

CETACEAN OCCURRENCE OFF VIRGINIA'S OUTER CONTINENTAL SHELF

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Abstract

One hundred forty kilometers (km) east of Naval Station Norfolk (NSN), the world's largest U.S. Navy base, lies the continental shelf break and the Norfolk Canyon – areas known to have considerable cetacean species diversity based on previous broad-scale stock and population survey assessments. These waters also play a vital role in the U.S. Navy's training and testing operations given their complex bathymetry and proximity to NSN. In 2015, the U.S. Navy initiated a multi-year study to provide a more detailed assessment of species occurrence, diversity, and habitat use in the Norfolk Canyon region, and to examine medium-scale movements and dive behavior of large whales. Between April 2015 and August 2017, twenty-five small-boat surveys using photo-ID, biopsy sampling, and satellite-monitored tagging techniques were conducted. There were 401 sightings of 14 cetacean species recorded (including sightings over the continental shelf en route to the study area). Priority species encountered were fin whales (*Balaenoptera physalus*) (n=16), sperm whales (*Physeter macrocephalus*) (n=23), minke whales (*Balaenoptera acutorostrata*) (n=5), humpback whales (*Megaptera novaeangliae*) (n=3), sei whales (*Balaenoptera borealis*) (n=1), and Cuvier's beaked whales (*Ziphius cavirostris*) (n=1). The species most often sighted were pilot whales (*Stenella grahami*) (n=153), bottlenose dolphins (*Tursiops truncatus*) (n=112), and short-beaked common dolphins (*Delphinus delphis*) (n=57). Additional observations of Atlantic spotted dolphins (*Stenella frontalis*) (n=14), Risso's dolphins (*Grampus griseus*) (n=10), striped dolphins (*Stenella coeruleoalba*) (n=4), and harbor porpoise (*Phocoena phocoena*) (n=2) were also recorded. Fifteen LIMPET-configured satellite-monitored tags (SPOT6 and SPLASH) have been deployed to date on fin whales (n=7) and sperm whales (n=8). Preliminary tag results suggest site-fidelity to the Norfolk Canyon by sperm whales over periods of weeks, while fin whales show a mix of both minimal and extreme movement patterns within and outside of the study area. Future efforts will provide more detail on habitat use in this region.

Acknowledgements

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Background and Methods

Primary objectives:

- Describe which cetacean species occur over the outer continental shelf, shelf break, and continental slope and how occurrence fluctuates seasonally.
- Study the baseline behaviors and ecological relationships of offshore cetaceans within the study area.
- Determine whether individual cetaceans exhibit site fidelity within specific regions of the study area.
- Investigate the seasonal extent of cetacean movements within and around U.S. Navy Virginia Capes (VACAPES) operating area.
- Determine whether cetaceans spend significant time within or primarily move through areas of U.S. Navy live-fire or Anti-Submarine Warfare training events.



Figure 2. Photo-ID, biopsy, and satellite tagging techniques being utilized with a group of sperm whales.

Satellite tagging:

- Wildlife Computers (Redmond, Washington) Smart Position and Temperature (SPOT6) Argos satellite-linked tags in the Low Impact Minimally Percutaneous External-electronics Transmitter (LIMPET) configuration (Andrews et al. 2008)* (Figure 4) were utilized.
- The tags were remotely deployed using a DAN-INJECT JM25 pneumatic projector (www.dan-inject.com).
- Two 6.8-centimeter surgical-grade titanium darts with six backwards-facing petals were used to attach tags to the dorsal fin or just below the dorsal fin.
- Maximum tag attachment duration was expected to be less than 30 days; therefore, tags were programmed to maximize the number of transmissions and locations received during attachment rather than to extend battery life.
- Based on satellite availability in the area, tags were programmed to transmit for 22 hours/day with an unlimited number of transmissions for the first 40 days.
- Locations of tagged individuals were approximated by the Argos system using the Kalman filtering location algorithm (Argos Users Manual © 2007-2015 CLS), and unrealistic locations (i.e., those on land) were manually removed using tools provided within Movebank (www.movebank.org).

* Andrews, R.D., R.L. Pitman and L.T. Balance. 2008. Satellite tracking reveals distinct movement patterns for Type B and Type C killer whales in the southern Ross Sea, Antarctica. Polar Biology, 31(12), 1461–1468. DOI 10.1007/s00300-008-0487-z.

