Determining the Trend of Chum Population Dynamics in Area 5 and Measuring the Success of Small Hatcheries for Stock Assistance (First Year Return Clipped Fish 2010)

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EXECUTIVE SUMMARY

The concept of this project is to look at the contribution of small coastal hatcheries such as the Oona River hatchery to increase chum salmon populations in small coastal systems such as the Kumealon River and provide baseline data on chum salmon in coastal system Area 5. During this study (2006 to the present), a biophysical analysis was done within the Kumealon system using standard fisheries techniques for determination of spawning area for chum redds and to aid in quantifying the maximum potential population of chum spawners. (Refer to the reports ***Determining the Trend of Chum Dynamics in Area 5 and Measuring the Success of Small Hatcheries for Year 1(2006) and Year 2 (2007)*** and for maps and measurements). The determination of a probable maximum population based on spawning habitat criteria alongside testing for resident timing has contributed to an understanding of the spatial and temporal usage of the system by chum spawners.

Reviewing historical chum records from the 1950's to the present indicates that there has been lots of variation in chum populations in Kumealon. Declines in population can be attributed to various activities such as the past logging activity in the Kumealon watershed, bycatch in the Area 4 sockeye and pink commercial fishery and Area 5 seine pink fishery and the possible effects of climate change. Historical records showed that the decadal average in the Kumealon system for returning chum spawners in the 1950's was 725 and the historical mean from 1950-1989 was 370 with a maximum reported 1500 spawners in the system. The recent records show that the 1990-2001 average was 67 chums but during this study we have seen a low of 30 chums in 2008 and a high of 800-1000 chum in 2009. In 2010, we had approximately 300 chum returning to the system which was our first year that we would expect to see any of the 4 year old clipped chum.

Total chum spawning area in the Kumealon system at this present time was 2166 m2. Using the criteria of average chum redd size, consecutive redds per coupling and amount of area needed for coupling we calculated that the system could accommodate up to 850 spawners in its present condition **(Refer to 2006 Report for habitat measurements).** Determination of enhancement success will be conducted on visual surveys of returning spawners that have been clipped in relation to overall returning spawners. Since 95% of chum spawners in Kumealon system are 4(1) brood year at age (personnel communication with Brian Spilsted FAO North Coast biologist) we would expect the majority of the 2007 clipped frys from the 2006 brood year to return as adults in 2010.

Temperature loggers were placed in the Oona River Hatchery, Kumealon main flow (2006-2010) and the Kumealon gravel (only in 2007). The daily temperature data for 2006-2010 has been consistent in showing a distinct difference in water temperature as the Kumealon system is a much more warmer than Oona River and therefore results in more accumulated thermal units (ATU's) for faster development of a chum's egg to fry.

INTRODUCTION

There appears to be a continuous downward trend in the observed chum salmon stocks in Area 5 from the 1950's to their present population numbers in the first decade of this new

millennium according to the Fisheries Salmon Escapement database. The Oona River Resource Association (ORRA) in partnership with the Stock Assessment Branch of the North Coast Fisheries and Oceans decided it would be a beneficial to investigate the spawning potential of a typical chum bearing system in Area 5 alongside using a small hatchery for increasing chum salmon stocks in this system.

The Kumealon system was chosen because it has a small standing chum population, easy access by boat, clarity of water for observing chum populations and in the vicinity of the operating area of the Oona River hatchery for acquiring broodstock. The biologist and fish technicians of ORRA are familiar with the Kumealon system and are experienced in acquiring broodstock and are knowledgeable in hatchery techniques for the successful incubation of eggs to the fry stage.

The project has maintained five objectives:

1. To sample a major chum bearing system in Area 5 for quantifying spawning potential in this system. **Spawning habitat assessment was done in 2006**.
2. To enumerate the in migrating adult chum and dead spawners for the duration of their migration into the Kumealon system. Resident time of the chum spawners has been determined by the observation of different coloured elastic bands placed on the peduncle of spawners to observe their spatial and temporal movement. Coverage on average was every 2-3 days and the coordination of visits with the FAO streamwalker allowed even better coverage. **(The resident time recordings were done in 2006 and 2007 and the enumeration by the Oona River crew and the FAO streamwalker was done 2006-2010).**
3. To collect DNA samples of chum salmon for FAO Fisheries stock assessment for building up DNA profiles for North Coast streams**. (This has been done from 2006-2009)**
4. To collect broodstock from the Kumealon system and transfer the fertilized eggs into incubation trays in the hatchery at Oona River. These eggs would be monitored for the next six months for disease and water quality to ensure a good egg-fry survival rate. **(Chum broodstock has been collected each year (2006-2009) and we were able to do a limited broodstock take in 2009 due to the budget restraints). No broodstock was taken in 2010 as this would be the first year of observing clipped ventral fin of returning adults.**
5. In the early spring, the emergent chum fry would be held for a short time at the hatchery and then returned back to the Kumealon river for imprinting. Before they are released they would be fin-clipped in order to differentiate the returning adult chum as wild or enhanced stock.
6. In the last phase of this study starting this year in 2010 we are capturing as many live chum and collecting all morts for identifying if any of the sample fish has the markings of a clipped left ventral fin.

METHODS

The North Coast has many river systems but most of these systems are not clear because of the tannic in the water. Kumealon was chosen as the target river because the water

clarity for observing in migrating fish and distinguishing the different species is excellent. It also has good historical records for chum presence and it has a small standing crop of spawners. The system has some damage to its spawning habitat from logging in the past and the estimation of the potential of chum spawners is based on spawning area in its present condition. It is approximately 12 nautical miles from Oona River and there is a good trail (1.5km) from the estuary into the main river system. Access on certain stages of the tide (high slack water) through the rapids allows the use of a small skiff for movement into the lower part of the river that flows into a salt lagoon. We use the skiff through the rapids when we are returning the clipped fry to the Kumealon river.

The collection of broodstock is accomplished by the use of small mesh barrier nets on the lower and upper target areas where chum salmon can be visually seen. We try to get our broodstock in the last part of July and early part of August as the main pink salmon in migration is towards the middle and last part of August. We use a larger 152mm mesh net to catch the chum salmon for easier release that reduces stress and helps in very little bycatch of the smaller pink salmon. Dipnetting is very successful under low water conditions.

We tried to catch and match at least 3 males to one female for the purpose of genetic integrity. All males after obtaining some milt or immature females were released and tagged by using different coloured elastic band on their peduncle for determining resident time (2006-2007). We ensured that all fish were in good condition before release. All chums that were caught had a small clip from the operculum for a DNA sample which was put in a vial containing 30% ethanol. Scales samples and hypural and fork lengths were also taken during sampling.

