Occurrence, Distribution, and Density of Protected Marine Species in the Chesapeake Bay near NAS PAX: 2015 Annual Progress Report

Submitted to:

Naval Facilities Engineering Command Atlantic under Contract No. N62470-10-D-3011, Task Order 55, issued to HDR, Inc.

Prepared by

Michael Richlen[1], Tiffany Keenan-Bateman[2], Erin Cummings[2], Ryan McAlarney[2], William McLellan[2], D. Ann Pabst[2], Jessica Aschettino[1], Amy Engelhaupt[3], and Dan Engelhaupt[1]

[1]HDR
Virginia Beach, Virginia

[2]Department of Biology and Marine Biology
University of North Carolina Wilmington
Wilmington, North Carolina

[3]Amy Engelhaupt Consulting
Virginia Beach, Virginia

Submitted by:

Virginia Beach, VA

01 March 2016

Suggested Citation:

Richlen, M., T. Keenan-Bateman, E. Cummings, R. McAlarney, W. McLellan, D.A. Pabst, J. Aschettino, A. Engelhaupt, and D. Engelhaupt. 2016. *Occurrence, Distribution, and Density of Protected Marine Species in the Chesapeake Bay near NAS PAX: 2015 Annual Progress Report.* Prepared for U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command (NAVFAC) Atlantic, Norfolk, Virginia, under Contract No. N62470-10-3011, Task Order 55, issued to HDR Inc., Virginia Beach, Virginia. 01 March 2016.

Cover Photo Credit:

Bottlenose dolphins (*Tursiops truncatus*) observed in Chesapeake Bay. Photo taken by Jessica Aschettino under National Marine Fisheries Service permit no. 16239.

This project is funded by Naval Air Systems Command and managed by Naval Facilities Engineering Command Atlantic as part of the U.S. Navy's Marine Species Monitoring Program.

Table of Contents

Figures

Tables

Acronyms and Abbreviations

BSS	Beaufort sea state
DPM	detection-positive minutes
hr	hour(s)
m	meter(s)
km	kilometer(s)
MADBC	Mid-Atlantic Bottlenose Dolphin Catalog
NAS	Naval Air Station
PAX	Patuxent
photo-ID	photo identification
UNCW	University of North Carolina Wilmington
U.S.	United States

This page intentionally left blank

1. Summary

The HDR Monitoring Team initiated a monitoring project that will provide quantitative data and information on the seasonal occurrence, distribution, and density of protected species (marine mammals and sea turtles) in Chesapeake Bay waters near Naval Air Station (NAS) Patuxent (PAX) River, roughly from Drum Point, south to Smith Point along the western shore and over to the coastal waters of the eastern shore. An area of interest was determined during discussions with United States (U.S.) Naval Air Systems Command personnel, for which protected marine species occurrence and density data is desired for use in environmental planning and regulatory compliance efforts. Aerial surveys were initiated in April 2015 and the first deployment of C-PODs (passive acoustic data loggers; chelonia.co.uk) was in July 2015.The University of North Carolina Wilmington (UNCW) is conducting monthly fixed-wing aerial line-transect surveys to document the occurrence and distribution of marine mammals and sea turtles in the study area. HDR has recovered the first deployment of C-PODs to complement the aerial survey data by assessing the seasonality and occurrence of echolocating cetaceans in the study area. Additionally, HDR has collected opportunistic sighting photographs of bottlenose dolphins (*Tursiops truncatus*) during the first C-POD deployment and will continue to collect photo-identification (photo-ID) data if additional sightings occur during subsequent field efforts. The Centre for Research into Ecological and Environmental Modeling at the University of St. Andrews has operated in an advisory capacity on survey design for both the visual data and the passive acoustic data, and will analyze data from the line-transect surveys using standard design-based analysis methods.

This page intentionally left blank.

2. Methods

2.1 Passive Acoustic Methods

After securing the necessary waterways permits, HDR deployed five underwater acoustic monitoring devices to detect the presence of bottlenose dolphins that may be occurring in the study area (**Figure 1**). The acoustic devices (C-PODs) can detect the presence of echolocating bottlenose dolphins and were dispersed in areas of interest to complement the aerial surveys. Alternate deployment sites were included in the permit to allow for flexibility in case interest shifted to other areas over the course of the study. The C-PODs were bottom-mounted and an acoustic release (Edgetech Sport MFE) was used for retrieval. To ensure that the device will float to the surface upon release, a syntactic foam float was attached to the unit, which remains submerged during deployment and only rises to the surface upon release. The devices were first deployed on 11 July 2015 and recovered/redeployed on 23 and 24 November 2015. Subsequent trips will be made every 4 months for the remainder of the 2-year project.

Preliminary results from the first deployment show that all C-PODs have recorded good quality data. The raw click data are imported into custom analysis software and processed using the KERNO classifier (custom function built into proprietary software) to detect click trains and identify their likely sources. A secondary classifier called GENENC (chelonia.co.uk) (which uses a longer time window) can improve the detection performance and was applied to the PAX C-POD data and assessed for its effectiveness for correct classification of Tursiops.

