

Virginia Capes (VACAPES) FIREX & ASW Training Events Marine Species Monitoring

**AERIAL MONITORING SURVEYS
9–11 AUGUST 2010
TRIP REPORT**



8 FEBRUARY 2011

HDR

ACRONYMS AND ABBREVIATIONS

AFAST	Atlantic Fleet Active Sonar Training
ASW	anti-submarine warfare
ESA	Endangered Species Act
FIREX	Firing Exercise
HDR EOC	HDR Environmental Operations & Construction, Inc.
ICMP	Integrated Comprehensive Monitoring Program
IMPASS	Integrated Maritime Portable Acoustic Scoring and Simulator
km	kilometer(s)
km ²	square kilometers
LOA	Letter of Authorization
m	meter(s)
MMPA	Marine Mammal Protection Act
NM	nautical mile(s)
NMFS	National Marine Fisheries Service
OPAREA	operating area
SOCAL	Southern California Range Complex
SPUE	Sightings Per Unit Effort
VACAPES	Virginia Capes Range Complex

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Section 1 Introduction

Between 9 and 11 August 2010, a Firing Exercise (FIREX) with Integrated Maritime Portable Acoustic Scoring and Simulator (IMPASS) and Anti-Submarine Warfare (ASW) Exercise occurred off the coast of Virginia in the U.S. Navy's Virginia Capes Range Complex (VACAPES). These types of events occur periodically throughout the year and allow the Navy to fulfill essential training requirements.

As part of the compliance requirements of the Marine Mammal Protection Act (MMPA) of 1972 and the Endangered Species Act (ESA) of 1973, the Navy developed the Integrated Comprehensive Monitoring Program (ICMP). The ICMP applies by regulation to those activities on Navy training ranges and operating areas (OPAREAs) for which the Navy sought and received incidental take authorizations. In order to support the Navy in meeting regulatory requirements for monitoring established under the Final Rules and to provide a mechanism to assist with coordination of program objectives under the ICMP, monitoring of marine mammals and sea turtles during this exercise included visual surveys from a fixed-wing aircraft.

The results of marine mammal monitoring reported here are part of a long-term monitoring effort under the U.S. Navy's Marine Species Monitoring Program (Contract # N62470-10-D-3011) issued to HDR Environmental Operations & Construction, Inc. (HDR EOC).

Section 2 Methods

Study Area

The Navy's Virginia Capes Operating Area lies primarily off the coast of Virginia. Protected marine species monitoring conducted during the VACAPES FIREX and ASW training events was focused within the U.S. Navy's VACAPES OPAREA boxes 7C, 7D, 1B2, 1C1, and 1C2 (see **Figure 1**). This training exercise area is approximately 14 to 90 nautical miles (NM) offshore, covers an area approximately 3,080 square kilometers (km²) in size, and ranges in bottom depth from 20 to 2,600 meters (m).

Aerial-Based Monitoring

Aerial-based monitoring effort was performed over a 3-day period from 9 to 11 August 2010 (see **Table 1**). Survey methods were consistent with current accepted Distance Sampling theory (Buckland et al. 2001) and followed a protocol used for surveys in the Southern California (SOCAL) Range Complex (Smultea et al. 2009). A survey altitude of approximately 1,000 feet and 100 knots was attempted while on-effort, but might have varied slightly based on weather conditions in the area. Once a marine mammal sighting was made, a focal follow circling session was attempted at 1,000 feet or higher. A lower altitude of approximately 700 to 800 feet was established after focal follows for photography purposes to provide sharper images required for species identification.

The observation platform was a Cessna T337H Turbo Skymaster aircraft operating out of Norfolk International Airport in Norfolk, Virginia. A total of five surveys were conducted following pre-determined transect lines covering the two ranges (see **Table 1** and **Figure 1**).

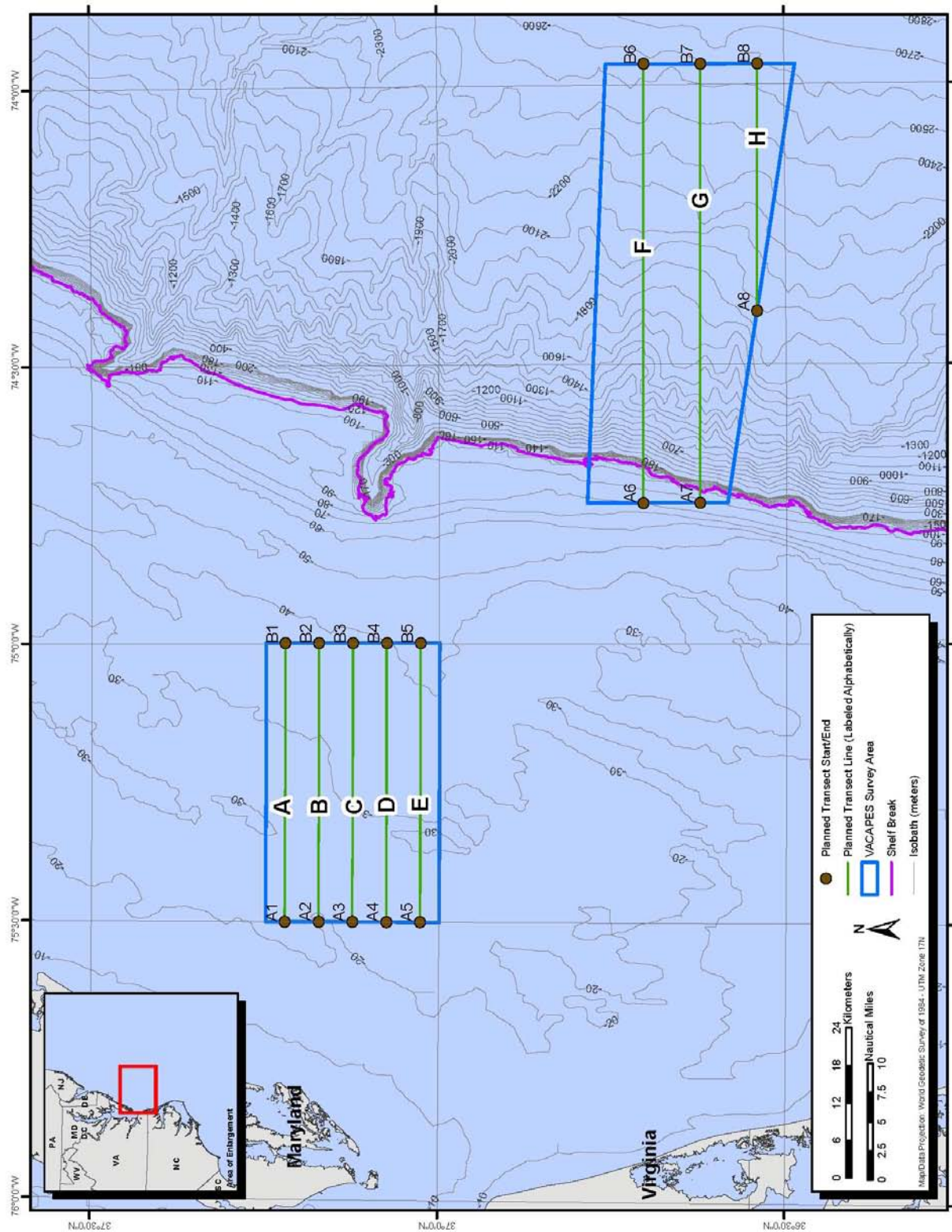


Figure 1. Predetermined Tracklines for the Survey Effort during VACAPES August Exercises 2010

Table 1. Summary of VACAPES Monitoring Effort

Date	Description	Start Time	Stop Time	Total Survey Minutes*	Total On-Effort Minutes	Trackline On-Effort Distance (km)
August 9 (ASW)	Aerial transect survey	1208	1523	195	52	169
August 10 (FIREX)	Aerial transect survey	0724	0830	66	54	180
August 10 (FIREX)	Aerial transect survey	1205	1253	48	30	108
August 10 (ASW)	Aerial transect survey	1314	1451	97	59	195
August 11 (FIREX)	Aerial transect survey	0720	1113	233	135	442
Total				639 (≈11 hrs)	330 (≈6 hrs)	1,094 km

Note: * Total Survey Minutes reflect minutes occupied in the range/area of interest and include both on-effort (systematic) and off-effort (random) total minutes.