Mature female chums that were captured were stripped of their eggs and the unfertilized eggs were put into separate containers. Milt from the males were placed in small whirlpak or ziplock bags and kept cool in a small cooler and taken back to the Oona River hatchery. We timed it that no more than 3 hours would elapse from the time we took the first eggs or milt to arriving at the hatchery in Oona River. At the hatchery, the eggs were fertilized using at least a 3:1 ratio of males to females and then the fertilized eggs were transported to the incubation trays. The eggs were washed in a solution of Ovadine (10ml in 10 liters of water) for protection against fungus and bacterial infections

The fertilized eggs were monitored during the winter from the egg to fry swim up stage and a technician was paid some hours each week to monitor water quality and pick any dead eggs from the trays and record the temperature in the tank .The fry at swim up stage were fed using a feed timer that distributed Ewos micro feed using a standard formula calibrated to chum juveniles.

Transportation of the fry was done by putting the fry in a large insulated tote filled with water and supplied with an air stone running on 12VDC battery power. The tote was placed in a large skiff and towed to Kumealon by a larger vessel. The skiff then was taken through the tidal rapids at high slack water to utilize the bigger tides for allowing further movement up the river for release of the fry.

A thermal temperature logger (StowAway Tidbit TB3237) each year of this study was placed in the water flow at the Oona River hatchery and two temperature loggers in the spawning area of Kumealon in both the main river flow and one buried in the gravel. The data from the tidbit was downloaded using the BoxCar 3.7 for Windows Program. The interval for readings was 4 times a day and the 4 temperatures were averaged to give an average daily temperature.

This year we used a 146 mm size gillnet and dipnets for catching a sample of the current population each day we transverse the system. Enumeration was at least every 3 days and sometimes everyday if there was a lot of chum entering the system. Every live fish sampled was checked for a ventral fin clip and the operculum was hole punched so that the same fish was not sampled again. Morts were sampled the same way but the caudal fin was cut off in order not to sample the mort again. Every chum salmon sampled was thoroughly checked for any regeneration of the ventral fin as per communication with Rob Dams FAO.

RESULTS

Monitoring of Chum In Migration and Acquiring Broodstock

The movement of chums into the Kumealon system begins in late July and spawning usually is over by the first part of September. In 2010,

Incubation of Chum Eggs and Development Time for Eyed Stage, Hatch Stage and Swim up stage.

Salmon species	To Eyed Stage(ATU's)	To Hatched Stage (ATU's)	To Swim Up Stage (ATU's)
Coho	217-237	448-475	777-829
Chum	***217-250***	***498-546***	***845-1126***
Chinook	242-258	512-526	825-1029
Pink	224-257	545-662	868-1034
Sockeye	236-257	614-694	943-1088

Table 1. Average Accumulated Thermal Units (ATU's) for Developmental Stages of the Different Salmonids.

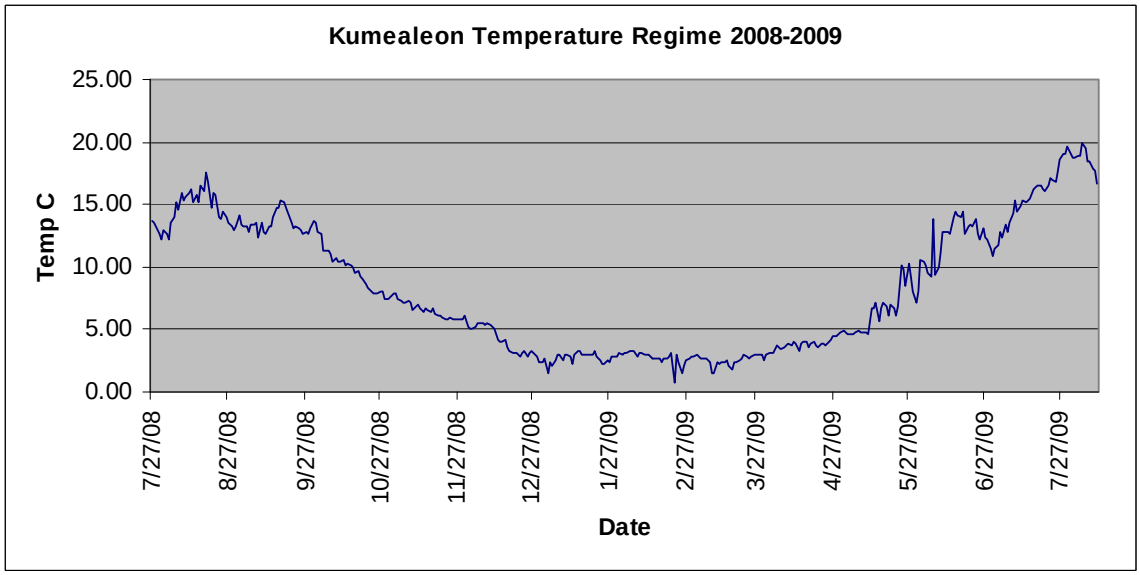

Fig 1. Average Daily Temperature of Kumealeon Stream from July 27 2008 to Aug 10 2009

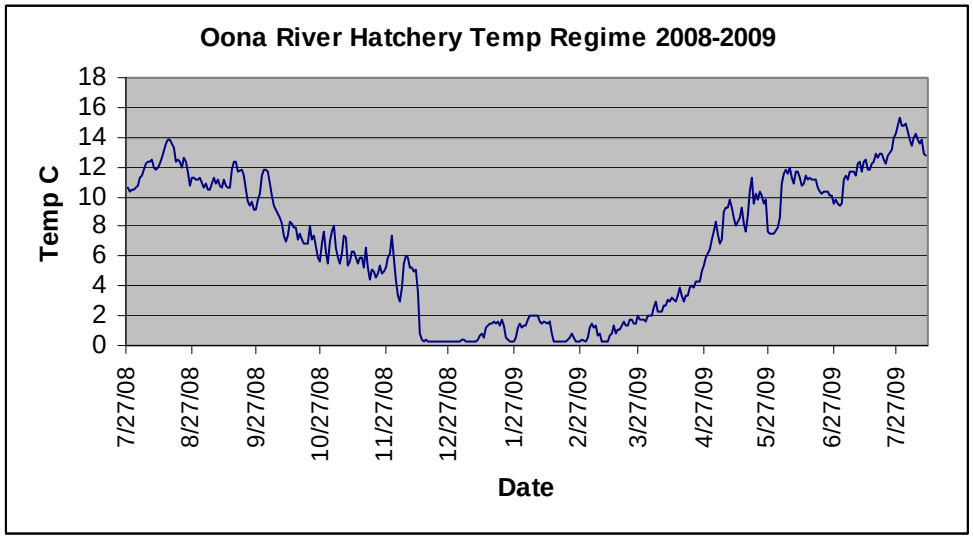

Fig. 2 Average Daily Temperature recorded at Hatchery in Oona River from July 27 2008 to Aug 10 2009.

