2012 Pacific Ocean Parks Technical Assistance

Monitoring beluga whales in Yakutat Bay and the waters of Wrangell-St Elias National Park

FINAL Report - December 2013

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1. WORK COMPLETED

In June 2012, four C-PODs were deployed in the waters of the WRST National Park, Reserve and adjacent Disenchantment Bay area. The selected locations, shown in Figure 1, were:

1- Off Grand Wash River mouth
2- Off Esker Creek mouth
3- Turner Glacier
4- North of Khantaak island

Three units were deployed with an acoustic release in areas of higher risk of potential entanglement or interaction with ice (1, 2 and 3) and one unit was deployed with a standard surface buoy configuration (4).

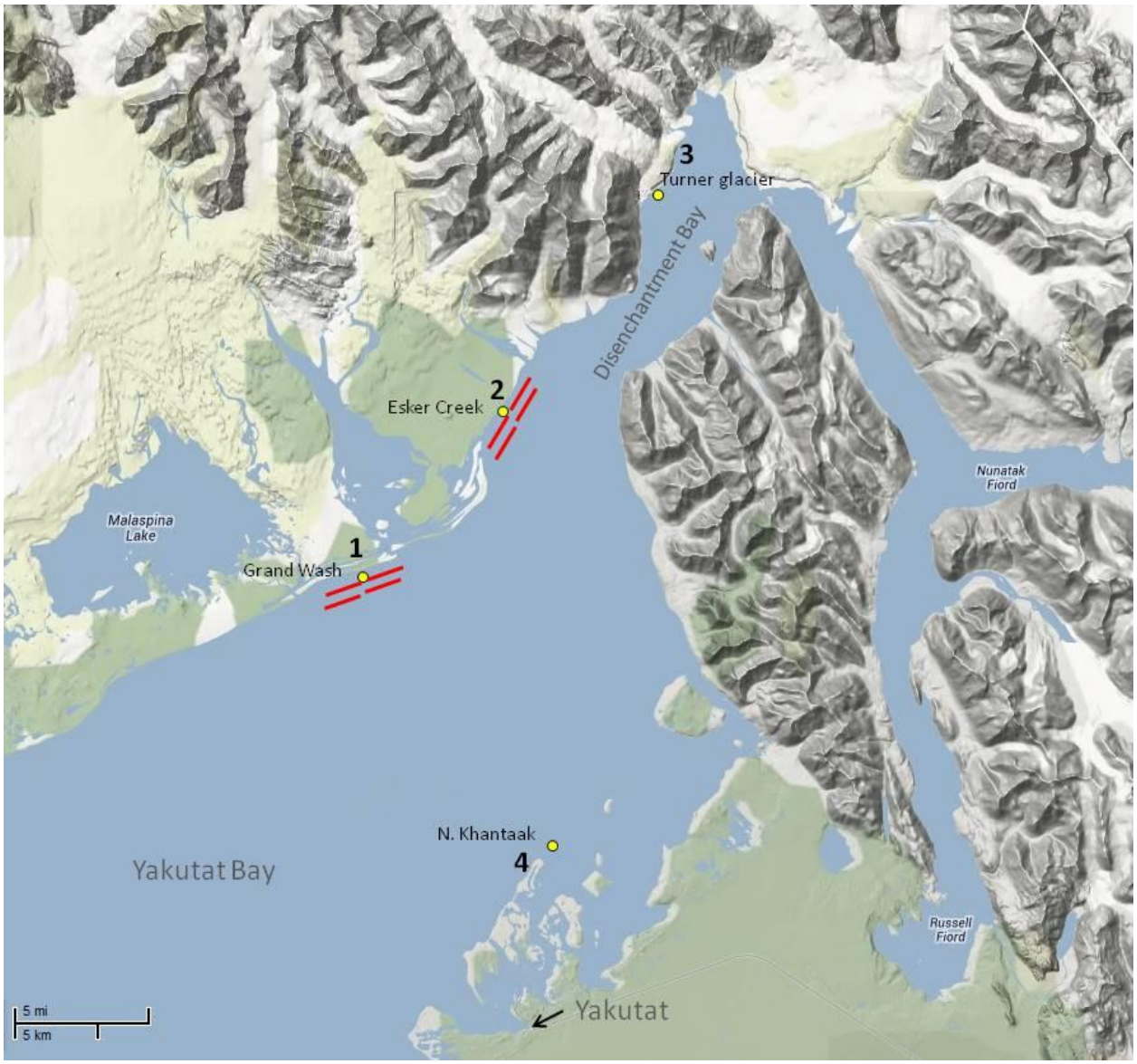


Figure 1: Map of Disenchantment and Yakutat Bays, mooring deployment locations (yellow circles) and trawl transects (red lines).

The instruments were attempted to be recovered in October 2012 to refurbish and redeploy them in same locations to overwinter. During the October field work, only two moorings were recovered and redeployed (Grand Wash River and Esker Creek), one was found but non-recoverable as it was stuck in sediment (Turner Glacier) and one was lost (Khantaak).

A third one-day field trip was organized later in October 2012 to try to recover the stuck mooring near Turner Glacier and look for the lost mooring in Khantaak. A grapple system was used to attempt entangling the moorings in the recovery line. Despite multiple grappling

attempts in and around the GPS location of the deployment, none of the moorings were recovered.

A fourth one-day field trip was organized in March 2013 with an underwater camera system to try to visually locate the lost moorings in Khantaak and Turner Glacier. However, turbidity was too high to locate the moorings (Fig. 2).

Figure 2: video still of the bottom in Turner Glacier location. The lower right side of the screen includes a boulder sitting in the bottom approximately 3 feet away to appreciate the high turbidity level in that location.

