Upper And Lower Beaver Areas,

Beginning in mid- June a seasonal habitat movement out of the winter habitat areas described above into the faster water habitats in the North Tributary and Takatz Creek was observed. In October, after spawning was completed Dolly Varden moved back into winter habitats. This movement was completed by much of the adult population and some of the juveniles. Spawning in these faster water areas began in late-August and ended by late October at which time spawning in other the other sub areas was still occuring. Much of the spawning was concentrated just below the cascade in the North Tributary and to a lesser extent in Reach 2 of Lower Takatz Creek at confluence pools with the North Tributary and East Tributary.

Chum salmon began entering the creek in mid July 2011, with a peak count on July 26 of 542 fish and counts declined after that. The last viable chum salmon were observed on September 27. Pink salmon were first observed on July 20, and the number of pinks peaked on September 13 with 1633 observed, and decreased rapidly after mid-September with the last viable pink salmon observed on September 27. Both chum and pink spawning activity was highly concentrated in a short section of the upper intertidal area (Sub-Reach 1-4) dominated by medium to coarse (11-64 mm) gravels.

**TAKATZ BAY**

During brackish water surveys conducted at large minus tides at total of ten fish species and dungeness crab *(Metacarcin magister)* were observed. The intertidal species assemblage was limited to those adapted to sand habitats due to the lack of other habitats particularly eelgrass. During these surveys large concentrations of juvenile Pacific herring *(clupea pallasii)* and Pacific sandlance *(Ammodytes hexapterus)* were observed that were present throughout the bay in early summer.

**SMALL TAKATZ BAY DRAINAGES**

All of the Small Takatz Bay Drainages were primarily intertidal or contained very short areas of fish passage. Chum salmon counts in all the potentially affected drainages were very low and ranged from 0 to 5 fish. Pink salmon counts likewise were relatively small and ranged from 0 to 25 pink salmon.

## SADIE LAKE BASIN

Sadie Lake contains a naturalized population of cutthroat trout (*Oncorhynchus clarki*) that are generally regarded to have originated from Baranof Lake stock planted by a non-agency entity. Work on the Sadie Lake Drainage was limited to foot surveys on May 31, August 20, and August 21 of 2010 as well as personal communications with people familiar with the drainage. Work in 2011 was limited to temperature monitoring. Both foot surveys and communications suggest that that the main inlet tributary and the outlet are potentially important habitat areas.

## BARANOF LAKE BASIN

Cutthroat trout (*Oncorhynchus clarki*) are the only fish species known to inhabit Baranof Lake and its inflow tributaries downstream to a large water fall at tidewater. During snorkel surveys in early May of 2010 a total of 216 cutthroat were observed, primarily >160 mm in length. Except for the Lower Baranof River Outlet, the highest counts in this size range were in tributaries at upper (west) end of the lake. During 2011 spawning was observed in the Beaver Area and in the inlets to this area on May 31 and June 3 respectively. Both of these areas are west end tributaries to the lake.

## MEDVEJIE RIVER BASIN

Like the Takatz Basin fish distribution in the Medvejie River Basin is influenced by likely fish passage barriers. As in 2010, during 2011 surveys we encountered Dolly Varden from a cascade approximately .31 miles upstream from the Upper Medvejie River's confluence with the lake to its outlet. Anadromous fish distribution in the Medvejie River Basin is influenced by barrier nets at tidewater and hatchery weirs as well as a series of cascades upstream. These upstream cascades correspond to the current ADF&G limits of anadromous distribution (ADF&G, 2009a, ADF&G, 2009b). During much of the year the area from just below the outlet of Medvejie Lake to the vicinity of the hatchery is reduced to subsurface flow due to low lake levels.

A snorkel survey in 2011 documented emergent fry along the west shoreline of Medvejie Lake to a point just below the cascade in the Upper Medvejie River mentioned above.

**TABLE OF CONTENTS**

## LIST OF FIGURES

## LIST OF TABLES

## PROJECT DESCRIPTION

Generally, the Project would consist of one or two dams on Takatz Lake, a power conduit consisting of a mostly unlined tunnel and steel penstock leading to a powerhouse located at tidewater on Takatz Bay (Figure 1). Installed capacity of the Project would be approximately 27 megawatts (MW).

The originally proposed Project transmission line would extend from the powerhouse underwater in Takatz Bay, Chatham Straight and Warm Springs Bay to overhead or buried segments which would continue westward past Baranof Lake and Baranof River. The transmission line would then enter a tunnel through the Baranof Mountains. From the western tunnel portal, the transmission line would continue down the Medvejie River valley past Medvejie Lake and on to its interconnection with the existing transmission line from the City's Green Lake Project (FERC No. 2818).

## ALTERNATIVE TRANSMISSION ROUTING

Based on comments received during SD1 review and after Scoping meetings, the City has developed a new transmission alternative which avoids potential effects on marine resources and on the community of Baranof Warm Springs. This routing, referred to as the "Overland Transmission Alternative", or simply "Overland Alternative" is shown in Figure 1 below.

The primary feature of this transmission route would be the overland segment south from the powerhouse, past Sadie Lake, thence south and west to the shore or Baranof Lake. While Figure 1 shows an underwater segment beneath Baranof Lake, the City may elect to use an overhead segment along the north shore of Baranof Lake, depending on the outcome of fisheries and bathymetric surveys.

The Overland Alternative does not change the routing of the transmission segments beyond the point at which the line emerges from upper Baranof Lake.

At this time, the Overland Alternative is the City's preferred transmission alternative because it responds to concerns for impacts on both the community of Baranof Warm Springs and those on marine resources in Chatham Straight. Further, the Marine Alternative would necessitate extensive and difficult marine engineering feasibility analyses.

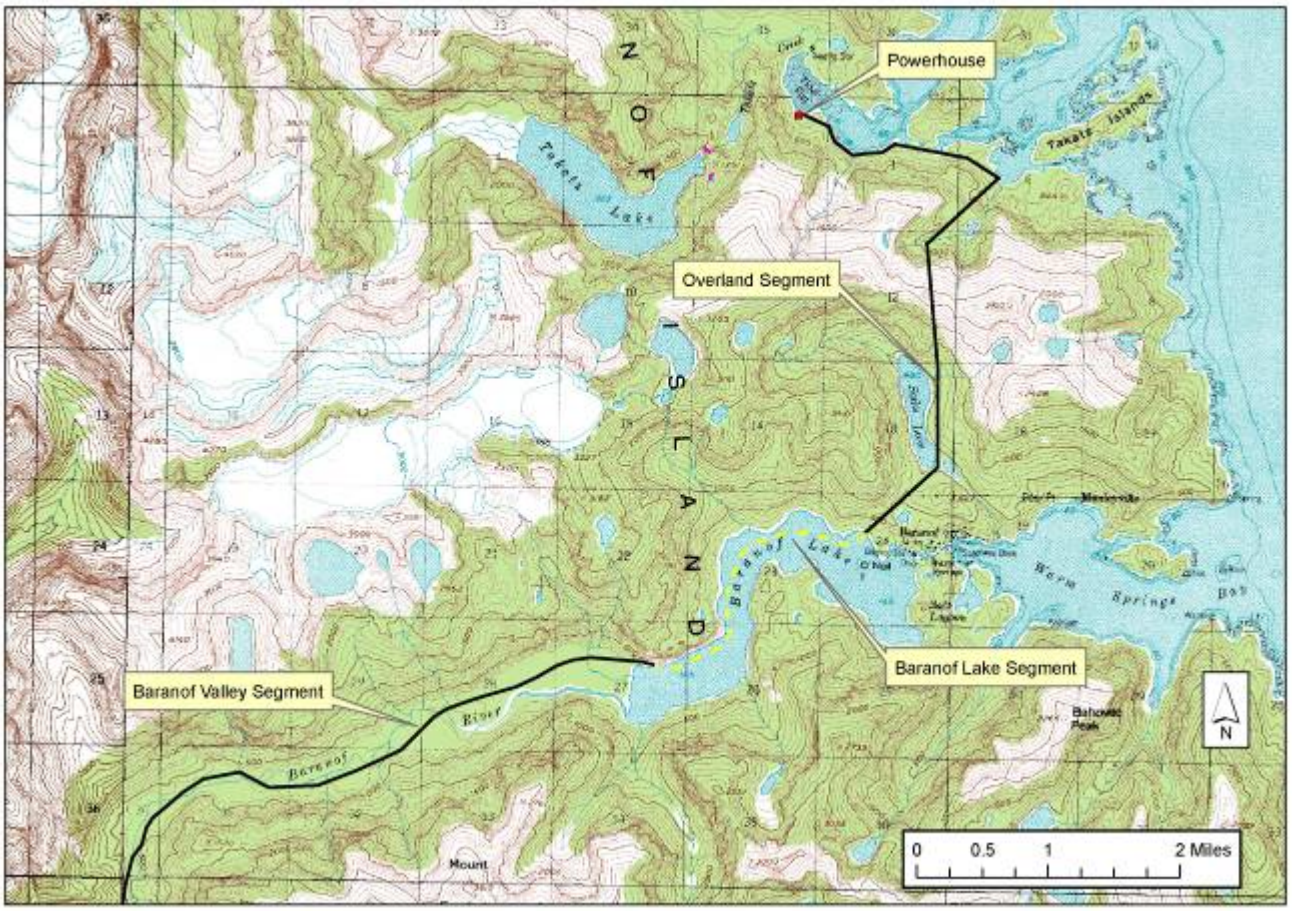


**Figure 1. Detail of Overland Transmission Alternative**

## STUDY PLANNING and CONSULTATION

### STUDY PLANNING

A Draft Fisheries Study Plan for 2010 was distributed for agency review on March 23, 2010 (CBS 2010). Written comments on the Draft Plan were submitted by Alaska Department of Fish and Game (ADF&G) on April 29, 2010. An interagency meeting was conducted on May 13, 2010, to discuss ADF&G's comments on the Draft Plan. Draft minutes of the interagency meeting were distributed on June 9, 2010. Based on this meeting objectives and priorities were developed for 2010 fisheries studies.

Based on a Draft Fisheries Study Plan (City, 2010), the City, under contractor Karl Wolfe, conducted studies in 2010 in all potentially-affected river basins, that is, Takatz, Baranof, Sadie Lake and Medvejie. Those studies are documented in Wolfe, 2011. Generally, those studies documented that:

- No fish of any species were found in Upper Takatz Creek, Takatz Lake or Lower Takatz Creek upstream of a waterfall called the "Upper Falls" in Wolfe 2011;

- Only Dolly Varden char were found in Reach 2 of Lower Takatz Creek between the Upper Falls and the Lower Falls;

- There was very complex habitat in Reach 2, consisting of significant beaver activity and existence of sloughs, backwaters and wetlands fed both by Takatz Creek and other inflows;

- Only cutthroat trout were found in Baranof Lake and Upper Baranof River;

- Only Dolly Varden were found in the Medvejie drainage above a stream control feature.

It was also found that the Northern Southeast Regional Aquaculture Association (NSRAA) chum salmon net pens were in the area of potential effects of the Project, relative to water temperature.

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Based on these priorities a draft study plan for 2011 field studies was distributed in May 2011 (CBS 2011). This report documents the results of 2011 field studies.

## 2011 STUDY SCOPE and OBJECTIVES

The overall objective of the proposed 2011 studies was to build on data and information gathered in 2010 to provide an aquatic resources baseline and information suitable to assess Project impacts. As described in Wolfe 2011, almost all aquatic resources potentially-affected by the Project are in the lower reaches of Takatz River and consist of 1) Dolly Varden in Reach 2; and 2) chum and pink salmon in Reach 1 and Takatz Bay. Studies completed in 2010 showed no fish of any species above Reach 2.

Therefore, 2011 studies focused on these areas with the following objectives:

1. Confirm lack of fish presence in upper Takatz River basin;
2. Determine habitat types and fish habitat utilization and timing for Dolly Varden in Reach 2, Lower Takatz Creek, in particular spawning;
3. Further document timing and abundance of chum and pink salmon in Lower Takatz Creek; and
4. Conduct water temperature studies in Takatz Lake and Takatz Bay to help determine potential effects on fish in Takatz Bay and the NSRAA net pens.

Except where otherwise noted this report describes studies conducted in 2011 only. Results from 2010 studies are included in sections in order to aid the reader with previous back ground data and are labeled as such.

## STUDY AREAS and NOMENCLATURE

Because studies would be conducted in several different river basins, stream reaches and other aquatic habitats, researchers established the following study area breakdown and nomenclature. Generally, these areas are organized by major river basin or other drainage area, with stream reaches and other features identified within the broader areas.

### TAKATZ RIVER BASIN

### Major Takatz River Basin Study Areas

Study Areas in the Takatz River Basin included the following, from upstream down (Figure 2):

**Upper Takatz Creek**, extending from about 2.0 miles from the Takatz Lake confluence to the Creek's headwaters;

**Takatz Lake,** including all normally inundated lake areas; and

**Lower Takatz Creek,** extending from the outlet of Takatz Lake downstream to its confluence with tidewater at normal low tide (Figure 3). This Study Area included Lower Takatz Creek tributaries and adjacent sub- areas.