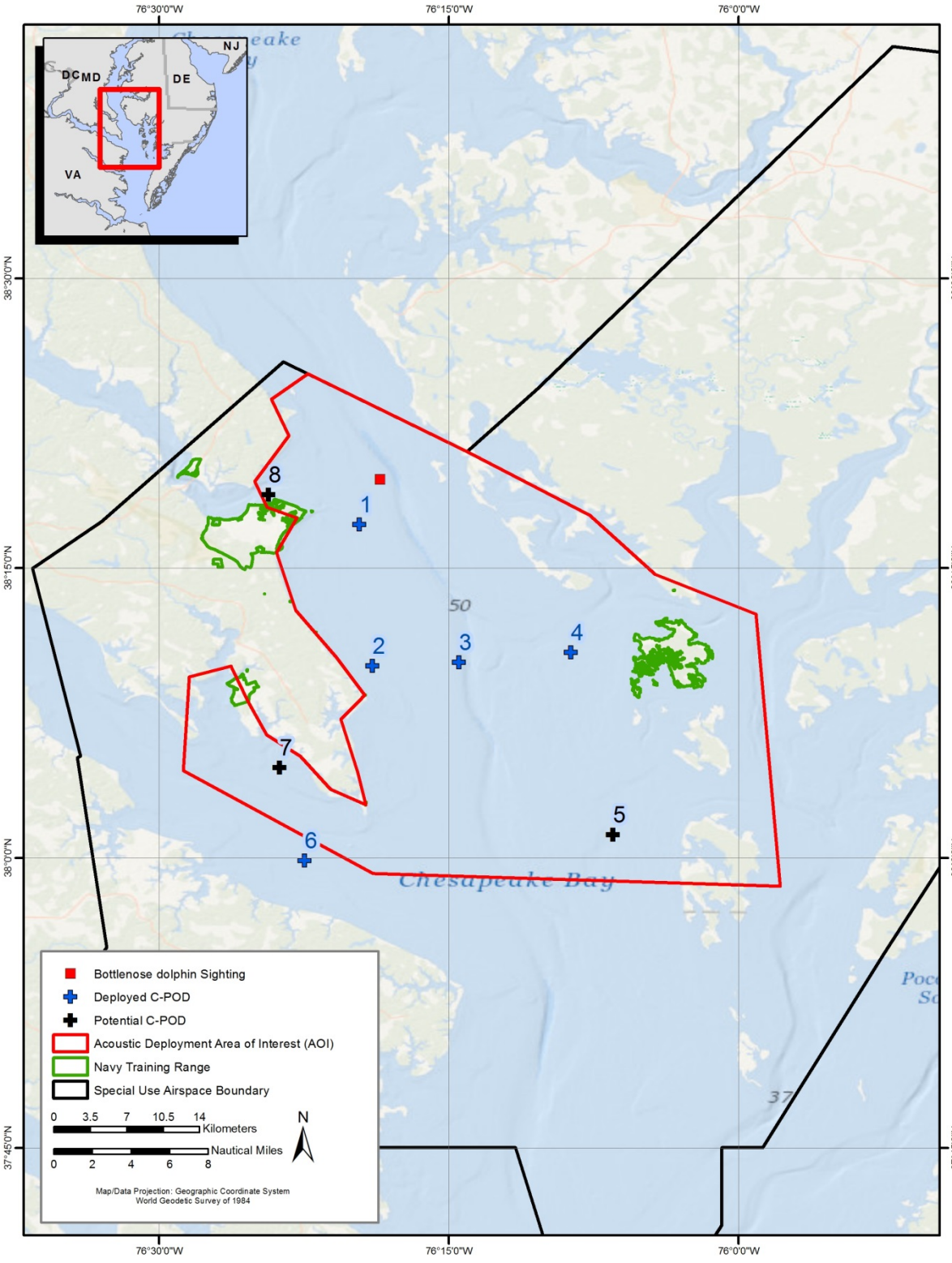

Figure 1. Locations of C-POD deployments around Naval Air Station PAX (blue +) and alternative sites for future deployments (black +). The red square indicates the location of the only dolphin sighting during the first C-POD deployment on 12 July 2015 (see section 3.2 for details).

2.2 Dolphin Photo-Identification and Visual Surveys

During each of the C-POD deployment/recovery trips, HDR researchers maintained a visual lookout for dolphins while underway. These surveys were non-systematic and opportunistically conducted to maximize data collection while on the water. Time and weather permitting, efforts were made to obtain photographs to be used for photo-ID analysis. A recent collaboration was also established with researchers from Georgetown University (Potomac-Chesapeake Dolphin Project), who are also conducting bottlenose dolphin surveys in the Potomac River, and may result in combining efforts to establish a catalog of all photographed individuals in the PAX region. Photo-IDs can also be made available for comparisons with HDR's bottlenose dolphin photo-ID catalog from Norfolk and Virginia Beach, Virginia (Engelhaupt et al. 2016) which are also included as part of the Mid-Atlantic Bottlenose Dolphin Catalog (MABDC), curated by Duke University.

2.3 Aerial Survey Methods

Aerial line-transect surveys were conducted in the waters of the Chesapeake Bay, and the mouth of the Potomac River, surrounding the NAS PAX site (**Figure 2, Table 1**). Surveys employed the same methodology and monitoring goals as other surveys conducted in support of Atlantic Fleet Training and Testing throughout the Atlantic. Surveys were flown in an over-wing, twin-engine Cessna 337 Skymaster, at an altitude of 305 meters (m) and airspeed of 185 kilometers (km)/hour (hr). Two observers, one positioned on each side of the aircraft, carried out surveys. Each monthly survey was flown over the course of a single day and covered all established tracklines within the survey site (**Table 2**).

Table 1. Trackline endpoint coordinates for the Patuxent River study site. Note that the seven Z line points denote endpoints for six tracklines.

Transect	Latitude (N)	Longitude (W)	Transect	Latitude (N)	Longitude (W)	Transect	Latitude (N)	Longitude (W)
1W	37.92217	76.29089	1E	37.92583	75.89691	Z1	38.14046	76.50664
2W	37.95300	76.35423	2E	37.95738	75.89579	Z2	38.02788	76.51701
3W	37.98468	76.24193	3E	37.98893	75.89582	Z3	38.13213	76.43518
4W	38.01637	76.32963	4E	38.02047	75.89584	Z4	37.99095	76.44934
5W	38.04801	76.32098	5E	38.05202	75.89587	Z5	38.07689	76.37031
6W	38.07945	76.33015	6E	38.08356	75.89590	Z6	37.95600	76.37821
7W	38.11091	76.33740	7E	38.11510	75.89593	Z7	38.01216	76.33126
8W	38.14261	76.32279	8E	38.14618	75.95522			
9W	38.17386	76.34884	9E	38.17775	75.95189			
10W	38.20512	76.37349	10E	38.20963	75.90946			
11W	38.23644	76.39159	11E	38.24073	75.96450			
12W	38.26790	76.39853	12E	38.27197	76.00080			
13W	38.29972	76.37556	13E	38.30154	76.21005			
14W	38.33082	76.41266	14E	38.33258	76.25759			
15W	38.36267	76.38674	15E	38.36422	76.24889			
16W	38.39403	76.40185	16E	38.39542	76.28056			
17W	38.42525	76.42832	17E	38.42681	76.29400			