A fifth trip was organized in June 2013 to recover the two remaining moorings and try once more to grapple the Turner Glacier stuck mooring. Turner Glacier terminus had advanced drastically and the mooring location was under the glacier, therefore it was impossible to attempt any recovery and it was determined that this mooring was no longer recoverable. The Grand Wash mooring was recovered but the Esker Creek mooring did not surface despite successful communications with the release and was not successfully grappled even though several attempts were made. The subsurface float recovered in the Grand Wash mooring was badly damaged and collapsed and had lost most of its flotation (Fig. 3).

Figure 2: Grand Wash mooring recovered in June 2013. The black spherical subsurface float is collapsed and punctured.

2. METHODS

Acoustic moorings were composed of an echolocation logger (C-POD, Chelonia Ltd.) that continuosly listens for echolocation signals in the range 20-160 kHz and logs the date, time, and acoustic parameters of detected signals, an acoustic release (CART, ORE Edgetech) that releases the mooring from its anchor when activatedby an acoustic signal from a deck unit. The mooring configuration was linear, with a vinyl subsurface float 3 feet above the C-POD and an anchor comprised of 5 gravel bags with a total approximate weitgh of 150 lbs (Fig. 3).

C-POD data were analyzed with custom written software from the manufacturer (CPOD.exe version 2.043, Chelonia Ltd.) using train and click settings shown in Table 1. All porpoise and beluga whaledetections were manually validated to correct errors in the automatic classification or omit false detections.

Fish and invertabrate data was collected utlizing a bottom trawl as part of a separate study conducted by the City and Borough of Yakutat in cooperation with the US Army Corps of Engineers. The mouth of the trawl is 2.6 m wide and 1.2 m deep and is attached to a 6.3 m long brindle of 2.1 cm braided line. The trawl has two weighted doors (33 cm by 61 cm) and is 5.2 m in total length; inside the outer skirt of 29 mm stretch mesh is a 1.7 m long cod end of 3.2 mm stretch mesh. The trawl was towed from the boat at about 2-2.5 knots for 5 minutes. Scope of the tow line (1.6 cm polypropylene) was 30 m. Four sets of trawls were conducted at each acoustic logging site. The inner trawls were in approximately 7-8 meters in depth and the

outer trawls were 10 -12 meters deep. GPS locations were recorded for the beginning and end of each trawl.

After retrieval of the trawl, the entire catch was sorted into live tanks, then individually sorted to lowest taxon. A total count was taken and a subsample of up to 50 individuals was measured to the nearest millimetertotal length. Life stage was assigned to fish in the field based on ontogenetic characteristics. Fish were considered adults when their length exceeded species-specific estimates of length-at-first-maturity (FishBase 2012). Invertabrates were also individually counted and some amphipods.

Catch data is expressed in absolute numbers (i.e. total catch and species richness) and relative abundance signified by Catch per Unit Effort (CPUE). Total catch is the total number of individuals captured. Individuals not identified to species are counted but only compared if no other species occurred in that taxon. The CPUE is the total numer of species captured per trawl.

Beluga whale and porpoise detection results were converted into detection positive hours (hours with at least one echolocation click train, DPH) and DPH were summed for each day to obtain DPH/day. DPH/day was averaged for each month and the trend was calculated from June to August to compare beluga whale seasonal presence in Esker Creek to trawling data. Total CPUE)/month and CPUE/month for each fish and invertebrate species was compared with beluga whale average DPH/month to identify potential similarities in seasonal presence.

Salmon run data was requested to ADF&G for Grand Wash and Esker for the 2012 season in order to compare beluga and porpoise DPH/day between the salmon run peak periods and the two weeks before and after the peak run periods. Kruskal-Wallis test and post hoc paired comparisons were used in this analysis.

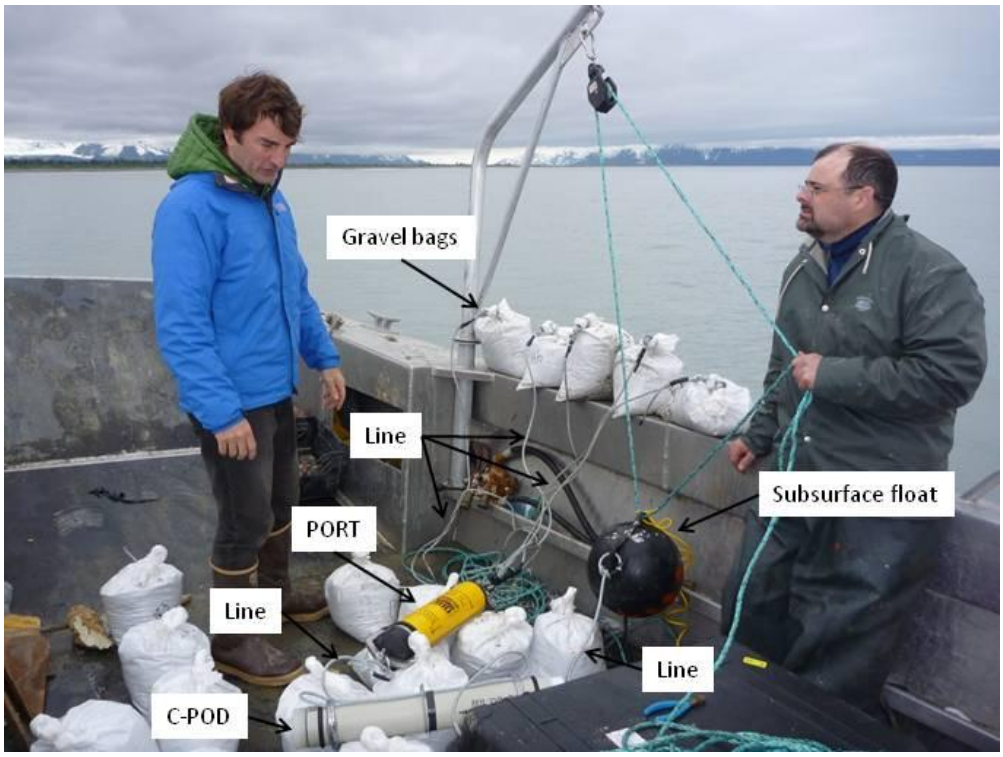
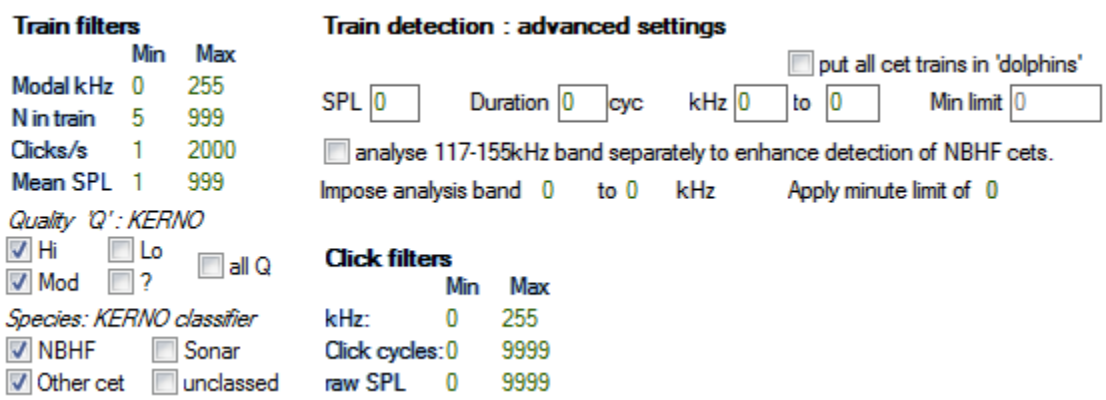