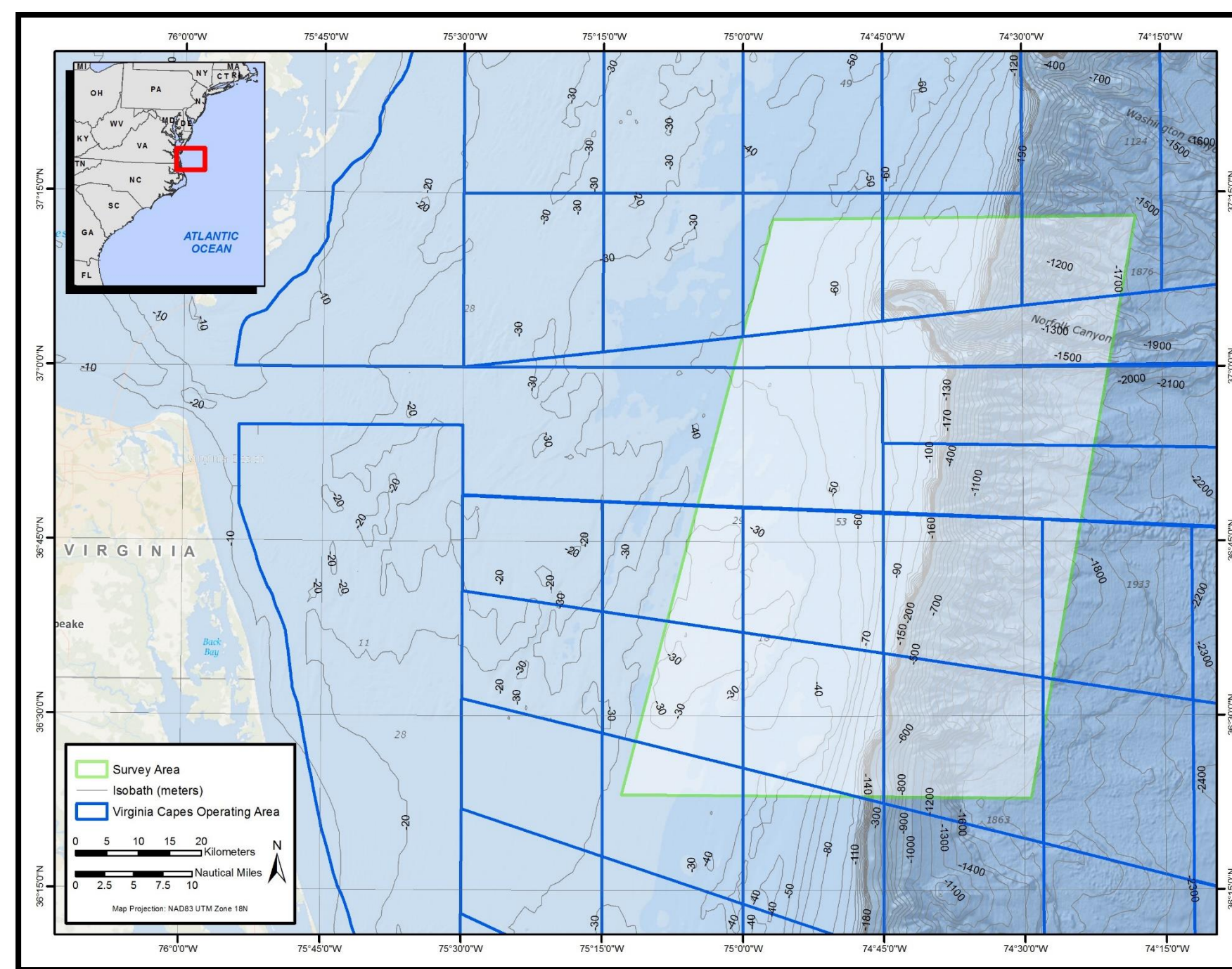


Figure 1. Primary study area (green shaded box) showing U.S. Navy VACAPES range boxes (blue boxes).

- Small vessel (16-17 meter [Figure 2]) VACAPES conducted 2015-2017.
- Surveys focused on photo-identification, biopsy sampling, and satellite tagging for priority species (i.e. baleen and deep-diving whales).
- Survey area: Outer continental shelf, shelf break, and continental slope waters off Virginia within the VACAPES training range (shown in Figure 1).



