Hetta Lake Sockeye Salmon Stock Assessment

2012 Annual Report for Study 10-606

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TABLE OF CONTENTS

ABSTRACT

The Hydaburg Cooperative Association has continued the Hetta Lake sockeye salmon stock assessment program which started in 2001. A subsistence harvest survey, sockeye salmon escapement count and age, sex, and length analysis on sockeye salmon were completed for 2012. An alternative method for validating the weir count with a video net weir system was attempted. The harvest survey documented approximately 4,771 sockeye salmon from Hetta Cove. A total of 19,073 adult sockeye salmon were counted at the Hetta Creek weir from June through mid-September. The 2007 brood year for sockeye salmon dominated the 2012 escapement (92.5%).

INTRODUCTION

Hetta Lake is a primary subsistence sockeye salmon (*Oncorhynchus nerka)* system that has played a central role in the history of the village of Hydaburg, as well as former Haida and Tlingit settlements which pre-date the modern village (Langdon 1977; Betts et al. 1997). Subsistence fishing for sockeye salmon still plays an integral role in a long and rich cultural history of customary and traditional use of a natural resource. Hetta Lake sockeye salmon are subsistence fished by residents of Hydaburg, as well as other communities on Prince of Wales Island.

Early estimates of Hetta Lake sockeye salmon come indirectly from abundant commercial harvest numbers for Hetta Inlet, from which it is suggested that hundreds of thousands of fish return to Hetta Lake (Moser, 1899). The first assessment of the Hetta Lake sockeye salmon run was conducted in 1967 and 1971 by the U.S. Fish and Wildlife Service where fish weir counts ranged between 15,000 and 24,000 fish. In 1982, the Alaska Department of Fish and Game (ADF&G) operated a weir on the Hetta Lake system, but it is now known that the weir only enumerated sockeye salmon from an early portion of the run as operations were shut down August 20 (Bednarski and Heinl 2010; Blikshteyn and Conitz 2009; Conitz 2008). In general, the early portion of the sockeye salmon returning to Hetta (June and July) are stream spawners in upper Hetta Lake, while the August to September portion of the return are beach spawners around Hetta Lake.

In 2001, in response to concerns by the community of Hydaburg, the Hydaburg Cooperative Association (HCA) and ADF&G began a stock assessment project on Hetta Lake sockeye salmon. Initially, mark-recapture studies were used to estimate the number of sockeye spawners in the inlet stream and accessible lake spawning areas. Because of practical difficulties in estimating the lake spawning sub-population, the mark-recapture estimates were questioned (Cartwright et al. 2005; Conitz et al. 2007). In 2005, a weir was installed on Outlet Creek to improve the reliability of escapement estimates.

Table 1 represents seven consecutive years of weir count data for Hetta Lake. Mark-recapture studies were also included through 2010, in order to attempt to validate weir counts. However, mark-recapture studies in those years either failed (Blikshteyn and Conitz 2009; Conitz and Blikshteyn 2010; Needham and Christianson 2011) or did not meet the objectives for precision (Conitz 2008). In 2011, other methods for validating weir counts were explored for implementation in the 2012 field season.

Additionally, since 2001, the subsistence harvest of sockeye salmon has been monitored including all sockeye salmon systems traditionally important to Hydaburg: Hetta Cove, Eek Inlet, Kasook Bay, Klakas Inlet, and Hunter Bay. While Hetta Cove tends to be the primary subsistence use system, when sockeye salmon counts are low the community voluntarily shifts subsistence harvest to other systems so residents of Hydaburg have opportunity to meet their subsistence needs (Needham and Christianson 2011).

The primary objectives of continuing the Hetta Lake Sockeye Salmon Stock Assessment Study, are to continue to obtain reliable estimates of sockeye salmon and document subsistence harvest. Information is used in the short term for in-season management of the subsistence harvest as well as the long term management of the Hetta Lake sockeye salmon population.

Table 1. Recent sockeye salmon weir counts from Outlet Creek weir of Hetta Lake

Year	Weir count
2005	1,930
2006	17,930
2007	12,860
2008	4,884
2009	20,520
2010	21,228
2011	23,588

OBJECTIVES

1. Survey all subsistence fishers on the fishing grounds or as they return to Hydaburg, to determine the total sockeye harvest in the terminal areas of Hetta, Eek, Kasook, and Hunter Bay.
2. Count the number of sockeye salmon returning to Hetta Lake through a weir, throughout as much of the spawning migration as is feasible.
3. Estimate the age, length, and sex composition of the Hetta Lake sockeye escapement.
4. Roughly estimate the escapement of early run sockeye salmon into Hetta Lake using mark-recapture methods so that the estimated coefficient of variation is less than 20%.