Both aerial observers (see **Table 2**) were experienced with line-transect survey methodology, had experience in identification of Atlantic marine mammal and sea turtle species, were knowledgeable of marine mammal biology and behavior, and had previous experience conducting marine mammal and sea turtle observations from aircraft.

Table 2. Observers and Roles

Observer	Role(s)
Greg Fulling	Chief Scientist/Observer
Mari Smultea	Observer

Survey effort within the five VACAPES range boxes consisted of waypoints designed to cover the entire ranges (approximately 3,080 km²) during each 4-hour maximum flight-time window. For boxes 7C and 7D, five parallel tracklines running from west to east, measuring 44.23 kilometers (km) in length, and spaced approximately 5.4 km apart were observed on-effort during the surveys (see **Figure 1**). For boxes 1B2, 1C1, and 1C2, three parallel tracklines running from west to east, ranging in length from 39.68 km to 70.20 km long, and spaced approximately 8.74 km apart were observed on-effort during the surveys (see **Figure 1**). Original lines were followed when possible, but exact transects followed were subject to modifications as a result of unfavorable weather conditions and airspace exclusion during Naval exercises (see **Table 1 and Figures 2 through 7**).

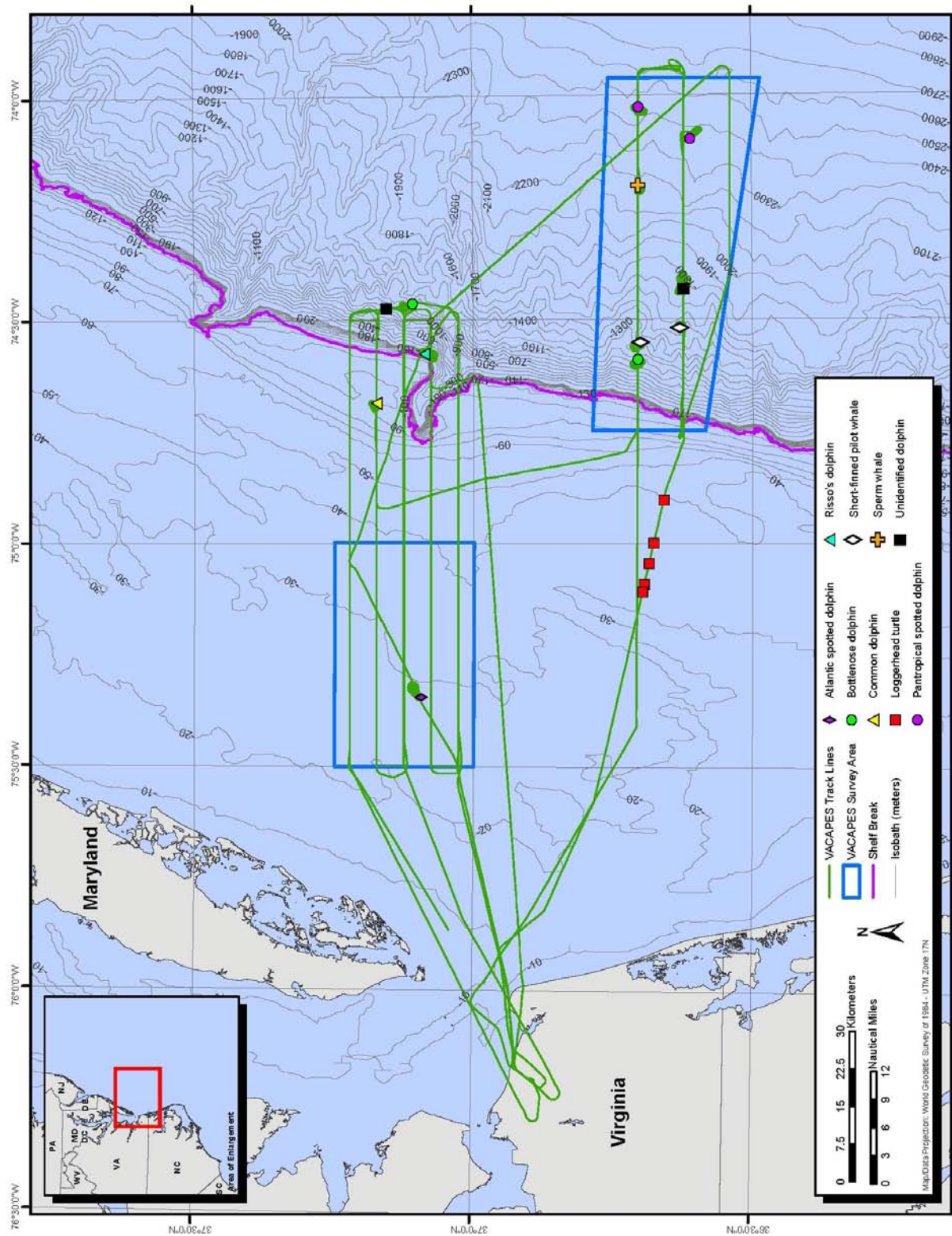


Figure 2. Location of All Cetacean and Sea Turtle Sightings during VACAPES August Exercises 2010