Figure 3: Mooring elements: C-POD (gray instrument), the acoustic release (yellow instrument), gravel bags and subsurface float.

Table 1: CPOD.exe settings for click train detection and classification.



3. RESULTS

Acoustic data were obtained from 2 of the 4 deployment locations. A total of 120 days were acoustically monitored in Esker Creek and 261 days in Grand Wash. Acoustic detections of both beluga whale and harbor porpoise echolocation were identified in each location.

Figure 4 shows the number of DPH per day for the complete deployment period off Grand Wash River for both detected species. Figure 5 shows the number of positive detection hours per day for the complete deployment period off Esker Creek for both detected species.

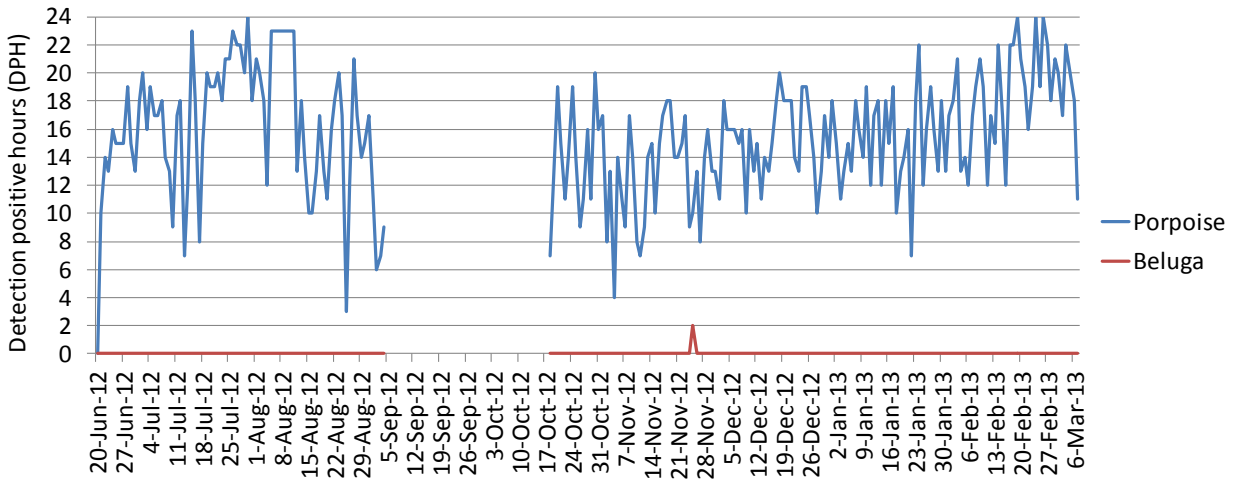


Figure 4: Number of detection positive hours (hours with at least one echolocation click train, DPH) per day for the full deployment period off Grand Wash River for both beluga whale (red line) and harbor porpoise (blue line).

