Acoustic Monitoring and Prey Association for Beluga and Harbor Porpoise off Two River Mouths in Yakutat Bay, Alaska

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BACKGROUND

Little is known about the ecology of beluga and harbor porpoise in Yakutat Bay. Various human activities occur in their habitat including cruise ship visits, commercial fishing, marine geophysical surveys, seal hunting, and scientific activities, but none of these have been evaluated for potential impacts on this small and isolated population. Improving knowledge of Yakutat's beluga and porpoise seasonal distribution and habitat use is needed to better evaluate the potential effects of anthropogenic activities and to define proper conservation management measures.

OBJECTIVES

To determine beluga and harbor porpoise seasonal and geographic usage of the waters around two river mouths, Esker Creek and Grand Wash, in Yakutat Bay, and whether their presence near these river mouths was related to potential prey field.

METHODS

ACOUSTIC DATA

Three acoustic moorings with echolocation loggers (C-POD, Chelonia Ltd.) deployed on June 2012.

Beluga and porpoise detection results were converted into detection positive hours (hours with at least one echolocation click train, DPH). The percentage of feeding buzzes (DeRuiter et al. 2009, Castellote et al. 2013) over the total number of click trains detected per month for each species was calculated.

SALMON RUN DATA

A Coho salmon, *Oncorhynchus kisutch*, run occurred in Esker Creek from 25 August until 5 October, and no salmon runs were detected in Grand Wash River (ADF&G).

DPH/day and presence of feeding buzzes assessed for both beluga and harbor porpoise in three time periods: pre-, peak-, and post-salmon run.

FISHERY TRAWL DATA

Fish and invertebrate data collected in 2013 using bottom trawl at both Esker Creek and Grand Wash River (Fig. 1).

Catch data expressed as catch-per-unit-effort (CPUE; relative number of fish captured per trawl) and percent frequency of occurrence (FO; relative number of tows in which species was captured). Beluga and porpoise DPH/day from 2012 were averaged for each month and qualitatively compared to CPUE/month from 2013 for overall fish and invertebrate catch.

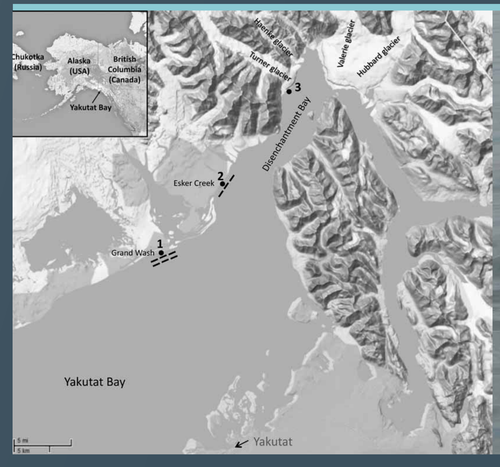

Figure 1. Disenchantment and Yakutat Bays, mooring deployment locations (dots) and trawl transects (lines).

Beluga catching a salmon. By R. Michaud

Harbor porpoise around a prey shoal. By K. Stafford

Table 1. Total catch, mean catch-per-unit-effort (CPUE, unit = tow) and percent frequency of occurrence (FO) of fish and invertebrate taxa captured with a bottom trawl at Esker Creek and Grand Wash River, Yakutat Bay, Alaska. A total of 35 trawls were made during June - August, 2013 at Esker Creek (n = 9) and March - August, 2013 at Grand Wash River (n = 26).