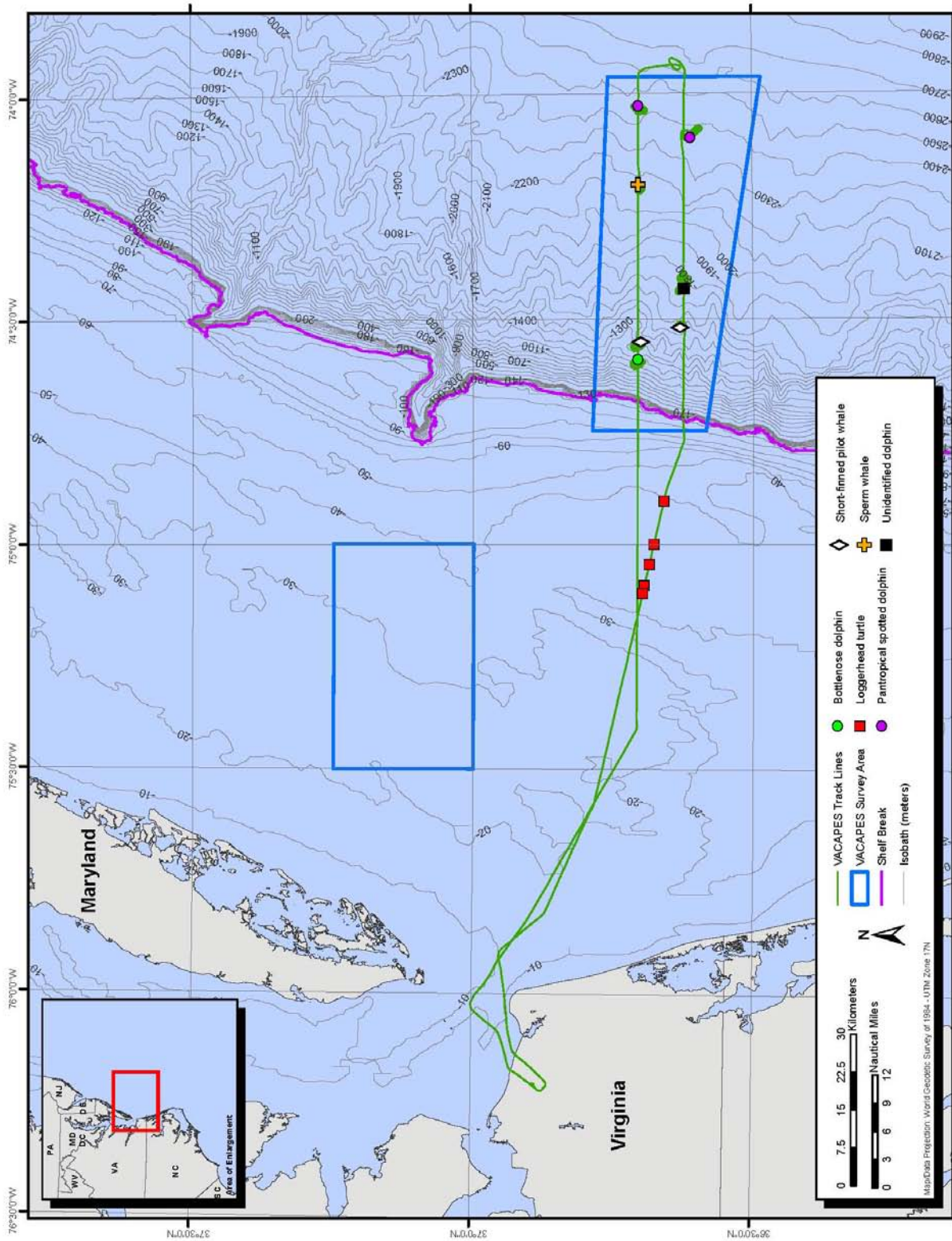


Figure 3. Location of Cetacean and Sea Turtle Sightings Seen During VACAPES ASW (August 9)

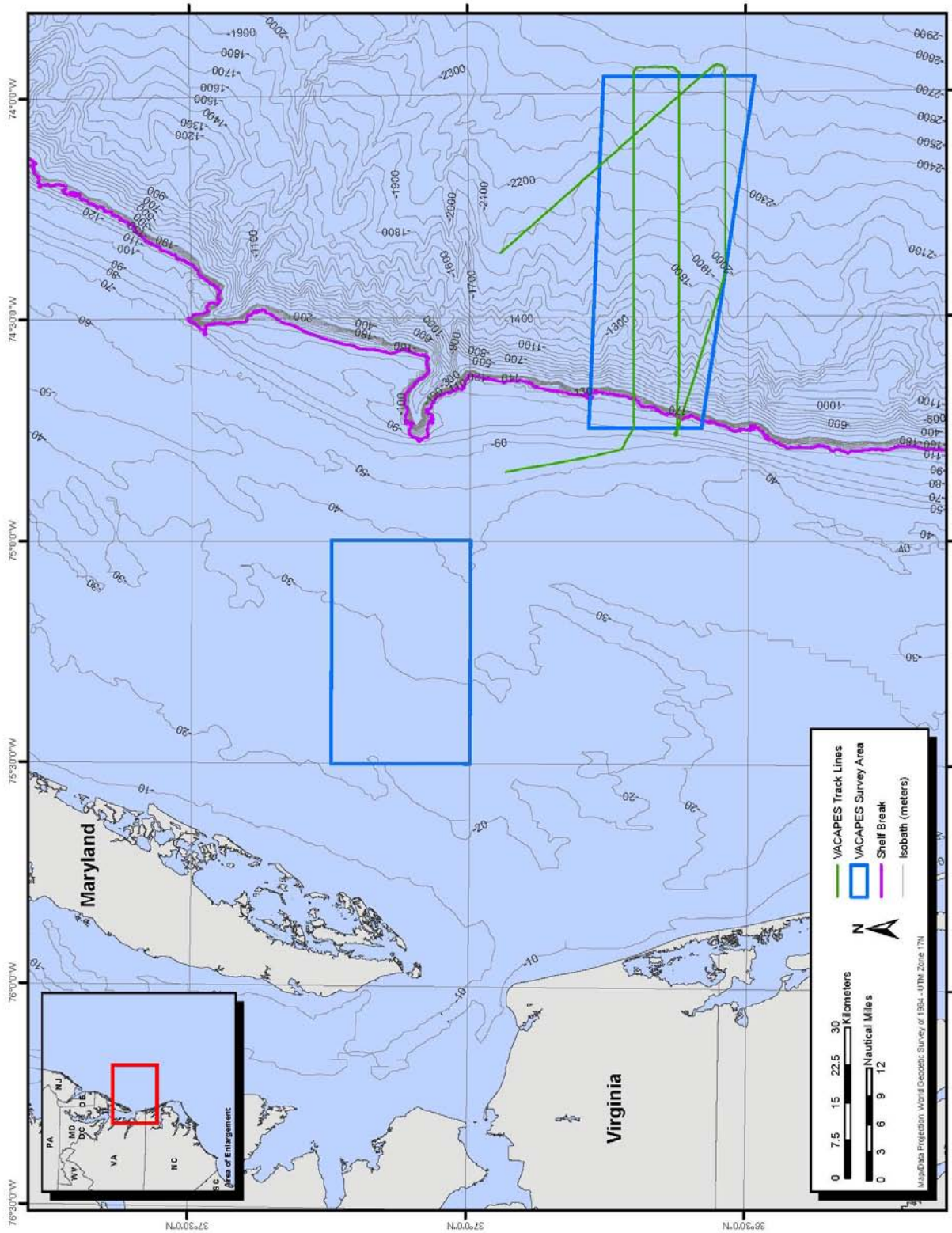


Figure 4. Location of Cetacean and Sea Turtle Sightings Seen During VACAPES ASW (August 10).