Figure 3. Wildlife Computers SPOT6 satellite tag deployed on fin whale.



Figure 4. Wildlife Computers SPLASH satellite tag deployed on sperm whale.

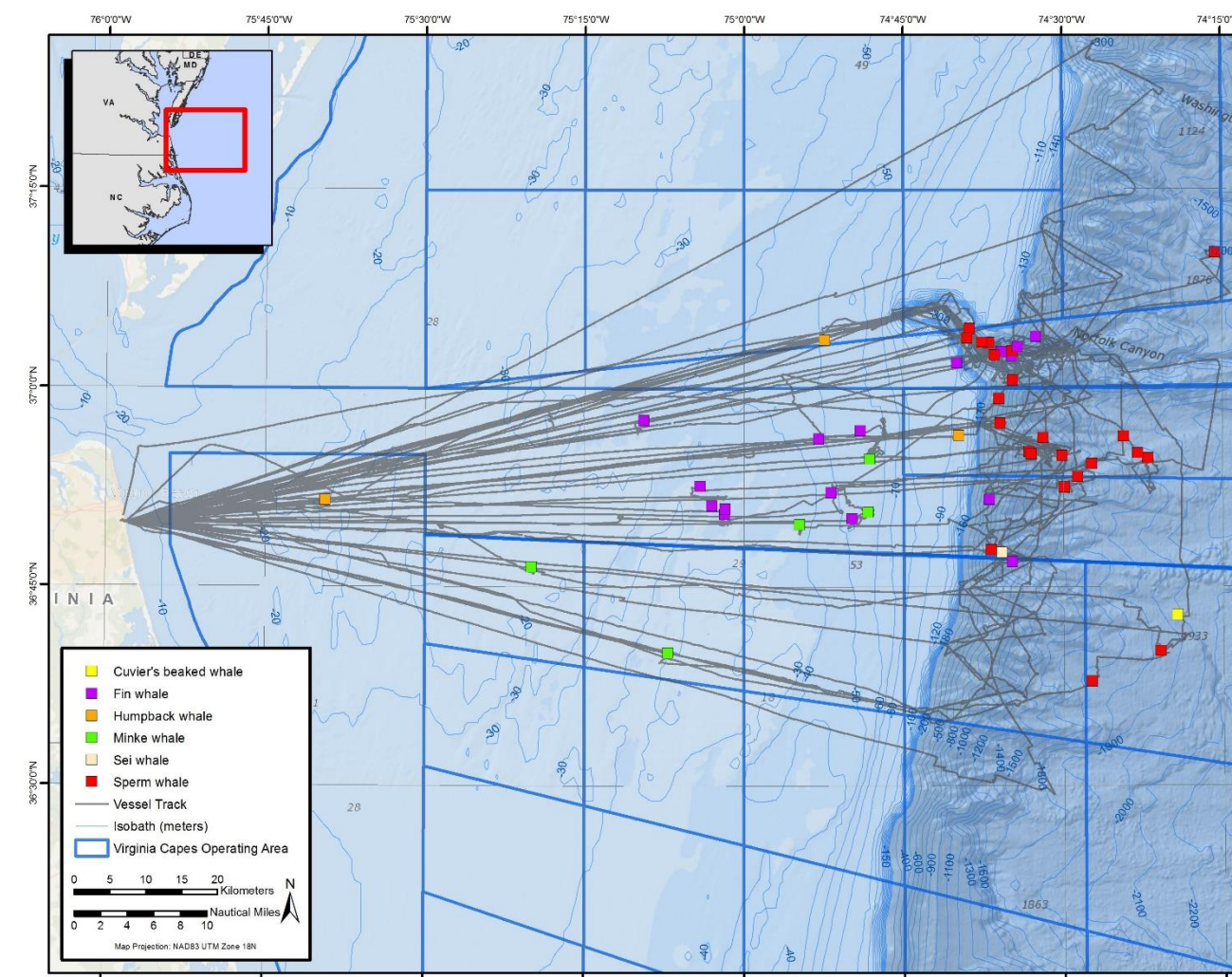


Figure 5. Survey tracks and locations of all priority species sightings (baleen, sperm, and beaked whales): January 2015–August 2017.