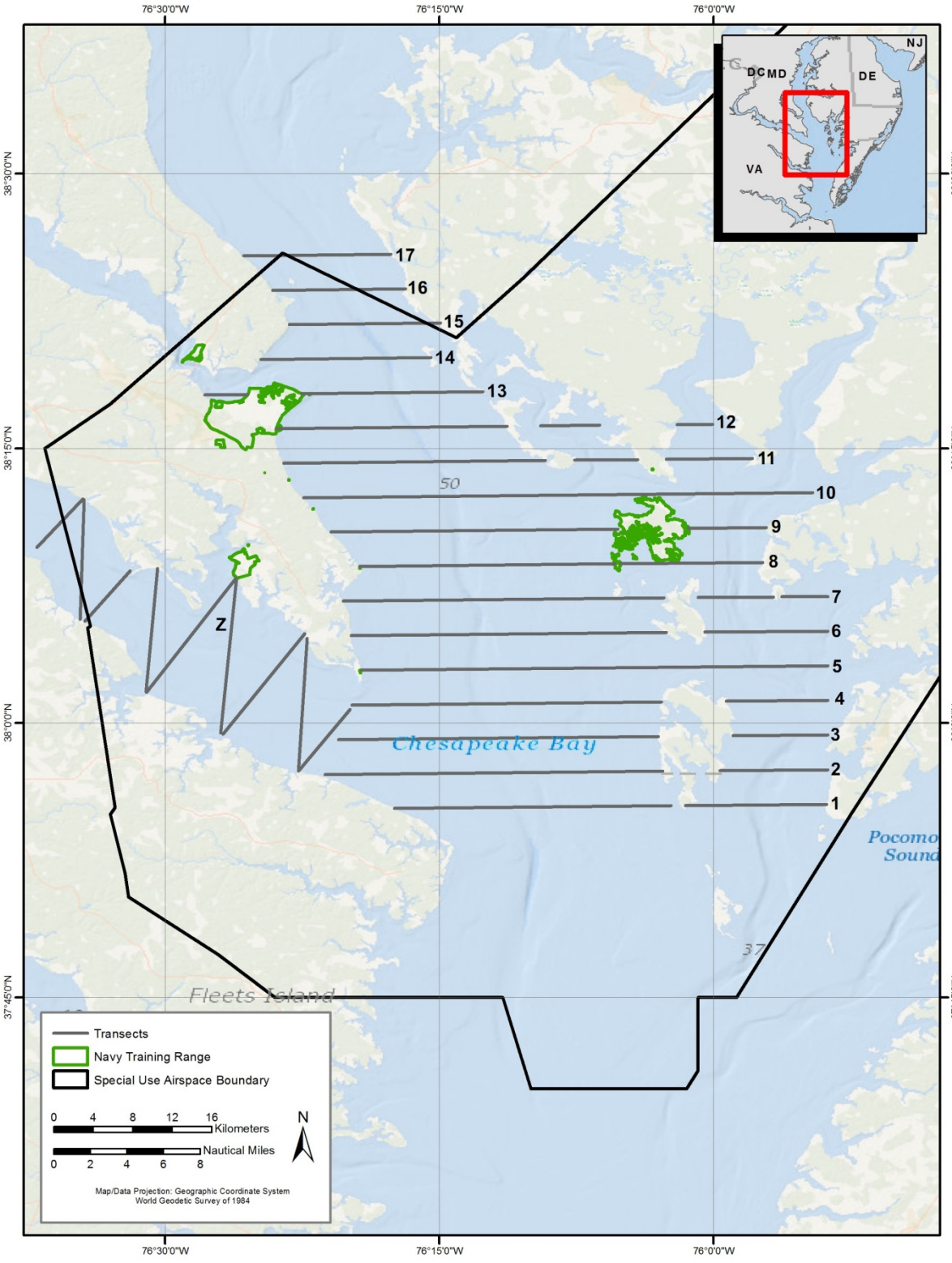

Figure 2. Aerial survey tracklines for the PAX River study area.

Table 2. C-POD results from the first deployment of all five instruments. Detections have been filtered to remove low amplitude click trains and false positives. DPM and DPD are detection positive minutes and days, respectively.

Date & Time		Dolphin DPM		Dolphin DPD	Boat Sonar DPM	Logged days	minutes ON	% Time Lost
Start	End	no.	%					
07/11/2015 08:12 EST	11/23/2015 14:05 EDT	5	0.00%	11	40	136	194754	1
07/11/2015 09:06 EST	11/23/2015 14:53 EDT	56	0.03%	6	15	136	194747	0
07/11/2015 09:51 EST	11/23/2015 15:16 EDT	50	0.03%	5	36	136	194726	0
07/11/2015 10:42 EST	11/23/2015 15:44 EDT	35	0.02%	6	0	136	194703	0
07/11/2015 12:40 EST	11/24/2015 08:58 EDT	45	0.02%	5	47	109	195619	0

This page intentionally left blank.

3. Preliminary Results

3.1 Passive Acoustic Monitoring

All five C-PODs from the first deployment recorded good quality data and all were still logging data when recovered in late November 2015. For these data, the KERNO classifier was found to work better than the GENENC classifier, and the results were filtered for moderate- and high-quality click trains that had a minimum sound pressure level threshold (100). This was to remove weak boat sonar that could otherwise be misclassified as dolphins. Dolphins were detected on all of the C-PODs.

In general, the C-PODs detected very low dolphin occurrence, measured by the presence of clicks within one-minute blocks of data (detection-positive minutes [DPM]). Due to the low number of detections, the data were able to be visually inspected for data validation. Only three DPM were removed due to being false positives and all data presented here were verified to be correctly classified as dolphins (**Table 2**).