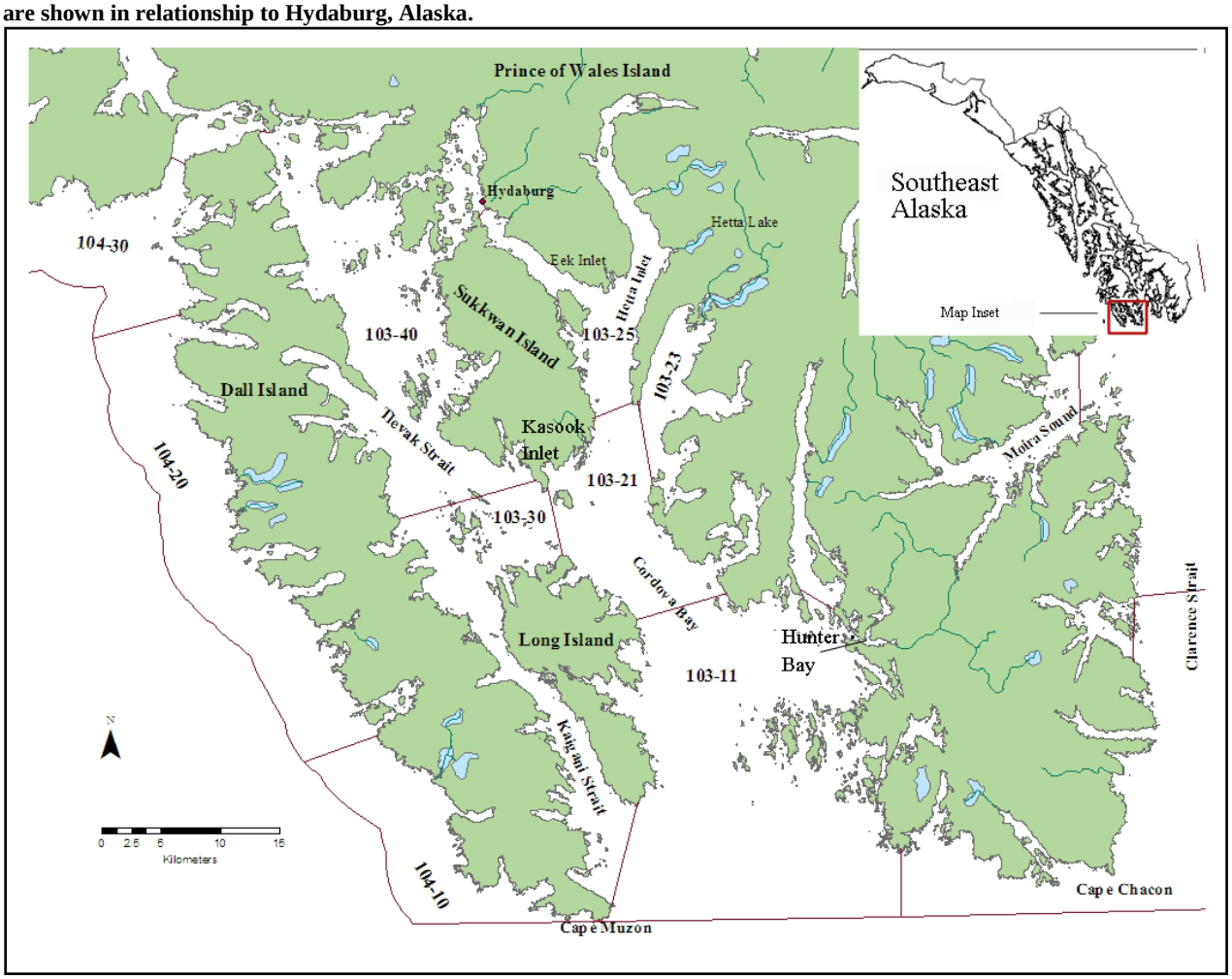
METHODS

Study Site

Hetta Lake (Anadromous Waters Catalog Number 103-25-10470-0010) is located on the southwestern side of the Prince of Wales Island (55.17^{o} N, 132.57^{o} W; Figure 1). The Hetta Lake watershed is composed of spruce, cedar, and hemlock forest, with alpine habitat above the 550 m elevation level. Hetta Lake has three main tributaries, Hetta, Hatchery, and Camp creeks. Numerous small unnamed creeks also empty into Hetta Lake. Its outlet stream, Outlet Creek, empties into Hetta Cove, approximately 600 m from the lake. The lake surface area is 207 hectares and the volume is 99.4 million m^3. Hetta Lake is an oligotrophic lake, with organically stained water. In addition to sockeye salmon, indigenous fish species include pink