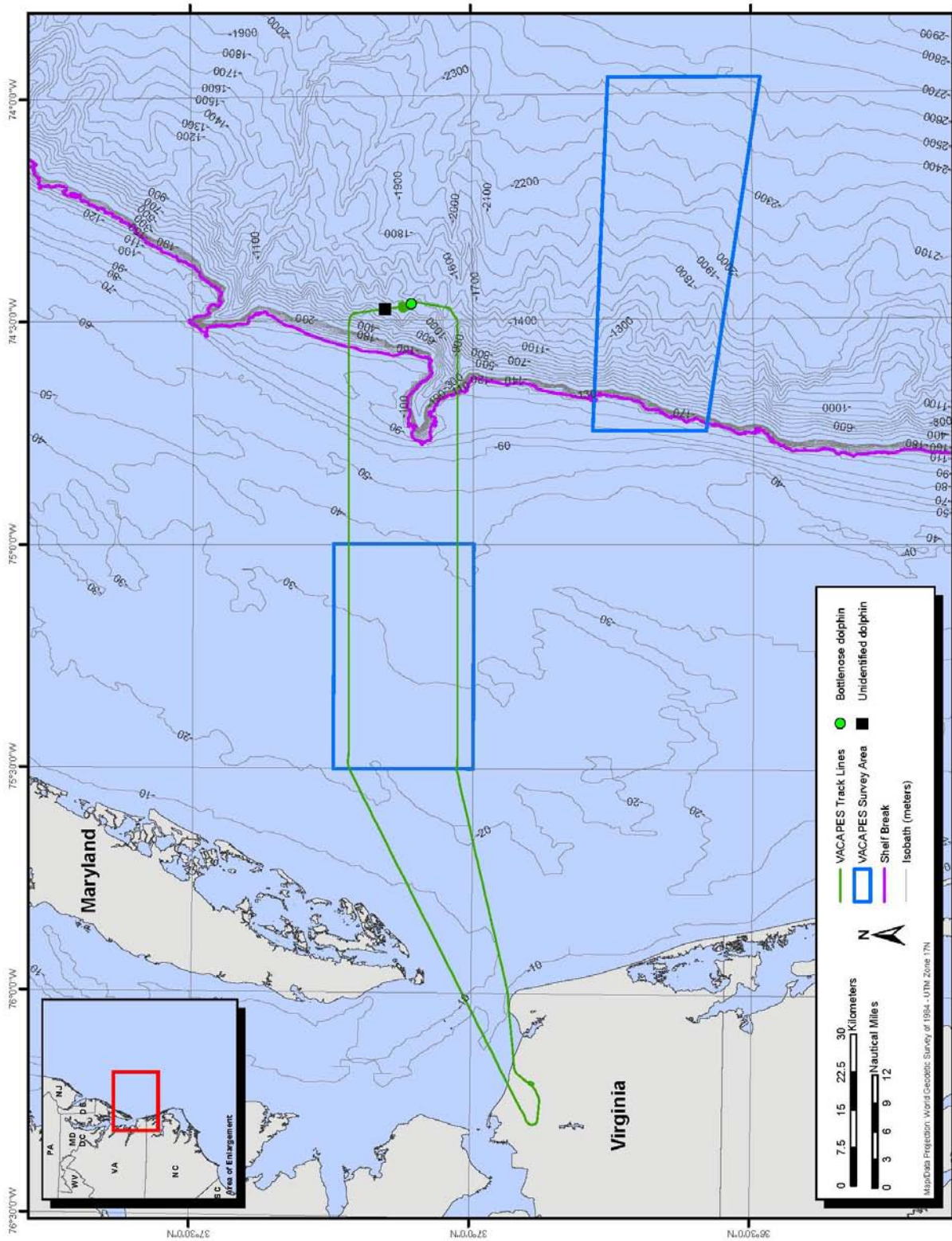


Figure 5. Location of Cetacean and Sea Turtle Sightings Seen During VACAPES FIREX (August 10 (am)).

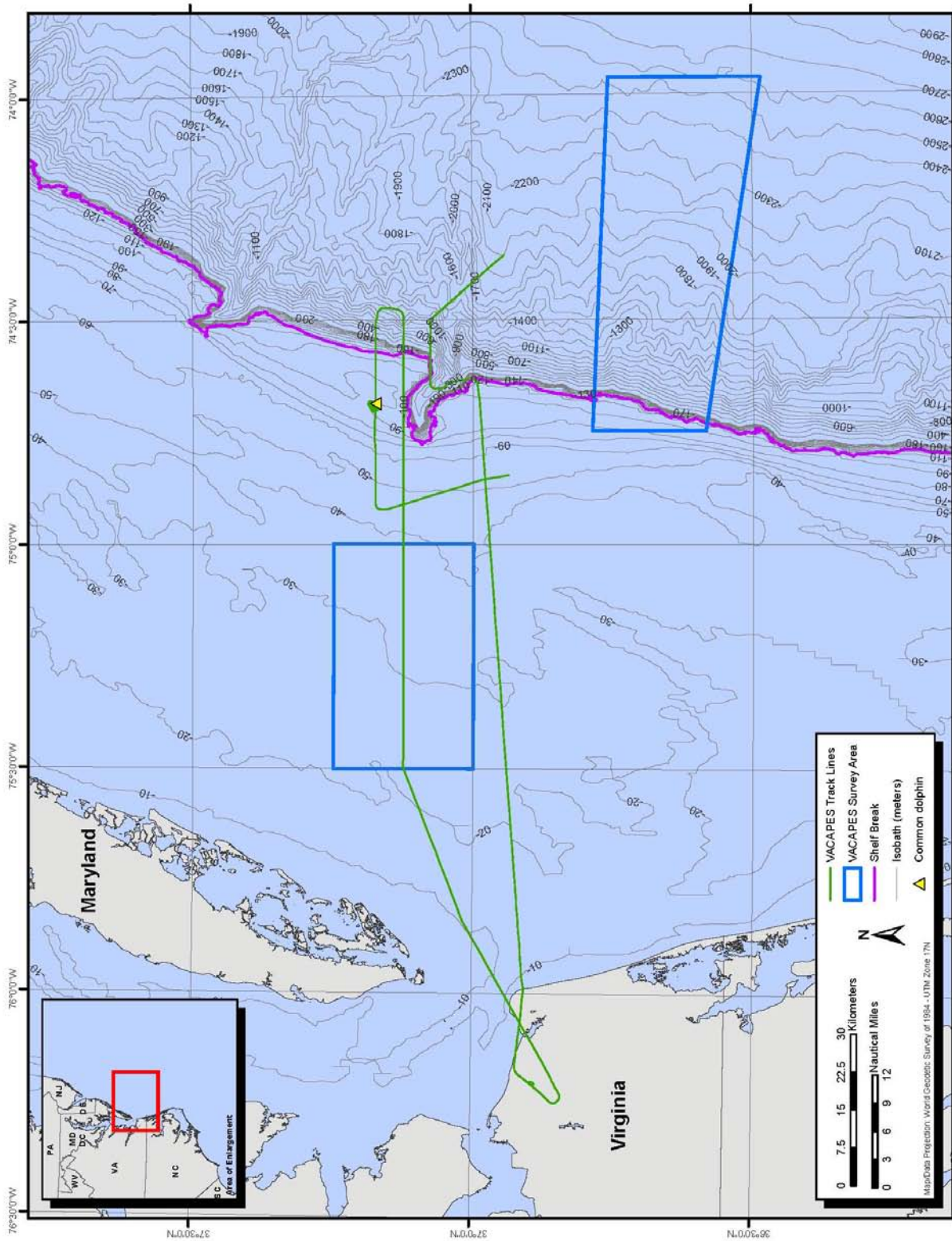


Figure 6. Location of Cetacean and Sea Turtle Sightings Seen During VACAPES FIREX (August 10 (pm)).