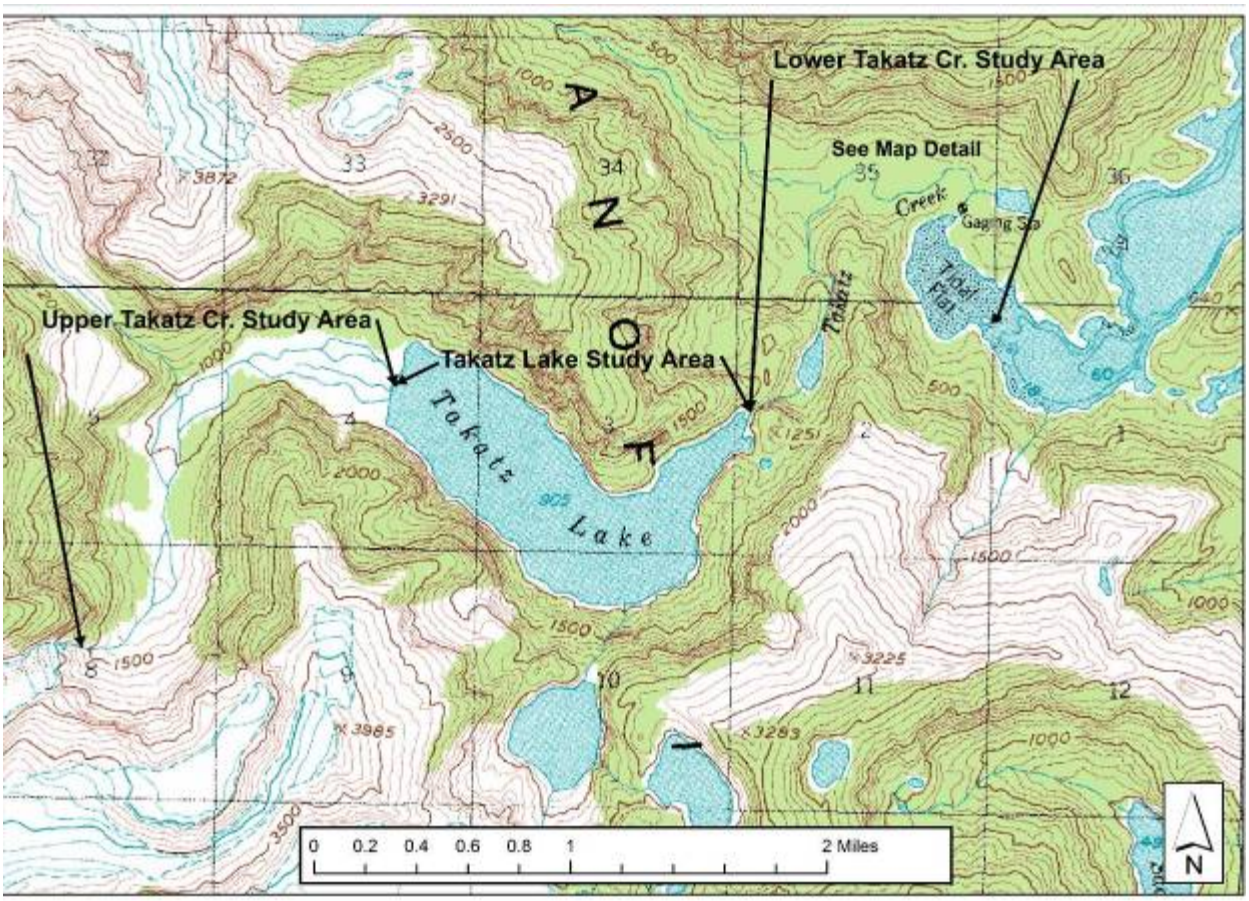


**Figure 2. Major Takatz River Basin Study Areas**

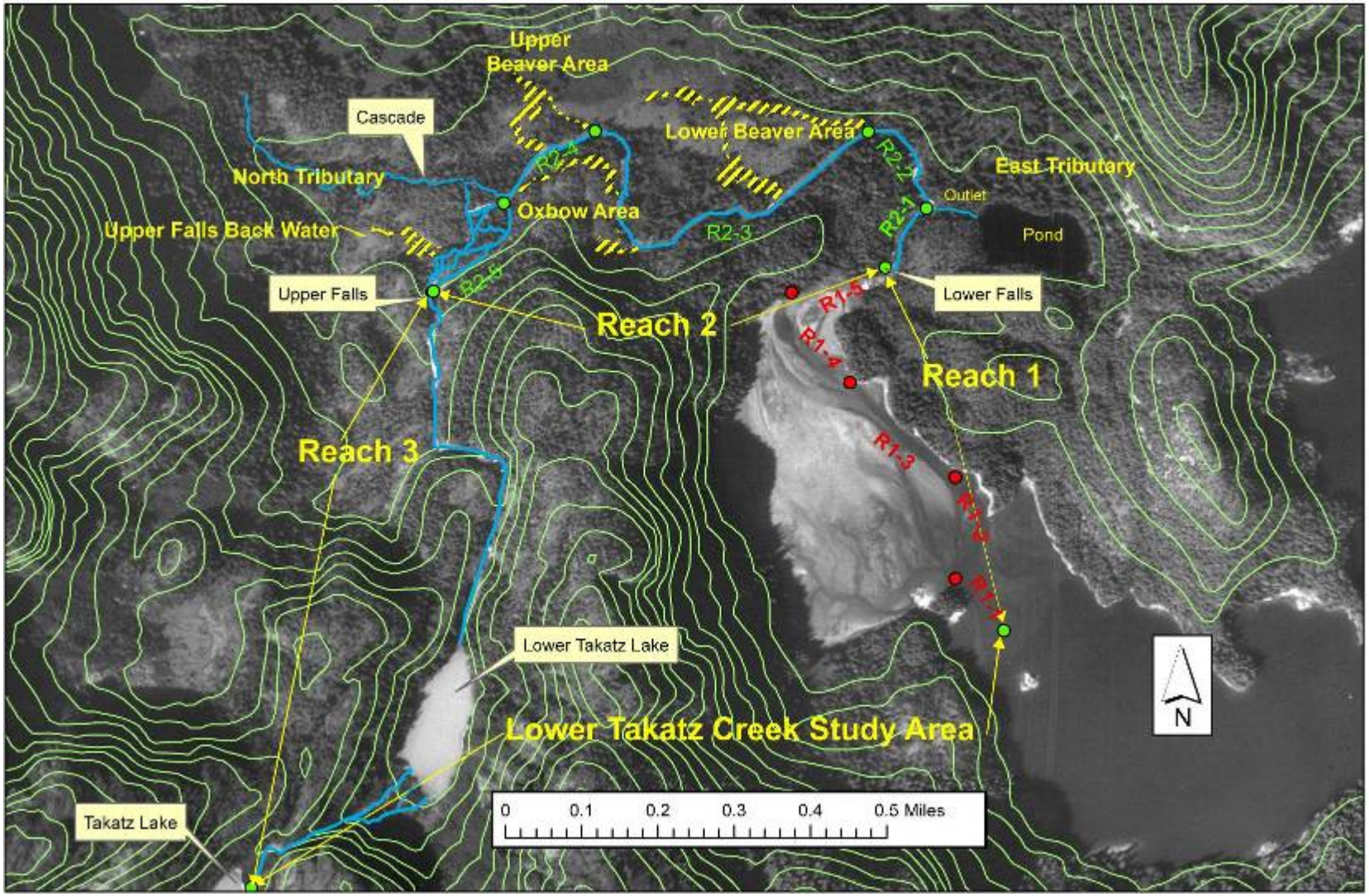


**Figure 3. Lower Takatz Creek Study Area detail with reach and sub-reach breaks indicated by dots**

## LOWER TAKATZ CREEK STUDY AREAS

The most intensive area studied in 2011 was from the base of the Upper Falls (Reach 2) to the areas in Lower Takatz Creek which were exposed by changes in tide stage (Reach1). During 2010 studies, study sub-areas were designated to illustrate different habitat types and stream reaches defined by fish passage barriers.

### Major Stream Reaches

Lower Takatz Creek, from the outlet of Takatz Lake to the upstream limit of tidewater was divided into three Study Reaches, numbered 1, 2, and 3, as described in the following:

**Reach 3** extended from the outlet of Takatz Lake approximately 1.04 miles downstream to the the Upper Falls;

**Reach 2** continued from the downstream end of Reach 3, 1.13 miles to the base of the Lower Falls in Takatz Bay. Reach 2 was further subdivided into five Sub-Reaches, (numbered 1 through 5) of the main channel, based on differences in stream characteristics and habitat type (See Figure 3).

**Figure 4. Upper Falls at SM 1.86 from top of Reach 2.**

Also within the limits of Reach 2 were several distinct aquatic habitat features (Figure 6, see Figure 3), including:

- **Fish Passage Barriers in Reach 2.** Two major waterfalls occurred in Reach 2, the Lower and Upper Falls, located at SM .73 and SM 1.86, respectively (Figure 4, Figure 5, and Figure 3);

- **Major Inflow Tributaries.** Fish surveys were conducted in the lower reaches of two significant tributaries which entered Lower Takatz Creek in Reach 2: 1) the North Tributary, entered at about SM 1.79 as well as SM 1.68; and 2) the East Tributary which consisted of a small inflow stream, a pond and an outlet stream which entered at about SM 0.83;

- **Beaver Areas.** Bordering Reach 2 to the north were two areas of intensive beaver activity, denoted Lower Beaver Areas and Upper Beaver Area. The Lower Beaver entered at SM .98 and SM 1.12 and the Upper Beaver Area entered at SM 1.51 and SM 1.57 (See Figure 3). These beaver complexes are minor tributaries of Lower Takatz Creek.

- **The Oxbow Area.** The Oxbow Muskeg was a tributary area adjacent to Lower Takatz Creek that entered at SM 1.34. The Oxbow Channel was a side channel that communicated hydraulically with Reach 2 and extended downstream from SM 1.73 to SM 1.43 (Figure 6, See Figure 3).

- **The Upper Falls Backwater.** A backwater pond with a small spring fed inflow tributary entered at about SM 1.82 (Figure 6, See Figure 3).

- **Emergent Creek**. In 2011 we added this micro-channel tributary that entered at SM .85 due to the fish activity we observed there (Figure 7).

**Reach 1** extended from the downstream end of Reach 2 to the normal low tide mark in Takatz Bay. Like Reach 2, Reach 1 was further subdivided into five Sub-Reaches, (numbered 1 through 5) of the main channel, based on differences in stream characteristics, tidal influence, and habitat type (See Figure 3).

**Figure 5. Lower Falls at SM .73 from top of Reach 1**


**Figure 6. Lower Takatz Photo Detail**

**Figure 7. Bottom of Emergent Creek where fish activity was observed.**

## SMALL TAKATZ BAY DRAINAGES

Several small streams drained into Takatz Bay within the potentially-affected area. These were named in a counter-clockwise rotation (See Figure 8) from the upper end of Reach 1 (note: these stream names were assigned by project personnel and may not relate to names assigned by previous mapping and/or naming protocols). These were:

- Cripple Creek;
- Powerhouse Creek;
- Cruise Boat Creek;
- South Shore Falls;
- Muskeg Creek; and
- Island Creek.

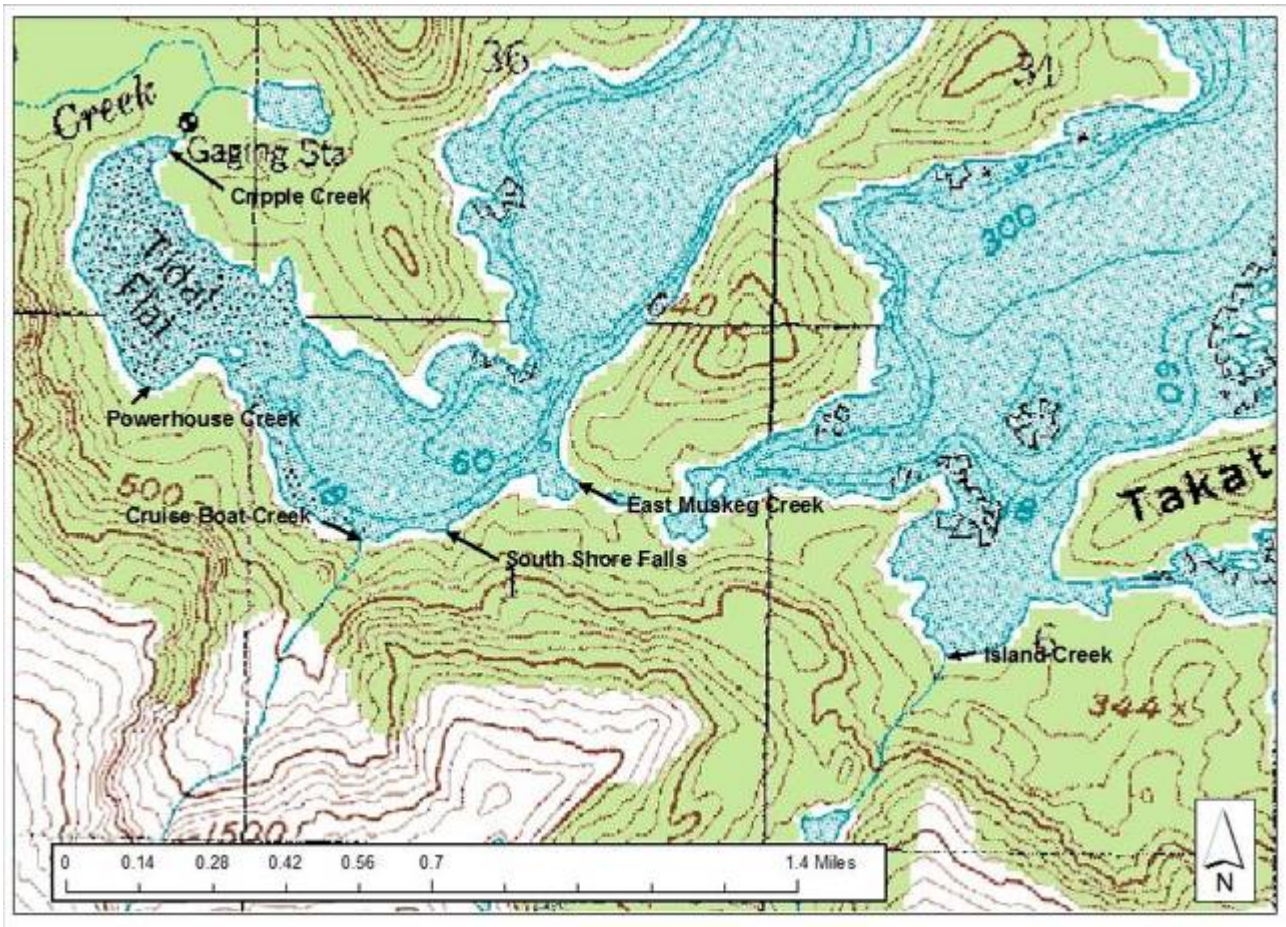


**Figure 8. Small Takatz Bay Drainages.**

## SADIE LAKE BASIN

Study areas in this lake basin were limited to the lake, its outlet, and two inlet streams (Figure 9).

## BARANOF RIVER BASIN

**Upper Baranof River,** from high water level in Baranof Lake upstream to its headwaters (Figure 10);

**Baranof Lake and Inflow Tributaries,** including all normally inundated areas of the lake and various inflow tributaries, primarily along the North and North Western lakeshore (Figure 10, Figure 11). These where initially assigned a three symbol code based on their ADF&G statistical area, the compass direction of their confluence with the lake, and finally their numeric relation east to west towards the back of the lake. Later most were assigned names when none previously existed. In a clock wise direction from the North East these are;

- Camp Creek BN1

- True Camp Creek BN2
- CW1
- Under Boulder Creek CW5
- Caddis Creek CW4
- Water Fall Creek CW6
- Cabin Creek CS2
- Slide Creek CS1
- South Creek AS1