(*Oncorhynchus gorbuscha)*, chum (*O. keta)*, and coho (*O. kisutch*) salmon; steelhead (*O. mykiss*) and cutthroat trout (*O. clarki*); Dolly Varden char (*Salvelinus malma*); three-spine stickleback (*Gasterosteus aculeatus*), and sculpins (*Cottus* sp.).

Figure 1: The geographic location of Hetta and Eek lakes and subsistence fishing areas of Hunter Bay and Kasook Inlet are shown in relationship to Hydaburg, Alaska.



Subsistence Harvest

To estimate the subsistence harvest for Hetta Cove, Eek Inlet, Hunter Bay and Kasook Inlet, all subsistence fishermen from Hydaburg were interviewed by Hydaburg Cooperative Association fisheries staff. Fisherman were interviewed either on the fishing grounds, at the harbor in Hydaburg or in a follow-up interview. The standard interview form included the date and area fished, the number of fish harvested by species, time and duration of fishing, and fishing gear used (Appendix A). No information which could identify individual participants was recorded in order to maintain confidentiality of individual catch records. Data were summarized and no formal analysis was performed.

Sockeye Salmon Escapement Estimate

An aluminum bipod and picket weir located on Outlet Creek was operated from June 6 through September 21, 2012. The weir spanned Outlet Creek and the structure is 17 m wide with picket

spacing 4.5 cm apart. A fish trap was constructed in the thalweg of the creek. The trap passed fish through an opening in the weir into a 2.5 m by 1.25 m rectangular trap box constructed of weir channel and pickets. All fish that entered into the trap were enumerated by species and released upstream of the weir. Sockeye jacks (sockeye salmon less than 400 mm in length) were counted separately from adults. A subsample of sockeye salmon were scale sampled to determine age, sex and length (see methods below). In order to minimize handling fish, fish not being sampled during peak run times were passed through a small temporary opening in the back of the weir trap made by pulling two pickets. A technician visually counted and tallied all fish by species. A white flashboard on the stream bed in the trap facilitates visibility for fish identification. Data were summarized and no formal statistical analysis was performed.

An attempt to validate the weir count was made using a mark-recapture estimate with an in-stream video net weir located immediately upstream of the aluminum bipod weir. A floating net weir with a video chute housing two underwater cameras was installed on July 10 and 11, 2012. After five days of attempting to operate the video net weir, the crew expressed concerns with the system. The netting kept getting tangled in the aluminum bipod weir regardless of numerous attempts at redesigning the net structure. In addition, sockeye salmon were swimming around the netting, and in some cases getting caught in the netting. On July 16, 2012 the video net weir was decommissioned.

Sockeye Salmon Escapement Age, Sex and Length Composition

A total of 640 adult sockeye salmon were sampled at the weir for scales, length measurement and sex identification. Fish were selected systematically to prevent selection bias, and weekly sampling goals were determined for the run based on average weekly escapement from previous years. Each week a portion of the fish returning were dip netted out of the weir trap and length of each fish was measured from mid eye to tail fork, to the nearest millimeter. Sex of the fish was determined by length and shape of the kype or jaw. The sex and length data were recorded on a special mark-sense form provided by the Alaska Department of Fish and Game, and paired by sample number with the scale sample. Four scales from each fish sampled were taken from the preferred area of each fish (INPFC 1963) using data collection procedures found in the ADF&G Length, Sex, and Scale Sampling Procedures, an unpublished manual to accompany the ADF&G Adult Salmon Age-Length Mark Sense Form Version 3.0 (ADF&G Div. of Commercial Fisheries, Region I, 2005). The following is a description of the statistical analysis performed on age-sex and age-length data:

The proportion of each age-sex group "k" and associated standard errors of the proportions were calculated by the standard binomial formula with correction for finite population size (Thompson 1992, p. 35-36). Variables in equations 1 and 2 are defined as follows: n_k is the number of samples in age-sex group k, n is the total number of samples aged, and N is the estimated escapement.

$$\hat{p}_k = \frac{n_k}{n} \tag{1}$$

$$SE(\hat{p}_k) = \sqrt{\left(1 - \frac{n}{N}\right)\frac{\hat{p}_k(1-\hat{p}_k)}{n-1}} \tag{2}$$