Figure 1 and Figure 2 are both charts that were generated from the data from the BoxCar Program which takes the input of data from the optical reader. The recordings are then exported into Excel where the data can be manipulated to generate charts. Figure 1 shows that the Kumealeon watershed is buffered by the lake because of the less volatility of the water temperature and is presented by a smooth curve. Fig 2 shows the temp recordings from Oona River which expresses more volatility with some extreme cold temperatures

near zero degrees Celsius during the period of late November to early March. This is reflected in the difference of the ATU's shown in Table 3 in the Appendix.

DNA and Scale Analysis

Kumealon River 2004-2006 Area 5 North Coast Division Grenville Channel						
Sample Dates:						
Age Distribution						
	Species	**European**	**Gilbert**	**Brood**	**Frequency**	**Percent**
			Rich	**Year**		
	Chum	02	31	2004	3	4.3%
	Chum	03	41	2005	64	91.4%
	Chum	04	51	2006	3	4.3%
				Total	**70**	**100%**

Table 2 Summary of Scale Analysis for Kumealon for 2004-2006 from Brian Spilsted Biologist North Coast Division of Fisheries and Oceans.

The Table above is the information on the scale analysis done for the Kumealeon system which shows that the majority of the returning fish (91%) that return to the system are 4 year olds. For this study, the majority of the returning adults in 2010 would be from the 2006 broodstock year.

Kumealon River 2008-2010 Area 5 North Coast Division Grenville Channel						
				Chum Broodstock Year		
	3(1)	**4(1)**	**5(1)**	**3(1)**	**4(1)**	**5(1)**
2008	7	6	1	2005	2004	2003
2009	1	23	0	2006	2005	2004
2010	6	60	1	2007	2006	2005

Table 3 Summary of Scale Analysis for Kumealon for 2008-2010 from Brian Spilsted Biologist North Coast Division of Fisheries and Oceans.

We examined 165 chum of the reported 305 chum we believe that entered the system. Conditions were very good as visibility was clear and the system experienced low water levels throughout late July and August. However, we did not see any visible sign of any clipped ventral fins.

DISCUSSION

This project is examining the use of small hatcheries in doing stock assistance for chum salmon on the North Coast of British Columbia. The preliminary study of 2006 showed that there are some necessary questions that have to be investigated by using a small scale approach to understand why chum salmon streams in Area 5 are slowing losing their population base when compared with the historical records of the 1950's and onward in the Fisheries and Oceans Salmon Escapement Database.

The recorded number of chum salmon that was estimated by both this project's crew and the FAO Streamwalker was 100 chum in 2006 but Kumealon was exceptional in 2007 with an estimate 474 in the systems. In 2008 there were only 27 chum recorded in the Kumealon system and the 2009 chum count was 850 chums. This year the count by the FAO Streamwalker was 245 chums (Corey Martens FAO personal communications) but our estimate of 305 chums may be more accurate because of our more frequent walks of the system looking for clipped adults.

The temperature loggers in both Kumealon and Oona River show a striking difference in temperature regimes between the two systems. The comparison of the the graph shows that Oona River and the Kumealon temperature regimes do differ as the Kumealon system has a gradual slope with very little spiking which is attributed to the buffering action of the large lake at its headwaters. The Oona system is not a lake fed system and results in more spiking in its temperature profile. The Accumulated Thermal

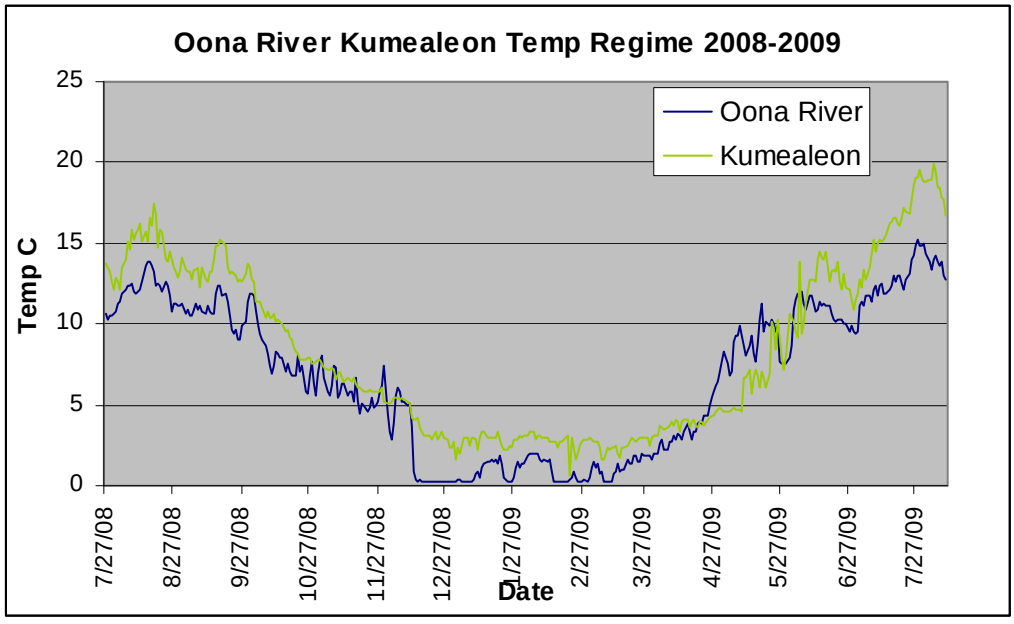

Fig 3 Comparison of Water Temperature in Kumealon and Oona River Watersheds from July 29 2008 to Aug 10 2009.