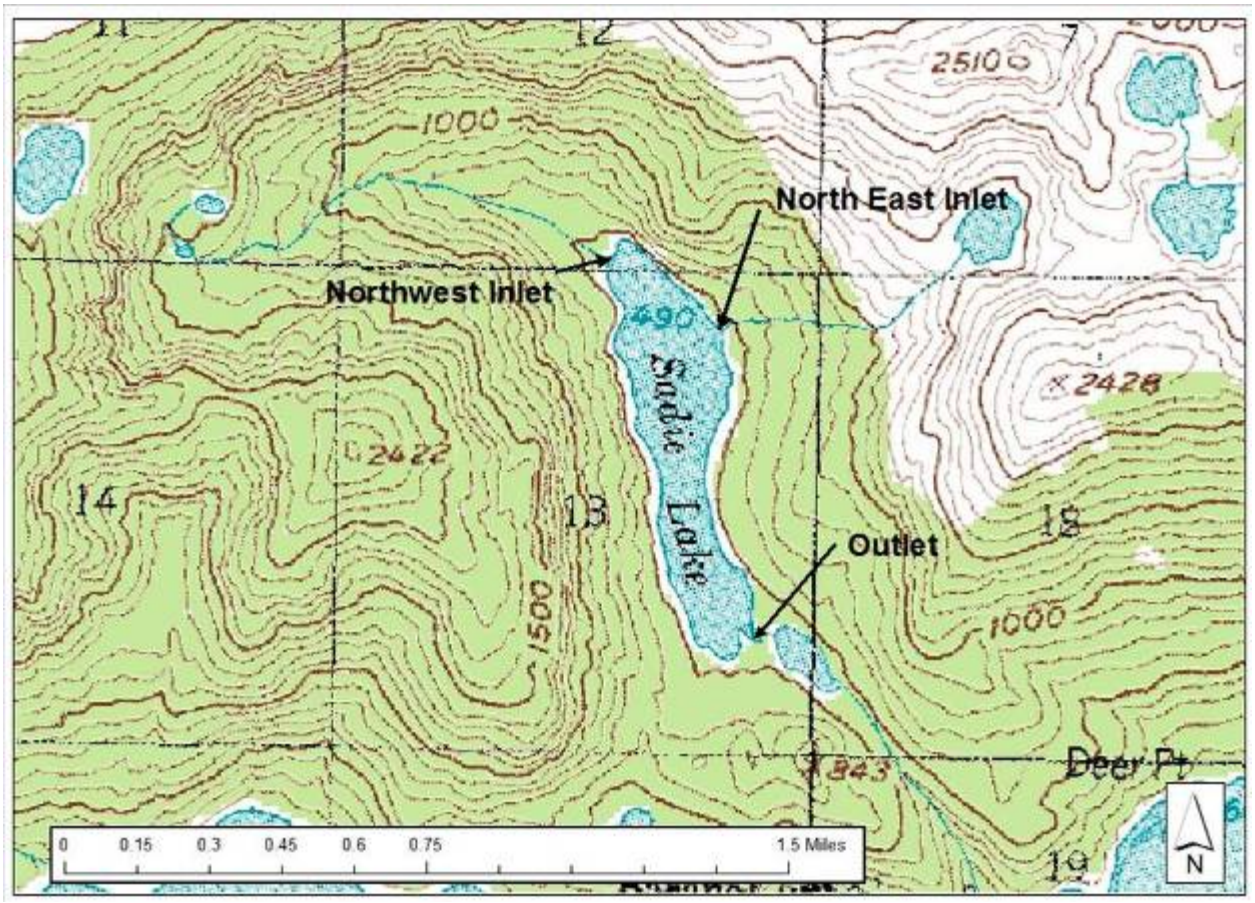


**Figure 9. Sadie Lake Study Areas.**

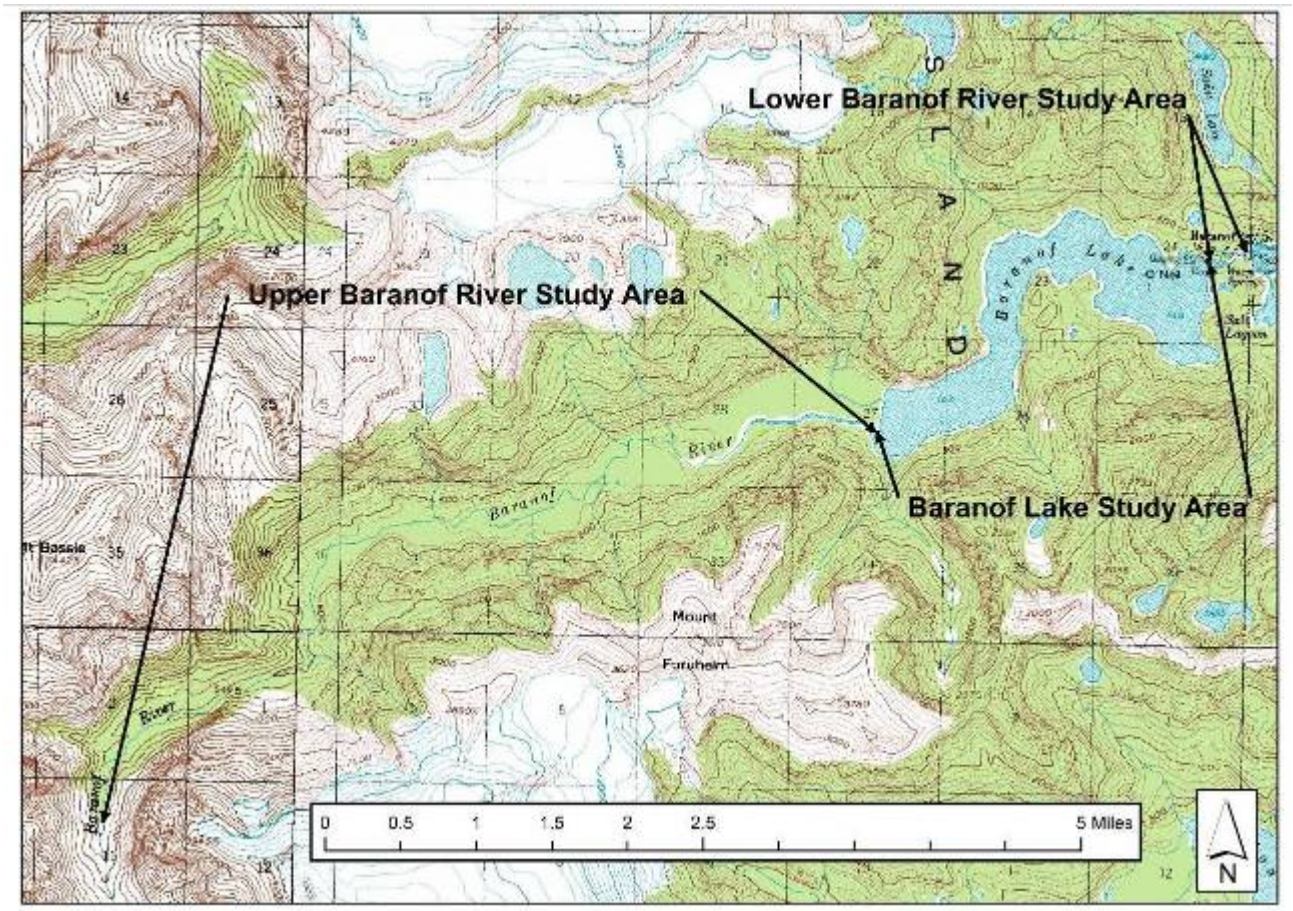


**Figure 10. Baranof River Basin Study Areas.**

Under Boulder Creek, Caddis Creek, and Waterfall Creek were located in the lower section of Upper Baranof River Valley. South Creek was a free stone muskeg based tributary and the remainders were alluvial in areas accessible to fish.

**The Beaver Area** which was located near the inflow of Upper Baranof River; and emptied into Water Fall Creek, Under Boulder Creek and Caddis Creek (Figure 11, Figure 12).

**Lower Baranof River,** located from the outlet of Baranof Lake to the normal high tide mark in Baranof Bay (Figure 10, Figure 11 (Outlet AE1)).

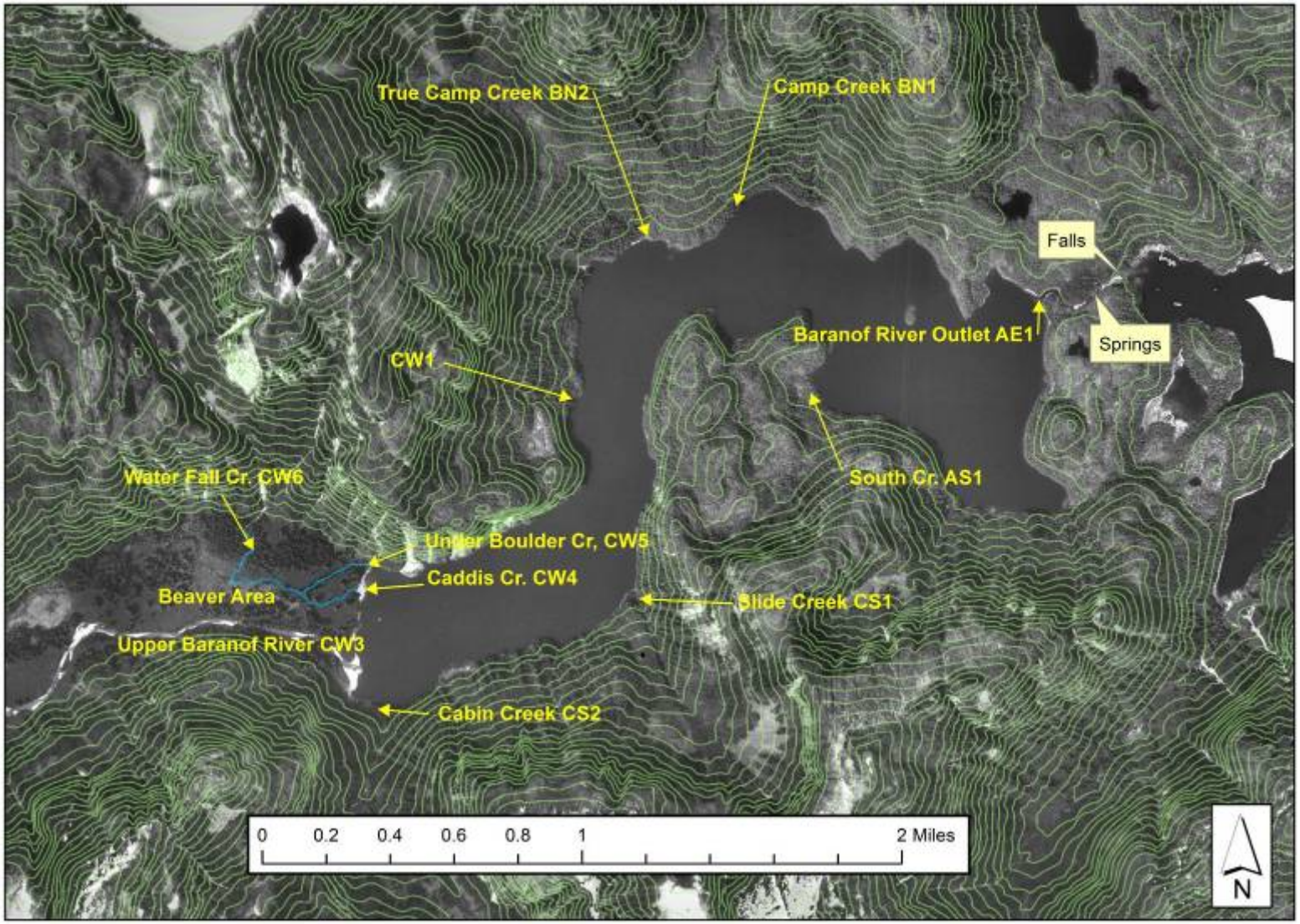


**Figure 11. Baranof Study Areas detail.**


**Figure 12. Baranof Basin west end lake tributaries.**

**MEDVEJIE RIVER BASIN**

Study areas in this basin included the following, from upstream down (Figure 13):

**Upper Medvejie River,** from high water level in Medvejie Lake upstream approximately 0.5 miles;

**Medvejie Lake,** including all normally inundated areas of the lake; and

**Lower Medvejie River,** from the Medvejie Lake outlet downstream to the normal high tide mark.

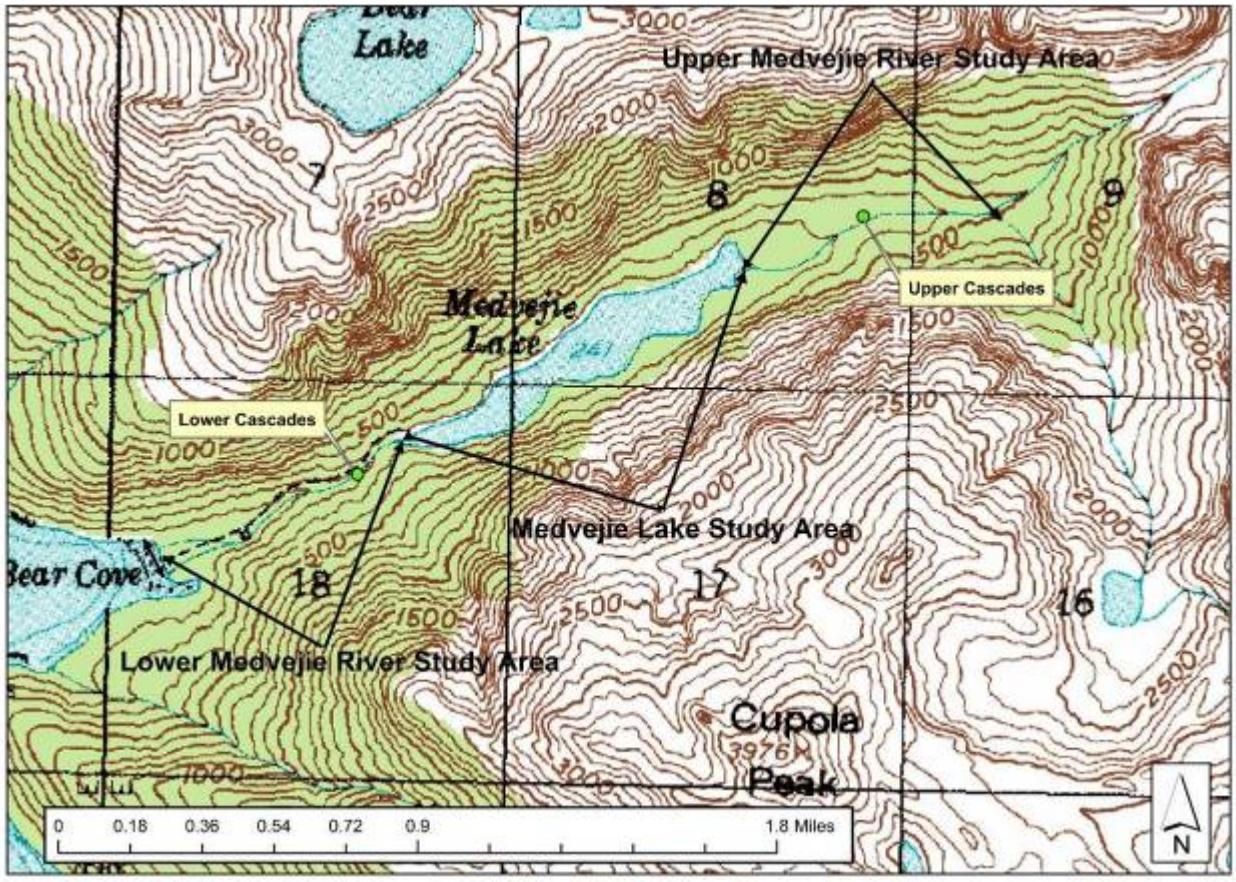


**Figure 13. Medvejie River Basin Study Areas.**

## METHODS

Based on the study planning and consultation, researchers conducted three primary study components during 2011. These were:

1. Fish Surveys, to determine presence or absence of fish, timing or periodicity of life stages and relative abundance; and

2. Habitat Evaluation, to determine aquatic habitat features associated with the various fish species and life stages. In 2011, Habitat Evaluation field methods consisted primarily of monitoring substrate composition and water temperature.

3. US Forest Service (USFS) channel class designations and Alaska Department of Fish and Game (ADFG) reach designations and available aerial photography were also reviewed prior to field work (Paustian et al 1992, USDA 2010, ADF&G 2010).

Detailed descriptions of methods for these study components are provided in the following:

(In this report, distances along streams are denoted by Stream Mile (SM), the distance upstream from the downstream major water body, e.g. tidewater or the primary lake in a basin.)

## FISH SURVEYS

Surveys of various types were used in 2011 to document presence fish utilization, as described in detail below. Surveys generally fell into two categories:
1) **Fish Observations** and 2) **Fish Captures**, as described below.

### Fish Observations

Fish observations fell into four categories: **1) *Index Surveys*; 2) *Stream Surveys*; 3) *Snorkel Surveys*; and 4) *Boat Surveys*** as described below.

#### *Index Surveys*

Index surveys were frequent general abundance surveys conducted at three locations in sub-reaches 2-2 and 2-3 of Reach 2 in Lower Takatz Creek that contained consistent sightings in 2010 (Figure 14). Information from these surveys was intended to add to the base line for the timing of fish utilization of Lower Takatz Reach 2. Index surveys were conducted from June 16 to October 28.

**Figure 14. Index Area 1 at the East Tributary confluence pool (east Tributary enters to the right) at beginning of Sub Reach 2-2 (S.M. 0.83).**

### *Stream Surveys*

Stream surveys were conducted as needed to determine anadromous and resident fish distribution, abundance, and habitat utilization throughout the potentially occupied sections of the stream. Polarized glasses were used to reduce water surface glare during all foot surveys. Stream surveys in 2011 varied depending on drainage due to differences in focus, species present, and logistical issues such as the inability to conduct snorkel surveys.

### *Snorkel Surveys*

Snorkel surveys were done to evaluate occurrence, activity, and habitat use of juvenile and adult Dolly Varden and were conducted within accessible areas in which stream hydraulics offered suitable observation conditions. Snorkel surveys were conducted in both upstream and downstream directions depending on environmental factors and likely holding areas were visually inspected using a mask and snorkel (Northcote and Wilkie 1963, Thurow R.F. 1994). Wherever stream conditions allowed, surveys were conducted upstream to minimize fish disturbance. Observations were initially recorded on a wrist mounted slate with a 100 mm scale in order to reduce disturbance and to allow for optic magnification due to the dive mask (Goldstein 1978, Gardiner 1984). Immediately after observations this and other relevant data were recorded on a standardized field form and efforts were quantified by recording start and stop locations using GPS coordinates. At this same time data was noted on detailed aerial photographs and/or maps of the various study areas.

### *Boat Surveys*

Boat surveys were conducted in intertidal and lake shore areas where foot or snorkel methods were not feasible. Polarized glasses were used and the primary observer was located on the bow.

