Longline fishery interactions and resource selection of satellite-tagged pelagic false killer whales in the North Pacific

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Pelagic false killer whales

- Most common species of cetacean bycaught in the Hawaiʻi-based deep-set longline fishery, almost all from the pelagic population[1]
- Observer records suggest that bycatch has exceeded sustainable levels for most of the last 15 years
- Though opportunities to satellite tag pelagic false killer whales are rare, five were tagged (in three groups) in 2013, two off the Northwestern Hawaiian Islands (NWHI), and three (in one group) off Hawaiʻi Island
- This study combines tag data, logbook data, and environmental data to assess interactions between false killer whales, the longline fishery and other environmental factors

Table 1: Details on tag deployments on pelagic false killer whales. PcTag039 and PcTag040 were found to act in close association with PcTag041, so they were excluded from most analyses.

| Tag ID	Deploy Date	# days	# positions	Cumulative distance moved (km)	Distance (km) from tagged animal location (mean/SD)	Distance (km) from shore (mean/SD)	Depth (m) (mean/SD)	#/% inside longline exclusion areas
PcTagP01	2013-05-15	154.1	1,105	12,857	529.4/328.4	135.3/74.3	4,174/1,109	564/52%
PcTagP02	2013-05-26	13.6	153	1854	187.7/81.9	243.1/57.1	3,702/1,127	82/54
PcTag039	2013-10-22	11.8	103	1,409	147.2/58.3	101.9/49.9	4,475/764	36/35%
PcTag040	2013-10-22	15.8	140	1,878	210.9/145.2	146.8/112.5	4,686/679	39/28%
PcTag041	2013-10-22	122.7	696	12,735	798.5/470.8	693.1/454.1	5,208/515	40/5.7%
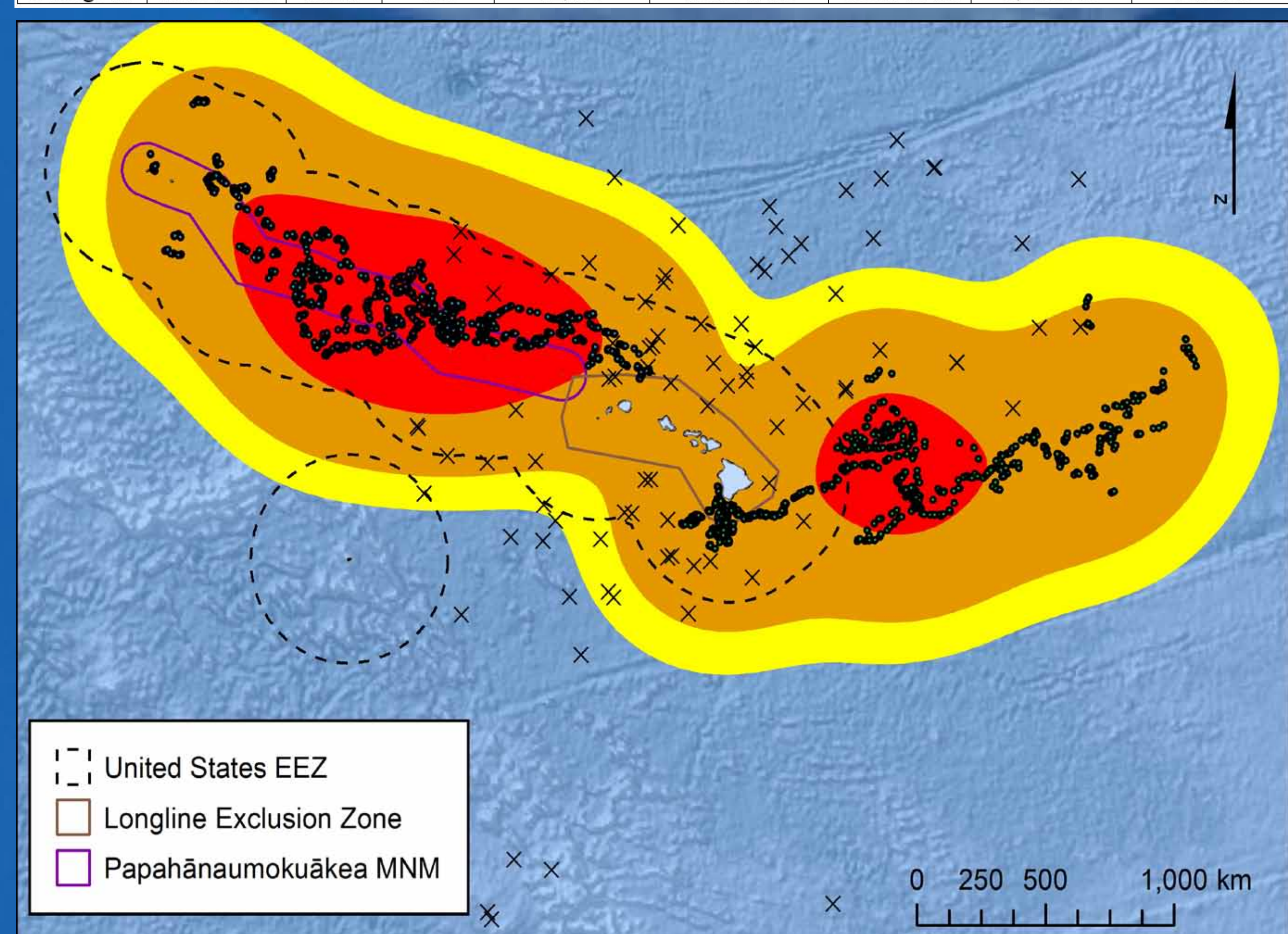
Fig. 1: Range calculated using Kernel Density Estimation for three tagged groups. Area in red, orange and yellow, represent areas with 50%, 95% and 99% kernel densities, respectively. Black × symbols represent locations where fisheries observers have recorded interactions.