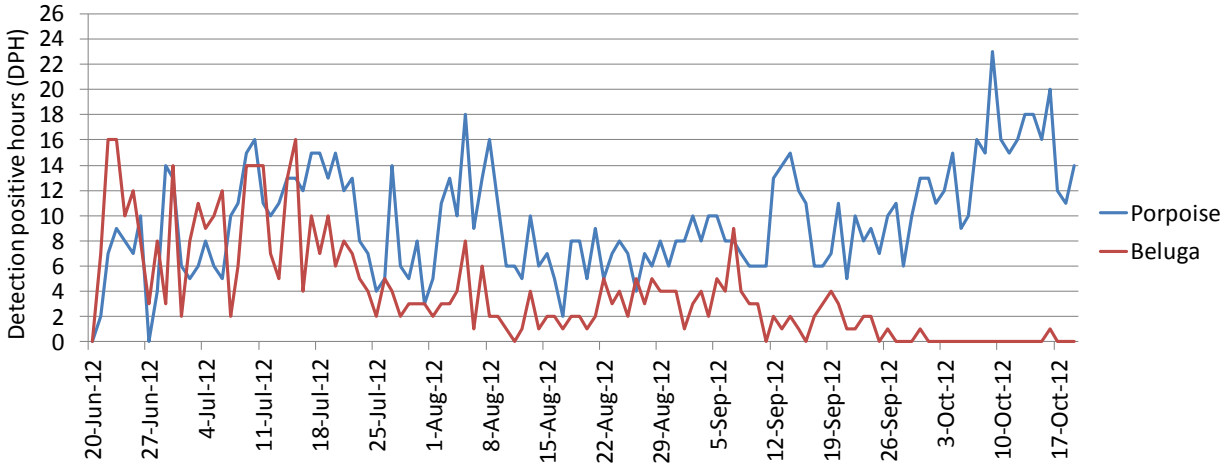


Figure 5: Number of detection positive hours (hours with at least one echolocation click train, DPH) per day for the deployment period off Esker Creek for both beluga whale (red line) and harbor porpoise (blue line).

Beluga whales:

A best fit trend line was calculated to the total catch per unit effort (CPUE)/month for all species and beluga whale average DPH/month for June to August 2013 and is presented in Figure 6. Total CPUE/month for all fish and invertebrate species matching the seasonal pattern of beluga whales is presented in Figure7.

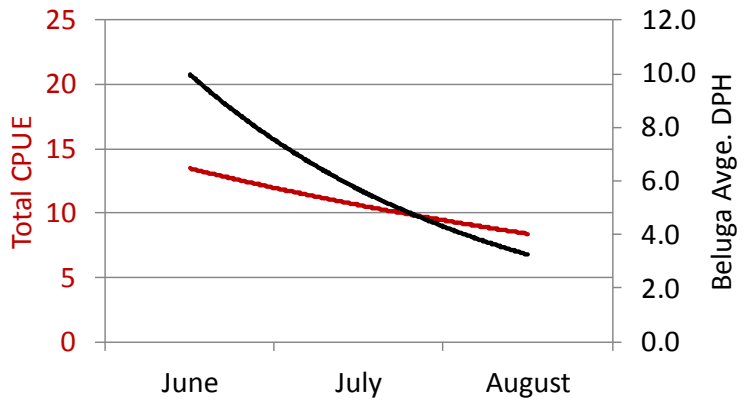


Figure 6: Best fit trend line in total catch per unit effort (CPUE)/month (red) from trawling and in beluga whale average DPH/month (black) in Esker Creek from June to August 2012.