The mean length for age-sex group "k" will be calculated as the sample mean of a simple random sample (eq. 3), with associated standard error (eq. 4) and variables defined as for eqs. 1 and 2, above (Thompson 1992, p. 42–43).

$$\bar{y}_k = \frac{1}{n_k} \sum_{i=1}^{n_k} y_{ki} \tag{3}$$

$$SE(\bar{y}_k) = \sqrt{\frac{1}{n_k^{\,2}}} * \sqrt{\left(\frac{1}{n_k - 1}\right) \sum_{i=1}^{n_k} (y_{k\,i} - \bar{y}_i)^2} \tag{4}$$

RESULTS

Subsistence Harvest

Hetta Cove and Eek Inlet were documented as systems fished for the 2012 subsistence fishing season. The total reported sockeye harvest at Hetta Cove was 4,711 fish, which comprised approximately 85% of the total reported sockeye salmon harvest for Hydaburg. In 2010 and 2011, the Hetta portion of the overall Hydaburg subsistence harvest was 62% and 91% respectively. A total of 839 sockeye salmon were reported harvested from Eek Inlet. No sockeye salmon were reported from other systems, such as Kasook Inlet, Hunter Bay or Manhattan Arm.

Sockeye Salmon Escapement Estimate

Sockeye salmon escapement was estimated using a weir count only. There were 19,073 adult sockeye salmon that passed the weir, and 68 sockeye jacks, for minimal escapement of 19,141 sockeye salmon. Daily weir count data is located in Appendix B. The first two sockeye salmon passed the weir on June 8, 2012 and the last sockeye salmon counted was recorded was on September 18, 2012. Figure 2 shows the run timing of adult sockeye salmon for the 2012 field season. The largest daily count was on August 1, 2012 when 1,762 adult sockeye salmon were counted past the weir. In 2010 the largest daily count for adult sockeye salmon was 3,194 and in 2011 it was 6,480. Figure 3 compares the run-timing of adult sockeye salmon at the weir site for 2010-2012. As mentioned, Hetta Lake has an early return of sockeye salmon in June and July, which constitute the stream spawning population and a late return of sockeye salmon in August and September which constitute the beach spawning population. During the 2012 field season, more sockeye salmon migrated into Hetta Lake prior to August than in years past (Figure 3; Table 2). Additionally, less sockeye salmon migrated past the weir in August and September than in years past (Table 2).

In addition to sockeye salmon, the crew counted: 3,212 coho salmon, 35,593 pink salmon, 862 chum salmon, and 34 Dolly Varden char. Coho, pink and chum salmon were still migrating past the weir site when the weir was removed at the end of the season.

Table 2. Summary of sockeye salmon migrating past the Hetta Lake weir site prior to August 1 and after August 1.

	Sockeye before August 1		Sockeye after August 1		
	Number of sockeye	% of total weir count	Number of sockeye	% of total weir count	Weir count
2005	564	29%	1,366	71%	1,930
2006	3,686	21%	14,244	79%	17,930
2007	2,362	18%	10,498	82%	12,860
2008	871	18%	4,013	82%	4,884
2009	2,605	13%	17,915	87%	20,520
2010	3,183	15%	18,045	85%	21,228
2011	6,979	30%	16,609	70%	23,588
2012	8,683	45%	10,458	55%	19,141

Figure 2. Run timing vs. water height of adult sockeye salmon for Outlet Creek of Hetta Lake in 2012, near Hydaburg, Alaska.