Common name	Species	Family	Esker Creek			Grand Wash River			Total		
Fishes			Catch	CPUE	FO	Catch	CPUE	FO	Catch	CPUE	FO
Longfin smelt	*Spirinchus thaleichthys*	Osmeridae				327	12.6	85	327	9.3	63
Pacific tomcod	*Microgadus proximus*	Gadidae	33	3.7	56	280	10.8	65	313	8.9	63
Capelin	*Mallotus villosus*	Osmeridae	1	0.1	11	164	6.3	38	165	4.7	31
Snake prickleback	*Lumpenus sagitta*	Stichaeidae	47	5.2	56	1	0.0	4	48	1.4	17
Sturgeon poacher	*Podothecus accipenserinus*	Agonidae	8	0.9	33	22	0.8	38	30	0.9	37
Pricklebreast poacher	*Stellerina xyosterna*	Agonidae				23	0.9	35	23	0.7	26
Pacific sandfish	*Trichodon trichodon*	Trichodontidae	3	0.3	22	11	0.4	23	14	0.4	23
Butter sole	*Isopsetta isolepis*	Pleuronectidae	1	0.1	11	10	0.4	23	11	0.3	20
Showy snailfish	*Liparis pulchellus*	Liparidae	1	0.1	11	9	0.3	12	10	0.3	11
Juvenile snailfish		Liparidae	1	0.1	11	7	0.3	15	8	0.2	14
Scalyhead sculpin	*Artedius harringtoni*	Cottidae	7	0.8	33				7	0.2	9
Starry flounder	*Platichthys stellatus*	Pleuronectidae				5	0.2	19	5	0.1	14
Sand sole	*Psettichthys melanostictus*	Pleuronectidae	1	0.1	11	3	0.1	8	4	0.1	9
Spinyhead sculpin	*Dasycottus setiger*	Psychrolutidae	4	0.4	33				4	0.1	9
Eulachon	*Thaleichthys pacificus*	Osmeridae				2	0.1	4	2	0.1	3
Fish larvae		Division Teleostei	2	0.2	11				2	0.1	3
Northern rock sole	*Lepidopsetta polyxystra*	Pleuronectidae	2	0.2	11				2	0.1	3
Buffalo sculpin	*Enophrys bison*	Cottidae	1	0.1	11				1	0.0	3
English sole	*Parophrys vetulus*	Pleuronectidae				1	0.0	4	1	0.0	3
Pacific spiny lumpsucker	*Eumicrotremus orbis*	Cyclopteridae	1	0.1	11				1	0.0	3
Prickleback larvae		Stichaeidae				1	0.0	4	1	0.0	3
Saffron cod	*Eleginus gracilis*	Gadidae				1	0.0	4	1	0.0	3
Smelt larvae		Osmeridae				1	0.0	4	1	0.0	3
			113	**12.6**	**13**	**868**	**33.4**	**14**	**981**	**28.0**	**19**
Invertebrates											
Mysid	*Neomysis spp.*	Mysidae	72	8.0	78	647	24.9	88	719	20.5	86
Crangon shrimp	*Crangon spp.*	Crangonidae	164	18.2	78	421	16.2	81	585	16.7	80
Pink shrimp	*Pandalus eous*	Pandalidae	241	26.8	56				241	6.9	14
Dungeness crab	*Cancer magister*	Cancridae	33	3.7	67	47	1.8	31	80	2.3	40
Unidentified jellyfish		Class Scyphozoa				74	2.8	31	74	2.1	23
Dock shrimp	*Pandalus danae*	Pandalidae	7	0.8	22				7	0.2	6
Unidentified copepod		Subclass Copepoda				6	0.2	4	6	0.2	3
Pacific glass shrimp	*Pasiphaea pacifica*	Pasiphaeidae	1	0.1	11	1	0.0	4	2	0.1	6
Unidentified amphipod		Order Gammeridea				2	0.1	4	2	0.1	3
Unidentified Pandalid shrimp	*Pandalus sp.*	Pandalidae				2	0.1	4	2	0.1	3
Coonstripe shrimp	*Pandalus hypsinotus*	Pandalidae	1	0.1	11				1	0.0	3
Hermit crab	*Pagurus sp.*	Paguridae				1	0.0	4	1	0.0	3
Unidentified worm		Phylum Annelida				1	0.0	4	1	0.0	3
			519	**57.7**	**7**	**2,611**	**100**	**10**	**1,721**	**49.2**	**12**

