Steak for breakfast and calamari for dinner – does 'Surf & Turf' for killer whales mean a predator pit for Steller sea lions?

Paul R. Wade – National Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS, NOAA
John W. Durban – Marine Mammal and Turtle Division, Southwest Fisheries Science Center, NMFS, NOAA
Russ D. Andrews – Alaska Sea Life Center/ School of Fisheries and Ocean Sciences, University Alaska Fairbanks
Tom Gelatt – National Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS, NOAA

Introduction

Predation by Bigg's ("Transient-type") killer whales has been proposed as one explanation for the continued decline of Steller sea lions in the western and central Aleutian Islands. There are relatively few reports of killer whale predation on marine mammals in this region; these include Dall's porpoise, Cuvier's beaked whale, sea otter, and one Steller sea lion pup (at Kasatochi Island in 2005). However, an acoustic recorder at a Steller sea lion (SSL) rookery on Agattu Island documented frequent (1 out of every 3 days) occurrence of Bigg's killer whales, suggesting predation of sea lions may occur regularly. Alternatively, several lines of evidence (observed predation, low nitrogen stable isotope ratios, and some satellite tagging movements) suggest Bigg's killer whales may also prey on squid. In June 2015, we deployed 3 satellite-linked dive tags on Bigg's killer whales in the central Aleutians (2 in Rat Island Pass east of Kiska Island, and 1 at Tag Island in the Delarofs) to investigate their foraging behavior.

Overall Results

The two whales tagged in Rat Island Pass near Kiska Is. (while on a kill of a marine mammal) continued to forage in that area initially. The whale tagged at Tag Is. foraged extensively in the Delarofs. Two of the whales showed repetitive diving to depths of 250-350m on a nearly daily basis, consistent with foraging on squid. The third whale did not provide much dive data, but also showed one bout of repeated dives to 350m, so all three whales showed some evidence of deep diving behavior. Additionally, two of the whales also spent considerable time at shallow depths around Steller sea lion rookeries.

Kiska/Rat Island Pass Whales

A group of 12 Bigg's killer whales were detected on June 25 in Rat Island Pass (just east of Kiska Island). The whales were in two clear sub-groups, and were on the site of a presumed kill of an unidentified marine mammal (there was a small oil slick, many birds feeding on visible prey remains in the water, and the whales appeared to be feeding – a prey sample was collected and will be submitted for genetic analysis to identify the species). Two whales were tagged, one from each sub-group.

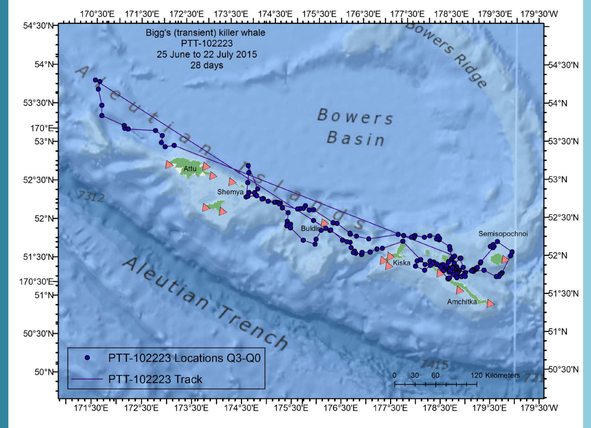


Figure 1. Locations (Q3-Q0) and track for the first whale tagged (tag PTT-102223). The tag duration was 28 days (June 26 to July 23). This whale was identified as WT318 (an adult female); she has been previously seen in 2006 in Rat Island Pass. WT318 foraged extensively in the Rat Island Pass region for ~2 weeks, then made 2 rapid trips west to the Near Islands (>400km), once to near Shemya Is., and once to halfway between Attu and the Commander Islands in Russia. After 17 days the tag was duty-cycled (to save battery life) to turn on every 5th day – this explains the long gaps in the western trips. WT318 did not forage routinely near SSL rookeries, but did occur near rookeries on 4 occasions (Ayugudak, Semisopochnoi, and Buldir twice). On her return from Shemya and Attu WT318 visited several shallow bank areas on the south side of the Aleutians west of Kiska.