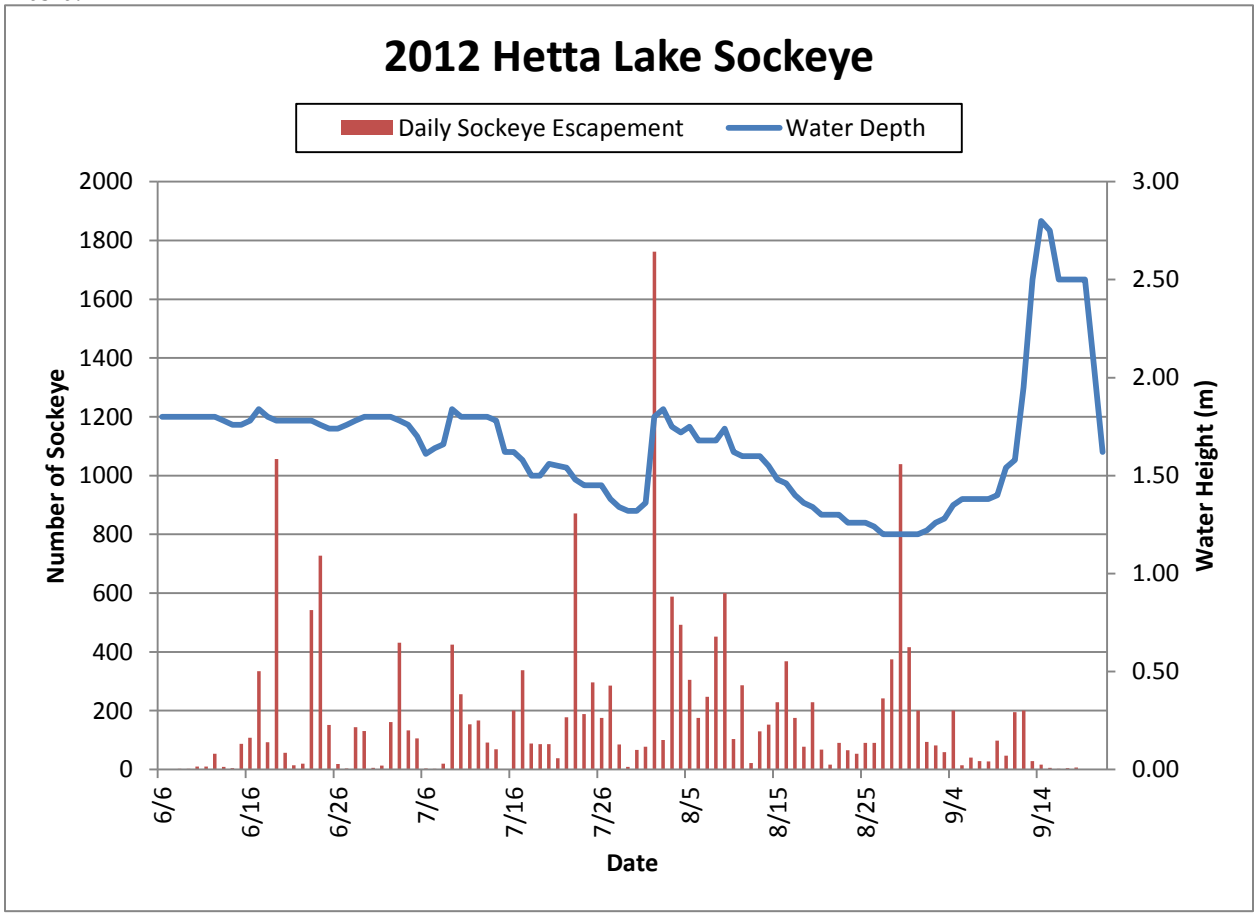
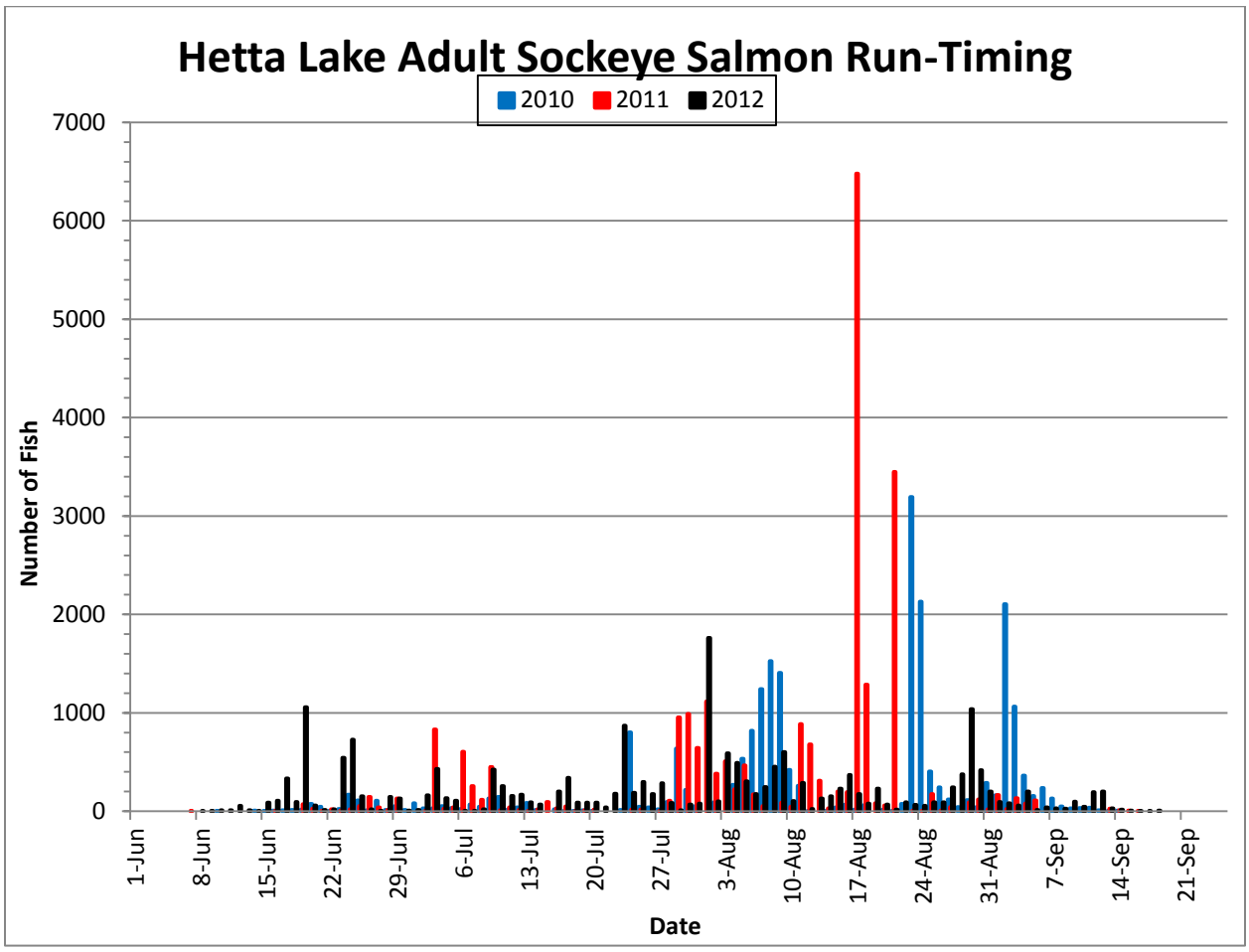