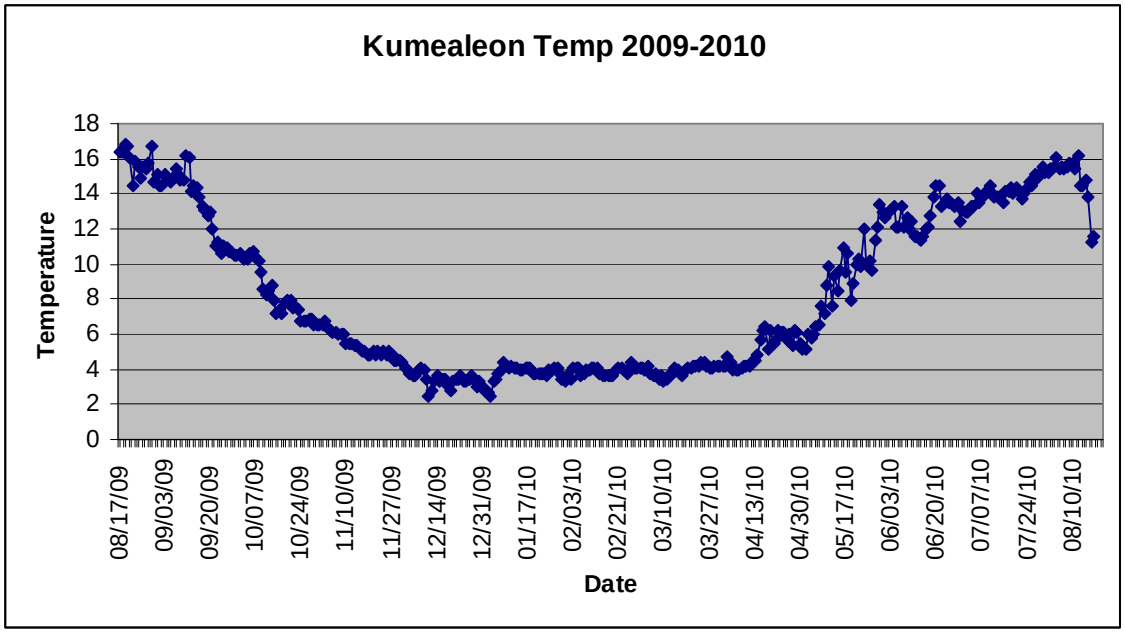

Fig 4 Water Temperature Tidbit recordings in 2009-2010

Units were quite similar for Oona River and the Main Flow of Kumealon for the period of July 29 2007 to April 7th 2008 with Oona River recording 1682 and the Main Flow of Kumealon 1685. However, in 2008-2009 in the same period of July 27th 2008 to April 7th 2009 the temperature recordings from the tidbits gave a count of 1338 ATU's for Oona River and 1803 ATU's for Kumealeon that represents a difference of 24%. In Fig 3 you can see that there was a cold snap of weather from late November to early March with very cold temperature in Oona River but buffered temperature from the lake in Kumealeon. The 2009-2010 temperatures for Kumealeon in Figure 4 shows the same pattern as previous years. No recordings were done for Oona River watershed in 2010.

We spent 16 days sampling and enumerating the entire system between July 15th and August 25th 2010. The first chum sighted entering the system was on July 22nd and the last new entrants were sighted on August 22nd with no new entrants at all on August 25th. Our frequent sampling of the system would have eliminated some of the bird and bear scavenging of the fish and morts which would have affected our count and sampling.

RECOMMENDATIONS AND CONCLUSIONS

No clips on the left or right ventral fin were found in our examination of 165 chum salmon which we believe was more than 50% of the population being sampled. Examination was thorough as we looked for any type of abnormality of the clipped fin. No conclusion can be made on these adult returns yet because of the difference in release dates between the returned chum juveniles from the Oona River hatchery and the natural outgoing wild juveniles from Kumealon. Also, the released juveniles from Oona River were close to 1.0 gram in weight which is almost double the size of the wild outgoing

juveniles from Kumealon. The question is whether these juvenile fish survived or were delayed because of different timing in leaving the system and will we see an increase of returning five year old chum. We clipped the fish differently for the 2006 and 2007 broodstock year as we released 7500 left ventral clipped fish in 2007 and over 16000 right ventral clipped fish in 2008. The 2011 field season would be the year that indicates if our endeavors were successful.

APPENDIX

Table 4 Readouts from Temperature Tidbits in Kumealon and Oona River and the Accumulated Thermal Units (ATU's) for 2008-2009.

Date	Oona River Temp C	OonaRiver ATU's	Kumealeon Temp C	Kumealeon ATU's
7/27/08	10.63	11	13.70	14
7/28/08	10.33	21	13.54	27
7/29/08	10.48	31	13.24	40
7/30/08	10.48	42	12.62	53
7/31/08	10.63	53	12.14	65
8/1/08	10.79	63	12.93	78
8/2/08	11.25	75	12.62	91
8/3/08	11.41	86	12.14	103
8/4/08	11.87	98	13.54	116
8/5/08	12.18	110	14.01	130
8/6/08	12.33	122	15.11	146
8/7/08	12.33	135	14.63	160
8/8/08	12.49	147	15.89	176
8/9/08	12.02	159	15.26	191
8/10/08	11.87	171	15.58	207
8/11/08	12.02	183	15.89	223
8/12/08	12.18	195	16.21	239
8/13/08	12.64	208	15.11	254
8/14/08	13.57	222	15.74	270
8/15/08	13.88	235	15.11	285
8/16/08	13.88	249	16.53	302
8/17/08	13.57	263	16.06	318
8/18/08	13.26	276	17.49	335
8/19/08	12.33	288	16.85	352
8/20/08	12.49	301	14.78	367
8/21/08	12.33	313	15.89	383
8/22/08	12.02	325	15.74	398
8/23/08	12.64	338	14.01	412
8/24/08	12.33	350	13.85	426
8/25/08	11.72	362	14.47	441
8/26/08	10.79	373	14.01	455

8/27/08	11.25	384	13.54	468
8/28/08	11.25	395	13.24	481
8/29/08	11.1	406	12.93	494
8/30/08	11.1	417	13.24	508
8/31/08	11.25	429	14.16	522
9/1/08	10.63	439	13.39	535
9/2/08	10.94	450	13.24	548
9/3/08	10.48	461	13.24	562
9/4/08	10.48	471	12.77	574
9/5/08	10.94	482	13.39	588
9/6/08	11.25	493	13.39	601
9/7/08	10.94	504	13.54	615
9/8/08	11.1	515	12.30	627
9/9/08	10.79	526	13.54	641
9/10/08	10.63	537	12.77	653
9/11/08	11.1	548	12.62	666
9/12/08	10.79	559	13.24	679
9/13/08	10.63	569	13.24	692
9/14/08	10.63	580	14.01	706
9/15/08	11.87	592	14.79	721
9/16/08	12.33	604	14.79	736
9/17/08	12.33	617	15.26	751
9/18/08	11.72	628	15.11	766
9/19/08	11.87	640	14.79	781
9/20/08	11.41	652	13.54	795
9/21/08	10.48	662	13.08	808
9/22/08	9.71	672	13.24	821
9/23/08	9.4	681	13.16	834
9/24/08	9.71	691	12.98	847
9/25/08	9.09	700	12.62	860
9/26/08	9.09	709	12.77	873
9/27/08	9.86	719	12.62	885
9/28/08	10.17	729	13.08	898
9/29/08	11.41	740	13.70	912
9/30/08	11.87	752	13.54	926
10/1/08	11.87	764	12.77	938
10/2/08	11.72	776	12.62	951
10/3/08	10.94	787	11.37	962
10/4/08	10.02	797	11.37	974
10/5/08	9.4	806	11.37	985
10/6/08	9.09	815	11.06	996
10/7/08	8.63	824	10.44	1007
10/8/08	8.17	832	10.76	1017
10/9/08	7.41	840	10.44	1028
10/10/08	6.94	847	10.44	1038
10/11/08	7.41	854	10.60	1049
10/12/08	8.33	862	10.13	1059
10/13/08	8.17	870	10.29	1069
10/14/08	7.87	878	10.13	1079
10/15/08	7.87	886	9.98	1089