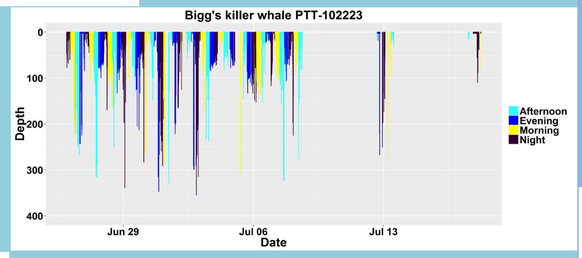


Figure 2. Dive time-series for WT318 (PTT-102223). Most of WT318's dives were 100m or less, but she did bouts of deep diving (200-350m) on a nearly daily basis (12 of 16 days with dive data). There was no pattern to the time of day of her diving behavior.

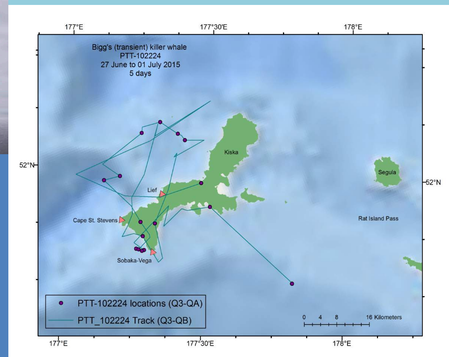


Figure 3. Locations and track for tag PTT-102224. The tag duration was 5 days. This whale was identified as WT313 (also an adult female). This whale was previously seen twice in 2006 in Rat Island Pass (one time with WT318). The deployment of the tag on WT313 was low (at the base of the dorsal fin), so as expected, location data were sparse and of poorer quality. Over 6 days (25 June to 1 July) the whale started in Rat Island Pass (where tagged), moved toward the southern end of Kiska Island, and then spent the next 5 days around Kiska. WT313 spent a lot of time close to shore, apparently foraging near the Sobaka, Lief, or Cape St. Stevens SSL rookeries on 5 occasions over the 6 days.

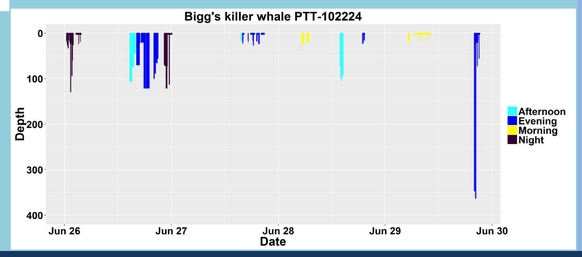


Figure 4. Dive time-series for WT313 (PTT-102224). Due to the location of tag low on the dorsal fin, little dive data was transmitted. However, most of WT313's dives were 100m or less, but she did one bout of deep diving to ~350m

Delarof Islands Whale

On June 27, a group of 4 Bigg's killer whales were found within a few hundred meters of the SSL rookery on Tag Island in the Delarofs. The group was composed of an adult male, a sub-adult male, and 2 adult females. The sub-adult male was tagged. These whales have not been previously identified.

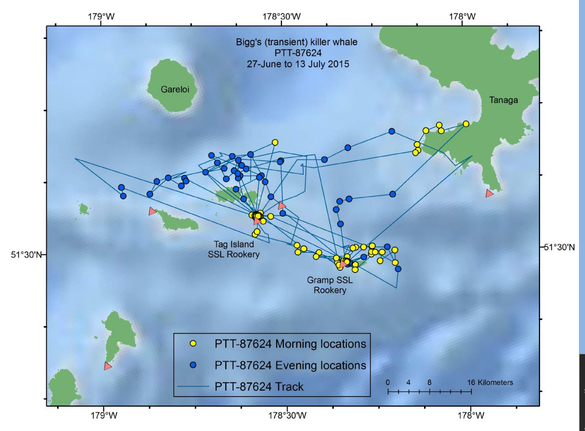


Figure 5. Locations (Q3-Q0) and track for the sub-adult male (tag PTT-87624). The tag duration was 17 days (June 27 to July 13). The entire track of the whale is plotted as the thin line, but for clarity only morning (4-10am, yellow circles) and evening (4-10pm, blue circles) positions were plotted. This whale stayed within a 60 by 80 km area in the Delarof Islands the entire time, extending east to the western side of Tanaga Island. The majority of the mornings he was close to either the Tag Island SSL rookery or the Gramp Island SSL rookery (about 20km southeast of Tag Island). On the majority of the days the whale would then move to deeper water in the evening and night time, usually in the wide channel south of Gareloi Island and north of the other Delarof Islands (called here Gareloi Channel). On one morning the whale occurred close to the coast of Tanaga Island in an area where several harbor seal haul-outs are located.

