Reinstallation of Slamgeesh Lake Smolt Trap

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Alicia Hooper
Allen Gottesfeld

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Gitksan Watershed Authorities
PO Box 166 Hazelton, BC V0J 1Y0
Ph: (250) 842-2213 Fax: (250) 842-2253

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ABSTRACT

Slamgeesh Lake is a small and productive sockeye and coho producing lake in an undeveloped part of the upper Skeena Watershed. We constructed a novel light-weight fyke trap for collection of spring smolts leaving Slamgeesh immediately after ice melt. The trap design is described and drawings presented. The first year of use of the fyke traps has past. The trap fishes at all stages including spring ice break up and floods. Small but adequate samples of sockeye smolts were collected in 2010 and 2011 and population estimates made. The traps caught nearly 10,000 coho smolts in 2010 which were marked with coded wire tags to establish marine survival and ocean capture rates in Southeast Alaska fisheries.

INTRODUCTION

Background

The Slamgeesh Salmon Project has been a focus of the Gitksan Watershed Authorities' (GWA) wild salmon research for the past eleven years. The Slamgeesh Lake field station was established in 2000 with the goal of becoming a long-term full index site for sockeye and coho in the upper Skeena Watershed. Part of this sampling involved enumerating and tagging coho and sockeye smolts from 2002 to 2005. During these years a fyke trap of varying design and a 2x2m inclined plane trap (IPT) were used to collect juveniles and a sufficient numbers were marked to obtain survival data. Smolt trapping was not attempted in 2006 and 2007 because of budget constraints. Meanwhile, channel changes in the lower tributaries in 2006 and 2007 eliminated the possibility of fishing an IPT.

The adult counting weir at Slamgeesh was rebuilt in 2007 with a permanent concrete foundation and modular aluminum structure that was able to be alternatively used as a smolt fence in the spring. In 2008 a weir was constructed with perforated aluminum panels and three inclined plane fan traps recycled from fry trap use at Fulton River (Babine Lake). The traps fished for two weeks before the rapid rise of the snowmelt flood removed them damaging the concrete footings. It was apparent that the structure of the weir was too weak to support the three fan traps which required backing up Slamgeesh Lake by one meter for sufficient flow depth. The concrete foundation was reinforced upon reinstallation for the 2008 adult project season.

In 2009 a lighter 1.8 m wide mesh fyke trap was adapted and mounted to the adult weir foundation and fished throughout the coho and sockeye smolt runs. Smolt captures numbers in 2009 were high for sockeye but barely adequate for coho. It was apparent that modifications to the juvenile trap mechanism would be needed. Increased efficiency in trapping of juvenile coho was needed so that sufficient coded wire tags could be applied to obtain marine survival and exploitation rates for this upriver population.

In 2010 we built a second fyke trap with the support of a Pacific Salmon Commission Northern Fund grant. We adapted the 2009 trap to a more efficient design and built a second trap unit. This report describes the new velocity-based fyke trap design and records the efficiency of the first year of use.

The Fyke Trap Design

The Slamgeesh fyke trap (Figures 1-3) is a rigid funnel shaped device of angle iron covered with stainless steel hardware cloth. The upstream end was adjusted to fit between two trusses of the adult trap structure and rest on the concrete foundation. The principal framework is of 1"x 1/8 " angle stock , the secondary framework of ¾ x 1/8" and ½ x 1/8" stock. It has two internal fykes. The fyke walls divide the trap into compartments. The compartments are accessed for cleaning by hinged doors: on the side for the upstream compartment, and on the top for the downstream compartment. The first fyke has an entrance of 6 ft. (1.8m) width and a square aperture of 6" (15cm). It has walls of ½" hardware cloth that serve as a barrier to fish passage and greatly decrease the flow. The consequence of this is that the flow in concentrated at the fyke and may be adjusted to be steady at over 0.8m/sec and thus provide a velocity barrier to smolt passage back upstream. The second compartment and fyke are covered with 3/8" hardware cloth to prevent the smallest smolts from gilling on the mesh.

The second fyke passes into a reducer that has a 6" pipe opening. A flexible 6" conduit brings the smolts to a live box 4 to 7 m downstream. The live boxes are fabricated with aluminum sheeting and perforated plate, approximately 72" long, 30" high and 30" wide with 2 access lids. Both are fitted with pontoon floats and a steel rod frame driven into the stream behind each box stops horizontal movement (Figure 8).