RESULTS

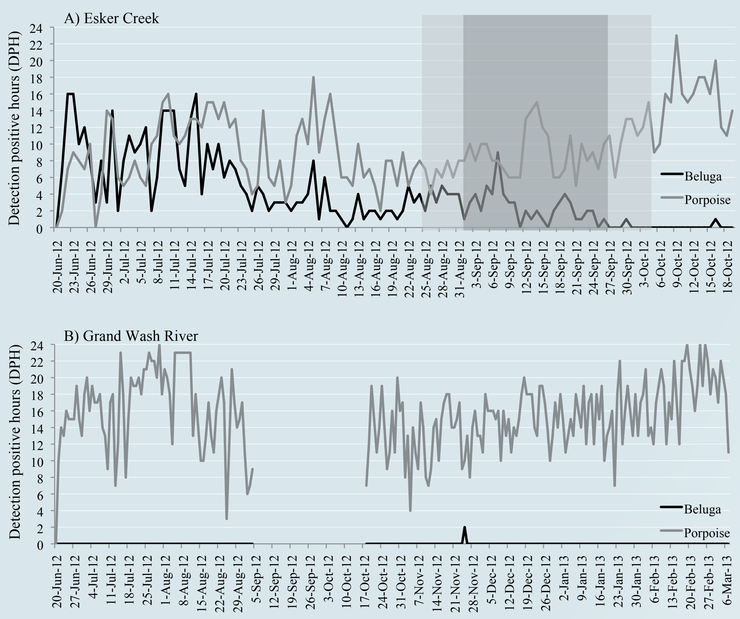

Figure 2. Detected positive hours (DPH) per day for beluga (black line) and harbor porpoise (gray line) for the full deployment period in A) Esker Creek and B) Grand Wash River. In Esker Creek, the coho salmon run period is denoted by a gray block with peak-run period by a dark gray block (note the different date scales between panels).

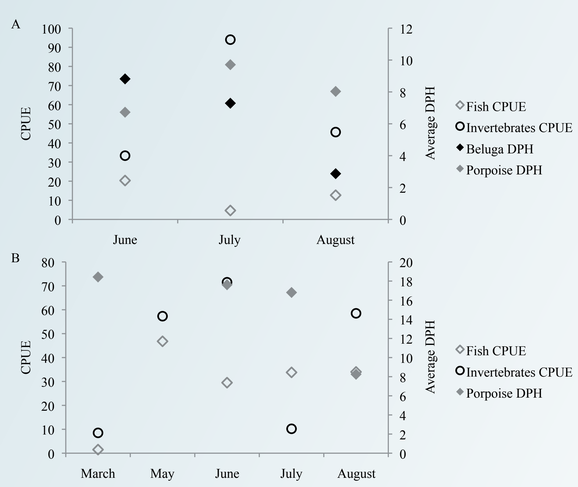

Figure 4. A) Monthly values in Esker Creek for overall CPUE for fish and invertebrates in June – August 2013 and DPH for beluga and porpoise in June – August 2012. B) Monthly values in Grand Wash River for overall CPUE for fish and invertebrates in March – August 2013 and DPH for porpoise in March – August 2012.

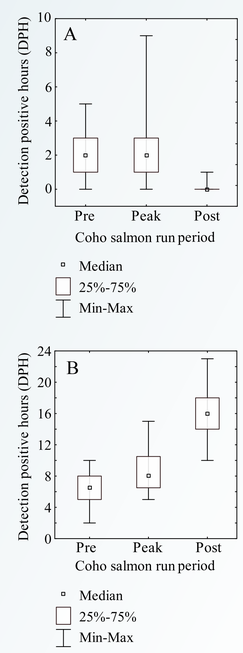

Figure 6. Median, percentiles, and maximum/minimum DPH/day for A) beluga and B) harbor porpoise, and the salmon run periods (pre-, peak-, post-) in Esker Creek.