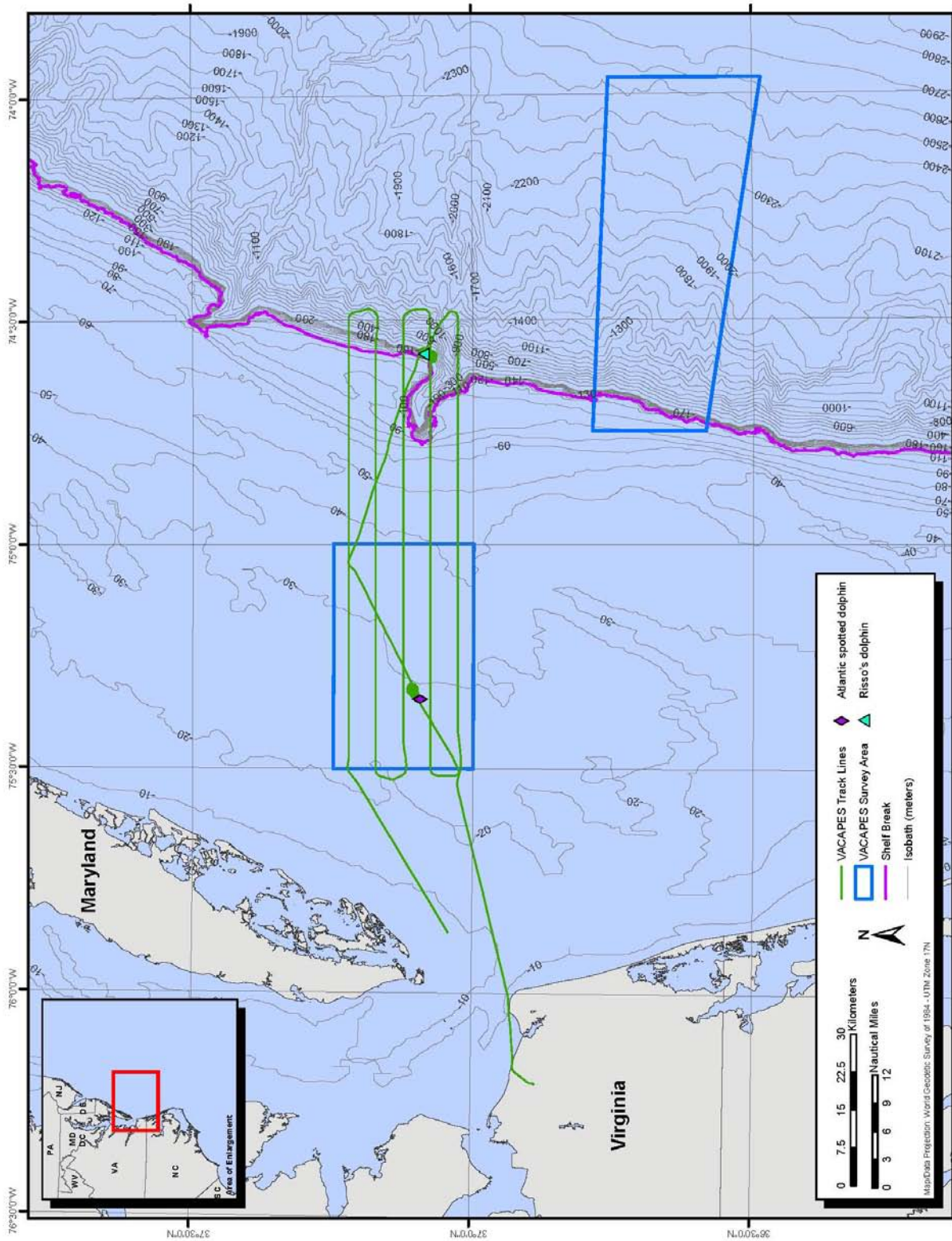


Figure 7. Location of All Cetacean and Sea Turtle Sightings Seen Post-VACAPES FIREX (August 11).

The general survey approach was as follows:

1. Follow pre-determined transect lines and waypoints using methods described by Smultea et al. (2009) until a sighting is made. Variables such as sea state, glare, and visibility are recorded.
2. Upon sighting a marine mammal/sea turtle group, record basic sighting information per established protocol (see Smultea et al. 2009). As outlined in the 2011 Atlantic Fleet Active Sonar Training (AFASST) Letter of Authorization (LOA), information is to include (1) species identification and group size; (2) location and relative distance from the ASW site if available; (3) the behavior of marine mammals and sea turtles including standard environmental and oceanographic parameters; (4) date, time, and visual conditions associated with each observation; (5) direction of travel relative to true north; (6) calves observed; and (7) duration of the observation.
3. If the species appears suitable for a focal follow, the aircraft increases altitude to approximately 365 to 455 m and radial distance increases approximately 0.5 to 1.0 km and the aircraft circles the sighting to obtain detailed behavior information as long as possible and logical, for a minimum of 5 minutes, including a combination of both video and digital photographs if possible.
4. If the species is not selected for a focal follow, and species and group size are unknown, the aircraft circles the sighting to obtain digital photographs for species identification confirmation and estimate group size/composition.

Section 3 Results

Survey Effort – ASW

For the ASW monitoring exercise, observers visually surveyed approximately 197 NM (364 km) of systematic trackline and 538 NM (997 km) of combined systematic and random (lines covered in transit to the next trackline) tracklines during 3 days for approximately 4.86 hours of total on- and off-effort (see **Table 1**). Beaufort sea state ranged from 1 to 2 with all cetacean sightings made in Beaufort sea states between 1 and 2 and all sea turtle sightings made in Beaufort sea state 1 only (see **Table 3**). A detailed description of environmental, oceanographic, and sighting conditions was recorded and is available if requested. Sightings per unit effort (SPUE) was calculated as the total survey effort (hours/km/NM) divided by the total number of marine mammal sightings (n=7) or sea turtles (n=5). For the ASW monitoring exercise, the SPUE for marine mammals was equal to 1 sighting per 0.69 hours, 142.42 km, and 76.85 NM and the SPUE for sea turtles was equal to 1 sighting per 0.97 hours, 199.4 km, and 107.6 NM.

Sightings – ASW

Seven cetacean sightings and no sea turtle sightings were recorded during 4.86 hours of combined effort (see **Figure 2** and **Table 3**). Digital photographs were collected during four surveys and used to determine or confirm species identification when possible. Sightings included one group of bottlenose dolphins (*Tursiops truncatus*), two groups of short-finned pilot whales (*Globicephala macrorhynchus*), one group of sperm whales (*Physeter macrocephalus*),

Table 3. Summary of Sightings

Sighting No.	Date & Event	Species	Group Size			Calves	Start Time	Stop Time	Beaufort Sea State	Latitude	Longitude	Vert. Angle	Distance off Track (km)	Heading	Bottom Depth (m)	Behavioral Summary
			Best	High	Low											
1	8/9/10 ASW	TT	45	50	30	3	12:12	12:47	2	36.706	-74.590	20	0.8	045	1,000	Travel NE: 2 subgroups staying tightly clumped; 3 subgroups of 14, 13, and 5 individuals.
2	8/9/10 ASW	GM	12	15	10	-	12:51	13:01	2	36.701	-74.551	41	0.4	000	1,500	Travel N: A few individuals headed west, but most headed north; 2 subgroups, 1 with 5 and 1 with 10 individuals.
3	8/9/10 ASW	PM	2	3	2	-	13:11	13:21	2	36.704	-74.201	45	0.3	045	2,100	Travel NE: 2 sperm whales spaced 0.25 NM apart; did focals to record behavioral data, did one surfacing sequence and saw them fluke up.
4	8/9/10 ASW	SA	300	400	200	-	13:28	13:51	1	36.702	-74.027	34	0.5	Unk	2,400	Surface Active Travel / Milling: Dolphins chasing big schools of fish, fast milling with short bursts of chasing, there's a fishing net there too, 5 subgroups, echelon formation.
5	8/9/10 ASW	SA	75	120	60	-	14:05	14:25	2	36.611	-74.098	9	1.9	135	2,300	Surface Active Travel SE: With fish school – maybe tuna?
6	8/9/10 ASW	Unid	65	85	35	-	14:35	14:58	2	36.624	-74.432	35	0.4	135	1,700	Travel SE: No initial reaction – later reacted to circling. Changed behavioral state, spacing, and dive times after we began circling later in observation.
7	8/9/10 ASW	GM	4	4	4	-	15:03	15:15	2	36.630	-74.519	38	0.4	000	1,500	Travel N: Echelon soldier formation.
8	8/9/10 ASW	CC	1	1	1	-	15:26	-	1	36.660	-74.903	20	0.8	Unk	30	Logging at surface.
9	8/9/10 ASW	CC	1	1	1	-	15:28	-	1	36.678	-74.999	10	1.7	Unk	30	Logging at surface.