The trap entrance is flanked by one or more 1m wide perforated panels that act as guides into the trap. At low stages the eastern trap is connected to the shore by three panels (Figure XX). The upstream 2 feet of the trap has a solid 20 gauge steel floor to permit cleaning of the upstream portion of the first fyke. The trap can be fished at a wide range of flows and velocities in part by making adjustments with aluminum panels on the bottom of the compartments below the fyke cones and the lower 6" of the sides to increase the flow and velocity at low water stages. Panels may be placed in the bottom of the upstream fyke to increase velocity at the first fyke aperture and retain smolts. At high water stages some of the liners may be removed to spill more water from the device and the amount of guide panels decreased.

The trap has been fished at all stages included several floods with stages nearly a meter above low flow. Maintaining sufficient flow at extreme low stage such as in April before ice melt on the lake upstream may require blocking the lower 15 cm of the weir structure to back up the lake and provide more hydraulic head at the trap.

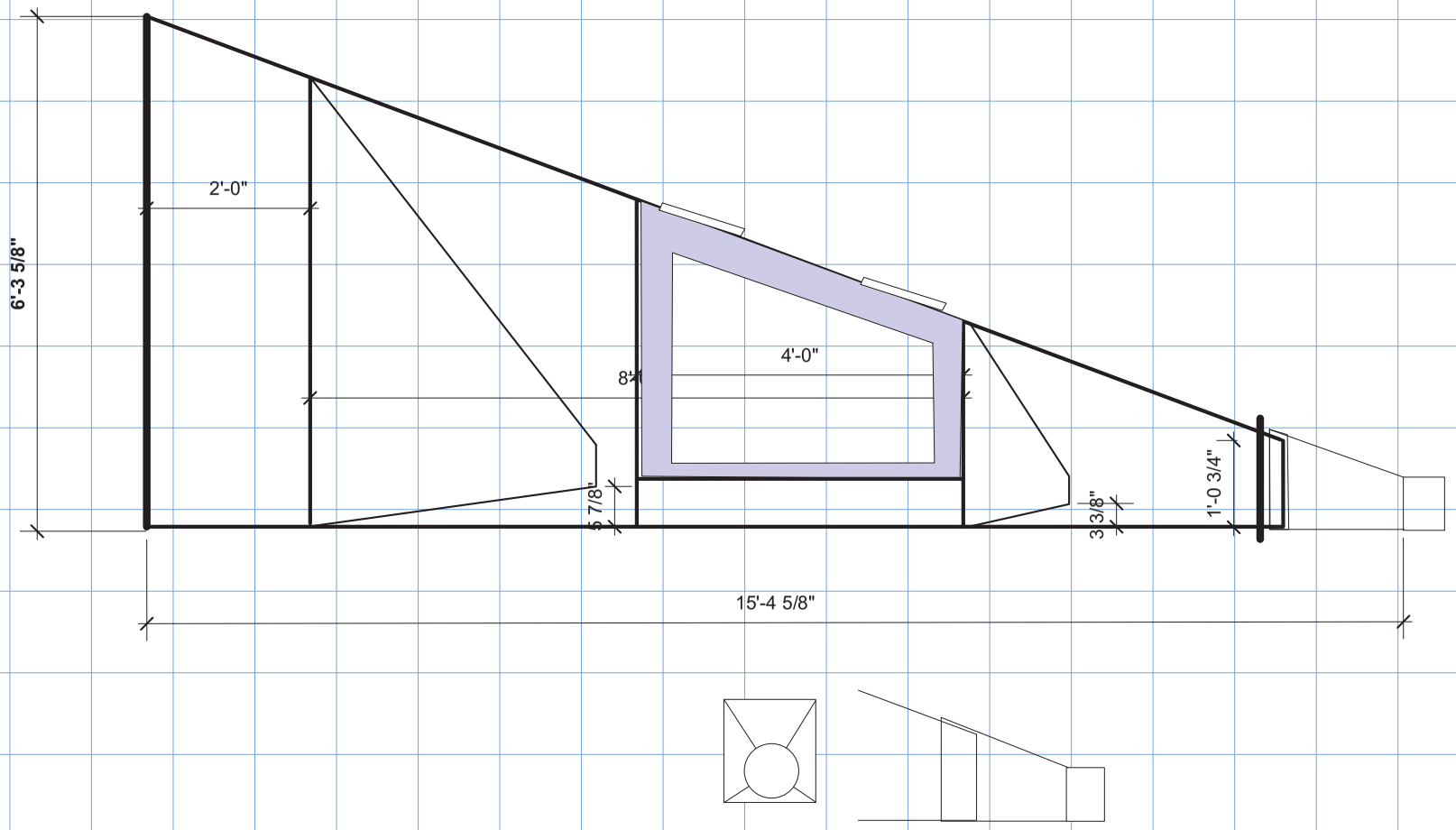
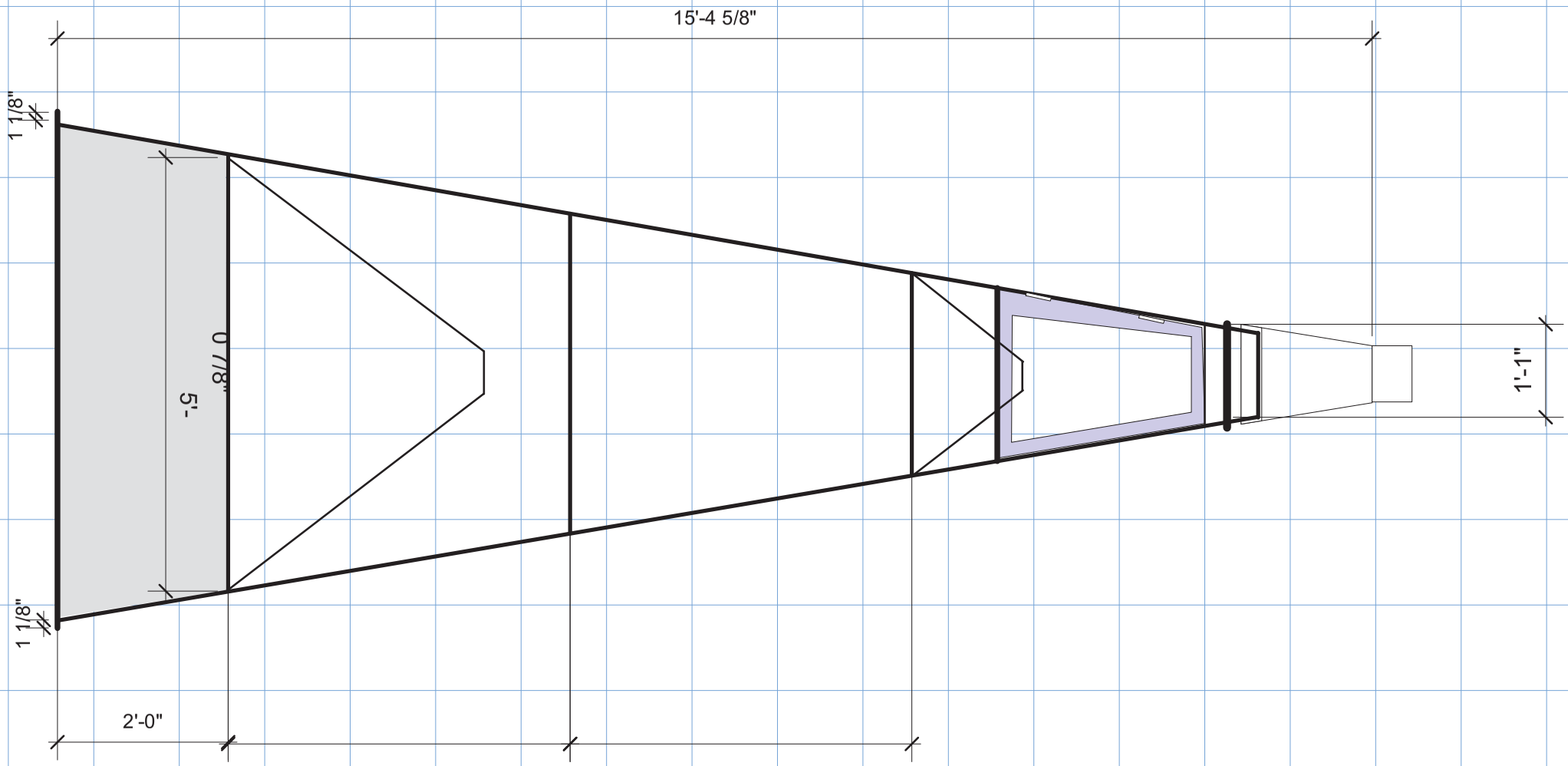


Figure 1. Lateral View of Slamgeesh 2010 Fyke Trap

TOP VIEW



1" angle iron 1/8" edges
The rest of solid stuff galvanized 14 ga.