10/16/08	7.09	893	9.51	1099
10/17/08	7.56	901	9.66	1108
10/18/08	7.09	908	9.19	1118
10/19/08	6.79	915	9.04	1127
10/20/08	6.79	922	8.58	1135
10/21/08	6.79	928	8.28	1144
10/22/08	8.02	936	8.12	1152
10/23/08	7.09	943	7.82	1160
10/24/08	7.41	951	7.82	1167
10/25/08	5.86	957	7.82	1175
10/26/08	5.7	962	7.97	1183
10/27/08	6.79	969	7.97	1191
10/28/08	7.71	977	7.51	1199
10/29/08	6.32	983	7.51	1206
10/30/08	5.54	989	7.66	1214
10/31/08	6.94	996	7.82	1222
11/1/08	7.71	1003	7.82	1229
11/2/08	8.02	1011	7.51	1237
11/3/08	6.63	1018	7.35	1244
11/4/08	5.86	1024	7.19	1251
11/5/08	5.54	1029	7.19	1259
11/6/08	6.17	1036	7.35	1266
11/7/08	7.41	1043	7.19	1273
11/8/08	7.25	1050	6.57	1280
11/9/08	5.39	1056	6.88	1287
11/10/08	5.7	1061	7.04	1294
11/11/08	6.32	1068	6.73	1300
11/12/08	6.32	1074	6.42	1307
11/13/08	5.54	1080	6.73	1314
11/14/08	5.86	1085	6.57	1320
11/15/08	5.86	1091	6.42	1327
11/16/08	5.23	1096	6.73	1333
11/17/08	6.63	1103	6.26	1340
11/18/08	5.23	1108	6.11	1346
11/19/08	4.46	1113	6.11	1352
11/20/08	5.08	1118	5.95	1358
11/21/08	4.92	1123	5.79	1364
11/22/08	4.62	1127	5.79	1369
11/23/08	4.77	1132	5.95	1375
11/24/08	5.39	1138	5.79	1381
11/25/08	4.77	1142	5.79	1387
11/26/08	4.92	1147	5.79	1393
11/27/08	5.23	1153	5.79	1398
11/28/08	5.86	1158	5.79	1404
11/29/08	6.17	1165	6.11	1410
11/30/08	7.41	1172	5.17	1415
12/1/08	4.46	1176	5.02	1421
12/2/08	3.37	1180	5.02	1426
12/3/08	2.9	1183	5.17	1431
12/4/08	3.84	1187	5.48	1436

12/5/08	5.54	1192	5.48	1442
12/6/08	6.01	1198	5.48	1447
12/7/08	5.86	1204	5.33	1452
12/8/08	5.23	1209	5.48	1458
12/9/08	5.23	1214	5.33	1463
12/10/08	4.92	1219	5.17	1468
12/11/08	5.08	1224	5.02	1473
12/12/08	3.68	1228	4.23	1478
12/13/08	0.85	1229	4.08	1482
12/14/08	0.37	1229	4.08	1486
12/15/08	0.21	1229	4.23	1490
12/16/08	0.37	1230	3.61	1494
12/17/08	0.21	1230	3.29	1497
12/18/08	0.21	1230	3.14	1500
12/19/08	0.21	1230	3.14	1503
12/20/08	0.21	1231	3.14	1506
12/21/08	0.21	1231	2.82	1509
12/22/08	0.21	1231	3.14	1512
12/23/08	0.21	1231	3.29	1516
12/24/08	0.21	1232	2.82	1518
12/25/08	0.21	1232	3.14	1522
12/26/08	0.21	1232	3.29	1525
12/27/08	0.21	1232	2.98	1528
12/28/08	0.21	1232	2.82	1531
12/29/08	0.21	1233	2.35	1533
12/30/08	0.21	1233	2.35	1535
12/31/08	0.21	1233	2.67	1538
1/1/09	0.21	1233	1.56	1540
1/2/09	0.37	1234	2.35	1542
1/3/09	0.37	1234	2.03	1544
1/4/09	0.21	1234	2.51	1547
1/5/09	0.21	1234	2.98	1550
1/6/09	0.21	1235	2.98	1552
1/7/09	0.21	1235	2.51	1555
1/8/09	0.21	1235	2.98	1558
1/9/09	0.37	1235	2.98	1561
1/10/09	0.69	1236	2.82	1564
1/11/09	0.85	1237	2.19	1566
1/12/09	0.53	1237	2.98	1569
1/13/09	1.17	1239	3.29	1572
1/14/09	1.33	1240	3.29	1576
1/15/09	1.48	1241	2.98	1579
1/16/09	1.48	1243	2.98	1581
1/17/09	1.64	1245	2.98	1584
1/18/09	1.48	1246	2.98	1587
1/19/09	1.64	1248	2.98	1590
1/20/09	1.33	1249	3.29	1594
1/21/09	1.8	1251	2.82	1597
1/22/09	1.33	1252	2.51	1599
1/23/09	0.53	1253	2.19	1601