Sighting No.	Date & Event	Species	Group Size Best/High/Low			Calves	Start Time	Stop Time	Beaufort Sea State	Latitude	Longitude	Vert. Angle	Distance off Track (km)	Heading	Bottom Depth (m)	Behavioral Summary
10	8/9/10 ASW	CC	1	1	1	-	15:29	-	1	36.686	-75.044	45	0.3	Unk	30	Logging at surface.
11	8/9/10 ASW	CC	1	1	1	-	15:30	-	1	36.695	-75.091	45	0.3	Unk	30	Logging at surface.
12	8/9/10 ASW	CC	1	1	1	-	15:30	-	1	36.698	-75.108	15	1.1	Unk	30	Logging at surface.
13	8/10/10 FIREX	Unid	12	20	8	-	07:51	7:54	3	37.157	-74.474	60	0.2	270	900	Travel W.
14	8/10/10 FIREX	TT	12	18	10	5	07:58	7:59	3	37.110	-74.463	10	1.7	270	1,100	Travel W.
15	8/10/10 FIREX	DD	65	75	50	-	12:38	12:52	3	37.174	-74.685	35	0.4	180	90	Travel S: echelon, porpoising.
16	8/11/10 FIREX	GG	6	8	6	-	09:50	10:26	4	37.088	-74.575	40	0.4	240	150	Travel: tight echelon formation, swimming underwater, milling, slow travel.
17	8/11/10 FIREX	SF	10	12	8	-	10:49	10:59	3	37.095	-75.344	50	0.3	Unk	20	Surface Active Milling and Travel: breaching, porpoising, travel medium to fast.

Key:

TT = Bottlenose dolphin (*Tursiops truncatus*)

PM = Sperm whale (*Physeter macrocephalus*)

SA = Pantropical spotted dolphin (*Stenella attenuata*)

GM = Short-finned pilot whale (*Globicephala macrorhynchus*)

GG = Risso's dolphin (*Grampus griseus*)

DD = Common dolphin (*Delphinus delphis*)

CC = Loggerhead turtle (*Caretta caretta*)

SF = Atlantic spotted dolphin

Unid = Unidentified dolphin

Unk = Unknown

two groups of pantropical spotted dolphins (*Stenella attenuata*), one group of unidentified dolphins, and five sightings of loggerhead turtles (*Caretta caretta*) (see **Figures 2 through 4** and **Table 3**). Cetaceans were sighted in water depths ranging from 1,000 to 2,400 m and loggerhead sea turtles were sighted in water depths ranging from 30 to 40 meters (see **Figures 2 through 4** and **Table 3**).

Survey Effort - FIREX

For the FIREX monitoring exercise, observers visually surveyed approximately 394 NM (730 km) of systematic trackline and 632 NM (1,171 km) of combined systematic and random (lines covered in transit to the next trackline) tracklines during 3 days for approximately 5.78 hours of total on- and off-effort (see **Table 1**). Beaufort sea state ranged from 1 to 4 with all cetacean sightings made in Beaufort sea states between 1 and 4 and all sea turtle sightings made in Beaufort sea state 1 only (see **Table 3**). A detailed description of environmental, oceanographic, and sighting conditions was recorded and is available by request. SPUE was calculated as the total survey effort (hours/km/NM) divided by the total number of marine mammal sightings (n=5). For the FIREX monitoring exercise, the SPUE for marine mammals was equal to 1 sighting per 0.86 hours, 234.2 km, and 126.4 NM.

Sightings – FIREX

Five cetacean sightings and no sea turtle sightings were recorded during 5.78 hours of effort (see **Figure 2** and **Table 3**). Digital photographs were collected during four surveys and used to determine or confirm species identification when possible. Sightings included one group of unidentified dolphins, one group of bottlenose dolphins (*Tursiops truncatus*), one group of common dolphins (*Delphinus delphis*), one group of Risso's dolphins (*Grampus griseus*), and one group of Atlantic spotted dolphins (*Stenella frontalis*) (see **Figures 5 through 7** and **Table 3**). Cetaceans were sighted in water depths ranging from 20 to 1,100 m (see **Figures 5 through 7** and **Table 3**).

Behavior

No visible evidence of distress or unusual behavior was observed during pre- and post-surveys in the VACAPES OPAREA (see **Table 3**). The team was able to conduct ten separate focal follow events on one group of unidentified dolphins and seven different species including bottlenose dolphins, pilot whales, sperm whales, pantropical spotted dolphins, common dolphins, Risso's dolphins, and Atlantic spotted dolphins. Detailed behavioral observations made during focal follows are presented in **Appendix A**. Digital photographs or HD video of suitable quality for species identification and for future behavioral assessment purposes were collected during focal follows.

Section 4 Acknowledgements

We would like to thank Orion Aviation's Director Ed Coffman and pilots Ron Schreck and Dave Huddle. These data were obtained under National Marine Fisheries Service (NMFS) permit no. 14451 issued to Joseph R. Mobley, Jr.

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- Smultea et al. 2009 Smultea, M.A., J.R. Mobley, Jr., and K. Lomac-MacNair. 2009. *Aerial Survey Monitoring for Marine Mammals and Sea Turtles in Conjunction with U.S. Navy Major Training Events off San Diego, California, 15-21 October and 15-18 November 2008, Final Report*. Prepared by Marine Mammal Research Consultants, Honolulu, HI, and Smultea Environmental Sciences, LLC., Issaquah, WA, under Contract No. N62742-08-P-1936 and N62742-08-P-1938 for Naval Facilities Engineering Command Pacific, EV2 Environmental Planning, Pearl Harbor, HI.

APPENDIX A

Focal Follow Data

Table A-1 shows the focal follow behavioral data from the VACAPES August 2010 monitoring efforts. A total of ten separate focal follow events on one group of unidentified dolphins and seven different species including bottlenose dolphins, pilot whales, sperm whales, pantropical spotted dolphins, common dolphins, Risso's dolphins, and Atlantic spotted dolphins were conducted during 9–11 August, 2010.

Table A-1. Focal Follow Behavior Data

Record Number	Time	Date	Latitude	Longitude	Recorded behavior
Sighting Number 1					
Species: <i>Tursiops truncatus</i>					
1	12:21	08/09/10	36° 41.938'N	74° 36.045'W	Travel NNE
2	12:25	08/09/10	36° 42.025'N	74° 35.310'W	Travel NNE
3	12:29	08/09/10	36° 42.207'N	74° 36.312'W	Travel N
4	12:31	08/09/10	36° 42.085'N	74° 36.363'W	Travel N, other subgroup of about 30 has dispersal 1–2 body lengths and in echelon formation.
5	12:34	08/09/10	36° 42.098'N	74° 35.809'W	Travel N, about 4 different subgroups at surface most in echelon formation ranging from 1–10 body lengths.
6	12:35	08/09/10	36° 42.186'N	74° 35.802'W	Travel NNW.
7	12:39	08/09/10	36° 42.385'N	74° 35.718'W	Travel NW, dispersal 2–4 body lengths.
8	12:41	08/09/10	36° 42.445'N	74° 35.742'W	Travel NW, dispersal 2–5 body lengths.
9	12:43	08/09/10	36° 42.953'N	74° 36.066'W	Travel NW, dispersal 1–4 body lengths.
10	12:46	08/09/10	36° 42.496'N	74° 36.531'W	Travel NW, dispersal 1–2 body lengths, 3–4 subgroups in area. Stayed with group and collected about 30 minutes of video and photographs.
Sighting Number 2					
Species: <i>Globicephala macrorhynchus</i>					
1	12:51	08/09/10	36° 42.080'N	74° 33.086'W	Travel.
2	12:58	08/09/10	36° 42.883'N	74° 33.657'W	Travel NNW.
3	12:59	08/09/10	36° 42.571'N	74° 33.856'W	Travel N.
Sighting Number 3					
Species: <i>Physeter macrocephalus</i>					
1	13:13:00	08/09/10	36° 42.216'N	74° 12.603'W	1 st whale travel NNE.
2	13:13:56	08/09/10	36° 41.564'N	74° 12.391'W	1 st whale travel NNE, spyhop by one of the two sperm whales.
3	13:16:52	08/09/10	36° 41.580'N	74° 12.232'W	1 st whale travel N, Fluke up by 1 st whale.
4	13:17:15	08/09/10	36° 41.985'N	74° 12.886'W	2 nd whale headed W, about 0.25 miles from first whale.
5	13:18:35	08/09/10	36° 42.094'N	74° 12.333'W	2 nd whale travel W.
6	13:19:35	08/09/10	36° 42.064'N	74° 12.338'W	2 nd whale travel W, been on surface constantly blowing, no observed obvious changes.
7	13:20:35	08/09/10	36° 42.090'N	74° 12.342'W	2 nd whale travel W.
8	13:21:06	08/09/10	36° 41.802'N	74° 13.120'W	2 nd whale travel W, fluke up.