## Fish Observation Data Recording and Mapping

For all observation techniques, data were entered into an Excel spreadsheet in the office, and checked against the original aerial photos, maps and field forms.

During each field survey, the observer noted the following:

- Number of fish by species
- Time of day (Stop and Start times)
- General weather condition
- Water temperature
- Relation of observation time to tide status (Reach 1 in Lower Takatz)
- 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 throughout the stream). Notations included locations of fish both across and up and down the channel.

A base map of the stream was annotated during each survey to show specific points of observation within the channel. Notes were made of species composition, fish activity, and habitat conditions and utilization.

**Fish Captures**

All fish captures were conducted under Collecting Permit number SF2011-191 issued in May, 2011 by ADF&G. The permit authorized captures by either fish traps of various types, gillnets (in Takatz Lake only), or hook and line sampling, as described in the following:

***Fish Trapping***

Bait for hoop traps and minnow traps consisted of sterilized salmon eggs or those disinfected in beta dine solution. Bait for hoop traps was placed in commercial cup canisters and for minnow traps perforated film canisters. All traps were marked with individual trap numbers for that day to avoid any confusion and to ensure all traps were retrieved at the end of the sampling period.

Hoop traps were 1.4 m long and consisted of four 0.6-m-diameter steel hoops with 9-cm throats attached to the first and third hoops. Knotless nylon netting with a mesh size of 1 cm covered the hoop traps. Traps were supported horizontally with at least two aluminum bars and willow or alder saplings were often used in conjunction with these to keep the outside mesh open near current. Cobble sized anchors were often utilized due to the necessity of sinking traps in specific locations before being caught in adjacent currents.

Minnow traps consisted of either 1/4 or 1/8 inch wire mesh and were 9 in. in diameter and 17 ½ in. long with two 1 in. entrances. Minnow Traps were connected to floats and/or anchored to shore or other immobile objects, depending on location and other environmental conditions.

In August trapping was conducted in a variety of areas and habitats. Trapping later in the year in the Lower Takatz Creek Study Area and its adjacent inflow tributaries (adjacent sub-areas) was focused in areas shown during snorkel surveys to support spawning.

***Rod and Reel Sampling***

No rod and reel sampling was conducted in 2011.

**Fish Capture Data Recording and Mapping**

All fish captured were measured for fork length to the nearest mm and were released immediately after recovery in the area of capture. No anesthetics were used during this study.

Location, catch, habitat descriptions, and the number of gear units (rod and reel and trap hours) for each gear type were recorded on trap catch forms. Location was also recorded on maps or aerial photographs as well as trap catch forms. Pictures taken at trap sights for later referrals were linked by photograph number to location and waypoint. Sample number, lengths, gear type, and trap number for captured fish were recorded by date and location. Other comments including but not limited to mortality status, scars, physical condition, evidence of sexual maturity (see below), etc. were also recorded.

Way points were downloaded using Expert GPS software and linked to photographs using the same software. Data were entered into an Excel spreadsheet in the office, and checked against the original maps and field forms. Catch per unit effort (CPUE) was determined using the means of ratios approach in order to examine possible factors effecting daily catch rates as well as the total ratio approach for the entire event (Neilsen and Johnson 1982). Length-frequency plots were developed for the various study areas and dates to examine size classes and develop baseline information.

All mortalities where examined for sexual maturity and beginning in late-August a sub-sample of fish was examined using methods adapted from Schwanke and Hubert, 2003. Later during spawning focused trapping all fish were examined for sexual maturity. To determine sexual maturity fish where examined for color, sex, reproductive products, ovipositor extension, kype, abdomen development, and abdomen hardness characteristics. Based on these characteristics, fish were determined to be immature, mature, or unknown. In addition mature fish were assigned to one of the four following sexual maturity categories: pre spawn, spawn, post spawn, or unknown. All fish with any indication of gravidity or any amount of viable gametes were labeled as mature. All characteristics as well as maturity category and sample number, where recorded on custom “dura paper” sheets.

To estimate length at maturity, lengths of pre-spawn, spawn and post-spawn fish were combined and noted as fish which had reached sexual maturity (mature/adult). As described above all mortalities were examined for mature or immature gametes and reproductive organs. Minimum length, maximum length and standard deviation of lengths were determined for both immature (juvenile) and mature fish for both sexes.

To estimate run timing, percentages of pre, post, and ripe fish where evaluated relative to the time periods in which they were seen in various habitat features. This data was then analyzed with snorkel surveys to confirm spawning activities, timing, and locations.

## HABITAT EVALUATION

### Substrate Composition

Substrate particle size distributions were calculated from at least 100 individual foot step samples per analysis taken along zig-zag transects **(**Bain 1995**,** Bevenger and King 1995,

Wolman 1954**).** All substrate composition samples were taken in confirmed spawning areas in Reach 1 Sub Reach 4 of the Lower Takatz Creek Study Area.

Substrate size categories were assigned using a modified Wentworth scale as described in the USFS Tier III sampling protocol (USFS 2001) using a USGS Gravelometer (US_SAH-97**)**. Substrate sampling took place on Sept 13th.

In areas where quantitative methods were not practical due to depth, velocity, or a small sample area, qualitative measurements were taken during snorkel surveys using the same wrist mounted scale described above.

**Temperature Monitoring**

Water temperature was measured in all basins using both continuous and grab-sample measurement techniques.

***Continuous Temperature Monitoring***

Continuous temperature monitoring was conducted using Optic StowAway temperature loggers (Model 3, Version 5) manufactured by Onset Computer Corporation. These loggers were capable of measuring and recording temperatures between -4 and +38°C.

In the Upper Takatz Creek, Takatz Lake and Sadie Lake Study Areas, continuous temperature monitoring was centered on lake outflow temperatures. In the Lower Takatz River study area, temperature loggers were placed in all sub-study areas and tributaries.

In the Baranof River Basin, temperature loggers were placed in all tributary inflows, the lower reaches of Upper Baranof River, the west end of Baranof Lake and in the Lower Baranof River.

In the Medvejie River Basin, loggers were placed in the Upper Medvjie River, near the outflow of Medvejie Lake, and in areas adjacent to the two water intakes for Medvejie Hatchery.

***Grab-Sample Temperature Measurement***

Grab sample temperature measurements were taken using Enviro-Safe Armor Case thermometers capable of reading temperatures between -5 and +50$^{o}$C. Grab sample measurements were taken in all areas where temperature loggers were emplaced (to test accuracy of the loggers) and in areas of interest in terms of fish life stage usage and the effects of tributary inflow and other variable factors.

## STUDY TIMEFRAME

Unless otherwise noted, all dates in this report refer to field work done in 2011. Survey timing and frequency varied by River Basin, depending on logistical access, objectives, and species

encountered. Surveys began in April in the May in the Baranof River Basin and ended in October in the Lower Takatz River Study Area.

**TAKATZ RIVER BASIN**

Surveys in the Takatz River Basin began in the Lower Takatz Creek Study Area Reaches 1 and 2 on June 16 and ended in the same areas on October 22.

**TAKATZ BAY ESTUARY**

Two Brackish water surveys were conducted on June 17 and July 16 during large minus tides.

**SMALL TAKATZ BAY DRAINAGES**

Salmon surveys were conducted in the Small Takatz Bay Drainages on August 30 for chum salmon and pink salmon.

**SADIE LAKE BASIN**

Field Studies in Sadie Lake Basin were limited to temperature monitoring in 2011.

**BARANOF RIVER BASIN**

Surveys in the Baranof River Drainage were focused on spring spawning of cutthroat trout in the Beaver Area and were observational in nature. Surveys took place on May 31 and June 3.

**MEDVEJIE RIVER BASIN**

Medvejie Lake and the Upper Medvejie River were snorkel sampled on July 22.

## RESULTS

(Unless otherwise noted, all dates referenced in this section refer to dates in 2011.)

**TAKATZ RIVER BASIN**

**Upper Takatz Creek**

***Observation Surveys***

No fish or signs of fish activity were observed in Upper Takatz Creek during 2 fish observation surveys on July 12 and September 9.

***Fish Captures***

During 2010 studies no fish where captured during 262 trap hours in this area. Therefore no fish capture techniques were proposed in Upper Takatz Creek for 2011.

**Takatz Lake**

***Observation Surveys***

Since during 2010 studies no fish where observed in this area, no fish observation techniques were proposed in Takatz Lake for 2011.

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***Fish Captures***

Due to logistics and timing conflicts gill netting was not conducted in 2011 in Takatz Lake as proposed. In 2010 no fish where captured in Takatz Lake during 568 trap hours.

**Lower Takatz Creek**

***Reach 3***

***Observation Surveys***

During 2010 studies no fish were observed during a foot survey from Reach 2 upstream on May 23 or during 4 foot surveys from Takatz Lake downstream to SM 1.84. Due to this and the unsuitable habitat contained in most of Reach 3 no observation techniques were proposed for this area in 2011.

***Fish Captures***

During 2010 studies no fish where captured during 67 trap hours in this area. Therefore no fish capture techniques were proposed in Reach 3 of Lower Takatz Creek for 2011.

***Reach 2***

Like in 2010, during 2011 surveys Dolly Varden were the only fish species present and were distributed throughout Reach 2 to the Upper Falls. Dolly Varden were also present in both the North Tributary and East Tributary inflows as well as the other smaller beaver and muskeg inflows in their respective flood plains. Fish distribution in the smaller beaver, muskeg, and East Tributary inflows was limited by the steep foot slope topography running to the base of the flood plain creating springs in locations.

In order better describe the Dolly Varden population found there in 2010, extensive surveys and captures were conducted in Reach 2 in 2011. As in 2010, all fish observed or captured in Reach 2 were Dolly Varden char, as described in the following:

***Observation Surveys***

**Index surveys** were conducted a total of 14 times at each site for a total of 42 surveys. During Index Surveys in July, an increase in activity and number of fish was observed particularly in mid- afternoon to early evening. 83 of the 88 sightings were in July and the 5 observations in August were of fish > 120mm. Foot surveys in August corresponded with this main stem decrease with increased utilization of smaller tributary channels such as the East Tributary inflow and outflows, Emergent Creek, and the Upper Falls Back Water inflow observed (see below).

**Table 1. Number of Dolly Varden observed at Index Areas by month.**

| Index Area | July | August | September | October |
|---|---|---|---|---|
| **1** | 34 | 2 | 0 | 0 |
| **2** | 9 | 3 | 0 | 0 |
| **3** | 40 | 0 | 0 | 0 |
| Totals | 83 | 5 | 0 | 0 |

**Foot Surveys** in Reach 2 were generally utilized in small FPO and POA type channels (USDA 2010) where due to depth and obstructions other methods were not possible (Figure 15). These surveys were used to determine the presence of fish in particular emergent and spawning fish.

Emergent (0+ age class) Dolly Varden were first observed during foot surveys on June 19 at Emergent Creek and three fish found there on June 21 and 22 were measured at 19 mm, 24 mm, and 28 mm respectively (Figure 16). During foot surveys in June emergent fish were also observed at the Lower Beaver Area, Upper Beaver Area, East Tributary pond inlets and outlet and Upper Falls Backwater inlet. In both the beaver areas shallow sedge grasses appeared to be particular important areas where innumerable amounts of 0+ plus fish were observed. Emergent fish where observed in all other Reach 2 areas during snorkel surveys (see below).

During foot surveys in August increased numbers of fish <120mm in length were observed in the East Tributary inflow and outflows, Emergent Creek, and the Upper Falls Back Water Inflow.

Also in August there was increased activity of larger fish in the East Tributary Pond at the vicinity of the inflow and outflows. A few spawning fish were first observed in the inflows of both the Upper Falls Backwater and East Tributary pond inflow in September and fish were still observed spawning here in October. In October we also observed the first fish spawning in Emergent Creek. Unfortunately due to overhead obstructions in most of the area in creeks we were unable to get a complete sample.

**Figure 15. Example of small channel class tributary with typical overhead obstructions.**


**Figure 16. 0+ age class (emergent fry) examined at Emergent Creek on June 22, 2011.**

**Snorkel surveys** were conducted on June 19-23, August 7 and 25, September 24-25, and October 21. All Reach 2 Sub-Areas were surveyed except for Oxbow Area after June due to a bear attack and other safety reasons. The Lower Beaver Area also was not surveyed during the September surveys due to weather induced time constraints.

A total of 12,913 Dolly Varden were observed throughout the field season with the Upper Beaver Area having the highest fish counts and relative abundances followed by the North Tributary and Lower Beaver Area (Figure 17).

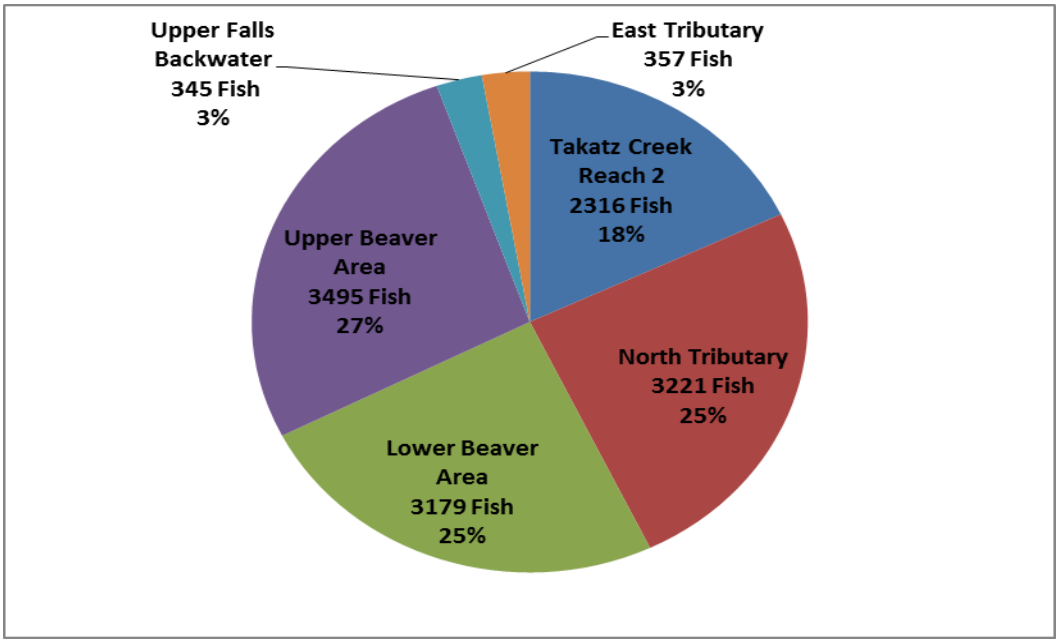


**Figure 17. Total Fish numbers observed and percent relative abundance in Lower Takatz Reach 2 and adjacent areas during all snorkel surveys.**

Based on 2011 sexual maturity studies (see below) and other snorkel and trapping data, fish observed during snorkel surveys in 2011 were broken down into two size class categories: fish< 80mm and those >80mm. Since sex was not readily apparent throughout much of the season and males tended be become sexually mature at a smaller size and slightly earlier in the year this ensured that all sexually mature fish were accounted for (see sexual maturity results below).

Throughout the year the majority of juveniles were observed in the Lower Beaver Area, and Upper Beaver Area which indicated their overall importance as juvenile rearing areas (Figure 18). Also throughout the season results for the relative abundance of fish observed in the various sub areas varied particularly in the case of adults in relation to the North Tributary and Reach 2 of Lower Takatz Creek which contained faster water habitats. This indicated movement of a portion of the population into and out of these faster water dominated habitats (see results below).