Dolphin occurrence, as expected, was higher during the first part of the deployment, indicating a summer presence in the PAX area (**Figure 3** and **Figure 4**). The DPM decreased in the fall and no detections were made towards the end of the first deployment (November 2015). There was a diel pattern evident in the data, with more DPM during nighttime periods (**Figure 5**). Each of the figures below aggregates detections across all five sites to demonstrate overall occurrence and acoustic detection trends.

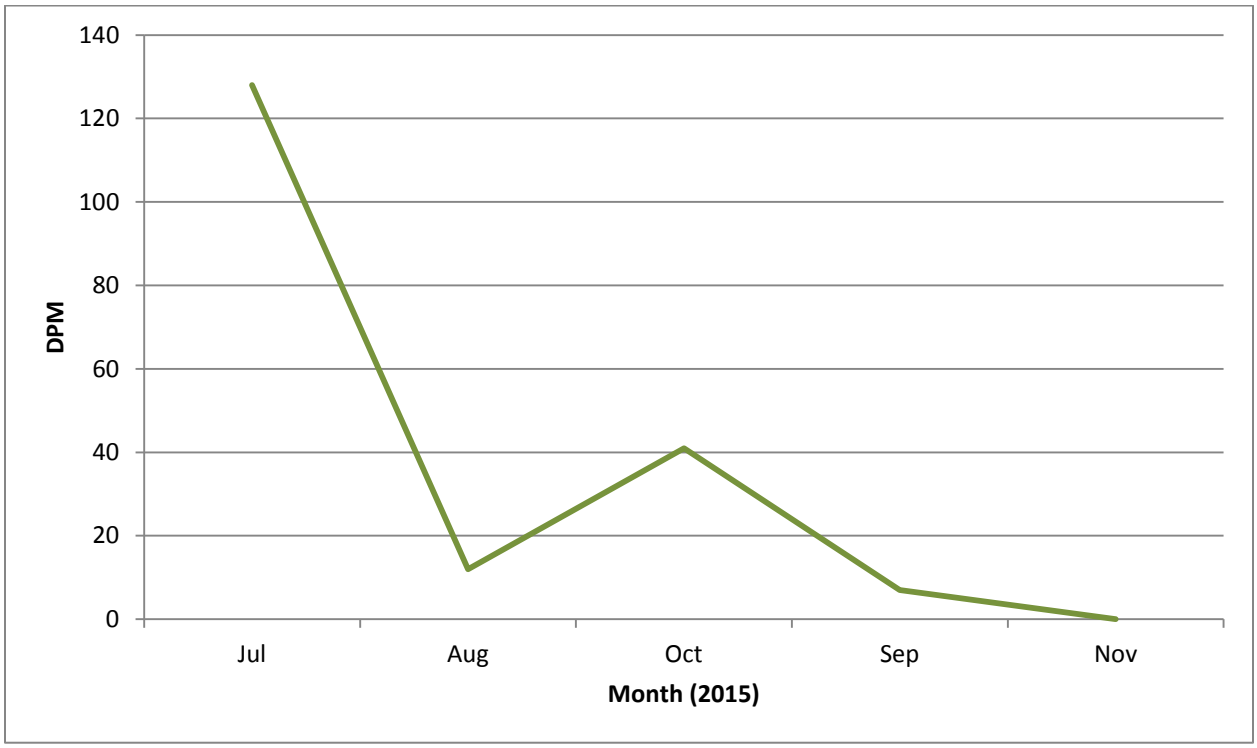

Figure 3. Number of dolphin detection-positive minutes, summed across all PAX sites by month, for the duration of the first C-POD deployment, 11 July–24 November 2015 (total n=188).

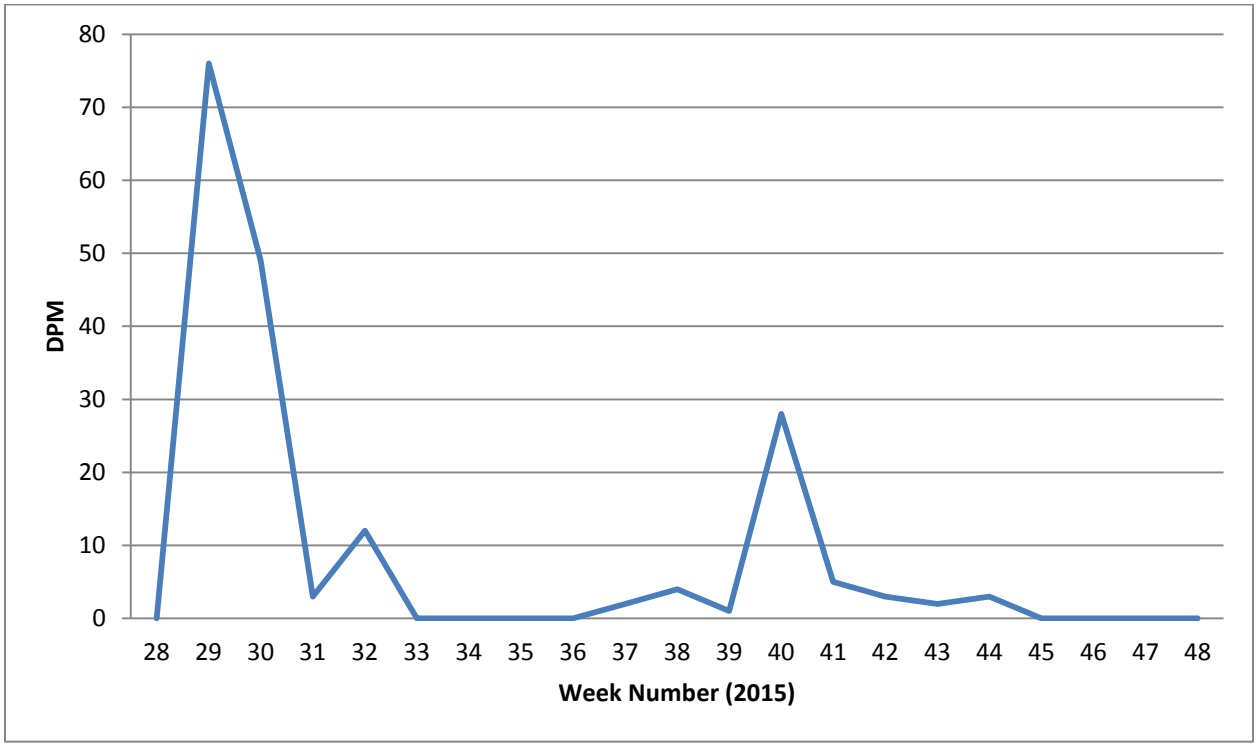

Figure 4. Weekly dolphin detection-positive minutes for the duration of the first C-POD deployment, 11 July–24 November 2015 (total n=188).