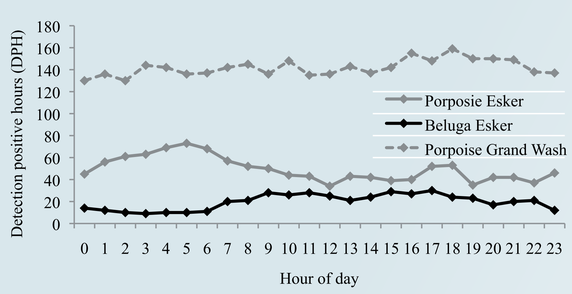

Figure 3. Distribution of summed number of DPH for beluga and harbor porpoise by hour of day in Esker Creek and Grand Wash River.

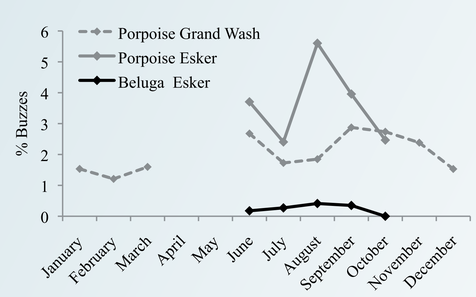

Figure 5. Percentage of beluga and harbor porpoise foraging buzzes (click trains containing terminal buzzes with ICI between 1 and 2 ms) per month in Esker Creek and Grand Wash River.

DISCUSSION

BELUGA

- Esker Creek is important during summer. Belugas do not leave Disenchantment Bay in fall but may move to another area north or northeast of Esker Creek.
- Belugas rarely move south of Disenchantment Bay area, despite high biomass and availability of known beluga prey.
- Core beluga habitat limit is somewhere between Esker Creek and Grand Wash River sites.
- Known beluga prey: snake prickleback and shrimp very abundant and ubiquitous in Esker Creek area.
- New beluga prey: Pacific tomcod dominant in both river areas. Dungeness crab and mysids very abundant in both river areas and might be important prey species.
- Foraging behavior did not increase until coho salmon started running upstream, which is indicative of beluga preying on coho salmon undergoing osmoregulation and thermoregulation prior to river entry (Figs. 5 & 6).

HARBOR PORPOISE

- DPH higher at Grand Wash River, seasonally (Fig. 2) and daily (Fig. 3). Although both areas are frequented by porpoise, changes in fish and/or invertebrate diversity or abundance may not affect foraging resources for porpoise, reinforcing the opportunistic nature of this species' foraging behavior.
- Known porpoise prey: crangon shrimp very abundant in both river areas.
- New porpoise prey: mysids, pink shrimp and dungeness crab very abundant. The single Yakutat porpoise stomach contents available to date showed a significant amount of shrimp, primarily crangon shrimp (ADF&G). Also abundant and ubiquitous were Pacific tomcod, longfin smelt, and snake prickleback. These could well be part of the Yakutat harbor porpoise diet.
- Harbor porpoise might actively avoid Esker Creek when beluga are present. The opposite diel pattern between both species in Esker Creek and the lack of a pattern in Grand Wash River for harbor porpoise suggests competitive overlap in prey between beluga and harbor porpoise, which share common prey.
- Foraging beluga may displace harbor porpoise during peak salmon run in Disenchantment Bay area (Fig. 6).

CONCLUSIONS

Passive acoustic monitoring of Yakutat beluga and harbor porpoise is feasible and effective.

Beluga likely inhabits Disenchantment Bay year-round, seldom venturing into southern areas of Yakutat Bay. Coho salmon run in Esker Creek might be a significant driver for beluga and merits further consideration because this area could be of biological value for the survival of this small Yakutat population of beluga.

Actual catches in Esker Creek and Grand Wash River

Yakutat beluga potential prey: Coho salmon, Pacific tomcod, snake prickleback, northern rock sole, crangon shrimp, pink shrimp, mysids, and dungeness crab.

Yakutat porpoise potential prey: Pacific tomcod, longfin smelt, capelin, snake prickleback, crangon shrimp, pink shrimp, and mysids.

Some of these taxa have not yet been described as part of the beluga or harbor porpoise diet in Alaska. The results presented here support the notion that both species are highly opportunistic in their feeding habits and invertebrates might be an important part of both beluga and harbor porpoise diets in Yakutat Bay.

LITERATURE CITED

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