Figure 2. Top View of Slamgeesh 2010 Fyke Trap

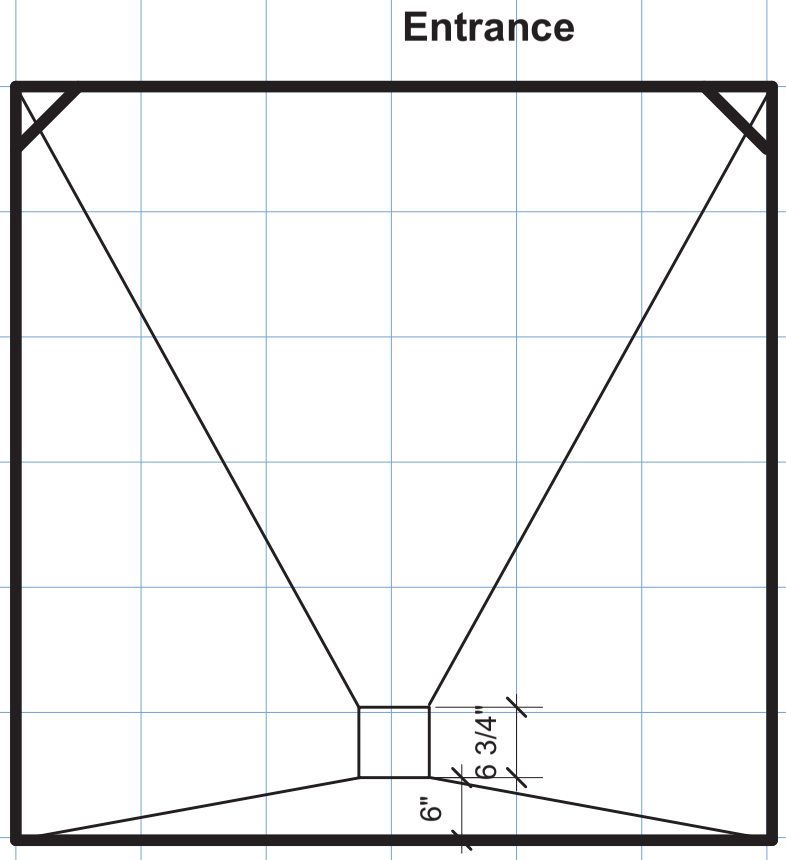


Figure 3. Entrance of Slamgeesh 2010 Fyke Trap

Figure 4. Fabrication of mesh covering to fyke frame of smolt trap #2. The trap bottom is to the left (half covered.

Figure 5. View downstream of newly constructed fyke trap (#2) opening and adjacent perforated panels from the bank left pier.

Figure 6. Smolt fyke traps and outlets leading to floating live boxes which are secured by steel rods (newly constructed trap #2 in foreground).

The fykes act as velocity traps. When smolts enter the trap they cannot leave it because the velocity at the fyke openings exceeds their peak swimming speed. Ultimately the smolts explore the downstream end of the trap and accumulate in the live box. It is critical to keep the upstream fyke outlet to the trap clean to maintain the water velocity. As larger fish such as bull trout can enter and leave the trap, a screen with 5 cm openings was inserted in the fyke entrance to exclude predatory fish and mammals such as mink.

To minimize weeds and ice blocking the trap entrance, a 3 m long steel fence with 5 cm mesh panels was installed approximately 10 m above the trap (Figure 6). Debris was removed daily by detaching the three sectional mesh frames. Basic log weed catchers were also anchored to shore along the lake outlet further up stream.

Initially we had a problem with small numbers of smolts dying while trying to move back upstream out of the trap along the trap walls and getting tangled along the attachment seam of the fykes. We eliminated this problem with a minor change in design for the second trap to eliminate the space and by filling the space in the first trap with triangular section inserts. With these changes trapping mortalities was reduced to 0.2 %.

Figure 7. Steel welded frame weed catcher upstream of smolt trap location.

Custom fabricated stainless steel screw jacks were mounted to each side of the trap outflow end to stabilize the trap at the desired height. The jacks are bolted to cement block bases with a hinged attachment. The second trap was moved with a basic jack instead on one side. Trap outflow ends were also supported underneath with sandbags.

A highline cable system permits the easy movement of the trap from a storage shed to the fishing position and removal for maintenance. Difficult trap modifications that were required after installation were made possible with the highline system. Using the highline, three staff are needed for trap installations and two for removal. Installation takes less than one day: removal only a few hours.