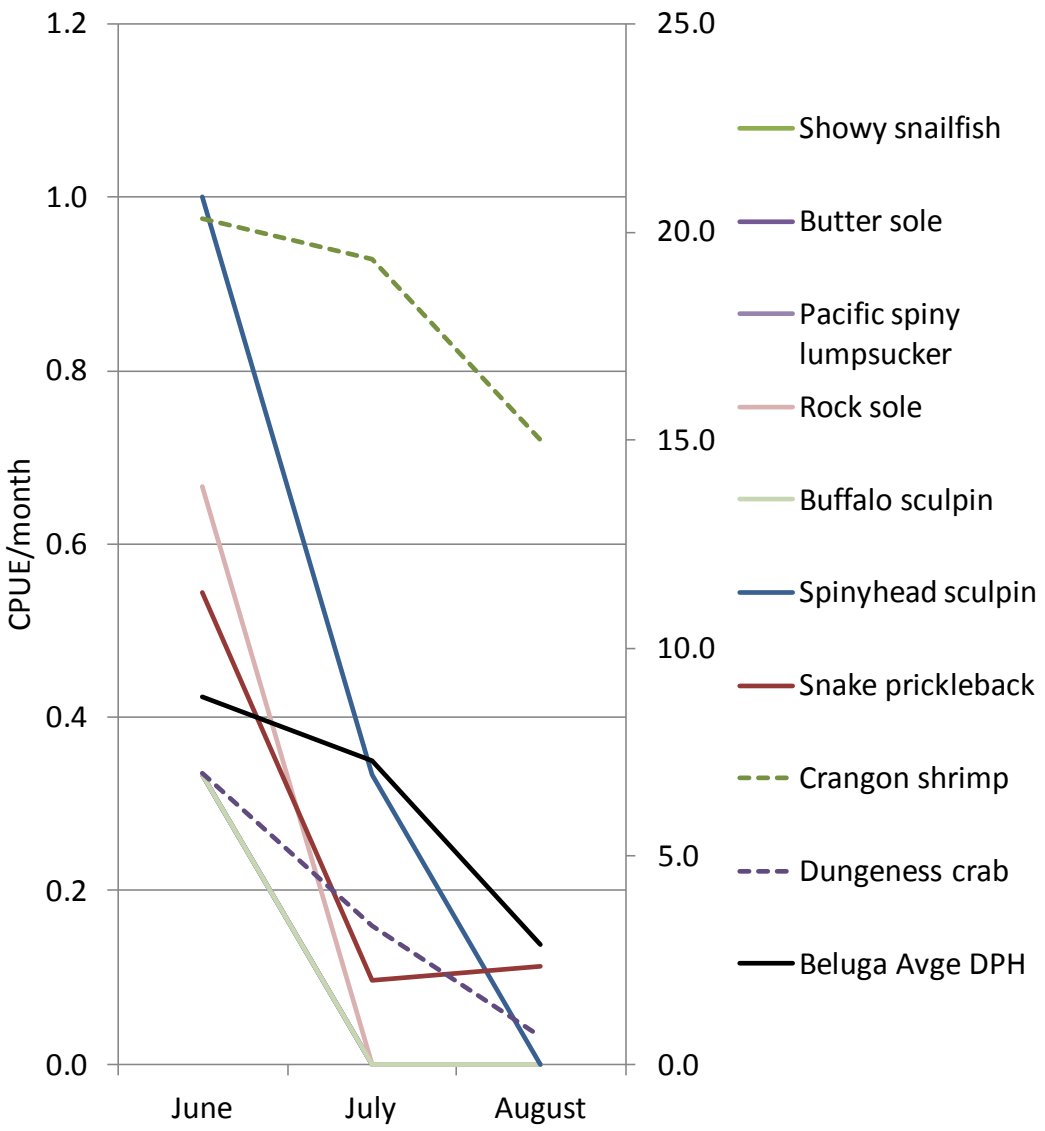


Figure 7: Total CPUE/month by species for fish and invertebrate species matching the seasonal pattern of beluga whales (in average DPH/month). CPUE values for Snake prickleback, Crangon shrimp and Dungeness crab correspond to the right vertical axis, as well as beluga whale average DPH/month.

Harbor porpoise:

Exponential trend of the total catch per unit effort (CPUE)/month and porpoise average DPH/month for June to August 2013 in Esker Creek is presented in Figure 8. Because porpoise DPH data from Grand Wash River is incomplete for the period March to August, results in Figure 6 are not presented in exponential trend but in total values per month. None of the fish

or invertebrates CPUE trends in Esker Creek matched the seasonal pattern of porpoises, but Pacific sandfish and pink shrimp had a relatively similar trend, and are presented in Figure 9. Similarly, for Grand Wash River, only three species showed a relatively similar trend in CPUE and porpoise DPH/month, presented in Figure 10.

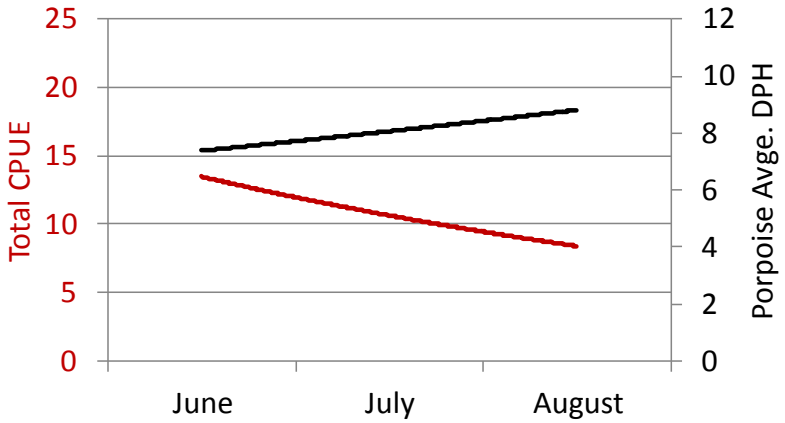


Figure 8: Exponential trend in total catch per unit effort CPUE/month from trawling and in porpoise average DPH/month in Esker Creek from June to August 2012.

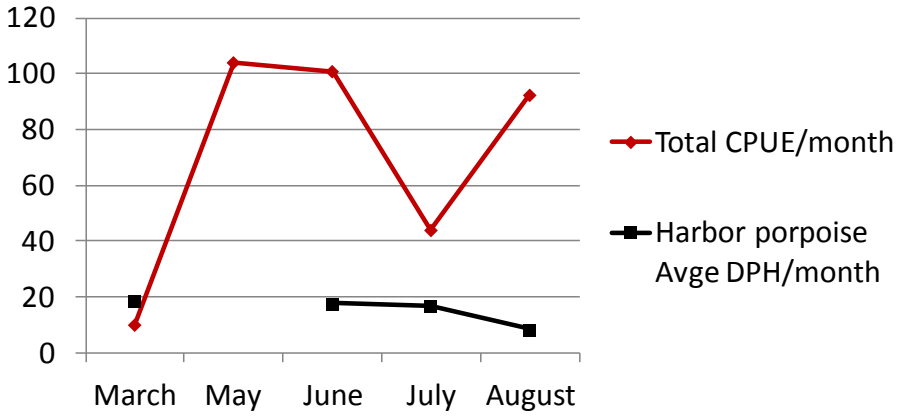


Figure 9: Total catch per unit effort (CPUE) per month from trawling data and porpoise average DPH/month in Grand Wash River from March to August 2012.

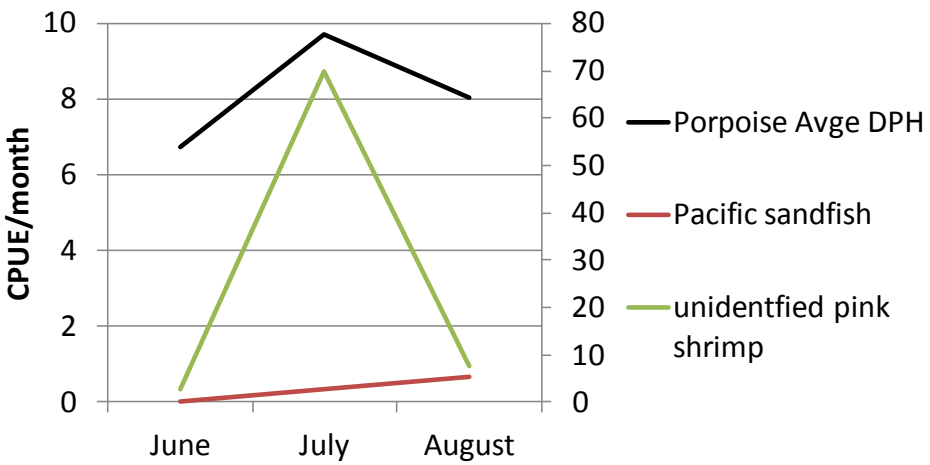


Figure 10: Total CPUE/month for fish and invertebrate species from Esker Creek with similar seasonal presence pattern than porpoises (in average DPH/month). CPUE values for pink shrimp correspond to the right vertical axis.