Figure 3. Comparison of run-timing for adult sockeye salmon into Hetta Lake for 2010-2012, near Hydaburg, Alaska



Sockeye Salmon Escapement Age, Sex and Length Composition

The crew sampled 640 sockeye salmon for age, sex and length composition, of which 477 scale samples were successfully aged. Fish returning from brood years 2006 to 2009 were represented in the sampled return. Fifty-five percent of the sampled fish were female and 45 percent were male. Approximately 93% of the fish in the return were from the brood year 2007, represented in age class 1.3 and 2.2 (Table 3).

Of the 640 sockeye salmon sampled, length data was only available for 625 fish. Average length of returning male adult sockeye salmon 560mm ±30mm and average length of returning females was slightly smaller at 544mm ±24.9mm (Table 4).

Table 3: Age composition of adult sockeye salmon escapement in Hetta Lake, by sex, in 2012.

Brood Year:	2009	2008	2007	2007	2006	
Age:	1.1	1.2	1.3	2.2	2.3	Total
Male						
Sample Size	2	8	198	2	1	211
Percent	0.4%	1.7%	41.5%	0.4%	0.2%	44.2%
Standard Error	0.3%	0.6%	2.2%	0.3%	0.2%	2.2%
Female						
Sample Size	1	22	243	0	0	266
Percent	0.2%	4.6%	50.9%	0	0	56%
Standard Error	0.2%	0.9%	2.3%	0.0%	0.0%	2.2%
All Fish						
Sample Size	3	30	441	2	1	477
Percent	0.6%	6.3%	92.5%	0.4%	0.2%	100.0%
Standard Error	0.4%	1.1%	1.2%	0.3%	0.2%	0.0%

Table 4. Mean mideye-to-fork length of adult sockeye salmon in 2012 Hetta Lake escapement.