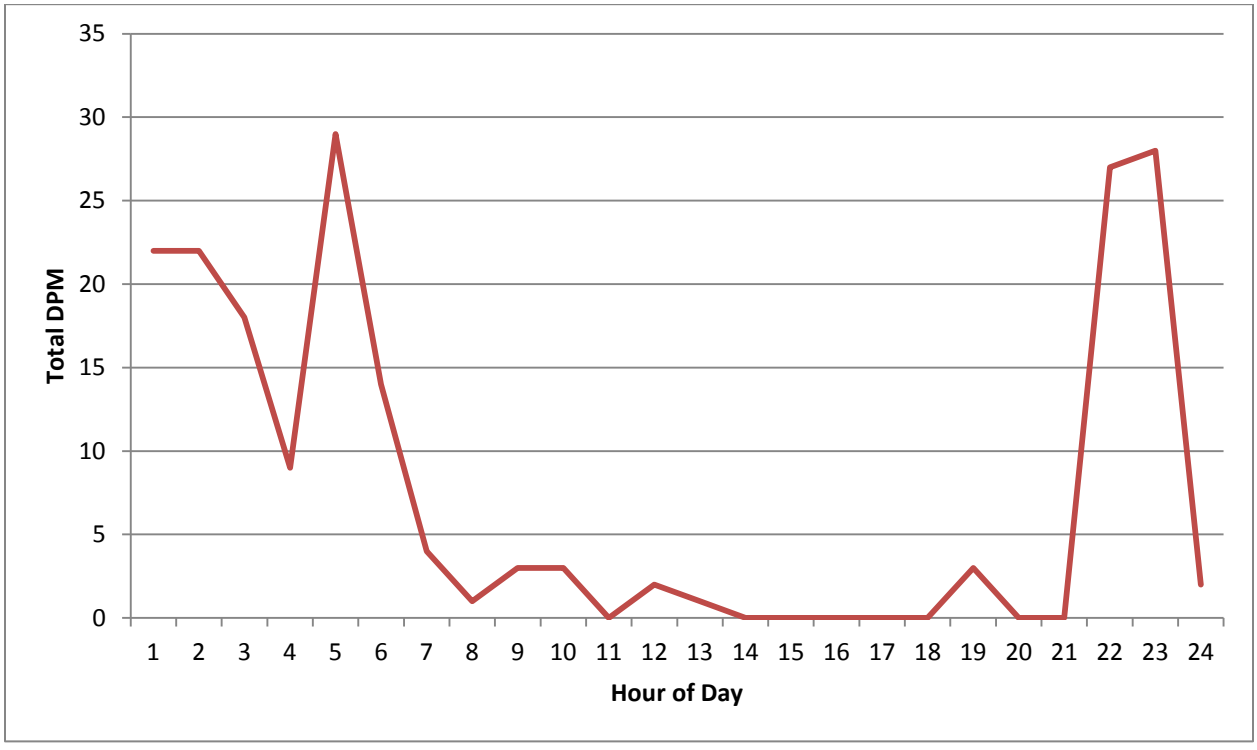

Figure 5. Dolphin detection-positive minutes per hour of the day summed across all PAX sites for the duration of the first C-POD deployment, 11 July–24 November 2015 (total n=188).

3.2 Photo-Identification

During the initial C-POD deployments on 11 and 12 July 2015, 283 km of visual survey effort was conducted while motoring between deployment sites (approximately 17 hours total duration). On 11 July, the survey effort also included areas just into the Patuxent River based on a reported bottlenose dolphin sighting. No dolphins were seen on 11 July. On 12 July a portion of the Patuxent River was again surveyed before the vessel made its way into the Chesapeake Bay. One dolphin sighting was made just west of the main channel of the Chesapeake Bay between NAS PAX and Barren Island (**Figure 1**). The group consisted of 35 dolphins, and photos were collected of all individuals present. The photos have since been sorted and prepared for cataloging. These data will be archived and available for future analysis and/or collaboration with researchers from Georgetown University and the MABDC.

3.3 Aerial Surveys

A total of nine days of aerial survey effort was conducted during the period of April 2015 through December 2015 (**Table 3**). A concerted effort was made to schedule survey effort during optimal weather conditions to maximize visibility. The average BSS across all survey effort was 2.3 (**Figure 6**).

One cetacean species, the bottlenose dolphin, and one sea turtle species, the loggerhead (*Caretta caretta*), were positively identified during this survey effort. The cownose ray (*Rhinoptera bonasus*) was also observed on multiple occasions. Sightings data are presented in **Tables 4–7** and **Figures 7–13**. Following the protocols of line-transect surveys, only species that were observed within the survey area were classified as “on-effort” sightings. Animals observed opportunistically between transect lines, or outside of the survey area, were classified as “off-effort” sightings. All 2015 effort sightings data have been submitted to OBIS SEAMAP under the current UNCW agreement.

Between April 2015 and December 2015, five on-effort (n=36 individuals) and three off-effort (n=28 individuals) sightings of bottlenose dolphins were recorded (**Figures 7–9**, **Tables 4, 5**). All on–effort sightings occurred between April and July and all were in the southern portion of the survey area near the confluence of the Potomac River with the Chesapeake Bay. All off-effort sightings occurred between September and December. Two of these were in Ingram Bay, approximately 13 km south of the west end of trackline 1. Water temperatures collected from the C-PODs during each of these sighting dates would be of interesting note.