Record Number	Time	Date	Latitude	Longitude	Recorded behavior
Sighting Number 4					
Species: <i>Stenella attenuata</i>					
1	13:34	08/09/10	36°42.097'N	74° 02.277'W	Group of at least 200 individual dolphins, main group is milling around a fishing net and chasing fish, milling spread out over about 1 mile, one subgroup of about 35–45 individuals is porpoising traveling fast to the W, others are in smaller subgroups milling probably feeding.
2	13:36	08/09/10	36°42.096'N	74° 02.669'W	Milling.
3	13:38	08/09/10	36° 41.767'N	74° 02.030'W	Surface Active (SAC) Milling – porpoising now and milling, feedings, lots of splashing.
4	13:39	08/09/10	36° 41.935'N	74° 01.872'W	SAC Milling – Water is frothy where animals are concentrated.
5	13:40	08/09/10	36° 41.992'N	74° 01.886'W	SAC Milling – still lots of porpoising, shark in the area, one main big group, breaching, staying together at or near surface constantly
6	13:41	08/09/10	36° 42.188'N	74° 02.101'W	SAC Milling – several other subgroups of about 2 animals each about 0.5 NM away from main group.
7	13:42	08/09/10	36° 42.206'N	74° 02.296'W	SAC Milling – main group is milling and swimming overall in a big circle with white large wake, doing 360s.
8	13:43	08/09/10	36° 42.123'N	74° 02.106'W	SAC Milling.
9	13:44	08/09/10	36° 42.153'N	74° 02.087'W	SAC Milling – not as much porpoising now, when they move they do more porpoising, maybe they caught what they were after, dolphins appear to be corraling fish or some prey.
10	13:45	08/09/10	36° 42.084'N	74° 02.038'W	SAC Milling – still generally doing big circles of about 200 feet in diameter, porpoising while running after then appear to circle on something.
11	13:46	08/09/10	36° 42.072'N	74° 02.116'W	SAC Milling.
12	13:47	08/09/10	36° 42.026'N	74° 02.221'W	SAC Milling – reduced overall surface active behavior but still porpoising.
13	13:48	08/09/10	36° 42.045'N	74° 02.174'W	SAC Milling – still milling tightly together in same location.
14	13:49	08/09/10	36° 41.990'N	74° 02.132'W	SAC Milling – 2 subgroups close together, totaling about 250.
15	13:50	08/09/10	36° 42.066'N	74° 02.000'W	SAC Milling.

Record Number	Time	Date	Latitude	Longitude	Recorded behavior
Sighting Number 5					
Species: <i>Stenella attenuata</i>					
1	14:13	08/09/10	36° 36.193'N	74° 04.763'W	SAC Travel SE – echelon formation.
2	14:14	08/09/10	36° 36.188'N	74° 04.716'W	SAC Travel SE – slow travel, no porpoising.
3	14:15	08/09/10	36° 36.314'N	74° 04.829'W	SAC Travel SE.
4	14:16	08/09/10	36° 36.304'N	74° 04.808'W	SAC Travel SE.
5	14:17	08/09/10	36° 36.280'N	74° 04.961'W	SAC Travel SE.
6	14:18	08/09/10	36° 36.271'N	74° 04.884'W	SAC Travel SE.
7	14:19	08/09/10	36° 36.195'N	74° 05.119'W	Travel SE – animals traveling just below the surface.
8	14:20	08/09/10	36° 36.019'N	74° 05.149'W	Travel SE – multiple pairs spaced 1 body length apart, then each pair max spacing between pairs 10 body lengths, so considered same subgroup by definition (subgroup = animals within 20 body lengths of each other).
9	14:21	08/09/10	36° 36.013'N	74° 05.021'W	Travel SE.
10	14:22	08/09/10	36° 35.963'N	74° 05.062'W	Travel SE.
11	14:23	08/09/10	36° 35.744'N	74° 05.123'W	Travel SE.
12	14:24	08/09/10	36° 35.708'N	74° 05.089'W	Milling.
13	14:25	08/09/10	36° 35.572'N	74° 05.037'W	Travel – in long spread out line now, traveled steadily slow at 3–5 knots entire time, one little bout of milling, very different than previous large group that was traveling at 12–15 knots.
Sighting Number 6					
Species: Unidentified Dolphins, Probably <i>Stenella attenuata</i>					
1	14:38	08/09/10	36° 37.938'N	74° 25.599'W	Travel SE.
2	14:39	08/09/10	36° 37.405'N	74° 26.347'W	Travel SE – 2 groups about 0.25 NM apart, 1 st group about 25 animals, 2 nd group about 35 animals.
3	14:40	08/09/10	36° 37.695'N	74° 25.544'W	Travel SE.
4	14:41	08/09/10	36° 37.164'N	74° 25.938'W	Down below surface, not in view.
5	14:42	08/09/10	36° 37.474'N	74° 25.839'W	Travel SE – up again.
6	14:43	08/09/10	36° 37.510'N	74° 25.937'W	Travel SE – fast travel at surface, all spread out now, possible reaction/change in behavior.
7	14:44	08/09/10	36° 37.787'N	74° 25.851'W	Travel E – staying below water surface.

Record Number	Time	Date	Latitude	Longitude	Recorded behavior
Sighting Number 6 (continued)					
8	14:45	08/09/10	36° 37.468'N	74° 25.665'W	Travel E – still visible, spread out over 0.5 miles, dispersal 4–10 body lengths? in both subgroups.
9	14:47	08/09/10	36° 37.379'N	74° 25.004'W	Travel E – drop in altitude to get better photos for ID, animals might be reacting to circling.
10	14:48	08/09/10	36° 37.208'N	74° 24.838'W	Travel E – animals under water – could be a reaction to plane circling too close to take photos.
11	14:49	08/09/10	36° 37.292'N	74° 24.679'W	Travel E.
12	14:50	08/09/10	36° 37.402'N	74° 24.486'W	Travel E.
13	14:51	08/09/10	36° 36.742'N	74° 24.745'W	Travel E – all dove under during low approach to get ID photos.
14	14:56	08/09/10	36° 37.911'N	74° 24.936'W	SAC Milling – milling and fast spring bouts in different directions, crisscrossing milling, maybe chasing something, some leaping out of water.
15	14:57	08/09/10	36° 37.608'N	74° 24.743'W	Very little leaping, moving generally to East, but overall milling with animals in different headings with overall movement to the E.
16	14:58	08/09/10	36° 37.395'N	74° 24.623'W	SAC Milling.
Sighting Number 7					
Species: <i>Globicephala macrorhynchus</i>					
1	15:05	08/09/10	36° 37.784'N	74° 31.116'W	SAC Travel N.
2	15:06	08/09/10	36° 37.966'N	74° 30.889'W	SAC Travel N.
3	15:07	08/09/10	36° 37.976'N	74° 30.747'W	Travel N – very widespread.
4	15:08	08/09/10	36° 37.849'N	74° 30.524'W	Travel N.
5	15:09	08/09/10	36° 37.546'N	74° 30.739'W	Travel N – 4 animals at surface.
6	15:10	08/09/10	36° 37.564'N	74° 31.009'W	Travel.
7	15:11	08/09/10	36° 37.565'N	74° 31.180'W	Travel N – all single animals 100–200 m apart, still slow travel this whole time.
8	15:12	08/09/10	36° 37.577'N	74° 30.951'W	Travel N.
9	15:13	08/09/10	36° 37.592'N	74° 30.818'W	Travel N – still slow travel, first seen all 4 animals together spaced closely together 0.5 body lengths apart min and max then they spread out then moved a little closer together but have kept same heading to N and same slow travel behavior state.
10	15:14	08/09/10	36° 37.670'N	74° 30.709'W	Travel N.
11	15:15	08/09/10	36° 37.650'N	74° 30.756'W	Travel N.