Brood Year:	2009	2008	2007	2007	2006		
Age:	1.1	1.2	1.3	2.2	2.3	Not Aged	All Fish
Male							
Av. Length (mm)	362	542	565	500	540	552	560
Standard Dev. (mm)	3.5	23.6	21.8	0.0	0.0	28.6	30.0
Sample Size	2	8	198	2	1	67	280
Female							
Av. Length (mm)	400	504	549	0	0	539	544
Standard Error (mm)	0.0	26.3	20.2	0	0	21.3	24.9
Sample Size	1	22	243	0	0	79	345
All Fish							
Av. Length (mm)	374	514	556	500	540	545	551
Standard Error (mm)	92.1	30.5	22.4	0.0	0.0	25.8	28.5
Sample Size	3	30	441	2	1	146	625

DISCUSSION

Hetta Cove sockeye salmon comprised 85% of the sockeye salmon harvest reported by the community of Hydaburg in 2012 (Table 5). Bednarski and Heinl (2010) reported an average of 28.3% subsistence harvest rate for sockeye salmon from Hetta Cove for the 2006-2009 time period. Subsistence harvest rate is calculated as the total reported harvest divided by the terminal run (subsistence harvest + escapement). Given an estimated escapement of 19,141 sockeye

salmon and a reported harvest of 4,711, the subsistence harvest rate for 2012 would be approximately 20%, which is well below the average subsistence harvest rate for sockeye salmon from Hetta Cove. The remaining 15% of sockeye salmon harvest was from Eek Inlet, a subsistence system located closer to the community of Hydaburg.

Table 5: A comparison of subsistence harvest and return estimates for Hetta Cove, Alaska

Year	Hetta Harvest	Total Harvest	Estimated Return	Percent of Total Harvest from Hetta	Percent Harvest of Hetta Return
2005	358	818	2,288	44%	16%
2006	9,797	10,533	27,727	93%	35%
2007	3,253	3,689	16,113	88%	20%
2008	3,585	3,585	8,468	100%	42%
2009	5,416	6,471	25,938	84%	21%
2010	3,580	5,812	24,627	62%	15%
2011	4,786	5,234	23,686	91%	21%
2012	4,711	5,550	19,141	85%	25%

Based on past sockeye salmon projects and local traditional knowledge, it is known that sockeye salmon returning to Hetta Cove in June and July constitute a sub-population of fish that typically spawn in Hetta Inlet Creek and sockeye returning in August and into September typically spawn along the lakeshore of Hetta Lake. Additionally, the early return of sockeye salmon into Hetta Lake has been substantially lower than the later portion of the return (Table 2). Conservation concerns on the early portion of sockeye salmon returning into Hetta Lake have the community voluntarily shifting their harvest to Eek Inlet for the early portion of the sockeye salmon return. During the 2012 field season, more sockeye salmon returned to Hetta in June/July than in the past seven years of weir operation (Table 2), which also constituted 45% of the entire estimated return. While one field season of increased sockeye salmon return on the early portion of the run does not necessarily mean an entire stock is on the rebound, the 2012 field season does support that the long term data collected through the Hetta Lake Subsistence Sockeye Salmon Assessment Project is becoming effective in making in-season management decisions that benefit the return of fish to the system.

The community of Hydaburg voiced concern over an early commercial fish opener in Cordova Bay, which included sub-district 103-25 (Figure 1). Residents felt the fishery was opened earlier in the northern part of Cordova Bay than normal, and they were not harvesting for subsistence needs at that time in order to assure escapement goals were met for the early portion of the return. The 2012 catch for sockeye salmon in sub-district 103-25 was 1,043 sockeye salmon, which was lower than the catch in the same district in 2011 which was 3,111 (S. Walker, personal communication, 2013). Sockeye salmon caught in Cordova Bay are a mixed-stock commercial purse seine fishery which largely targets pink salmon, but also catches sockeye salmon. Currently, Hetta Lake sockeye salmon cannot be distinguished in a mixed-stock commercial purse seine fishery and sockeye salmon bound for Hetta Lake may conceivably be caught in sub-districts 103-11, 103-21 and across the point of 103-23 (Figure 1). Therefore, the commercial harvest catch data does not ease the concerns of the community, as early returning

sockeye salmon may have been caught in other areas of Cordova Bay. Stronger coordination with ADFG, who manages the commercial fishery, for Cordova Bay would help to ease the concerns of the community. One key factor in the decision to open the northern end of Cordova Bay for a commercial fishery early, were the higher numbers of sockeye salmon returning in Hetta Lake (S. Walker, personal communication, 2012). However, longer term run-timing and the voluntary closure for subsistence harvesting in June/July were not taken into consideration.