Legend:
- United States EEZ
- Longline Exclusion Zone
- Papahānaumokuākea MNM

0 250 500 1,000 km

Longline interactions

- There were 26 longline sets where tagged whales were within 100 km for three or more positions
- Only one longline set had a dramatic movement towards the set, from ~100 km in less than 7 hours, with whales remaining in the area for the following 2 sets. Catch rates for these three sets were above average for the trip (Fig. 2)
- A tagged animal followed a vessel for five sets, with closest approach during the third set. No catch was recorded during this set, suggesting large scale depredation (Fig 3)
- The same animal was often within 50 km of other vessels setting or hauling gear without any noticeable responses
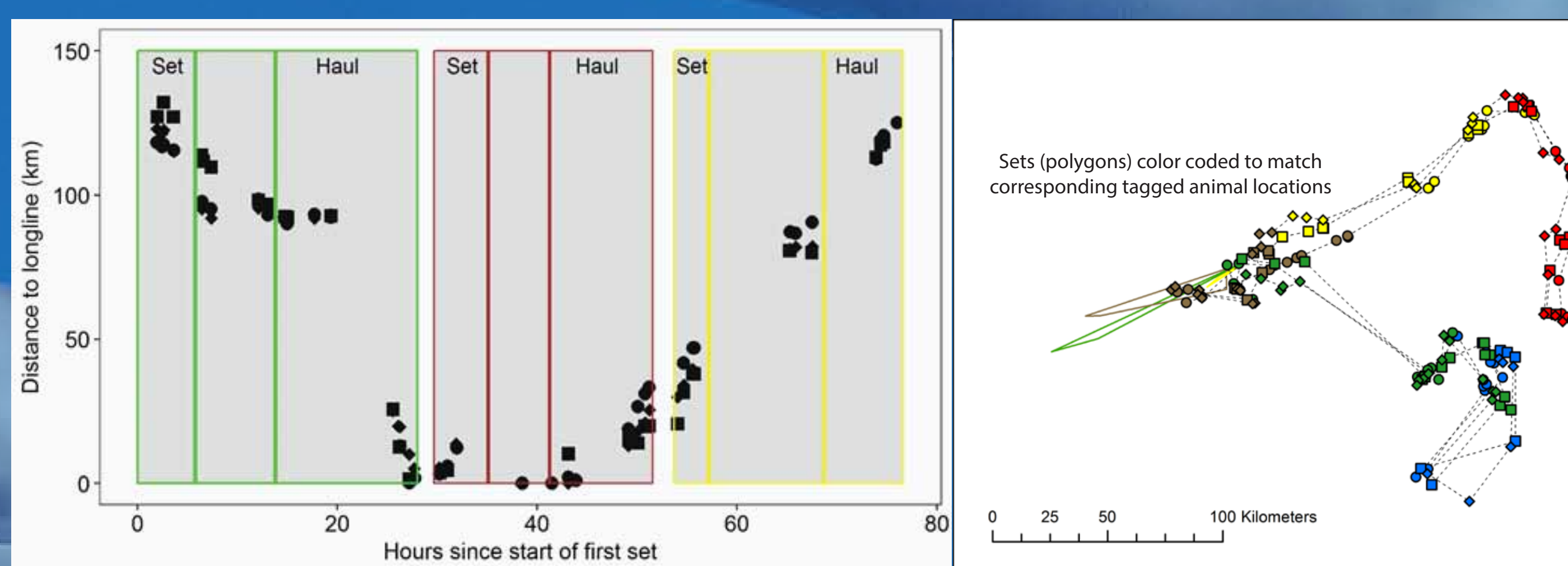
Figure 2: Interaction of three whales with longline vessel over three sets. Animals rapidly approached from ~100 km during the first hauling phase, stayed nearby during the start of the second set, before slowly moving away during the third. There was no evidence of depredation in the logs, and the vessel remained in the area, suggesting the captain was unaware of the animals' presence.
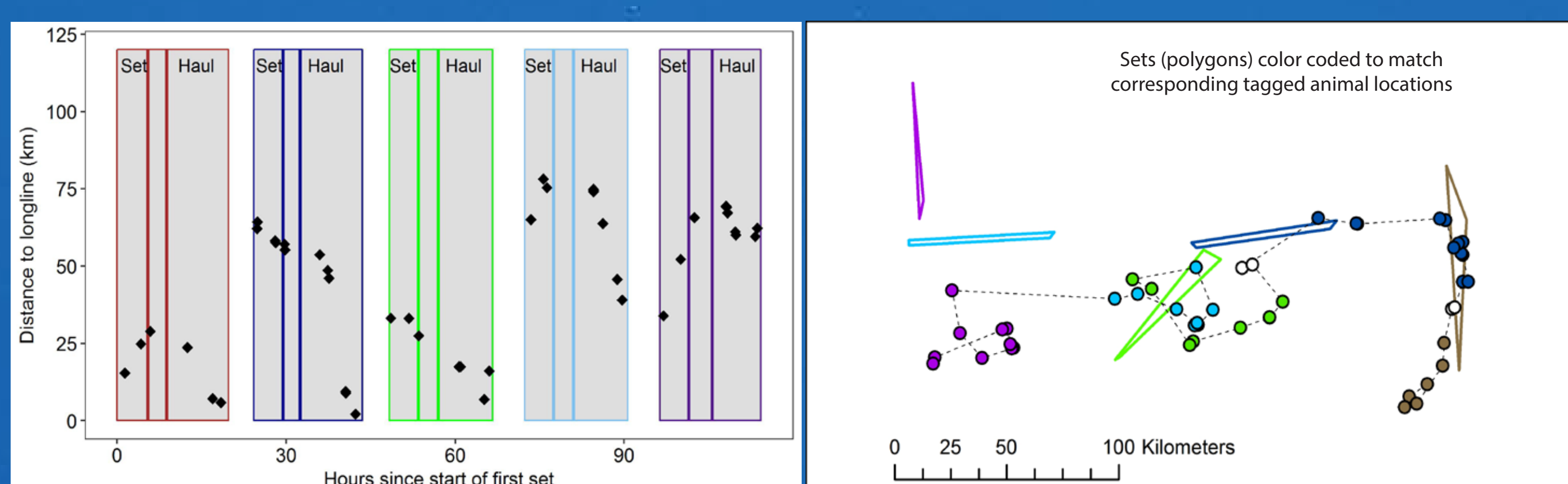
Figure 3: Interaction series of five sets. The whale followed the vessel, closely approaching during the haul of the first three sets. During the third set, logs show that there was no catch, suggesting depredation. The captain moved the vessel a greater distance after this set, which is common practice after depredation.

Behavior

- The behavioral state of the animals, determined with a switching state-space model[2], was compared to a variety of environmental variables
- There was a significant difference in behavior near the NWHI, and those to the east (traveling over the abyssal plains), suggesting different foraging patterns based on the environment
- Most environmental variables showed a significant relationship to behavioral state. These variables were also highly correlated with the difference between the NWHI animals and the group to the east

Resource selection

- A state-space model with a 24-hour time step was used to generate positions with even temporal spacing
- Fifty control positions were generated within a buffer of the 95th percentile daily travel distance.
- AIC was used to compare the influence of 24 variables as they relate to resource selection
- The best fit three variable model was monthly surface chlorophyll-a + distance to nearest longline + significant total wave height

Conclusions

- Some tagged animals possibly involved in depredation, though behavior around other sets suggest that they are not dependent on depredation
- Reactions tend to occur during hauling, supporting the idea that animals are responding to acoustic cues[3,4]
- Behavior differs by foraging area, suggesting changes in strategy for different conditions
- Resource selection analyses suggest habitat use related to several factors, although sample size is small and additional work would be informative

References
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Poster presented at the 22nd Biennial Conference on the Biology of Marine Mammals, Halifax, Nova Scotia, October 2017