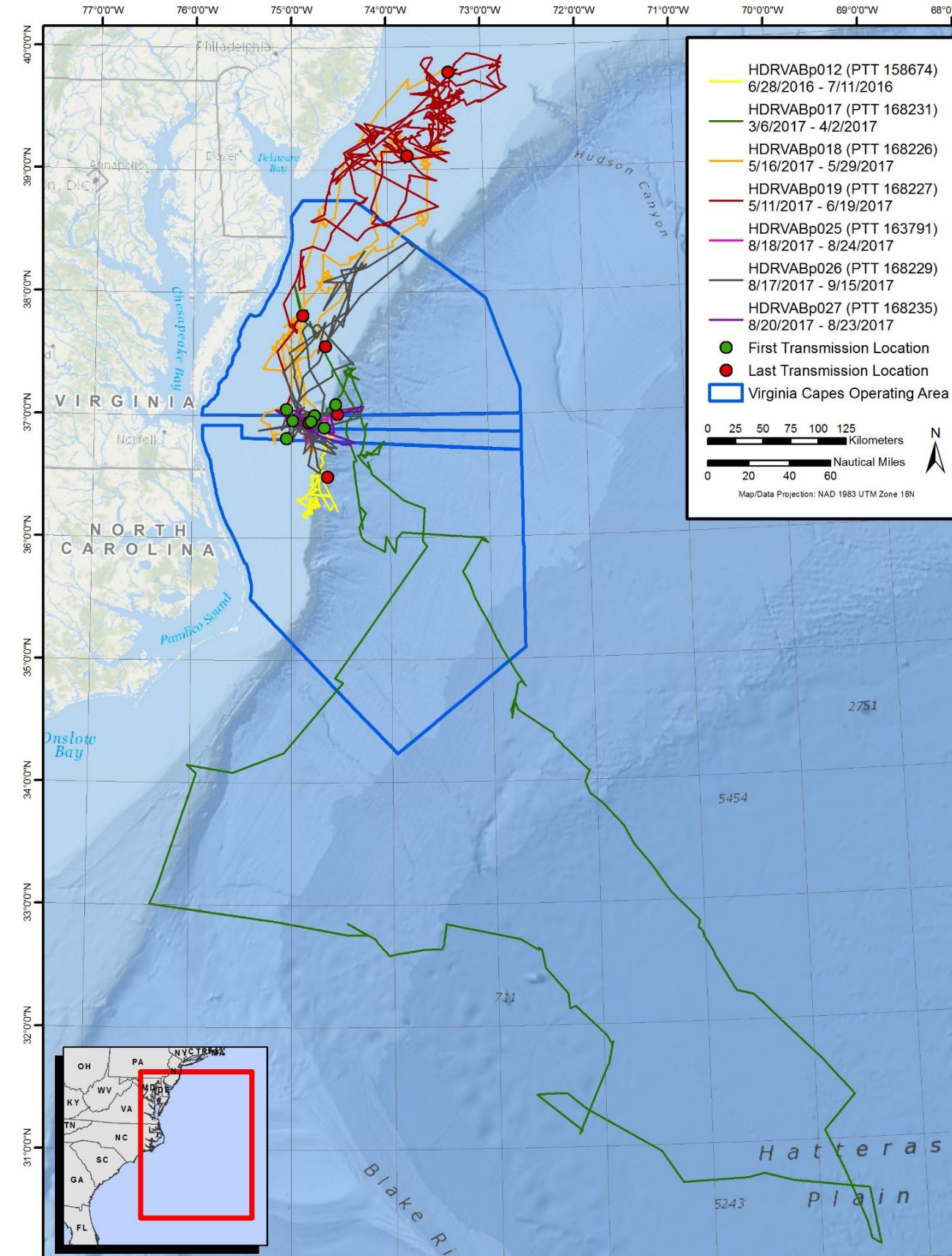


Figure 7. Filtered tracklines of all satellite tagged fin whales (n=7).

Table 1. Summary of results from satellite tag data, including number of days tag transmitted, number of locations post-filtering, percent of locations in VACAPES OAREA, and distance from initial tag location (max and mean).