Subsistence needs of sockeye salmon should not be determined by the number of sockeye salmon harvested in any given year. The need for sockeye salmon may be based on many factors that vary each year, including number of community events and the need for fish for other subsistence communities on the island. Recently, it has been acknowledged that the community subsistence harvest needs are closer to the 2006 reported harvest level of 10,533 (Table 5) (Needham and Christianson 2012). This level has not been accomplished since 2006, although estimated escapement data show that most years the Hetta Lake sockeye salmon run could support this higher harvest level. In Needham and Christianson (2012), the authors suggest possible contributing factors, including: higher fuel costs and loss of efficient harvesters from the community due to fewer jobs in the community. It is important to reiterate that harvest need has not changed and the community continues to strive for a sustainable escapement level that will always support a subsistence harvest of 10,500 sockeye salmon.

In 2012, the majority of returning sockeye salmon into the Hetta Lake system were from the brood year 2007, representing 92.5% of sampled fish. The estimated escapement in 2007 was 12,860. In general, four brood years have been returning to Hetta Lake each year, with four and five year old fish constituting a majority of the run. If this trend would continue for the 2013 field season, then the 2013 return may be smaller than the past few years because the estimated escapement in 2008 was relatively low at 4,884 sockeye salmon (Table 1). The longer term data set for Hetta Lake sockeye salmon is starting to assist the Hydaburg Cooperative Association and other resource managers in building predictions regarding estimated escapement and how different fisheries may be or may not be impacting escapement levels.

ACKNOWLEDGEMENTS

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APPENDIX A

Daily Creel Interview Form: Hetta / Eek / Kasook Page _____ of _________

Date _________________ Samplers ____

Interview #	Interview Type G, H, or F	Time (Military)	Missed Interview #	Gear Type	No. of Hours Fished	No. of Net Sets	Harvest Species						
							Sockeye	Coho	Chum	Chinook	Pinks	Other	Comments

Interview type: G = Fishing Grounds, H = Harbor, F = Follow up

Gear Type: GN = Gill Net, S = Seine Net, D = Dip Net, R = Fishing Rod

APPENDIX B

2012 Daily Weir Count Data

ADULT SOCKEYE SALMON		
Date	Daily	Cumulative
06/06	0	0
06/07	0	0
06/08	2	2
06/09	2	4
06/10	10	14
06/11	10	24
06/12	54	78
06/13	9	87
06/14	4	91
06/15	87	178
06/16	108	286
06/17	334	620
06/18	93	713
06/19	1056	1769
06/20	57	1826
06/21	14	1840
06/22	20	1860
06/23	542	2402
06/24	727	3129
06/25	152	3281
06/26	19	3300
06/27	3	3303
06/28	144	3447
06/29	131	3578
06/30	6	3584
07/01	13	3597
07/02	161	3758
07/03	431	4189
07/04	133	4322
07/05	106	4428
07/06	3	4431
07/07	2	4433
07/08	20	4453
07/09	425	4878
07/10	256	5134
07/11	154	5288

ADULT SOCKEYE SALMON		
Date	Daily	Cumulative
07/12	167	5455
07/13	92	5547
07/14	69	5616
07/15	0	5616
07/16	200	5816
07/17	338	6154
07/18	88	6242
07/19	86	6328
07/20	86	6414
07/21	38	6452
07/22	178	6630
07/23	871	7501
07/24	188	7689
07/25	296	7985
07/26	175	8160
07/27	285	8445
07/28	85	8530
07/29	9	8539
07/30	67	8606
07/31	77	8683
08/01	1762	10445
08/02	100	10545
08/03	588	11133
08/04	492	11625
08/05	305	11930
08/06	175	12105
08/07	247	12352
08/08	452	12804
08/09	600	13404
08/10	104	13508
08/11	287	13795
08/12	22	13817
08/13	130	13947
08/14	153	14100
08/15	229	14329
08/16	368	14697

ADULT SOCKEYE SALMON		
Date	Daily	Cumulative
08/17	175	14872
08/18	78	14950
08/19	229	15179
08/20	68	15247
08/21	16	15263
08/22	90	15353
08/23	65	15418
08/24	54	15472
08/25	91	15563
08/26	90	15653
08/27	242	15895
08/28	375	16270
08/29	1039	17309
08/30	416	17725
08/31	200	17925
09/01	94	18019
09/02	82	18101
09/03	59	18160
09/04	200	18360
09/05	14	18374
09/06	40	18414
09/07	28	18442
09/08	27	18469
09/09	98	18567
09/10	47	18614
09/11	195	18809
09/12	201	19010
09/13	28	19038
09/14	16	19054
09/15	6	19060
09/16	2	19062
09/17	4	19066
09/18	7	19073
09/19	0	19073
09/20	0	19073
09/21	0	19073