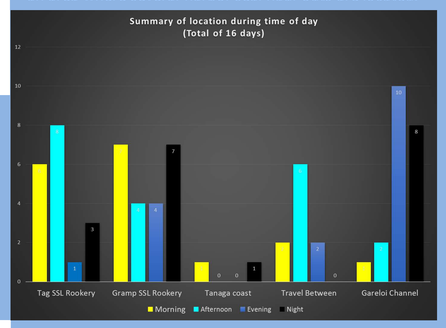


Figure 6. Geographic location by time of day for the sub-adult male tagged at the Tag Island SSL rookery (the whale could be at more than one location during a single time period). On 13 of 14 mornings that the tag reported a location, the whale was at either the Tag or Gramp SSL rookery; the 14th morning it was along the coast of Tanaga Is. During 12 of the afternoons the whale was still at the same rookery as the morning or had moved to the other rookery (3 occasions). On 10 of the nights the whale was also at one of the SSL rookeries (meaning he arrived prior to 4am). During 10 of the evenings and 8 of the nights the whale was in deeper water in Gareloi Channel.

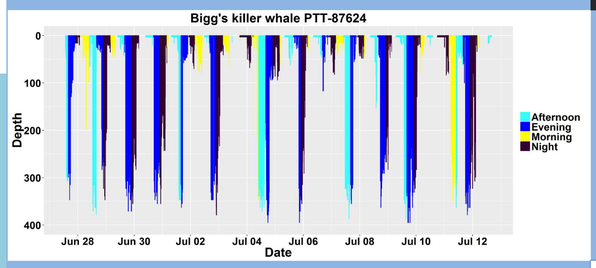
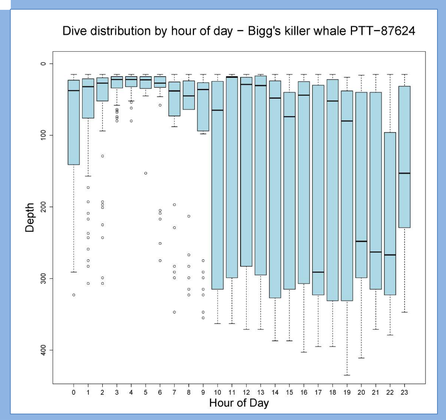


Figure 7. Dive time-series for the sub-adult male tagged at the Tag Island SSL rookery (PTT-87624). The whale spent substantial time doing repetitive deep-dives (300-400m) on 12 of the 15 days that had a full dive record. These deep-diving bouts occurred in late afternoon (light blue), evening (blue), and the night (black), when the whale was usually in Gareloi Channel, and are consistent with foraging on squid. The whale did only shallow dives in the morning when at SSL rookeries, consistent with hunting of sea lions.

Figure 8. Box plot of the depth distribution of dives plotted by hour of the day (in local time) for the sub-adult male tagged at the Tag Island SSL rookery. Note that from 3-7am the whale was staying within 30m of the surface, presumably while hunting Steller sea lions or resting. The whale started doing deep dives after 10am, but the median dive depth was still shallower than 100m until 5pm. From 8-11pm the median dive depth was greater than 250m. After 11pm, the dives, on average, became shallower as the night progressed. During this time period, sunrise was ~6:45am and sunset was ~11pm.



Summary of the foraging behavior of the sub-adult male tagged near the Tag Island SSL rookery

- Every morning he was in close proximity to a rookery, doing shallow dives near the surface, apparently hunting for Steller sea lions
- Every evening he did repetitive deep-dives (250-350m), apparently feeding on squid, suggesting this whale prey-switched between sea lions and squid on a daily basis

Conclusions

In the western and central Aleutian Islands, at least some Bigg's killer whales apparently prey extensively on Steller sea lions. At the same time, many (or perhaps all) Bigg's killer whales in the same region apparently also prey extensively on squid. If so, this raises the question of a "predator pit" – does the availability of squid sustain Bigg's killer whale abundance at levels so high that occasional killer whale predation is enough to prevent the recovery of Steller sea lions?

Acknowledgements:
The authors thank PCCRC and NOAA for project funding, the captain and crew of the USFWS R/V Tiglax, and the rest the Steller sea lion field work team, for making this tagging work possible.