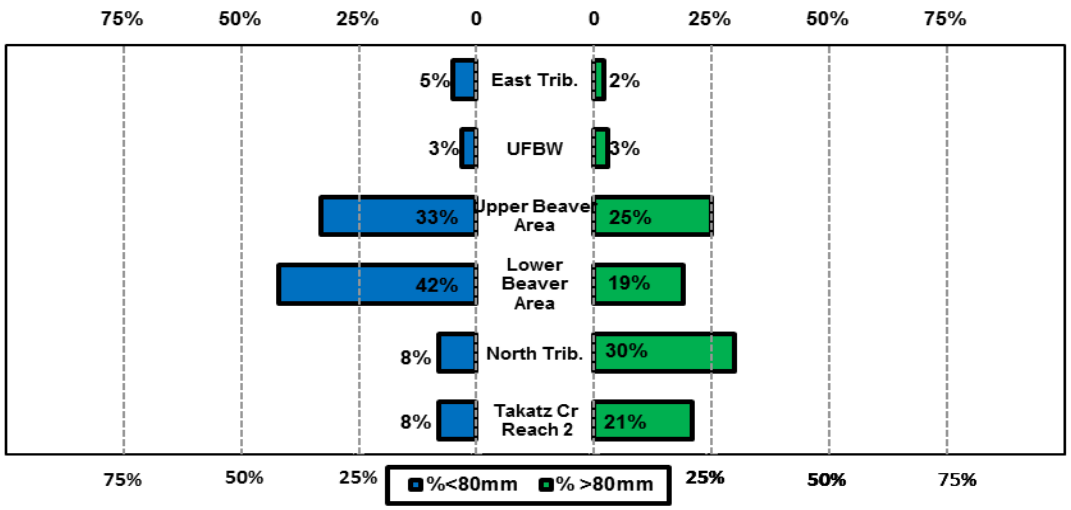


**Figure 18. Percent relative abundance of fish less 80 mm (left) and greater then 80 mm (right) during all snorkel surveys.**

During June surveys the majority of both juveniles and adults were observed in the Lower and Upper Beaver Areas and a relatively small amount of adults were observed in North Tributary and Takatz Creek (Figure 19). During snorkel surveys emergent fry <20mm- 35mm (0+) in length were observed in all sub areas except Lower Takatz Creek where emergent fish were not observed until August.

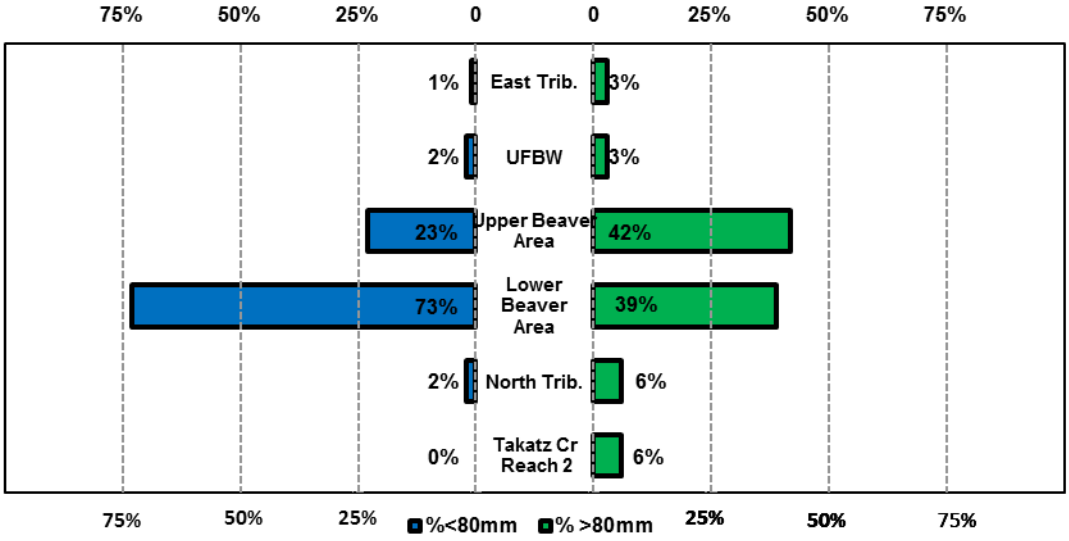


**Figure 19. Percent relative abundance of fish less than 80 mm (left) and greater than 80 mm (right) during June snorkel surveys.**

During August snorkel surveys there was an increase in observations of both juvenile and adult fish in fast water habitat dominated sub areas primarily the North Tributary and Takatz Creek.

Also in August increased feeding utilization by both juveniles and adults and adult spawning activity was first observed in the actual fast water micro habitats (ie. riffle, glide, run, and pool tailouts) within these larger areas. At the same time the Beaver Areas saw relative reductions in both juveniles and adults observed and the East Tributary saw a relative increase in juveniles observed (Figure 20).

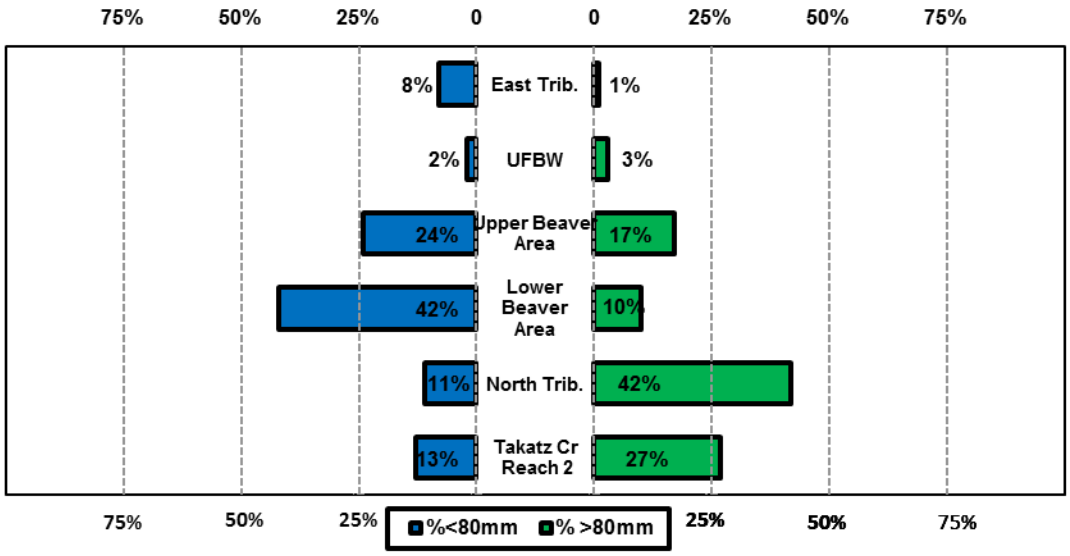


**Figure 20. Percent relative abundance of fish less than 80 mm (left and greater than 80mm (right) during August snorkel surveys.**

Spawning activity was witnessed in all sub areas, but in August the majority took place in the North Tributary followed by Takatz Creek. Spawning in the North Tributary was concentrated in a pool and tailouts just below the cascade (see Figure 21 below). Spawning in Takatz Creek was primarily concentrated in two areas: A confluence pool with the East Tributary (see Figure 14) and confluence pools with the two braids of the North Tributary. In addition to spawning fish there was an increase in juvenile fish which were observed holding or feeding close to the bottom in relation to spawning activities.

In Takatz Creek and the North Tributary spawning at all locations was observed where depth and velocity rose to create a transition point from sand to gravel substrates (2mm-32mm) with larger substrates (>32mm) nearby. In the Upper and Lower Beaver Area concentrated spawning was observed at spring inlets and beaver stream outlets. These later areas contained small amounts of small organic matter as well as the substrates mentioned above.

In September a decrease of both juveniles and adults in the North Tributary and Takatz Creek with subsequent increases in other areas particularly the Upper Beaver Area was observed. Unfortunately we were not able to sample the Lower Beaver Area to confirm the likely movement into that sub area. The remaining adults in the North Tributary and Takatz Creek were primarily found in the cascade pool and confluence pools described above in relation to spawning activities.

**Figure 21. Area of concentrated spawning in North Tributary with Cascade in background**.

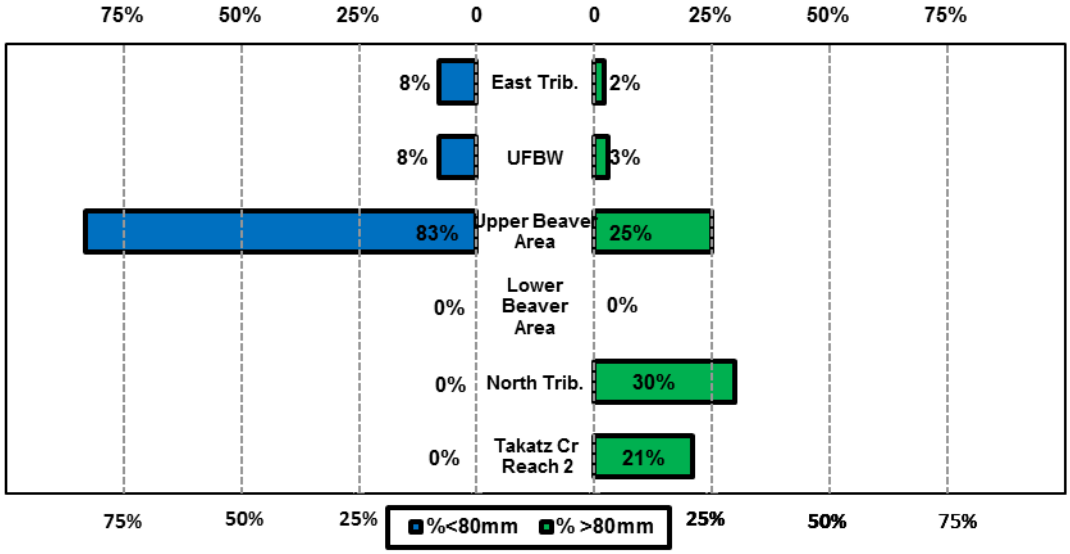


**Figure 22. Percent relative abudance of fish less than 80 mm (left) and greater the 80mm (right) during September snorkel surveys.**

Observed fish activity during October snorkel surveys was largely confined to the Upper and Lower Beaver Areas and in particular the pond areas located within these areas. No spawning was observed in Takatz Creek or the North Tributary. The Upper Beaver Area spring pond still

contained spawning fish in substrates similar to those observed during foot surveys in Emergent Creek, the East Tributary Inflow, and the Upper Falls Back Water inflow during foot surveys (Figure 23).

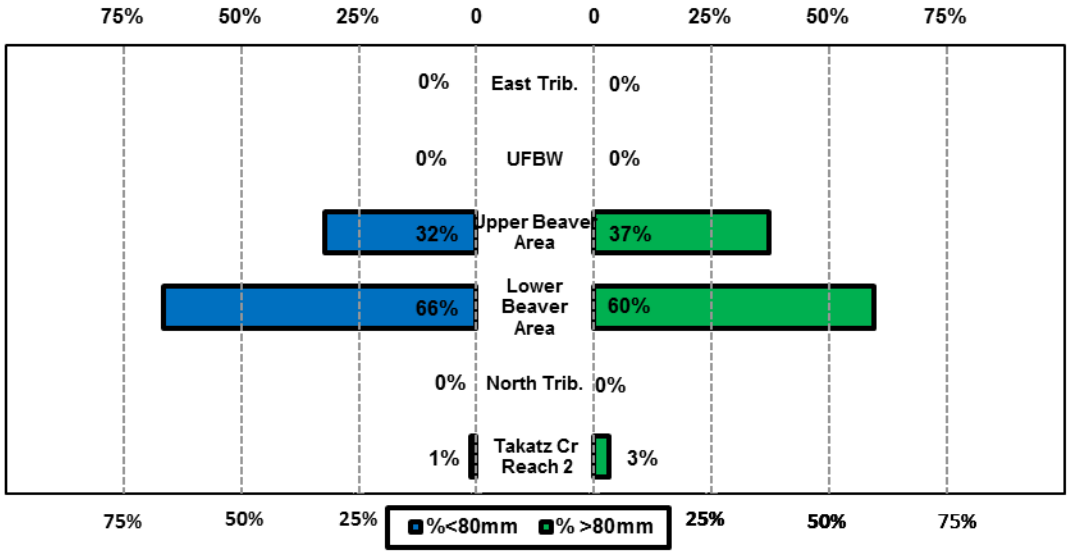


**Figure 23. Percent relative abundance of fish less than 80mm (left) and greater than 80mm (right) during October snorkel surveys.**

Observation surveys indicated primary use in Takatz Creek and the North Tributary beginning in June and culminating in late summer and early fall with spawning activities. Emergent fry and spawning were observed in all sub-areas, with the smaller spring and alluvial fan fed small channel tributaries having a later spawn periodicity extending into October. Emergent fry were apparent by mid-June with the largest concentrations occurring in flooded sedge portions of the Beaver Areas. Fish appeared to be moving out of winter habitats in June and in Takatz Creek were concentrated in high quality habitats. By August fish had either moved into areas where spawn was occurring or in the case of some juveniles into spring fed, pond and beaver habitats. By September the majority of the adults observed were spawning or had indications of previous spawning such as worn caudal fins and no juveniles were observed in Takatz Creek or the North Tributary. Juveniles that were observed in September were in the Beaver Areas or appeared to be in the process of moving into other spring areas and the East Tributary Pond. In October almost all of the fish appeared to have moved into winter habitats or were observed spawning in small spring fed tributaries that were also adjacent to probable wintering areas.

## ***Fish Captures***

As with the 2011 observation data, trapping data in 2011 indicated an August dispersal of a portion of the population with a predominance of juveniles in the Beaver Areas. Also as with the observation data both juveniles and adults were evident in all areas and spawning fish were captured in all the areas that we were able to sample. Sexual Maturity data indicated that spawning timing was slightly earlier in Takatz Creek and the North Tributary, males matured at a

shorter fork length then females, and there was some overlap in adult versus juvenile sizes for both sexes.

During August Trapping hoop trap CPUE's were highest in the Upper Falls Back Water and in Reach 2 of Lower Takatz (Table 2). The maximum hoop trap CPUE's both took place in or near confluence pools. During the same period minnow traps were more consistent with only the East and North Tributaries having CPUE's of less than one fish per hour (Table 3).

**Table 2. Lower Takatz Reach 2 and adjacent sub area inflow tributaries hoop trap CPUE and catch by area and date in August 2011.**

| Reach/Inflow | Sub Reach | Date Set | # of Traps | Total Catch | AVG CPUE | Max CPUE | Min CPUE |
|---|---|---|---|---|---|---|---|
| Lower Takatz Creek Reach 2 | 2 | 8/8-9 | 2 | 219 | 2.99 | 6.67 | 0.61 |
| | 3 | 8/9-11 | 12 | 366 | 1.60 | 4.73 | 0.26 |
| | 4 | 8/28 | 4 | 396 | 5.10 | 14.73 | 0.44 |
| | 5 | 8/28 | 2 | 42 | 0.97 | 1.29 | 0.65 |
| North Tributary | NT2 | 8/29 | 4 | 73 | 0.84 | 1.56 | 0.20 |
| East Tributary | ET (pond) | 8/8 | 1 | 17 | 0.59 | 0.59 | 0.59 |
| Lower Beaver Area | LBA1 | 8/26 | 4 | 245 | 2.40 | 4.23 | 1.91 |
| Upper Beaver Area | UBA | 8/27 | 2 | 83 | 1.66 | 2.96 | 0.37 |
| Upper Falls Backwater | UFBW | 8/29 | 1 | 178 | 10.26 | 10.26 | 10.26 |

**Table 3. Lower Takatz Creek Reach 2 and adjacent sub area inflow tributaries minnow trap CPUE and catch by area and date August 2011.**

| Reach/Inflow | Sub Reach | Date Set | # of Traps | Total Catch | AVG CPUE | Max CPUE | Min CPUE |
|---|---|---|---|---|---|---|---|
| Lower Takatz Creek Reach 2 | 2 | 8/8-9 | 6 | 114 | 1.02 | 1.69 | 0.66 |
| | 3 | 8/9-11 | 24 | 608 | 1.31 | 2.98 | 0.00 |
| | 4 | 8/28 | 5 | 137 | 1.46 | 2.04 | 0.55 |
| | 5 | 8/28 | 4 | 149 | 1.71 | 3.78 | 0.59 |
| North Tributary | NT2 | 8/29 | 6 | 106 | 0.88 | 1.56 | 0.00 |
| East Tributary | ET | 8/8 | 4 | 15 | 0.13 | 0.24 | 0.00 |
| Lower Beaver Area | LBA1 | 8/26 | 5 | 116 | 1.20 | 2.33 | 0.05 |
| Upper Beaver Area | UBA | 8/27 | 5 | 166 | 1.29 | 2.87 | 0.36 |
| Upper Falls Backwater | UFBW | 8/29 | 4 | 84 | 1.19 | 3.78 | 0.00 |

CPUES's of fish <80mm in length were highest in the Lower Beaver and Upper Beaver Areas in August indicating preferred juvenile use in these habitat areas even during the summer months. CPUE's of fish >80mm in length were less highest in sub reach 4 of Lower Takatz Creek due to high catches in the vicinity of the lower North Tributary confluence pool mentioned above in the snorkel section. Likewise other catches rates in the >80mm classes were influenced by their

proximity to spawning areas with the lowest rate of 0.83 in the North Tributary likely due to the inability to set traps in spawning areas (Table 4).