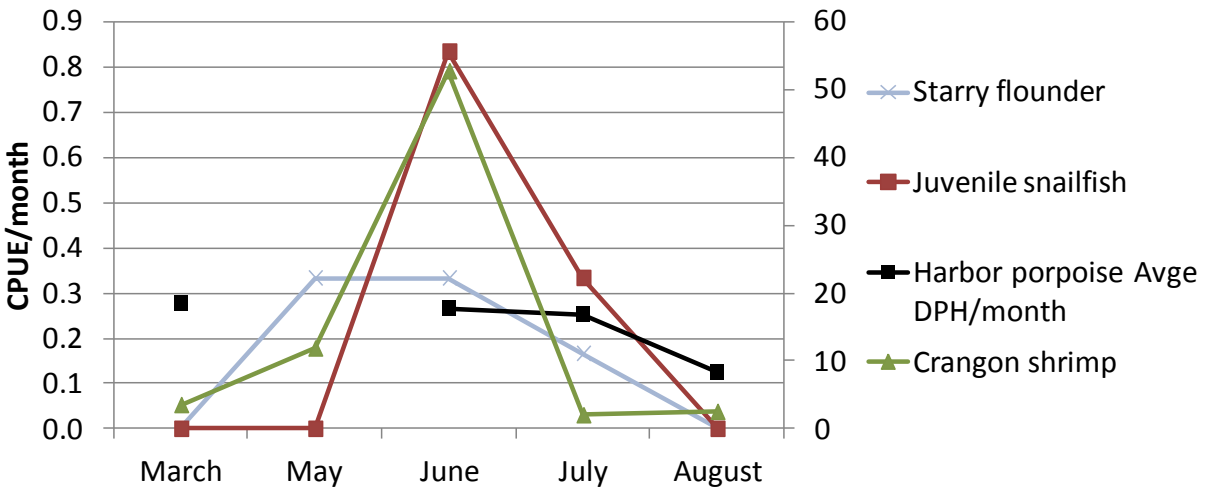


Figure 11: Total CPUE/month for fish species from Grand Wash River with similar seasonal presence pattern than porpoises (in average DPH/month). CPUE values for harbor porpoise DPH/month correspond to the right vertical axis.

Only one salmon run was identified by the ADF&G in Esker Creek and none in Grand Wash River during the 2012 season. Esker Creek accommodated a Coho salmon run from August 25 through October 5, with a peak period in September 1 through September 28 (ADF&G *pers. comm.*).

Highly significant differences were found in DPH/day between the salmon run peak period and the 2 weeks before and after the salmon run peak for both the beluga ($H_{2,56}$ =22.6 $p < 0.01$) and the porpoise ($H_{2,56}$ =31.3 $p < 0.01$). Post hoc paired comparisons highlighted differences between the 2 weeks after the run, the run period and the 2 weeks before the run, but no differences between the week before and the run period for both the beluga and porpoise presence (Fig.12).