All sea turtle sightings occurred during the months of May through August, and all were south of trackline 10 in the Chesapeake Bay (**Figures 10-12**, **Table 6**). Of the 22 sea turtle sightings, all but one were positively identified as loggerhead sea turtles.

Chondrichthyan fishes were observed across the range of the study area from May 2015 through December 2015. All chondrichthyan fishes were identified as either cownose rays (*Rhinoptera bonasus*) or unidentified rajiformes (**Figure 13**). While all chondrichthyan sightings were recorded, only those identified to species level are presented in **Table 7**.

Table 3. Summary of survey effort conducted from April through December 2015 in the PAX site.

Date	Tracklines Flown AM	Tracklines Flown PM	Total km Flown	Hobbs Hours
04/26/2015	1 to 9	17 to 10, Z	579.30	5.2
05/26/2015	1 to 9	17 to 10, Z	583.40	5.7
06/28/2015	1 to 9	17 to 10, Z	573.55	5.6
07/19/2015	Z, 17 to 9	8 to 1	579.70	5.2
08/16/2015	1 to 9	17 to 10, Z	577.95	5.2
09/20/2015	Z, 9 to 17	8 to 1	573.00	5.0
10/31/2015	1 to 9	17 to 10, Z	581.20	5.2
11/15/2015	Z, 9 to 17	8 to 1	584.41	4.7
12/06/2015	1 to 9	17 to 10, Z	590.00	5.4
Totals			**5222.51**	**47.2**

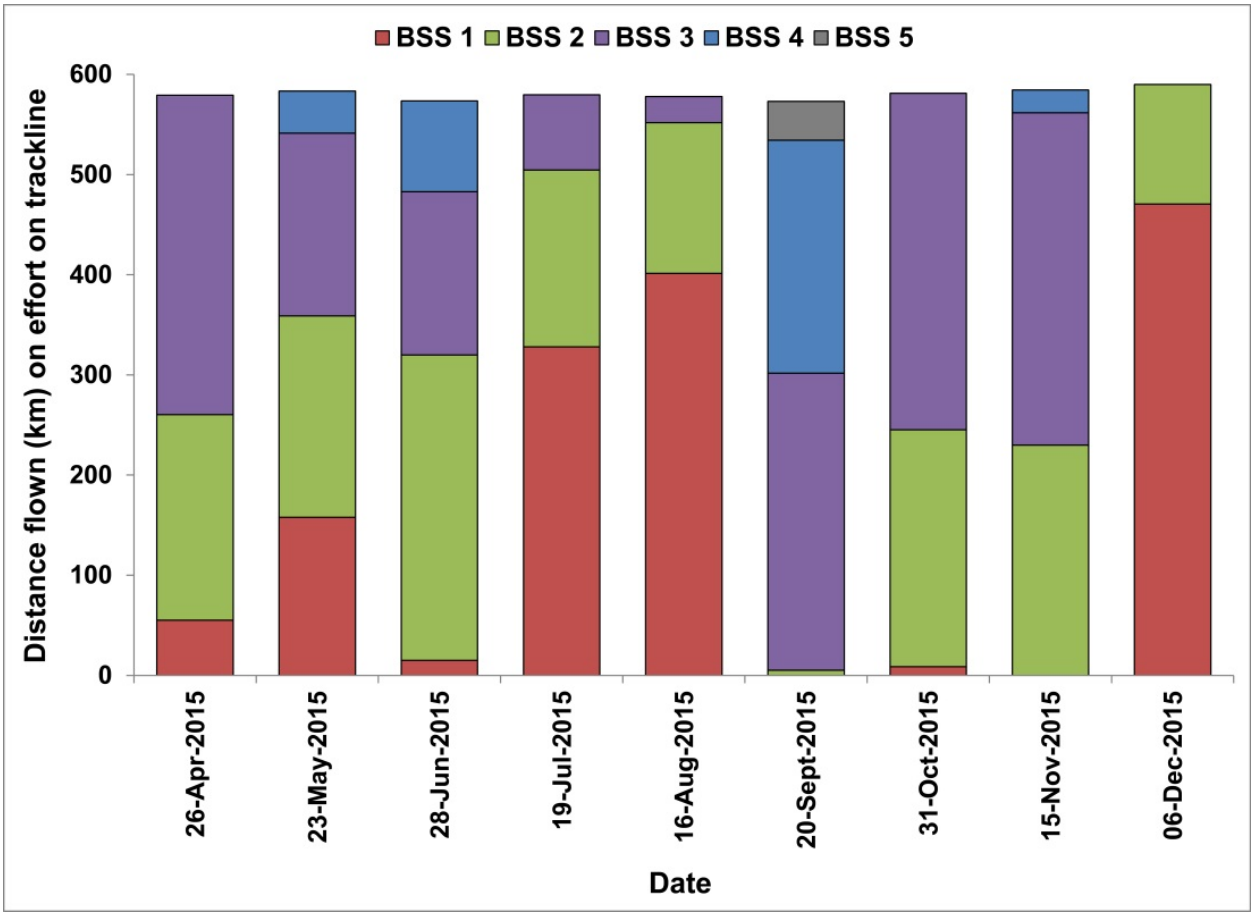

Figure 6. Effort by Beaufort Sea State for each survey day from April through December 2015 during aerial surveys in the PAX survey area.

Table 4. Sightings from aerial surveys conducted in the Patuxent River survey area, April through December 2015.