1/24/09	0.21	1253	2.19	1603
1/25/09	0.21	1253	2.51	1606
1/26/09	0.21	1253	2.35	1608
1/27/09	0.53	1254	2.82	1611
1/28/09	1.17	1255	2.82	1614
1/29/09	1.48	1256	2.82	1617
1/30/09	1.17	1258	3.14	1620
1/31/09	1.33	1259	2.98	1623
2/1/09	1.33	1260	3.14	1626
2/2/09	1.8	1262	3.14	1629
2/3/09	1.96	1264	3.29	1632
2/4/09	1.96	1266	3.29	1636
2/5/09	1.96	1268	3.29	1639
2/6/09	1.96	1270	2.82	1642
2/7/09	1.96	1272	3.14	1645
2/8/09	1.64	1274	3.14	1648
2/9/09	1.48	1275	2.98	1651
2/10/09	1.64	1277	2.98	1654
2/11/09	1.48	1278	2.98	1657
2/12/09	1.64	1280	2.67	1660
2/13/09	0.85	1281	2.67	1662
2/14/09	0.21	1281	2.67	1665
2/15/09	0.21	1281	2.67	1668
2/16/09	0.21	1281	2.35	1670
2/17/09	0.21	1281	2.67	1673
2/18/09	0.21	1282	2.67	1675
2/19/09	0.21	1282	2.82	1678
2/20/09	0.21	1282	3.14	1681
2/21/09	0.37	1282	0.67	1682
2/22/09	0.53	1283	2.98	1685
2/23/09	0.85	1284	2.35	1687
2/24/09	0.53	1284	1.56	1689
2/25/09	0.21	1285	2.03	1691
2/26/09	0.21	1285	2.51	1693
2/27/09	0.21	1285	2.67	1696
2/28/09	0.37	1285	2.82	1699
3/1/09	0.21	1286	2.82	1702
3/2/09	0.53	1286	2.98	1705
3/3/09	1.17	1287	2.82	1708
3/4/09	1.48	1289	2.67	1710
3/5/09	1.17	1290	2.67	1713
3/6/09	1.33	1291	2.67	1716
3/7/09	0.69	1292	2.35	1718
3/8/09	0.85	1293	1.56	1720
3/9/09	0.21	1293	1.56	1721
3/10/09	0.21	1293	2.35	1723
3/11/09	0.21	1293	2.19	1726
3/12/09	0.21	1294	2.35	1728
3/13/09	0.69	1294	2.35	1730
3/14/09	0.85	1295	2.51	1733

3/15/09	1.33	1297	2.03	1735
3/16/09	0.85	1297	1.72	1737
3/17/09	1.01	1298	2.36	1739
3/18/09	1.01	1299	2.35	1741
3/19/09	1.64	1301	2.51	1744
3/20/09	1.33	1302	2.67	1746
3/21/09	1.33	1304	2.98	1749
3/22/09	1.8	1305	2.82	1752
3/23/09	1.8	1307	2.67	1755
3/24/09	1.48	1309	2.82	1758
3/25/09	1.48	1310	2.98	1761
3/26/09	1.96	1312	2.98	1764
3/27/09	1.8	1314	2.98	1767
3/28/09	1.8	1316	2.98	1770
3/29/09	1.8	1318	2.51	1772
3/30/09	1.64	1319	2.98	1775
3/31/09	1.96	1321	3.14	1778
4/1/09	1.96	1323	3.14	1781
4/2/09	1.96	1325	3.14	1785
4/3/09	2.59	1328	3.77	1788
4/4/09	2.9	1331	3.61	1792
4/5/09	2.27	1333	3.45	1795
4/6/09	2.27	1335	3.61	1799
4/7/09	2.74	1338	3.77	1803
4/8/09	2.74	1341	3.92	1807
4/9/09	3.06	1344	3.77	1810
4/10/09	2.9	1347	4.08	1815
4/11/09	3.22	1350	3.92	1818
4/12/09	3.06	1353	3.29	1822
4/13/09	2.9	1356	3.92	1826
4/14/09	3.37	1359	4.08	1830
4/15/09	3.84	1363	4.08	1834
4/16/09	3.37	1366	3.61	1837
4/17/09	2.9	1369	3.92	1841
4/18/09	3.37	1373	4.08	1845
4/19/09	3.37	1376	3.77	1849
4/20/09	3.84	1380	3.61	1853
4/21/09	3.99	1384	3.92	1857
4/22/09	3.84	1388	3.92	1861
4/23/09	4.31	1392	3.77	1864
4/24/09	4.31	1396	4.08	1869
4/25/09	4.92	1401	4.23	1873
4/26/09	5.39	1407	4.39	1877
4/27/09	5.86	1412	4.39	1882
4/28/09	6.17	1419	4.55	1886
4/29/09	6.48	1425	4.71	1891
4/30/09	7.09	1432	4.86	1896
5/1/09	7.71	1440	4.71	1900
5/2/09	8.33	1448	4.55	1905
5/3/09	7.56	1456	4.55	1909

5/4/09	6.79	1463	4.55	1914
5/5/09	7.09	1470	4.71	1919
5/6/09	8.94	1479	4.86	1924
5/7/09	9.24	1488	4.71	1928
5/8/09	9.24	1497	4.71	1933
5/9/09	9.86	1507	4.71	1938
5/10/09	9.24	1516	4.55	1942
5/11/09	8.63	1525	6.71	1949
5/12/09	8.02	1533	6.73	1956
5/13/09	8.63	1541	7.19	1963
5/14/09	9.24	1551	5.64	1969
5/15/09	8.17	1559	6.73	1975
5/16/09	7.71	1567	7.19	1982
5/17/09	8.78	1575	6.79	1989
5/18/09	10.33	1586	6.11	1995
5/19/09	11.25	1597	7.04	2002
5/20/09	9.56	1607	6.73	2009
5/21/09	10.17	1617	6.11	2015
5/22/09	9.86	1627	6.88	2022
5/23/09	10.33	1637	10.13	2032
5/24/09	10.02	1647	9.82	2042
5/25/09	9.56	1656	8.43	2051
5/26/09	9.86	1666	10.29	2061
5/27/09	7.71	1674	9.19	2070
5/28/09	7.56	1682	7.97	2078
5/29/09	7.56	1689	7.19	2085
5/30/09	7.56	1697	7.97	2093
5/31/09	7.87	1705	10.60	2104
6/1/09	8.63	1713	10.44	2114
6/2/09	10.94	1724	10.13	2124
6/3/09	11.56	1736	9.51	2134
6/4/09	11.87	1748	9.19	2143
6/5/09	11.56	1759	13.85	2157
6/6/09	12.02	1771	9.35	2166
6/7/09	11.25	1782	9.98	2176
6/8/09	10.94	1793	11.22	2187
6/9/09	11.72	1805	12.77	2200
6/10/09	11.72	1817	12.77	2213
6/11/09	11.25	1828	12.77	2226
6/12/09	10.79	1839	12.62	2238
6/13/09	10.94	1850	14.01	2252
6/14/09	11.41	1861	14.47	2267
6/15/09	11.1	1872	14.16	2281
6/16/09	11.25	1884	14.01	2295
6/17/09	11.1	1895	14.47	2309
6/18/09	11.1	1906	12.62	2322
6/19/09	10.63	1916	13.24	2335
6/20/09	10.33	1927	13.39	2349
6/21/09	10.17	1937	13.24	2362
6/22/09	10.33	1947	13.85	2376