**Table 4. Lower Takatz Reach 2 and adjacent sub area inflow tributaries CPUE by juvenile (<80mm) and adult >80mm size classes .**

| Reach/Inflow | Sub Reach | Date Set | # of Traps | AVG CPUE <80mm | AVG CPUE >80mm |
|---|---|---|---|---|---|
| Lower Takatz Creek Reach 2 | 2 | 8-Aug | 8 | 0.24 | 1.40 |
| | 3 | 9-Aug | 35 | 0.17 | 1.20 |
| | 4 | 28-Aug | 10 | 0.30 | 2.77 |
| | 5 | 28-Aug | 6 | 0.18 | 1.28 |
| North Tributary | 5 | 29-Aug | 10 | 0.03 | 0.83 |
| East Tributary | 2 | 8-Aug | 5 | 0.10 | 0.12 |
| Lower Beaver Area | 3 | 26-Aug | 9 | 0.44 | 1.62 |
| Upper Beaver Area | 4 | 27-Aug | 7 | 0.40 | 0.99 |
| Upper Falls Backwater | 5 | 29-Aug | 5 | 0.35 | 2.66 |

**Table 5. 2011 Lower Takatz Creek reach 2 and adjcent sub area inflow tributaries hoop and minnow trap fork length statistics by area.**

| Reach/Inflow | Sub Reach | Mean FL (mm) | Min FL (mm) | Max FL (mm) | StDev FL (mm) | N= |
|---|---|---|---|---|---|---|
| Reach 2 Main Creek | 2 | 115.20 | 57 | 228 | 33.92 | 352 |
| | 3 | 106.10 | 39 | 233 | 25.43 | 920 |
| | 4 | 110.28 | 56 | 200 | 24.83 | 587 |
| | 5 | 113.10 | 61 | 183 | 25.35 | 191 |
| North Tributary | 5 | 112.58 | 63 | 171 | 19.53 | 244 |
| East Tributary | 2 | 124.42 | 39 | 200 | 38.46 | 109 |
| Lower Beaver Area | 3 | 101.06 | 62 | 176 | 20.24 | 361 |
| Upper Beaver Area | 4 | 91.67 | 54 | 203 | 19.00 | 249 |
| Upper Falls Back Water | 5 | 115.42 | 60 | 185 | 27.98 | 270 |
| Totals | | 107.94 | 39 | 233 | 26.88 | 3298 |

Fork lengths ranged from 39mm to 233mm and the range was fairly consistent in all areas (see Table 5, Figure 24). This indicated some dispersal in August of all size classes into summer habitat during which 95% of the captures took place. Lengths of 85 mm to 125 mm dominated the overall data. The smallest mean fork lengths were in the Lower Beaver Area and Upper Beaver Area (91.67 mm 101.06 mm respectively) due to the larger numbers on juveniles that

remained in these areas (see Table 5, Figure 24). Unlike 2010 fork lengths were also consistent among trap types.

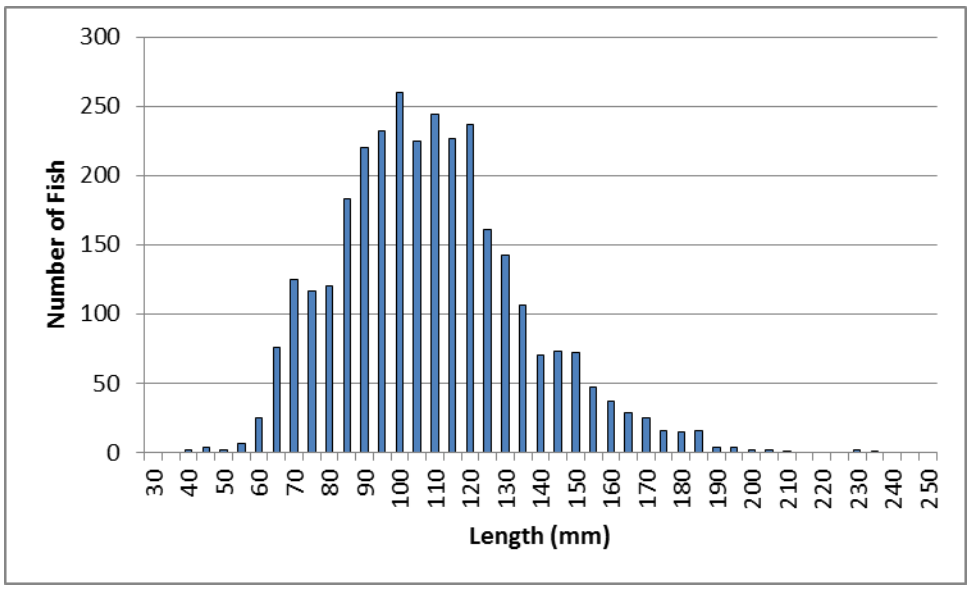


**Figure 24. Lower Takatz Creek Study Area length frequencies pooled for all sub- areas and dates.**

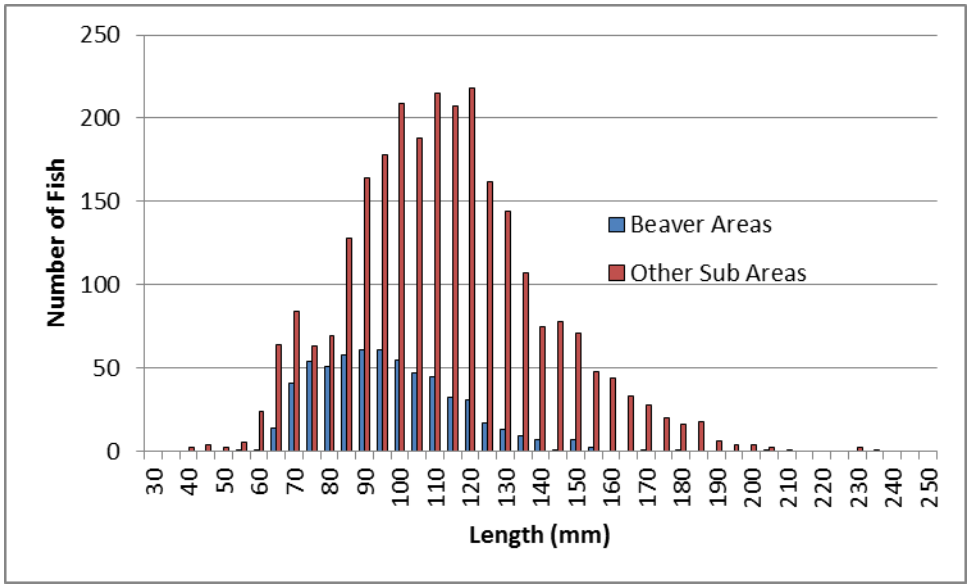


**Figure 25. Comparison of pooled Upper and Lower Beaver Area length frequencies to other sub areas captured in August 2011.**

A total of 364 fish ranging in size from 62mm to 233mm were sampled for **sexual maturity**. Of these fish 13 were unintended mortalities that were dissected and examined for signs of gravidity and 11 of these became the basis for known juvenile (immature) lengths. Another 22 fish showed

indications of immaturity and none of gravidity and where determined to be immature unknown. Seventeen fish (nine female and 8 male) showed signs of sex and maturity but ripeness could not be determined. There were 159 fish that sex, maturity or ripeness could not be determined and were discarded from the sample (Table 6).

**Table 6. Number of fish by sexual maturity category.**

| Sex | Sexual Maturity | | | | | Totals |
|---|---|---|---|---|---|---|
| | Immature | Pre-spawn | Spawn | Post-Spawn | Unknown | |
| **Female** | 8 | 27 | 28 | 24 | 9 | 96 |
| **Male** | 3 | 7 | 45 | 21 | 8 | 84 |
| **Unknown** | 22 | n.a. | n.a | n.a. | 159 | 184 |
| **Grand Total** | 33 | 34 | 73 | 45 | 176 | 364 |

Males matured at a shorter length and overall mature females tended to be longer in length. The shortest sexually mature male was 85mm and the longest was 189 mm, and the smallest mature female sampled was 110mm and the largest was 223 (Table 7, Figure 26). The was some overlap between mature and immature fish with both sexes with the longest juvenile male sampled 100mm in length and the longest juvenile female was 118 mm in length (Table 7, Figure 26). Egg sizes ranged from 2-4 mm in size, and averaged 3 mm in size. Although though there was some correlation to fork length and egg size there were some spawning females close to the median and mean mature fork lengths that had eggs at either end of the range.

**Table 7. Length statistics (mm) of adult and juvenile fish by sex.**

| Length Statistics (mm) | Mature/Adult | | Immature/Juvenile | |
|---|---|---|---|---|
| | Male | Female | Male | Female |
| **Minimum** | 85 | 110 | 75 | 71 |
| **Maximum** | 189 | 233 | 100 | 118 |
| **Stdev.** | 22.72 | 24.48 | 10.60 | 17.58 |
| **Median** | 125 | 141 | 87.5 | 102.5 |
| **Mean** | 128.18 | 147.30 | 87.50 | 97.38 |

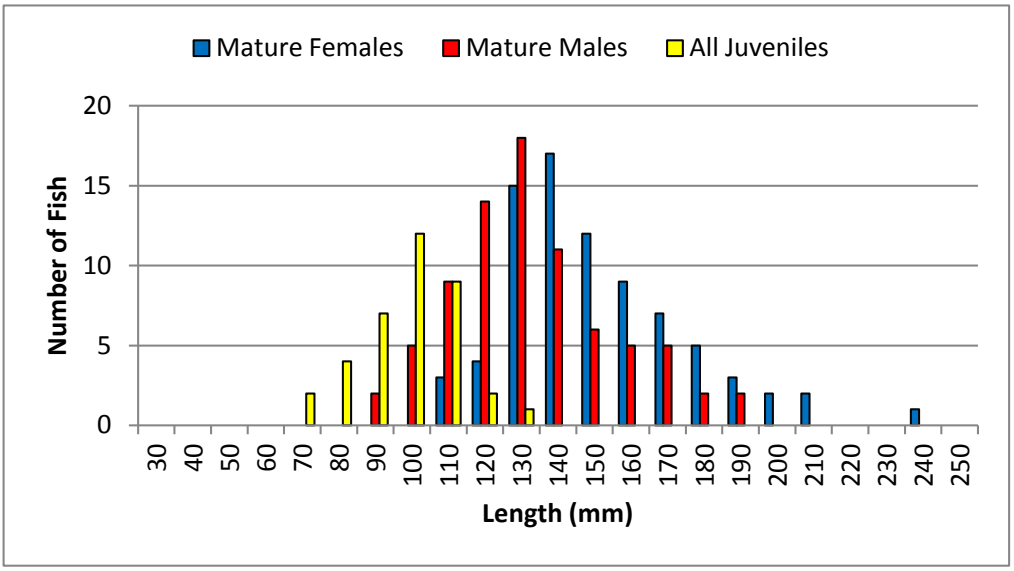


**Figure 26. Comparison of adult/mature lenght frequencies to all juvenile length frequecies.**

The first female with free eggs was captured on August 10 in Takatz Creek. Male to female composition ratios varied between August and September sample periods and to a lesser extent between sub-areas. During August there were a higher percentage of males in all sub- areas except for the Lower Beaver Area and Upper Falls Backwater (Figure 27). By Late September the ratios had essentially reversed with only the North Tributary having a lower female to male ratio and the Upper Falls Back Water having an equal composition (Figure 28). The North Tributary and Upper Falls Backwater composition abnormality's in the normal ratio of a greater percentage of males early in the run and then females later in the run are likely due to our inability to set traps adjacent to spawning areas. Based on male to female composition ratios spawning in most sub-areas, in particular Lower Takatz Creek and North Tributary, begins in August and is beginning to wind down by late-September.

As with male to female composition ratios, percent ripeness composition varied between August and September sample periods and to a lesser extent between sub-areas. Pre-spawn females and spawning males dominated the samples in August (Figure 27). Takatz Creek and the Lower Beaver Area contained the few post-spawn fish. Like the male to female composition discussed above, only the North Tributary and Upper Falls Backwater showed any abnormalities. This is likely due to no known females being captured in the former while the later contained a lower composition of pre-spawn females.

In late-September post-spawn fish dominated the known samples in Takatz Creek and in particular the North Tributary indicating that spawning in these areas was winding down. The East Tributary contained close to equal percentages of pre-spawning to spawning females, a slightly smaller percentage of spawning males, and a slightly larger percentage of post-spawn males suggesting that spawning was peaking. Likewise the equal percentage of male to female

spawn in the Upper Falls Backwater suggests that spawning was peaking in this sub-area (Figure 28).