Record Number	Time	Date	Latitude	Longitude	Recorded behavior
Sighting Number 13					
Species: Unidentified Dolphins, Probably <i>Delphinus delphis</i>					
1	12:38	08/10/10	37° 10.487'N	74° 41.126'W	Travel S, echelon, porpoising.
2	12:39	08/10/10	37° 10.913'N	74° 42.064'W	Travel S.
3	12:40	08/10/10	37° 10.706'N	74° 41.351'W	Travel S.
4	12:42	08/10/10	37° 10.309'N	74° 41.512'W	Travel S, at least 20 dolphins, 2 subgroups.
5	12:43	08/10/10	37° 10.365'N	74° 41.414'W	Travel S.
6	12:44	08/10/10	37° 10.447'N	74° 42.040'W	Travel S, small group of 5 and larger group of about 15.
7	12:45	08/10/10	37° 10.695'N	74° 42.031'W	Travel S.
8	12:48	08/10/10	37° 10.811'N	74° 41.878'W	Travel S, only 2 dolphins seen at the surface.
9	12:49	08/10/10	37° 10.869'N	74° 41.987'W	SAC Travel S – echelon, porpoising, larger group size estimated at 65.
10	12:50	08/10/10	37° 11.144'N	74° 41.505'W	SAC Travel S.
Sighting Number 16					
Species: <i>Grampus griseus</i>					
1	09:50	08/11/10	37° 05.335'N	74° 34.526'W	Travel WSW.
2	09:52	08/11/10	37° 05.087'N	74° 34.280'W	Not in view.
3	09:53	08/11/10	37° 05.060'N	74° 34.051'W	Travel WSW.
4	09:54	08/11/10	37° 05.097'N	74° 34.061'W	Not in view.
5	09:55	08/11/10	37° 05.320'N	74° 33.785'W	Dolphins in glare.
6	09:56	08/11/10	37° 05.589'N	74° 34.103'W	Travel WSW. Logging at surface, slow travel.
7	09:57	08/11/10	37° 05.522'N	74° 34.906'W	Travel WSW.
8	9:58	08/11/10	37° 05.074'N	74° 34.850'W	Travel WSW.
9	9:59	08/11/10	37° 04.674'N	74° 34.451'W	Travel WSW.
10	10:00	08/11/10	37° 04.951'N	74° 33.943'W	Not in view.
11	10:01	08/11/10	37° 05.290'N	74° 33.988'W	Travel WSW.
12	10:02	08/11/10	37° 05.258'N	74° 34.211'W	Not in view.
13	10:03	08/11/10	37° 05.244'N	74° 35.009'W	Milling underwater, dolphins in a couple of echelons, a couple of singles, pairs; 6-6-8 low best high.
14	10:04	08/11/10	37° 04.931'N	74° 35.030'W	Milling.
15	10:05	08/11/10	37° 05.154'N	74° 34.979'W	Milling.
16	10:06	08/11/10	37° 05.148'N	74° 34.974'W	Travel S.
17	10:07	08/11/10	37° 04.866'N	74° 34.882'W	Travel S, back into echelon formation.

Record Number	Time	Date	Latitude	Longitude	Recorded behavior
Sighting Number 16 (continued)					
18	10:08	08/11/10	37° 04.682'N	74° 34.930'W	Travel E, one animal at surface only; still no observed potential reaction or change in behavior in response to the plane.
19	10:09	08/11/10	37° 04.614'N	74° 34.732'W	Not in view.
20	10:10	08/11/10	37° 04.525'N	74° 34.546'W	Travel SW, echelon formation.
21	10:11	08/11/10	37° 05.186'N	74° 34.285'W	Not in view.
22	10:12	08/11/10	37° 05.254'N	74° 34.550'W	Travel, only 2 animals seen at surface; been slow travel throughout except when milling; a fishing trawler vessel is about 1 mile away – was headed away but now headed towards us/dolphins.
23	10:13	08/11/10	37° 04.970'N	74° 35.038'W	Not in view.
24	10:14	08/11/10	37° 04.598'N	74° 34.982'W	Not in view.
25	10:15	08/11/10	37° 04.314'N	74° 34.437'W	Travel W, 6 visible briefly, echelon formation slow travel, trawler is now within 1 mile of where dolphins were.
26	10:16	08/11/10	37° 04.244'N	74° 34.702'W	Not in view.
27	10:17	08/11/10	37° 04.385'N	74° 34.256'W	Not in view.
28	10:18	08/11/10	37° 04.844'N	74° 34.550'W	Not in view.
29	10:19	08/11/10	37° 04.680'N	74° 35.094'W	Not in view.
30	10:20	08/11/10	37° 04.137'N	74° 35.207'W	Not in view.
31	10:21	08/11/10	37° 04.256'N	74° 34.179'W	Travel SSW, 5 at surface, still tight formation surfing a wave, 1 in front 4 behind in echelon formation.
32	10:22	08/11/10	37° 04.631'N	74° 34.816'W	Travel SSW, animals spread out a bit, 2 individuals split out to side, 4 at surface, slow travel.
33	10:23	08/11/10	37° 04.664'N	74° 34.828'W	Travel SSW, at surface.
34	10:24	08/11/10	37° 04.677'N	74° 35.015'W	Milling, 5 at surface, 4 swimming closely together.
35	10:25	08/11/10	37° 04.638'N	74° 34.995'W	Milling.
36	10:26	08/11/10	37° 04.882'N	74° 34.902'W	Milling.
Sighting Number 17					
Species: <i>Stenella frontalis</i>					
1	10:49	08/11/10	37° 05.727'N	75° 20.674'W	SAC Milling, breaching, looks like around 3 subgroups initially, spacing 0.5–3 body lengths within subgroups.
2	10:50	08/11/10	37° 05.770'N	75° 20.567'W	SAC Travel E, breaching.
3	10:51	08/11/10	37° 05.909'N	75° 20.657'W	SAC Travel E, 2 animals at surface.
4	10:52	08/11/10	37° 06.128'N	75° 20.613'W	SAC Travel E, breaching.

Record Number	Time	Date	Latitude	Longitude	Recorded behavior
Sighting Number 17 (continued)					
5	10:53	08/11/10	37° 06.194'N	75° 20.424'W	SAC Travel E, breaching, there is a trailing group of 2-3.
6	10:54	08/11/10	37° 06.344'N	75° 20.531'W	SAC Travel E, porpoising.
7	10:55	08/11/10	37° 06.489'N	75° 20.377'W	SAC Travel E, at least 8 individuals spread out over at least 0.25 miles, clumped up in 2s and 3s into subgroups.
8	10:56	08/11/10	37° 06.686'N	75° 20.144'W	Travel E, travel medium to fast based on our plane tracks.
9	10:57	08/11/10	37° 06.746'N	75° 19.953'W	Travel NE, medium to fast.
10	10:58	08/11/10	37° 06.771'N	75° 19.826'W	Not in view.
11	10:59	08/11/10	37° 06.758'N	75° 19.648'W	Not in view, bad glare/haze/Beaufort 4, overall, the 8 individuals were initially spread out in 3 subgroups, then moved closer together and coalesced into one group, then spread out again into 3 subgroups. Reaction did not appear to be to the plane, never got less than 20 degrees declination near them, never flew over them, circled at 1,500 feet – well outside Snell's, no plane shadow.