6/23/09	10.33	1958	12.62	2388
6/24/09	10.33	1968	12.14	2401
6/25/09	10.02	1978	13.08	2414
6/26/09	10.02	1988	12.30	2426
6/27/09	9.56	1997	12.14	2438
6/28/09	9.86	2007	11.52	2450
6/29/09	9.56	2017	10.91	2460
6/30/09	9.4	2026	11.52	2472
7/1/09	9.56	2036	11.83	2484
7/2/09	11.1	2047	12.77	2497
7/3/09	11.41	2058	12.30	2509
7/4/09	11.1	2069	13.39	2522
7/5/09	11.72	2081	12.77	2535
7/6/09	11.72	2093	13.54	2549
7/7/09	11.41	2104	14.32	2563
7/8/09	12.18	2116	15.26	2578
7/9/09	12.33	2129	14.47	2593
7/10/09	11.72	2141	14.94	2608
7/11/09	12.33	2153	15.26	2623
7/12/09	12.49	2165	15.11	2638
7/13/09	11.87	2177	15.26	2653
7/14/09	11.87	2189	15.42	2669
7/15/09	12.18	2201	16.21	2685
7/16/09	12.33	2214	16.37	2701
7/17/09	12.96	2227	16.53	2718
7/18/09	12.64	2239	16.53	2734
7/19/09	12.96	2252	16.21	2750
7/20/09	12.96	2265	16.06	2767
7/21/09	12.49	2278	16.53	2783
7/22/09	12.18	2290	17.17	2800
7/23/09	12.8	2303	17.01	2817
7/24/09	13.11	2316	16.85	2834
7/25/09	14.03	2330	17.65	2852
7/26/09	14.19	2344	18.62	2870
7/27/09	14.81	2359	19.11	2889
7/28/09	15.28	2374	19.11	2909
7/29/09	14.81	2389	19.59	2928
7/30/09	14.81	2404	19.11	2947
7/31/09	14.97	2419	18.78	2966
8/1/09	14.34	2433	18.78	2985
8/2/09	13.88	2447	18.94	3004
8/3/09	13.42	2460	18.94	3023
8/4/09	14.03	2474	19.92	3043
8/5/09	14.19	2488	19.43	3062
8/6/09	13.88	2502	18.46	3081
8/7/09	13.57	2516	18.46	3099
8/8/09	13.88	2530	17.81	3117
8/9/09	12.96	2543	17.65	3134
8/10/09	12.8	2556	16.69	3151

Table 5 Sampling Data of Kumealeon chums in 2010

Date	Fish #	Species	Fin Clip	Scale #	Scale BK #	Length (cm)	Sex	Comments
25-Jul	1	Chum	NA	0.1	80482	65.6	F	Ventral Fin eaten
28-Jul	2	Chum	No	0.2	80482	NA	NA	
28-Jul	3	Chum	No	NA	80482	71.1	M	
28-Jul	4	Chum	No	NA	80482	71.1	F	Very mature
28-Jul	5	Chum	No	NA	80482	74.9	M	
30-Jul	6	Chum	No	0.6	80482	NA	NA	Head eaten
30-Jul	7	Chum	NA	0.7	80482	73.7	F	Ventral Fin eaten
30-Jul	8	Chum	No	0.8	80482	66	M	
30-Jul	9	Chum	No	0.9	80482	82.5	M	
30-Jul	10	Chum	No	NA	80482	71.1	F	
02-Aug	11	Chum	No	1.1	80481	78.7	M	
02-Aug	12	Chum	No	1.2	80481	71.1	M	
02-Aug	13	Chum	No	1.3	80481	68.5	F	
02-Aug	14	Chum	No	NA	80481	71.1	M	
04-Aug	15	Chum	No	NA	80481	76.2	F	
04-Aug	16	Chum	NA	1.6	80481	NA	NA	
04-Aug	17	Chum	No	NA	80481	74.9	F	
04-Aug	18	Chum	No	NA	80481	74.9	M	
04-Aug	19	Chum	No	NA	80481	71.1	F	
04-Aug	20	Chum	No	1.10	80481	71	F	
08-Aug	21	Chum	No	NA	80486	74.9	F	
08-Aug	22	Chum	No	NA	80486	67.3	M	
08-Aug	23	Chum	No	NA	80486	73.7	F	
08-Aug	24	Chum	No	2.4	80486	73	M	
08-Aug	25	Chum	No	2.5	80486	80	M	
08-Aug	26	Chum	No	2.6	80486	73.7	M	
08-Aug	27	Chum	No	2.7	80486	67.9	F	
08-Aug	28	Chum	No	2.8	80486	72.4	M	
08-Aug	29	Chum	No	2.9	80486	78.7	M	
08-Aug	30	Chum	No	2.10	80486	71.12	F	
08-Aug	31	Chum	No	3.1	80484	77.5	M	
08-Aug	32	Chum	No	NA	80484	81.2	M	
08-Aug	33	Chum	No	NA	80484	64.7	M	
11-Aug	34	Chum	No	3.4	80484	61	M	
11-Aug	35	Chum	No	NA	80484	71.1	F	
11-Aug	36	Chum	No	NA	80484	74.3	F	
11-Aug	37	Chum	No	3.7	80484	78.7	M	
11-Aug	38	Chum	No	3.8	80484	66.7	M	
11-Aug	39	Chum	No	3.9	80484	63.5	M	
11-Aug	40	Chum	No	3.10	80484	71.1	F	
11-Aug	41	Chum	No	4.1	80485	82.6	M	
11-Aug	42	Chum	No	NA	80485	81.5	M	
11-Aug	43	Chum	No	NA	80485	81.3	M	