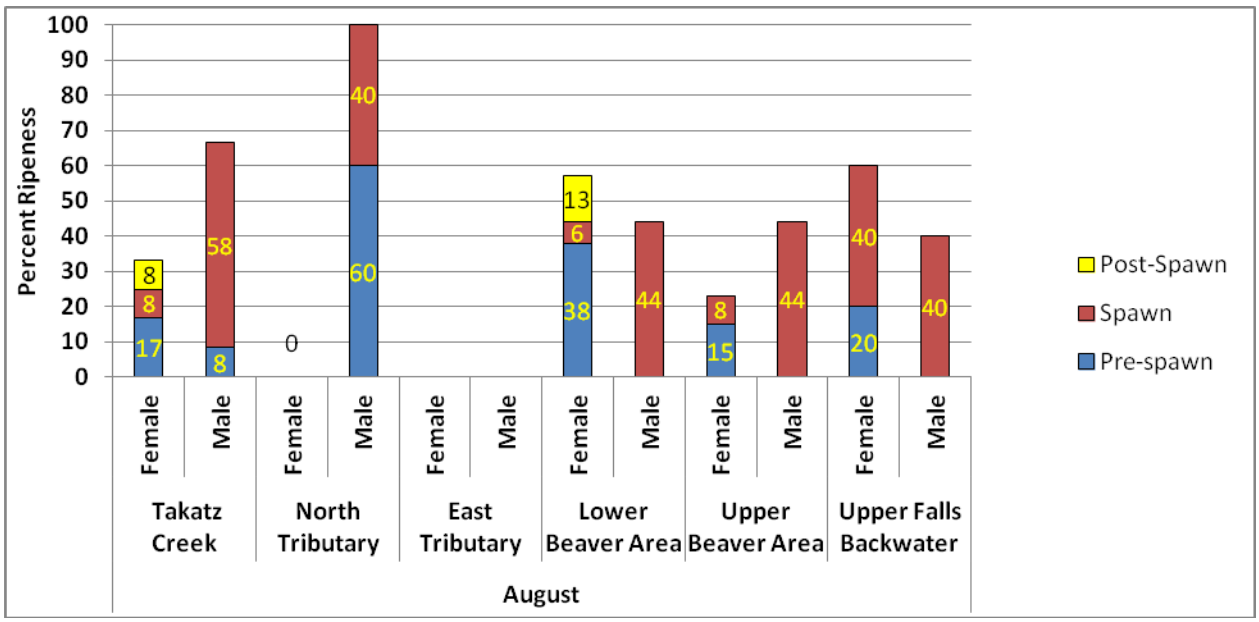


**Figure 27. Percent ripeness of known mature fish by sub area during August sexual maturity sampling.**

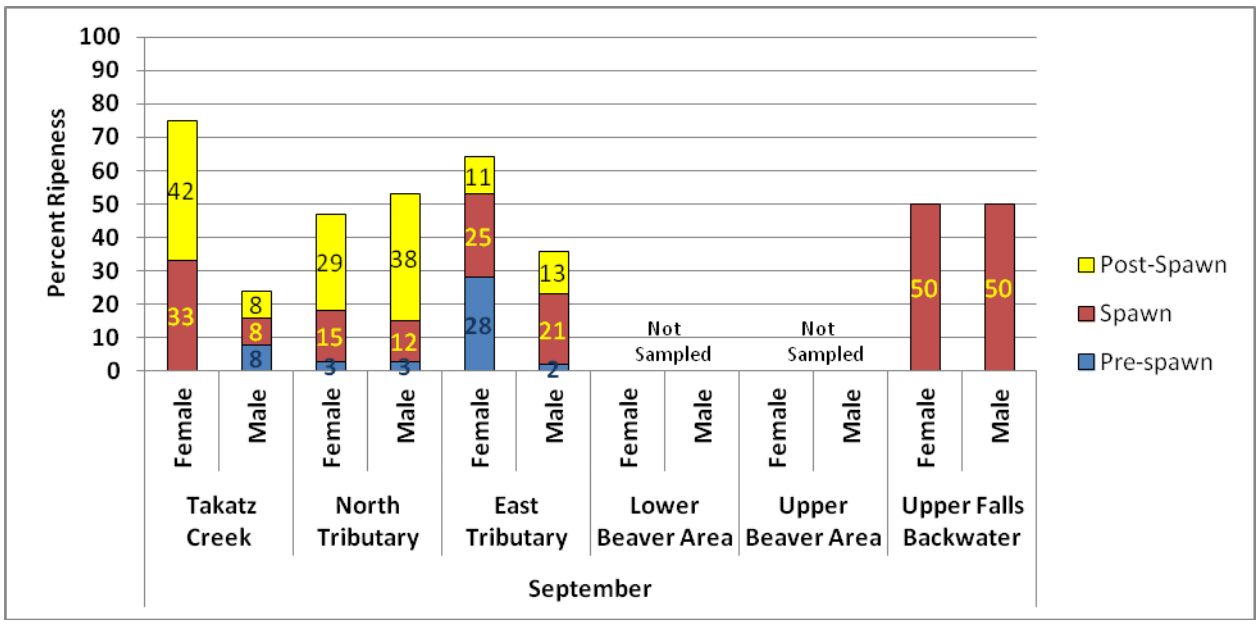


**Figure 28. Percent ripeness of known mature fish by sub area during September sexual maturity sampling.**

***Reach 1***

***Observation Surveys***

Reach One Surveys in 2011 focused on adult the adult life stages of chum and pink salmon.

Adult Dolly Varden were routinely observed to feed on salmon eggs. One adult sockeye salmon (*Oncorhychus nerka*) was evident on August 12 and one adult coho salmon (*Oncorhychus kisutch*) was observed on August 27.

As in 2010 other incidental observations included miscellaneous sculpin (*Cottidea sp.)* and gunnel (*Pholis sp.)* species as well as the occasional starry flounder (*Platichthys stellatus*) at high tides.

Small schools of adult chum salmon and large schools of chum salmon fry were milling in the bay and in the vicinity of Reach One as early as June 16. These fish were moving in and out with the tide and adult chum salmon were first recorded in Reach 1 on July 16th (Figure 29, Figure 31). Chum salmon numbers peaked on July 26th with 542 fish observed (Figure 29). The last viable chum salmon were observed on September 13th.

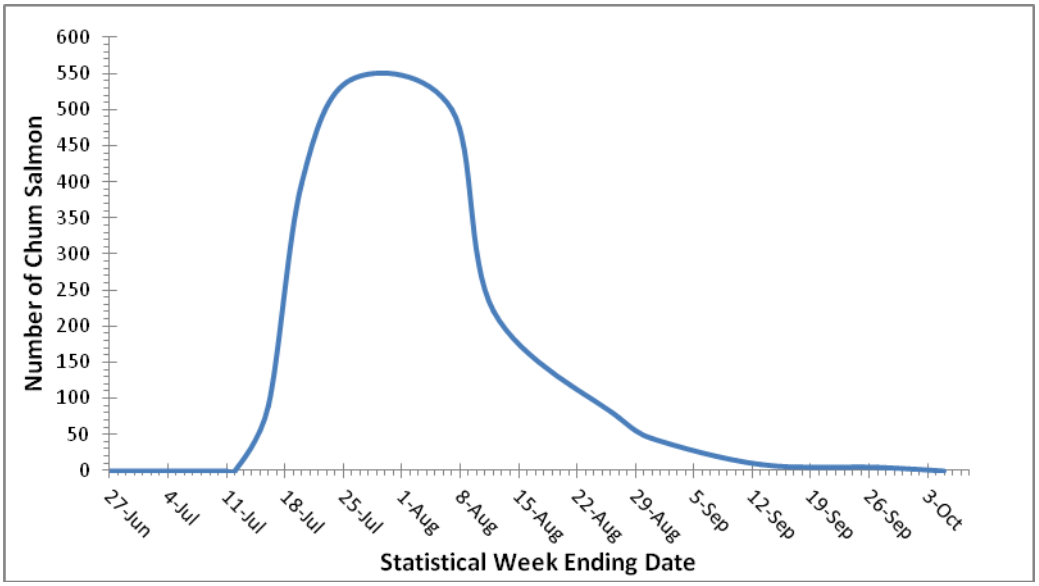


**Figure 29. Number of adult chum observed in 2011 organized by statistical week ending date.**

An influx of **pink salmon** was observed on July 20th with 146 bright fish observed holding. The number of pinks peaked on September 13th with 1633 observed and then decreased rapidly to 177 fish observed on September 27th (Figure 30).

Overall the primary salmon runs were observed from the last week of July to thru September in 2011 (Figure 31).

As in 2011, chum and pink activity and spawning was concentrated in Sub-Reach 4 of Reach 1 (Table 8, Table 9, See Figure 3).

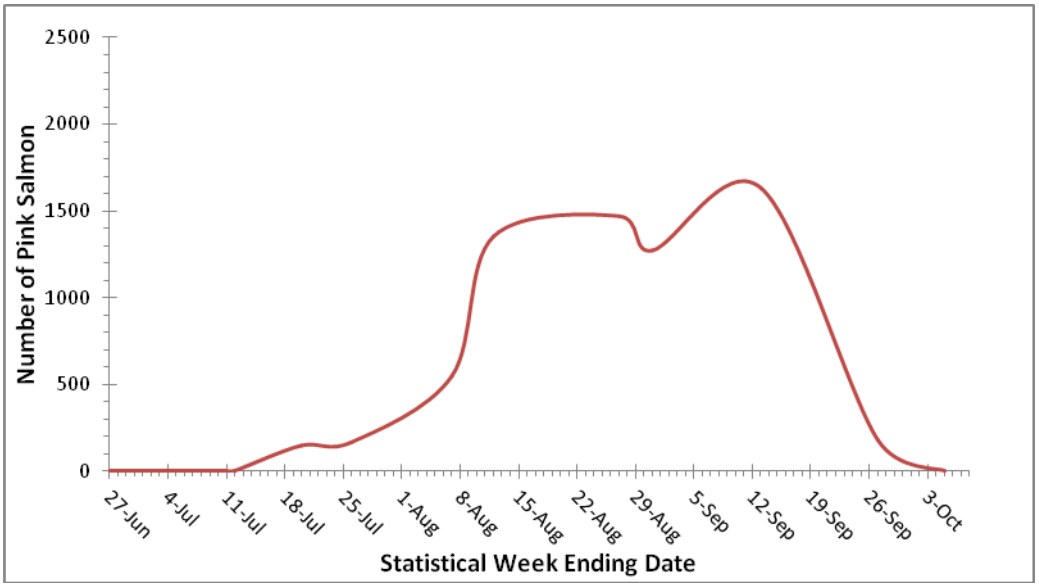


**Figure 30. Number of adult pinks observed in 2011 organized by statistical week ending date.**

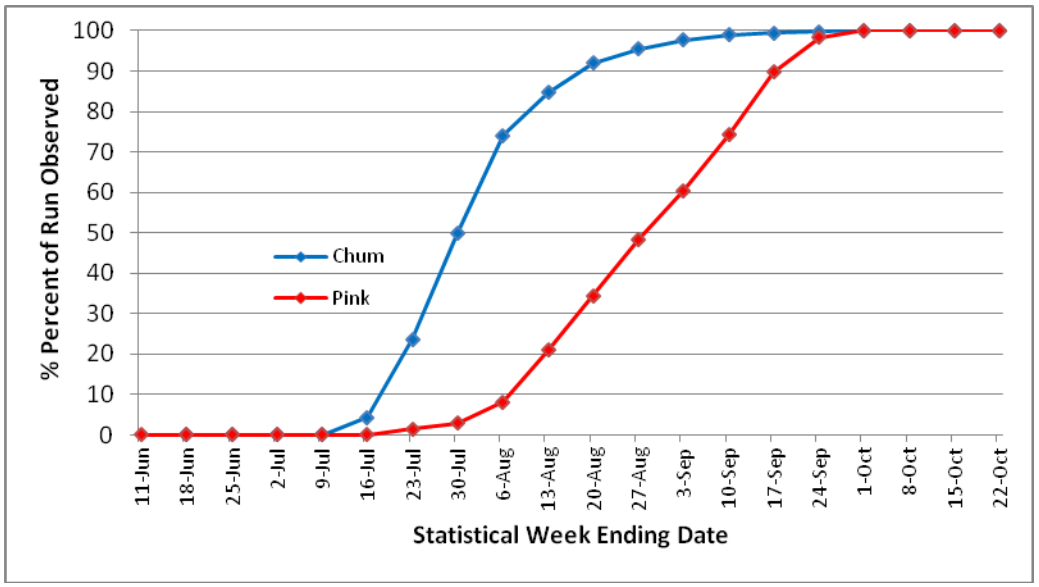


**Figure 31. Cumulative percent of pink and chum runs by average count observed during statistical week.**

**Table 8. Percent of adult chum salmon observed in reach 1 by sub-reach and activity.**

| Sub-Reach | % All Activities[1] | % Spawn Only | % Holding | % Actively Migrating |
|---|---|---|---|---|
| **1** | 0.00 | 0.00 | 0.00 | 0.00 |
| **2** | 1.11 | 0.00 | 2.41 | 7.21 |
| **3** | 6.58 | 0.16 | 10.01 | 61.26 |
| **4** | 92.30 | 99.84 | 87.57 | 31.53 |
| **5** | 0.00 | 0.00 | 0.00 | 0.00 |

[1] Includes counts of Spawning, Holding, Actively Migrating and all combinations thereof.

[2] Spawn/Other contains counts when a complete distinction couldn't be made between spawning and other activities for a count.

**Table 9. Percent of adult pink salmon observed in Reach 1 by-sub reach and activity.**

| Sub-Reach | % All Activities[1] | % Spawn Only | % Holding | % Actively Migrating |
|---|---|---|---|---|
| **1** | 0.00 | 0.00 | 0.00 | 0.00 |
| **2** | 4.60 | 0.99 | 4.52 | 8.42 |
| **3** | 8.25 | 3.64 | 5.05 | 18.63 |
| **4** | 87.15 | 95.36 | 90.43 | 72.95 |
| **5** | 0.00 | 0.00 | 0.00 | 0.00 |

[1] Includes counts of Spawning, Holding, Actively Migrating and all combinations thereof.

[2] Spawn/Other contains counts when a complete distinction couldn't be made between spawning and other activities for a count.

***Fish Captures***

No fish captures were conducted in Reach 1 during the 2011 field season.

***Habitat Evaluation***

Three separate foot step substrate samples were conducted on September 13 in areas of concentrated spawning in Reach 1-4. Although percentages of particle sizes varied slightly, during all sampling medium gravels to coarse gravels (11-64 mm) dominated the samples and median particle sizes ranged from to 19.0 to 22.6 mm (Table 9, Figure 19).

**Table 10. Particle size percentile points by transect and combined.**

| Date | Particle Size Statistics in (mm) | | | | | |
|---|---|---|---|---|---|---|
| | $D_{16}$ | $D_{35}$ | $D_{50}$ | $D_{65}$ | $D_{84}$ | $D_{95}$ |
| **Sample 1** | 10.1 | 15.7 | 22.6 | 29.8 | 42.9 | 59.5 |
| **Sample 2** | 11.1 | 14.5 | 19.0 | 25.6 | 37.7 | 54.8 |
| **Sample 3** | 10.2 | 16.9 | 22.6 | 27.0 | 36.6 | 52.6 |
| **Combined** | 10.4 | 15.4 | 21.2 | 27.2 | 39.4 | 55.8 |

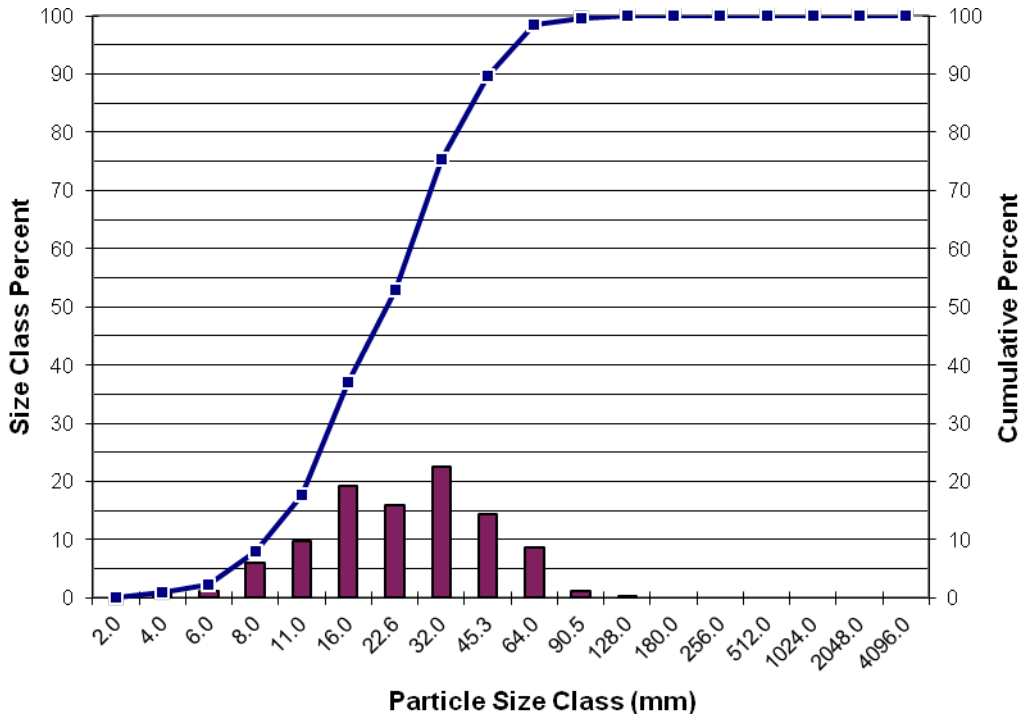


**Figure 32. Particle size class percent (bar graph) and cumulative frequency percent of zig-zag transects taken over concentrated spawning areas in Reach 1-4.**

## TAKATZ BAY ESTUARY

### ***Observation Surveys***

Two brackish water snorkel surveys were conducted on June 17 and July 16 during large minus tides when intertidal species were concentrated along a narrow band at SM 0.0. A total of ten fish species and dungeness crab *(Metacarcin magister)* were observed (Appendix 1). Of note during these surveys were the large concentrations of juvenile Pacific herring *(clupea pallasii)* and Pacific sandlance *(Ammodytes hexapterus)* and the lack of eelgrass habitats and thus species assemblages specific to that habitat.

### ***Fish Captures***

No capture techniques were utilized during 2011 field studies in Takatz Bay Estuary.