Common Name	Scientific Name	# of Sightings	# of Individuals
Bottlenose dolphin	*Tursiops truncatus*	5	36
Bottlenose dolphin (off effort)	*Tursiops truncatus*	3	28
Loggerhead sea turtle	*Caretta caretta*	21	28
Unidentified sea turtle	N/A	1	1

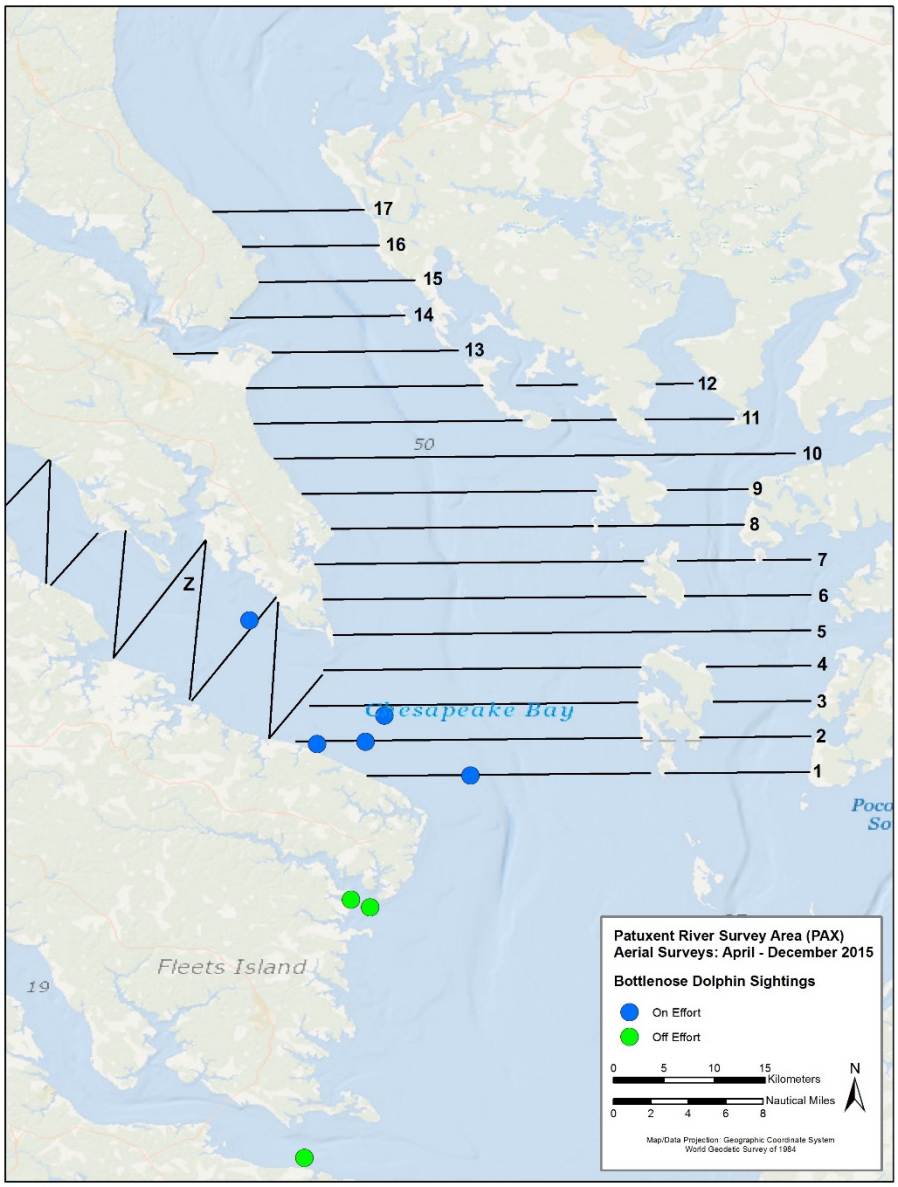

Figure 7. All bottlenose dolphin sightings from aerial surveys conducted in the Patuxent River survey area from April through December 2015.

Table 5. All dolphin sightings observed in the Patuxent River study area from April through December 2015 (* denotes EDT and all others are EST).

Date	Time	On/Off Effort	Latitude	Longitude	Trackline	Species	Common Name	Group Size
04/26/2015	10:32:48	On	37.952668	76.292179	2	*T. truncatus*	Bottlenose dolphin	3
06/28/2015	9:35:18	On	37.922720	76.198775	1	*T. truncatus*	Bottlenose dolphin	16
06/28/2015	10:06:14	On	37.950588	76.335386	2	*T. truncatus*	Bottlenose dolphin	6
06/28/2015	10:15:00	On	37.976134	76.275390	3	*T. truncatus*	Bottlenose dolphin	3
07/19/2015	9:26:48	On	38.060937	76.395910	Z	*T. truncatus*	Bottlenose dolphin	8
09/20/2015	8:56:30	Off	37.581500	76.346893	NA	*T. truncatus*	Bottlenose dolphin	8
11/15/2015	10:06:00*	Off	37.805033	76.288250	NA	*T. truncatus*	Bottlenose dolphin	8
12/06/2015	9:16:19*	Off	37.811791	76.305475	NA	*T. truncatus*	Bottlenose dolphin	12