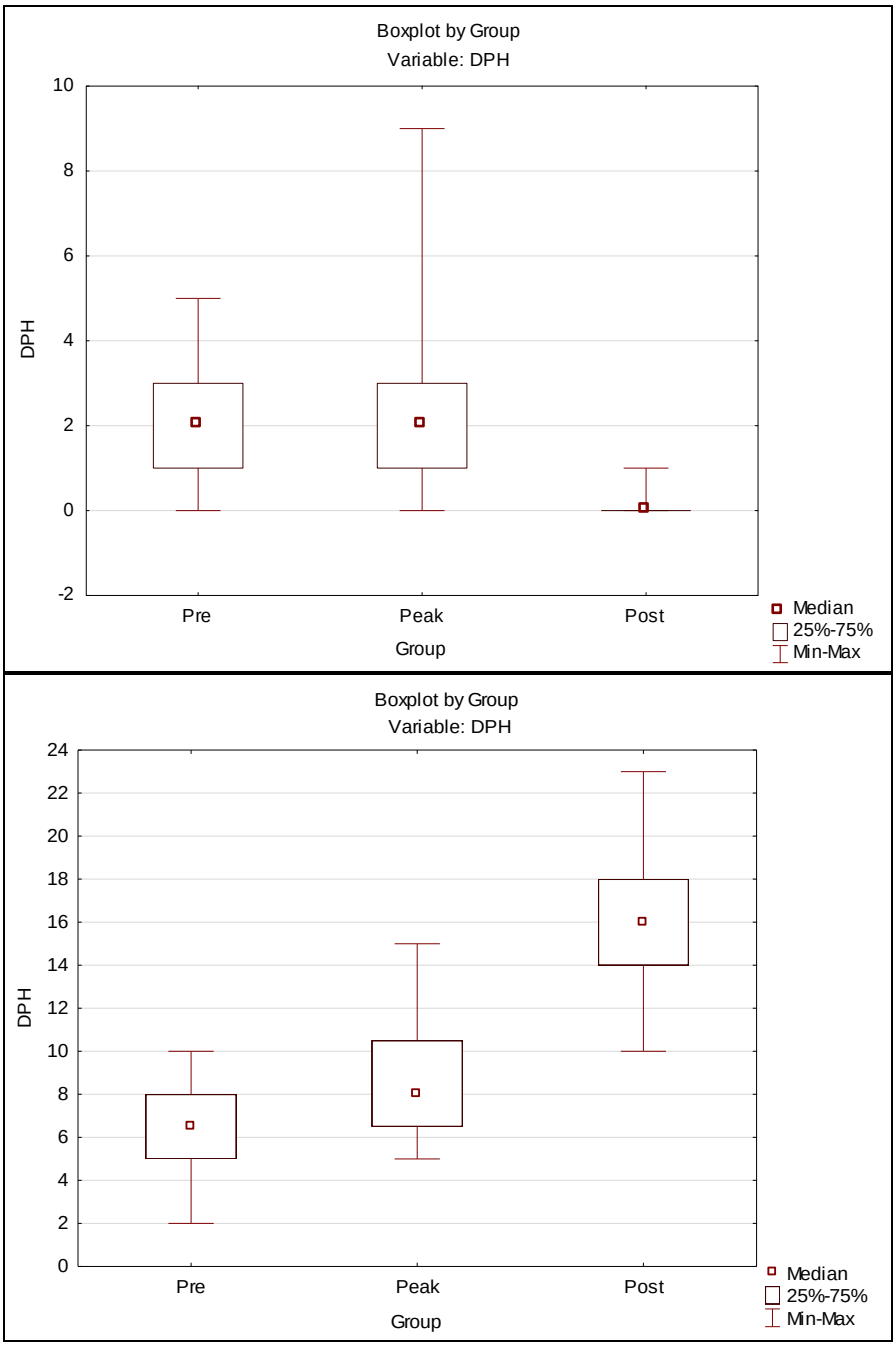


Figure 12: Box-whisker plots with the median, quartiles, minimum and maximum DPH/day for beluga (upper panel) and porpoise (lower panel) for the 2 weeks before (Pre), two weeks after (Post) and during the peak Coho salmon run in Esker Creek in 2012.

4. DISCUSSION

Only the mooring deployed at Grand Wash survived the 12 month monitoring period and logging ended on 7 March 2013 (C-PODs currently log on average 6 to 7 months so this was shorter than expected). Therefore this area was monitored for a total of 10 months. This shortage in logging autonomy was probably caused by the amount of noise created by ice as reported by Castellote *et al*. (2013) in Disenchantment Bay, filling the memory card sooner than expected. Beluga whale presence in Grand Wash area was very limited, with a single detection on 25 November 2012 over two hours. These results were expected as opportunistic beluga whale sightings have rarely been reported outside Disenchantment Bay (B. Lucey, unpublished), and confirm that beluga whales rarely move out from Disenchantment Bay area. Results from the mooring in Esker Creek, right at the entrance of Disenchantment bay, showed continued presence of beluga whales from June to October 2012, suggesting that this area is an important part of their summer distribution and that the limit of their core habitat is somewhere between the Grand Wash River and Esker Creek sites.

Unfortunately the Esker Creek mooring did not surface during recovery attempts in June 2013 and therefore beluga whale presence in this area in fall and winter is unknown. We believe the subsurface float failed in this mooring similarly to what was noticed in the Grand Wash mooring because the release communication was clear and indicated that the mooring was at a higher angle than 45 degrees, which probably meant that it was laying in the bottom. The float collapse could have been caused by interactions with icebergs or by a leak, but the latter is improbable because floats were tested for depth resistance prior to be deployed. Subsurface steel floats would be recommended for future deployments in this area, but limited funding impeded the use of this float type.

Visual observations in Disenchantment Bay confirm that beluga whale movements in this area occur very close to shore (O'Corry-Crowe *et al*. 2008) and most opportunistic sightings are reported near shore (B. Lucey, unpublished). Therefore, if beluga whales moved south from Esker Creek they should have been detected in the Grand Wash area. However, as the gradual decrease in beluga whale presence in Esker creek from June to early October and lack of detections throughout October is not paralleled with an increase in detections in the Grand Wash mooring, suggesting that beluga whales do not leave Disenchantment Bay in fall but move to another area north or northwest from Esker Creek.

Data from the Turner Glacier mooring would have been very useful to obtain more detail on beluga whale distribution changes. Unfortunately a major land slide occurred in May 2012 less than 5 miles north form this deployment location and this mooring most probably got buried in sediment because of the massive introduction of sediment into that area of the bay.

Alternatively, beluga whales in Disenchantment Bay could move out from the Disenchantment area in fall following the eastern shore towards Yakutat. The lack of data from the north Khantaak deployment location impede any further discussion, however very few sightings have been reported on the eastern shore of Yakutat Bay (B. Lucey, unpublished).

Only data from Esker Creek allowed for a comparison between beluga whale DPH/day and fish and invertebrate CPUE. Even if the time series in Grand Wash is longer, the absence of beluga whales impedes any comparison. Grand Wash River is more productive than Esker Creek as indicated by a difference of 26.8 fish between total CPUE for the period June-August. Also, capelin and smelt are an important contribution of the CPUE results in Grand Wash River. These two species are part of the primary diet of beluga whales in other stocks (Quakenbush *et al.* in press). It is interesting to note that even with a higher amount of fish density and prey species composition, beluga whales were barely detected off Grand Wash River. Therefore, it seems that other factors might have a stronger weight in the motivation of beluga whales to use that area. The presence of transient killer whales might play an important role here. Beluga whales might be more exposed to the risk of predation in river mouths further south than Esker Creek. Features such as water turbidity and presence of ice might be important for beluga whales. In this regard, Esker Creek is still highly influenced by the conditions of Disenchantment Bay while Yakutat Bay conditions have a stronger influence in Grand Wash River area.