OPERATIONS

2010 and 2011 Smolt Trapping

Slamgeesh smolt trapping was successful in providing population estimates for 2010 sockeye with a single trap and 2011 sockeye with two traps. Coho were sampled with both traps in both years. The estimated percentage of the smolt population that the trap captured (trap efficiency) is calculated using mark-recapture experiments. In 2010 the reinstalled fyke trap captured an estimated 4.4% of the sockeye smolt run (n=654). In 2011 two fyke were used for sockeye smolt enumeration. The joint efficiency of the two traps was 5.78%. The second trap was installed during the early part of the coho smolt outmigration in 2010. The overall capture of coho was 9,947 individuals, approximately 13.2% of the run. The greatly improved coho capture rates enabled sufficient marking to provide marine survival rates when adults return and to provide a coded-wire marked cohort for recovery in Southeast Alaska fisheries..

Sockeye Smolt Mark/Recapture Population Estimates

A total of 574 sockeye smolts were marked and released upstream of the traps in the spring of 2010. The fyke trap recaptured 25 of these fish. A total of 519 sockeye were marked and released in 2011. The two fyke traps jointly caught 30 of the marked fish.

The 2010 mark-recapture population estimate was 30,245 sockeye smolts with a 95% confidence interval of ±5238 (Table 13). The preliminary population estimate for 2011 is 9,544 ±3122.

Table 1. **Sockeye smolt mark/recapture summary 2010 and 2011.**

Year	Caught	Marked	Recaptured	Trap Efficiency	Population Estimate	95% C.I.
2010	645	574	25	4.35%	14,485	9,247 – 19,722
2011	568	519	30	5.78%	9,544	6,422 – 12,665

Note: mark/recapture calculations for population estimate (Seber, 1982). 2011 data are preliminary up covering the interval of 3 May to 11 June.

Coho Smolt Mark/Recapture Population Estimates

Two mark-recapture experiments were carried out in 2010: early and late in the smolt run. There was a one week hiatus in release of marked coho before the second mark-recapture experiment commenced on June 4th. The second fyke trap was installed before the beginning of the second experiment. During the second experiment trap efficiency increased by nearly three-fold. The combined stratified Petersen population estimate for 2010 is 60,776 coho smolts with a 95% confidence interval of ±8,435 (Table 4). A similar experimental design was carried out in 2011 but the experiments are still underway at the time of preparation of this report.

Table 2. Coho smolt mark/recapture summary 2010.

M/R Experiment		Caught	Marked	Recaps	Population Estimate	95% C.I.	Trap Efficiency
1	(Trap 1 only) April 28-June 3	1125	317	22	15,567	9,625 – 21,510	6.94%
2	(Trap 1 & 2) June 4 – July 11	8,822	4,667	910	45,208	42,715 – 47,701	19.50%
Combined Stratified M/R Estimates					60,776	52,340 – 69,211	Avg. 13.22 %

Note: mark-recapture calculations for population estimate (Seber, 1982)

Improved trapping of coho smolts enabled coded wire tagging and marking (adipose fin clipped) of 9,947 coho smolts. Marked returns in 2012 and 2013 will confirm smolt trap capture rates and be valuable in determining overall marine survival and coho capture rate in Alaska fisheries. The CWT retention was 96%. Short-term tagging mortality was assessed by holding a total of 303 tagged and marked coho smolts in a live box for a 24 hour period, during which 0% mortality rate occurred. After factoring in tag retention and survival, 9,477 coho smolts were released alive with adipose fin clips and coded-wire tag retained. The proposed minimal goal of 7,000 tagged coho smolts was exceeded.

Catch of Non-Target Species

The smolt traps are highly selective for migrating sockeye and coho smolts. About 99% of the total catch was of these target species. The highest catch other than the target species was a mix of juvenile bull trout and Dolly Varden (Table 2).

Table 3. **Total number of fish by species caught in the smolt traps in 2010.**

Sockeye	Coho	Bull Trout/ Dolly Varden	Rainbow Trout	Prickly Sculpin	Longnose Sucker	Mountain Whitefish
645	9947	90	26	43	6	13

CONCLUDING REMARKS

In 2011 we will be able to resume the accumulation of data sets evaluating escapement to brood year production for fresh water and marine survival reporting. Preliminary results for coho brood years 2007 and 2008 were provided to Fisheries and Oceans stock assessment biologists at the Post Season Salmon Review in Prince Rupert, B.C. in December 2010. Full results are provided in the annual GWA Slamgeesh reporting. The use of two smolt traps during the entire smolt season in future years will likely improve sockeye capture efforts. Development of location specific trapping systems is fundamental to delivering reliable sockeye and coho smolt programs.