Animal ID	Species	Tag Type	Days Transmitted	Number of Locations Post-Filtering	Within VACAPES range(%)	Max Distance from Initial Location (km)	Mean Distance from Initial Location (km)
158674	Fin whale	SPOT6	13.7	163	100	83.3	54.6
168226	Fin whale	SPOT6	18.5	356	71.3	362.4	156.1
168227	Fin whale	SPOT6	39.0	503	10.1	374.8	268.2
168229	Fin whale	SPOT6	30.1	341	43.4	194.6	36.0
168235	Fin whale	SPOT6	6.8	38	39.5	48.0	14.5
163791	Fin whale	SPLASH	6.8	59	15.3	25.5	9.7
168231	Fin whale	SPLASH	26.8	217	53.9	905.3	288.9
Mean	Fin whales	All	20.2	239.6	47.6	284.8	84.8
166684	Sperm whale	SPOT6	29.6	283	83.4	582.5	120.2
168228	Sperm whale	SPOT6	24.9	184	100	128.0	74.3
163792	Sperm whale	SPLASH	21.0	127	99.2	26.1	4.6
168232	Sperm whale	SPLASH	30.8	274	93.4	357.0	91.8
168234	Sperm whale	SPLASH	13.0	126	87.3	276.1	69.7
171879	Sperm whale	SPLASH	3.6	18	100	106.3	52.3
171880	Sperm whale	SPLASH	15.5	137	100	115.6	71.5
171881	Sperm whale	SPLASH	5.7	79	100	582.5	27.5
Mean	Sperm whales	All	18.0	153.5	95.4	271.8	64.0

Results

- 25 offshore surveys completed between April 2015 and August 2017 (Figures 5 & 6)
- 401 cetacean sightings with confirmed species identification (Figures 5 & 6)
 - Priority Species
 - 23 sperm whale (44 individuals)
 - 16 fin whale (32 individuals)
 - 5 minke whale (6 individuals)
 - 3 humpback whale (3 individuals)
 - 1 sei whale (2 individuals)
 - 1 Cuvier's beaked whale (5 individuals)
 - 15 satellite tags deployed
 - 5 SPOT6 and 2 SPLASH on fin whales (Figure 7)
 - 2 SPOT6 and 6 SPLASH on sperm whales (Figure 8)
 - 9 biopsy samples collected (4 fin whales and 5 sperm whales)

Photo-ID catalog results:

- Sperm whale
 - 31 identified individuals
 - 5 re-sights (3 same-day, 2 within-season)
- Fin whale
 - 34 identified individuals*
 - 4 re-sights (1 same-day, 3 within-season)
- Minke whale
 - 8 identified individuals*
 - no re-sights
- Pilot whale
 - 81 identified individuals
 - 4 re-sights (all same-day)
 - 6 matches to Duke University NC catalogs

*some data from inshore humpback surveys were added to these catalogs (see Engelhaupt et al. poster – Look Both Ways Before Crossing the Channel – Humpback Whale Affinity for Shipping Channels off Virginia can be Lethal)



Satellite tag results:

- Satellite tags transmitted 3.6-39.0 days (mean=19.1 days) (Table 1).
- Sperm whales had a higher percentage of locations within the VACAPES range compared to fin whale tag locations (Table 1).
- Fin whale movements show majority of locations over the continental shelf, with the exception of one individual – HDRVAp017 (Figure 7).
- Sperm whale movements show ranges closer to shelf edge and canyons, with some staying very close to initial tagging location (Table 1 & Figure 8).
- Mean fin whale dive duration ranged from 8.8–10.4 minutes and mean dive depth ranged from 27.6–52.4 meters (Table 2).
- Mean sperm whale dive duration ranged from 25.8–38.2 minutes and mean dive depth ranged from 437.5–886.7 meters (Table 2).

Conclusions

- Endangered Species Act-listed sperm and fin whales were frequently observed in the study area.
- High cetacean species diversity overlaps with areas utilized for U.S. Navy training exercises.
- Preliminary sighting locations and satellite tag data support different habitat use patterns and ranges for each species of interest, which is an important consideration to potential impacts.
- Incorporation of switching state space modeling will provide insight into foraging ecology.
- Further study is needed to assess patterns of residency for individuals of all species using a combination of photo-ID and satellite tagging techniques, a critical element with respect to population consequences.



Scan using smartphone's camera to see project profile

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