11-Aug	44	Chum	No	NA	80485	78.7	M	
11-Aug	45	Chum	No	4.5	80485	78.7	M	
11-Aug	46	Chum	No	NA	80485	86.3	M	
11-Aug	47	Chum	No	4.7	80485	87.6	F	
11-Aug	48	Chum	No	4.8	80485	71.1	F	
11-Aug	49	Chum	No	4.9	80485	87.6	M	
11-Aug	50	Chum	No	4.10	80485	77.5	M	
11-Aug	51	Chum	No	5.1	80490	68.6	M	
11-Aug	52	Chum	No	NA	80490	78.7	M	
11-Aug	53	Chum	No	5.3	80490	78.7	M	
11-Aug	54	Chum	No	NA	80490	82.6	M	
11-Aug	55	Chum	No	5.5	80490	68.6	M	
11-Aug	56	Chum	No	5.6	80490	78.7	M	
11-Aug	57	Chum	No	5.7	80490	68.6	M	
11-Aug	58	Chum	No	5.8	80490	74.9	M	
11-Aug	59	Chum	No	5.9	80490	73.7	F	
11-Aug	60	Chum	No	NA	80490	68.6	F	
11-Aug	61	Chum	No	NA		71.1	M	No scales taken
11-Aug	62	Chum	No	NA		80.0	M	No scales taken
11-Aug	63	Chum	No	NA		69.9	M	No scales taken
11-Aug	64	Chum	No	NA		82.6	M	No scales taken
11-Aug	65	Chum	No	NA		67.3	M	No scales taken
11-Aug	66	Chum	No	NA		72.4	F	No scales taken
11-Aug	67	Chum	No	NA		73.7	M	No scales taken
11-Aug	68	Chum	No	NA		69.9	F	No scales taken
11-Aug	69	Chum	No	NA		74.9	M	No scales taken
11-Aug	70	Chum	No	NA		77.5	M	No scales taken
12-Aug	71	Chum	No	7.1	80487	86.4	M	
12-Aug	72	Chum	No	7.2	80487	73.7	F	
12-Aug	73	Chum	No	7.3	80487	74.9	M	
12-Aug	74	Chum	No	7.4	80487	72.4	M	
12-Aug	75	Chum	No	NA	80487	80.0	M	
12-Aug	76	Chum	No	NA	80487	78.7	M	
12-Aug	77	Chum	No	7.7	80487	68.6	F	
12-Aug	78	Chum	No	NA	80487	86.4	M	
12-Aug	79	Chum	No	7.9	80487	68.6	F	
12-Aug	80	Chum	No	7.10	80487	74.9	M	
11-Aug	81	Chum	No	8.1	80489	82.6	M	
11-Aug	82	Chum	No	NA	80489	73.7	M	
12-Aug	83	Chum	No	8.3	80489	76.2	M	
12-Aug	84	Chum	No	NA	80489	76.2	M	
12-Aug	85	Chum	No	8.5	80489	71.1	F	

12-Aug	86	Chum	No	NA	80489	73.7	M	
12-Aug	87	Chum	No	8.7	80489	94.0	F	
12-Aug	88	Chum	No	8.8	80489	73.7	M	
12-Aug	89	Chum	No	NA	80489	80.0	M	
12-Aug	90	Chum	No	NA	80489	63.5	F	
12-Aug	91	Chum	No	9.1	80488	78.7	M	
12-Aug	92	Chum	No	9.2	80488	83.8	M	
11-Aug	93	Chum	No	9.3	80488	73.7	F	
11-Aug	94	Chum	No	9.4	80488	71.1	M	
12-Aug	95	Chum	No	NA	80488	71.1	F	
12-Aug	96	Chum	No	9.6	80488	81.3	M	
12-Aug	97	Chum	No	NA	80488	67.3	F	
12-Aug	98	Chum	No	9.8	80488	68.6	M	
12-Aug	99	Chum	No	9.9	80488	81.3	M	
12-Aug	100	Chum	No	9.10	80488	81.3	M	
14-Aug	101	Chum	No	10.1	77038	67.3	M	
14-Aug	102	Chum	No	10.2	77038	77.5	M	
14-Aug	103	Chum	No	10.3	77038	74.9	M	
15-Aug	104	Chum	No	10.4	77038	76.2	M	
15-Aug	105	Chum	No	NA	77038	73.7	F	
15-Aug	106	Chum	No	10.6	77038	72.4	M	
15-Aug	107	Chum	No	10.7	77038	78.7	M	
15-Aug	108	Chum	No	NA	77038	78.7	M	
15-Aug	109	Chum	No	NA	77038	67.3	F	
15-Aug	110	Chum	No	10.10	77038	70.5	F	
15-Aug	111	Chum	No	NA	77039	71.1	F	
15-Aug	112	Chum	No	NA	77039	74.9	M	
15-Aug	113	Chum	No	NA	77039	74.9	M	
15-Aug	114	Chum	No	NA	77039	77.5	M	
15-Aug	115	Chum	No	NA	77039	64.8	F	
15-Aug	116	Chum	No	NA	77039	85.1	M	
15-Aug	117	Chum	No	11.7	77039	82.6	M	
15-Aug	118	Chum	No	NA	77039	67.3	F	
15-Aug	119	Chinook	No	11.9	77039	97.8	F	
15-Aug	120	Chum	No	NA	77039	72.4	F	
15-Aug	121	Chum	No	NA	NA	71.12	F	No scales taken
15-Aug	122	Chum	No	NA	NA	81.28	M	No scales taken
17-Aug	131	Chum	No	13.1	77035	77.47	M	
17-Aug	132	Chum	No	13.2	77035	78.74	M	
17-Aug	133	Chum	No	13.3	77035	64.77	F	
17-Aug	134	Chum	No	NA	77035	86.36	M	
17-Aug	135	Chum	No	NA	77035	62.23	F	
17-Aug	136	Chum	No	NA	77035	72.39	M	
17-Aug	137	Chum	No	13.7	77035	64.77	F	
17-Aug	138	Chum	No	13.8	77035	72.39	M	
17-Aug	139	Chum	No	13.9	77035	78.74	M	
17-Aug	140	Chum	No	NA	77035	82.55	M	
17-Aug	141	Chum	No			72.39	F	
17-Aug	142	Chum	No			77.47	F	

17-Aug	143	Chum	No			73.66	F
17-Aug	144	Chum	No			67.31	F
17-Aug	145	Chum	No			67.31	F
17-Aug	146	Chum	No			66.04	F
17-Aug	147	Chum	No			68.58	M
17-Aug	148	Chum	No			66.04	F
17-Aug	149	Chum	No			71.12	F
17-Aug	150	Chum	No			71.12	M
20-Aug	151	Chum	No	NA	77036	71.1	F
20-Aug	152	Chum	No	15.2	77036	71.1	F
20-Aug	153	Chum	No	15.3	77036	64.8	F
20-Aug	154	Chum	No	15.4	77036	73.7	M
20-Aug	155	Chum	No		77036	58.4	F
20-Aug	156	Chum	No	15.6	77036	67.3	F
22-Aug	157	Chum	No	15.7	77036	80.0	F
25-Aug	158	Chum	No	15.8	77036	64.8	F
25-Aug	159	Chinook	No	15.9	77036	91.4	F
25-Aug	160	Chinook	No			91.4	F
25-Aug	161	Chinook	No			63.5	M
25-Aug	162	Chum	No			69.9	F
25-Aug	163	Chum	No			78.7	M
25-Aug	164	Chum	No			69.9	F
25-Aug	165	Chum	No			72.4	M