The most updated review of beluga whale diet in Alaska by Quakenbush *et al*. (in press) analyzed stomach contents from 355 beluga whales taken in subsistence harvests or from beluga whales found dead from all five recognized stocks (Beaufort, eastern Chukchi, eastern Bering Sea, Bristol Bay and Cook Inlet). Diet was highly variable among stocks. The northernmost stocks feed mostly on Arctic cod, shrimp and octopus. To the south, saffron cod replaces Arctic cod, and octopus is no longer prevalent. For the two southern-most stocks, Bristol Bay and Cook Inlet beluga whales, Arctic and saffron cod are largely replaced by salmon and smelt. Shrimp are common prey for all beluga whale stocks in Alaska. When comparing the list of fish and invertebrate species obtained in Esker Creek trawls and the list of prey species described in Quakenbush *et al*. (in press), snake prickleback (found in Cook Inlet beluga whale diet), northern rock sole (found in Eastern Bering and Bristol Bay beluga whale diets) and Crangon shrimp (found in all beluga whale stock diets) were identified in Esker Creek as potential diet species for Yakutat beluga whales. Also, crabs are found to be part of beluga

whale diet in all stocks except in Kotzebue, therefore Dungeness crab might also be an important prey species for Yakutat beluga whales in Esker Creek.

It is not clear if the presence of Coho salmon in Esker Creek increased the amount of beluga DPH/day. Statistical results indicate significant differences between the salmon run and the 2 weeks after the run, but not with the two weeks before the run. Figure 5 shows a slight increase in DPH/day during the peak salmon run, however the fact that the DPH/day during the days prior to the salmon run are high does not confirm a clear relationship. Maybe if belugas are attracted to Esker Creek at the beginning of the salmon run, instead of to the peak run period, these results could be indicative of an interest for preying on Coho salmon. Accessibility to Coho salmon, more than density at the river mouth might better explain these results, however this study did not aim to analyze foraging behavior. However, the lack of an evident increase in DPH/day in Esker Creek during the salmon run suggests that Coho salmon might not be as important in the Yakutat beluga whale diet as in the Cook Inlet or Bristol Bay populations, or that other rivers in Disenchantment Bay are preferred during Coho salmon runs.

Although harbor porpoise presence was continuous in both Esker Creek and Grand Wash areas for the entire sampling period, the trend in porpoise detections did not match the total fish and invertebrate CPUE trend in any of the two locations sampled. This suggests that, although both areas are of interest for porpoises, foraging resources for this species might not be affected by changes in fish and/or invertebrate diversity or abundance. Although none of the fish and invertebrate species collected in the trawling effort shows a parallel trend in CPUE with porpoise presence, some potential prey species have been identified in both river areas. Shrimp showed a similar trend in CPUE than porpoise DPH/month in both Esker Creek and Grand Wash River areas. It is interesting to note that the only Yakutat porpoise stomach content analyzed to date showed a significant amount of shrimp, mostly Crangon shrimp (ADF&G unpublished data), one of the shrimp species identified in Grand Wash River. Other species known to be part of porpoise diet in Alaska are pink salmon, walleye Pollock, saffron cod, sandlance and Pacific sandfish, and from the stomach obtained in Yakutat, surf smelt, eulachon and herring (ADF&G unpublished data, 11 stomachs since 2003). From all these, only Pacific sandfish CPUE followed the trend in porpoise presence. Saffron cod was only present in Grand Wash River in June. Smelt species and eulachon did not follow the porpoise DPH trend in Esker Creek or Grand Wash River areas. Herring, pink salmon, sandlance and walleye Pollock were not identified among the trawled fish or were absent during the months sampled acoustically. However, other fish species that have not been identified as part of the harbor porpoise diet showed a relatively similar trend, including starry flounder and juvenile snailfish in Grand Wash River area. Benthic fish species are common in porpoise diets, therefore these two species could well be part of their diet. Similarly to the beluga results, the peak Coho salmon run in esker Creek that occurred in September 1st through September 28th is coincides with an increase in harbor

porpoise detections from September 12th until the 17th. However, the gradual increase in porpoise presence by the end of the salmon run, impede statistical confirmation of an interest for Coho salmon as prey for harbor porpoises in this area.

Based on the results of this study, the availability of known beluga whale prey in the Grand Wash area does not seem to attract beluga whales. Similarly, harbor porpoise seasonality in Grand Wash River and Esker Creek areas seems to have little relationship to the presence of known prey species. However prey seasonal presence in Esker Creek area might be a significant driver for beluga whales and merits further consideration. This area could be of biological value for the survival of Yakutat beluga whales. Considering the unique conditions in which these isolated and reduced group of beluga whales live, understanding their habitat preferences and the potential link to prey seasonality within Disenchantment Bay should be considered a priority.

5. CONCLUSIONS

Passive acoustic monitoring of Yakutat beluga whales, although technically challenging, has proven to be feasible and effective. Mooring design lessons have been learned that will improve the recovery success of future monitoring efforts. Results suggest that beluga whales inhabit Disenchantment Bay year-round and do not normally venture into southern areas of Yakutat Bay, at least following the western coastline. Based on CPUE trends across June to August in esker Creek, snake prickleback, northern rock sole, Crangon shrimp and Dungeness crab have been identified as potential prey for Yakutat beluga whales. Both Esker Creek and Grand Wash River areas are of interest for harbor porpoises but their seasonality might not be driven just by prey diversity or abundance. Results support the notion that shrimp might be an important part of beluga whale diet in Yakutat and suggest that harbor porpoise might also prey on this type of invertebrate, as well as on starry flounder and snail fish, two species that have not yet been described as part of the harbor porpoise diet in Alaska. This study demonstrates the applicability of this remote monitoring technology to better understand the distribution, seasonal presence, habitat preference and potential diet description of Yakutat beluga whales and harbor porpoises.

6. REFERENCES

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