## SMALL TAKATZ BAY DRAINAGES

### *Observation Surveys*

The Small Takatz Bay Drainages were typically short with upstream fish passage limited by steep terrain just upstream from the high tide line (see Figure 8). Takatz Bay Drainages except Island Creek were sampled on August 30. Chum salmon counts in all inflow tributaries ranged from 0 to 5 fish.

Pink salmon counts varied from 0 to 25 with the greatest number observed in Powerhouse Creek (Table 11). The second greatest numbers of pink salmon were seen in Cruise Boat Creek with 17 fish.

**Table 11. Chum and pink salmon counts at Small takatz Bay Drainages on August 30, 2011.**

| Tributary | Chum | Pink |
|---|---|---|
| **Cripple Creek** | 5 | 0 |
| **Powerhouse Creek** | 3 | 25 |
| **Cruise Boat Creek** | 0 | 17 |
| **South Shore Falls** | 0 | 0 |
| **East Muskeg Creek** | 0 | 7 |
| **Island Creek (formerly Unnamed Creek)** | Not Surveyed | Not Surveyed |

### *Fish Captures*

No capture techniques were utilized during 2011 surveys in the Small Takatz Bay Drainages.

## SADIE LAKE BASIN

Work on the Sadie Lake Drainage was limited to temperature monitoring in 2011 at locations at the main inlet and outlet. These locations were based on foot surveys performed on May 31 2010, and August 20 and 21, 2010 as well as personal communications with people familiar with the drainage. Cutthroat trout are known to populate the lake (Figure 33), and in particular the main inlet at the Northwest head on the lake (Figure 34), and outlet (Figure 35). Fish are also reported from the outlet to saltwater. A smaller inlet is located at the northeast end of the lake and spawning habitat there appears to be confined to a small delta.

### *Observation Surveys*

No observation surveys were performed in 2011. During both foot surveys in 2010, cutthroat were observed in the submerged log piles near the outlet (Figure 22), rising at various locations thorough the lake, as well as in the vicinity of a beaver lodge near the main inlet (Figure 21).

Although no spawning activities were observed, the main northwest inlet and the small delta at the northeast inlet appear to contain suitable spawning habitat. Due to its steep and confined nature, the lower outlet populations are most likely due to a cascade down effect from the lake population.

***Fish Captures***

No fish captures were conducted in Sadie Lake Basin in the 2011 field season

**Figure 33. Sadie Lake looking north from vicinity of outlet.**

**Figure 34. Main Inlet at the northwest head of Sadie Lake with beaver lodge located at the center of the frame.**

**Figure 35. Entrance to the outlet of Sadie Lake.**

## BARANOF LAKE BASIN

Foot surveys were conducted on May 31 and June 3 in the Upper Baranof Study Area Beaver Area and its inflows (see Figure 11, see Figure 12) in order to better describe to spawning utilization and timing there.

### ***Observation Surveys***

During foots surveys on May 31, 2011 cutthroat trout were observed spawning in the Beaver Area and on June 3, 2011 cutthroat trout were observed spawning in the upper west inflows to the Beaver Area.

### ***Capture Techniques***

No capture techniques were conducted in 2011 in the Baranof Study Area

**Figure 36. Cuthrouat trout spawning in the west (upper) end of the Beaver Area on June 3, 2011.**

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## MEDVJIE RIVER BASIN

### *Upper Medvejie River*

Dolly Varden were the only species encountered during surveys in the Upper Medvejie River and were observed from its confluence with Medvejie Lake to a point about .31 miles upstream just downstream of a small cascade (Figure 37).

**Figure 37. Small cascade just upstream of the last Dolly Varden observed in the Upper Medvejie River**.

#### ***Observation Surveys***

During a snorkel survey on July 22, a total of 36 Dolly Varden were observed. Six of these Dolly Varden ranged from 60-100mm in length, and the other 30 were young of the year (0+).

#### ***Fish Captures***

No fish capture techniques were utilized in the Upper Medvejie River during 2011 studies.

### *Medvejie Lake*

#### ***Observation Surveys***

During observation surveys on July 22 a total of 250 young of the year Dolly Varden were observed in shallow water along the east margins of the lake.

***Fish Captures***

No fish capture techniques were utilized in Medvejie Lake during 2011 studies.

***Lower Medvejie River***

***Observation Techniques***

No observation techniques were utilized in the Lower Medvejie River during 2011 studies.

***Fish Captures***

No capture techniques were conducted in Lower Medvejie River.

## DISSCUSSION

### TAKATZ BASIN

Fish distribution in the Takatz Basin and its inflow tributaries is limited by its geo morphology which has created barriers to fish passage. The most significant in-stream barriers are the "Lower Falls" and "Upper Falls" which appear to be barriers to anadromous and resident fish populations respectively. Above the Upper Falls, Reach 3 is a series of water walls, cascades, and rapids in a high gradient and highly contained channel. The two exceptions to this are a small lake basin (Lower Takatz Lake) from about SM 2.40 to SM 2.60, and a short section extending .06 miles downstream from the Takatz Lake outlet at the top of Reach 3.

As in 2010 **Reach 2 of the Lower Takatz Study Area, its Inflow Tributaries, and adjacent aquatic habitat areas** contained only Dolly Varden. The absence of coho salmon fry suggests that the Dolly Varden sampled are part of an above barrier isolated "resident" population(s). These isolated resident populations have been well documented in Southeast Alaska (Ihnlenfeldt 2005; Armstrong and Morrow 1980, Hastings 2005, Schmidt and Robards 1976, Blacket 1973). Barrier isolated populations were created when prehistoric geologic conditions such as ice, terminal moraines, and/or ocean levels made streams accessible to anadromous Dolly Varden populations (Hastings 2005). As anadromous access was discontinued with changing conditions these isolated populations created resident forms which have been further divided into stream-resident form and stream-lake resident forms (Armstrong and Morrow 1980). Data taken during the 2010 field season suggested that we had both resident forms with seasonal movements and habitat usage. In order to get look into this studies in 2011 focused on determining habitat usage by sub area and size class as well as periodicity.

Emergent fry were observed in all sub areas in mid-June with the shallow sedge areas of the Upper and Lower Beaver areas having the largest concentrations. These areas along with the East Tributary Pond appear to be important rearing areas for both juvenile and adult fish. In mid-June some Dolly Varden appeared to be moving out of these rearing areas and concentrating in high quality pool habitat in Takatz Creek and the North Tributary. By August fish had either moved into areas where spawn was occurring or in the case of some juveniles into spring fed tributaries, pond and beaver habitats. Spawning was observed in all sub areas with the largest concentrations at the North Tributary just below the cascade followed by areas just below several confluence pools in Lower Takatz Creek Reach 2 (two with the North Tributary and one with the East Tributary). By September we observed few juveniles in Takatz Creek and North Tributary, the majority of the adults we did observe were spawning or showed indications such as worn caudal fins that they had spawned, and juveniles had moved into Beaver Areas or were in the process of moving into other spring or pond areas. In October almost all of the fish had moved into winter habitats or were observed spawning in small spring fed tributaries that were also adjacent to probable wintering areas.

Our mean lengths of 128mm for mature males and 141mm for mature females are closer to that of lake-resident forms. Studying the stream-resident form nearby in Falls Creek on Admiralty Island Blackett (1973) found that the females there matured at age three and four with an average length of 114mm (range 91-207mm). Schmidt and Robards (1976) studied the stream-lake resident form at Osprey Lake on Baranof Island and found that most of the fish were four years old and averaged 157mm in length with the oldest 8 years and 217 mm in length. The relatively long length of Dolly Varden in Reach 2 is likely due to their utilization of high quality winter habitat in the form of the East Tributary pond, the Beaver Areas, and small spring fed inflows such as Emergent Creek and the Upper Falls Backwater.

Dolly Varden data from the 2011 field season in Reach 2 and adjacent inflow areas suggest a complex life history. Many adults and some juveniles have a seasonal habitat movement out winter rearing areas beginning in mid- June, into faster water habitats in the North Tributary and Takatz Creek and then back again in October after spawning. Spawning in these faster water areas began in late-August and ended by late October while spawning in other the other sub areas was still taking place.

In **Reach One** chum and pink salmon were the primary species encountered during both the 2010 and 2011 field seasons.

Like in 2010 **Chum Salmon** in Reach One of Lower Takatz Creek began entering the creek in mid to late July 2011 with a peak count in August and counts declining after that. This run timing is similar to both the adjacent terminal harvest area (THA) and the stocks in Kelp Bay just to the north from which the THA stock is derived. Like those stocks Lower Takatz Creek run timing was likely about one statistical week late for 2010. In 2011 Takatz Creek cumulative returns started close to the 2010 returns but overall were closer to average returns overall in timing (NSRAA 2011). In both years escapement was more than sufficient to ensure natural reproduction. On average approximately 40,000,000 million chum fry are reared and released Takatz Bay each year contributing to a major seine fishery. At this time it is unknown what

percentage of the chum observed in Takatz Creek are from the nearby rearing facility and what percentage are from either naturalized stock or stock native to the stream. Whatever the source of the stock spawning area was mainly limited to a small area and escapement returns are strong enough to support the current population spawning there. Upstream of this area the strong current (during most tide levels) and subsequent larger substrate make the upstream area less suitable for spawning. Downstream, unlike pink salmon, chum salmon are less likely to spawn in lower intertidal areas (Salo 1991).

**Pink Salmon** in Reach One began entering in late July with a peak count during the second week in September. Pink counts began to decline rapidly after the second week in September and no pink salmon were observed on October 3. This run timing is consistent with other nearby "middle timing" runs as described by Sheridan (1962). Like chum salmon, pink salmon spawning was largely concentrated in one area. Pink salmon are known to spawn lower in the intertidal zone then chum salmon. One possible reason for the concentration of pink salmon spawning is the relatively low peak number pinks which allowed their use of only preferred habitat.

**Habitat Evaluation** in Reach One consisted of three separate zig-zag foot step surveys with each survey containing greater then equal to 100 substrate measurements. The domination of medium gravels 11-64mm in all the samples is indicative of very high quality spawning substrate. As in 2010 there was a lack of smaller substrate samples particularly fines. A study in Glacier Bay with a similar delta just below fast water also had a small percentage of particle size classes <11mm with most of theirs in that range consisting of glacial silt (Shipley 2010). Rukholv (1969) found that the percentage of small substrate sizes (<2 mm) was lower in redds then in stream bed samples. Like 2010, in 2011 Reach 1-4 spawning and redd distribution was bank to bank during the low tide at which the samples were taken. Our tight grouping of particle sizes is probably due to both factors.

As in 2010 the higher medians ($D_{50}$) of 22.6 are close to the median size preferred by chum salmon while the 19.0 ranges between those preferred by pink and chum salmon (Kondolf and Wolman 1993). The use of his area by both species suggests that other factors are also involved selection of this area by both species.

Chum salmon tend to prefer sites with upwelling spring water (Heard 1991). Prior to redding activities large portions of Reach 1-4 were covered in sea hair *(Enteromorpha sp.)* which is known to prefer freshwater seeps in the mid to upper tidal zone. It is likely that this area contains upwelling freshwater at its uppermost point either from a pool located directly above or possibly sub-surface spring flows. It is likely that pink salmon utilize prefer this area due to the above factor and to their relatively small numbers compared to other drainages. Because of these factors they likely do not occupy less desirable spawning areas.

## TAKATZ BAY ESTUARY

Due to its lack of other habitats, particularly eelgrass, the species assemblage was limited to those adaptable to the sand substrates found there. The large amounts of juvenile herring and Pacifc sandlance may be due to the vicinity of the Takatz Bay net rearing facility. The researcher has observed schools of juvenile herring attracted to similar southeast net rearing aquaculture facilities.

## SMALL TAKATZ BAY DRAINAGES

Takatz Bay Inflow Drainages consisted of six small drainages. Two of these, Cripple Creek and Power House Creek, entered Reach One (intertidal area) of Lower Takatz Creek at the upper and lower tidal zones respectively. The other four are located along the south shore of Takatz Bay at all tide levels.

In all of the tributaries both chum and pink salmon counts were low due to the small amount of available habitat. Power House Creek contained the largest overall counts with counts including fish that could possibly have been holding just upstream of it confluence of Lower Takatz Creek until water or tide levels allowed easier upstream access in the main creek. Power House Creek counts were still relatively small and spawning habitat was limited to the upper intertidal due to low flows and areas of fine sediment in lower sections.

## SADIE LAKE BASIN

Sadie Lake contains a naturalized population of cutthroat trout that are generally regarded to have originated from Baranof Lake stock planted by a non-agency entity. The Northwest Inlet (main) and its confluence appeared to contain the majority of suitable spawning habitat while both this area and the outlet area appeared to be important rearing areas. In-stream habitat in the North East Inlet was limited by steep topography to a small delta, but it likely contributed some nutrient input as well as limited spawning habitat. Fish downstream of the outlet are likely due to a cascade down effect and upstream mobility is limited by steep topography.

## BARANOF BASIN

Baranof Lake is considered a “high use” cutthroat trout lake by the Alaska Department of Fish game (Bangs 2008) and contains only that species. As such it has been one of the most intensively studied lakes in South East Alaska (Bangs 2008, Harding *et.al* 2009**).** The abundance of cutthroat trout in Baranof Lake was estimated for a ten year period from 1994 and 2003 with estimates ranging from 5616 to 12,511 and an average of estimate of 8,235 (SD=1980) of fish greater than or equal to 180 mm.

Finding larger fish in shallower depths particularly near the west inlets, Der Hovanisian and Marshall (1994) concluded that spawning was likely underway while sampling May 27-29 and June 10- 12, 1993. During foot surveys in 2010 0+ juveniles were observed in nearby adjacent areas, and spawning was observed in the Upper Baranof River and in inflows to the Beaver Area. In 2011 spawning was observed in the Beaver Area on May 31 and concentrated spawning was observed at the upper inflows to the Beaver Area on June 3, 2011. It is likely that much of the

cutthroat trout spawning in the Baranof Basin takes place at the west end inlets over a period of time as upstream areas become suitable with warming temperatures.

## MEDVEJIE RIVER BASIN

For anadromous stocks fish timing and distribution in the Lower Medvejie River is influenced by barrier nets and hatchery weirs near tidewater and a series of cascades upstream. These upstream cascades correspond to the current ADF&G limits of anadromous distribution (ADF&G, 2009a, ADF&G, 2009b). During much of the year the area from just below the outlet of Medevjie Lake to the vicinity of the hatchery is reduced to subsurface flow due to low lake levels. We found Dolly Varden from the outlet of Medvejie Lake upstream about .31 miles to a series of short cascades.

**Observation Surveys** on October 8, 2010 we observed 17 Dolly Varden in the Upper Medvejie River, 2 fish in the main body of Medvejie Lake, and 15 Dolly Varden just below the lake outlet, indicating that most of spawning likely took place in the Upper Medvejie River, and the outlet. With some of the fish beginning to show signs of sexual maturity during trapping in late September 2010 it was likely that Dolly Varden spawning took place from September through October. With the large amounts of emergent fry we saw during snorkel surveys in the Upper Medvejie River and the East End of the lake on July 22, 2011 it reinforced that most of the spawning took place in the Upper Medvejie River.

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# APPENDICES

## Appendix A. Species and number observed by species during Takatz Bay brackish water snorkel surveys.

| | **Pacific Herring** *(Clupea pallasii )* | **Pacific Sandlance** *(Ammodytes hexapterus)* | **Surf Perches** *(Embiotocidae sp.)* | **Dungeness Crab (***Metacarcinus magister)* | **Cresent Gunnel** *(Pholis laeta )* | **Saddle Back Gunnel** *(Pholis ornata )* | **Sculpin** *(Cottoidea sp.)* | **Starry Flounder** *(Platichthys stellatus)* | **Sand Dab** *(Citharichtys sp.)* | **Dolly Varden** *(Salvelinus malma)* | **Tube Snout** *(Aulorhychus flavidust)* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **6/17** | 1550 | 550 | 72 | 35 | 101 | 173 | 8 | 0 | 0 | 0 | 24 |
| **7/16** | 73000 | 26750 | 2 | 56 | 122 | 131 | 25 | 1 | 1 | 10 | 3 |