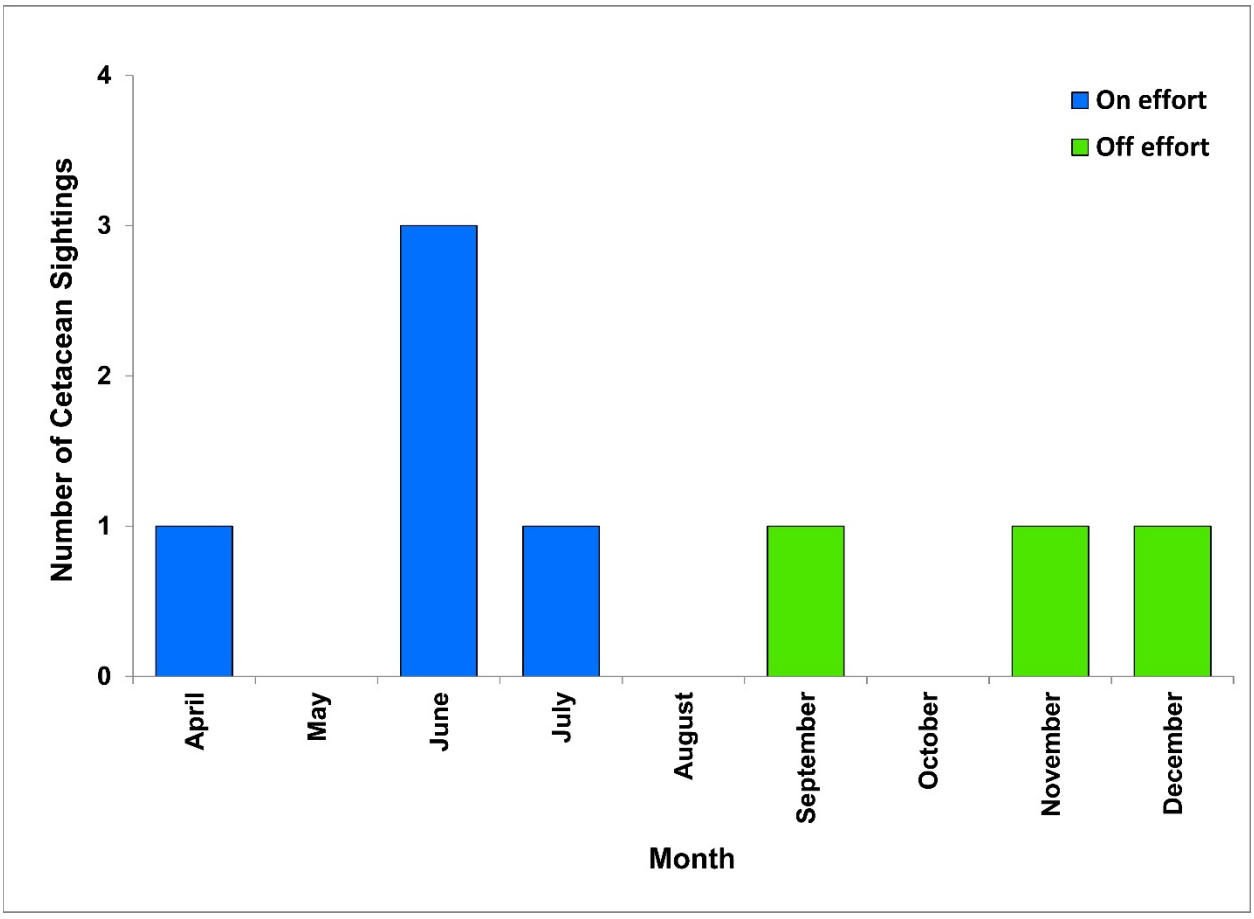

Figure 8. Bottlenose dolphin sightings per month from April through December 2015 during aerial surveys in the Patuxent River survey area.

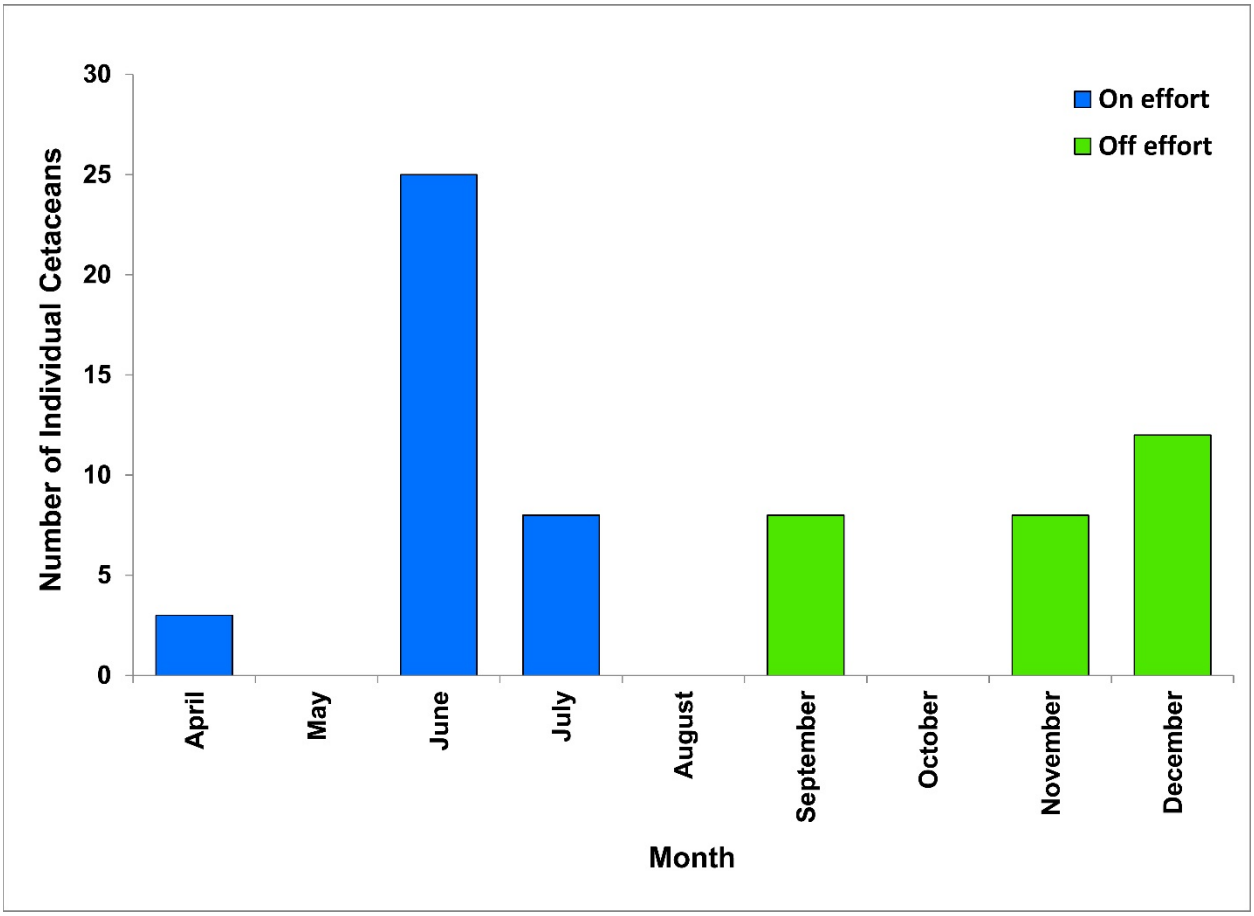

Figure 9. Number of individual bottlenose dolphins observed per month from April through December 2015 during aerial surveys in the Patuxent River survey area.

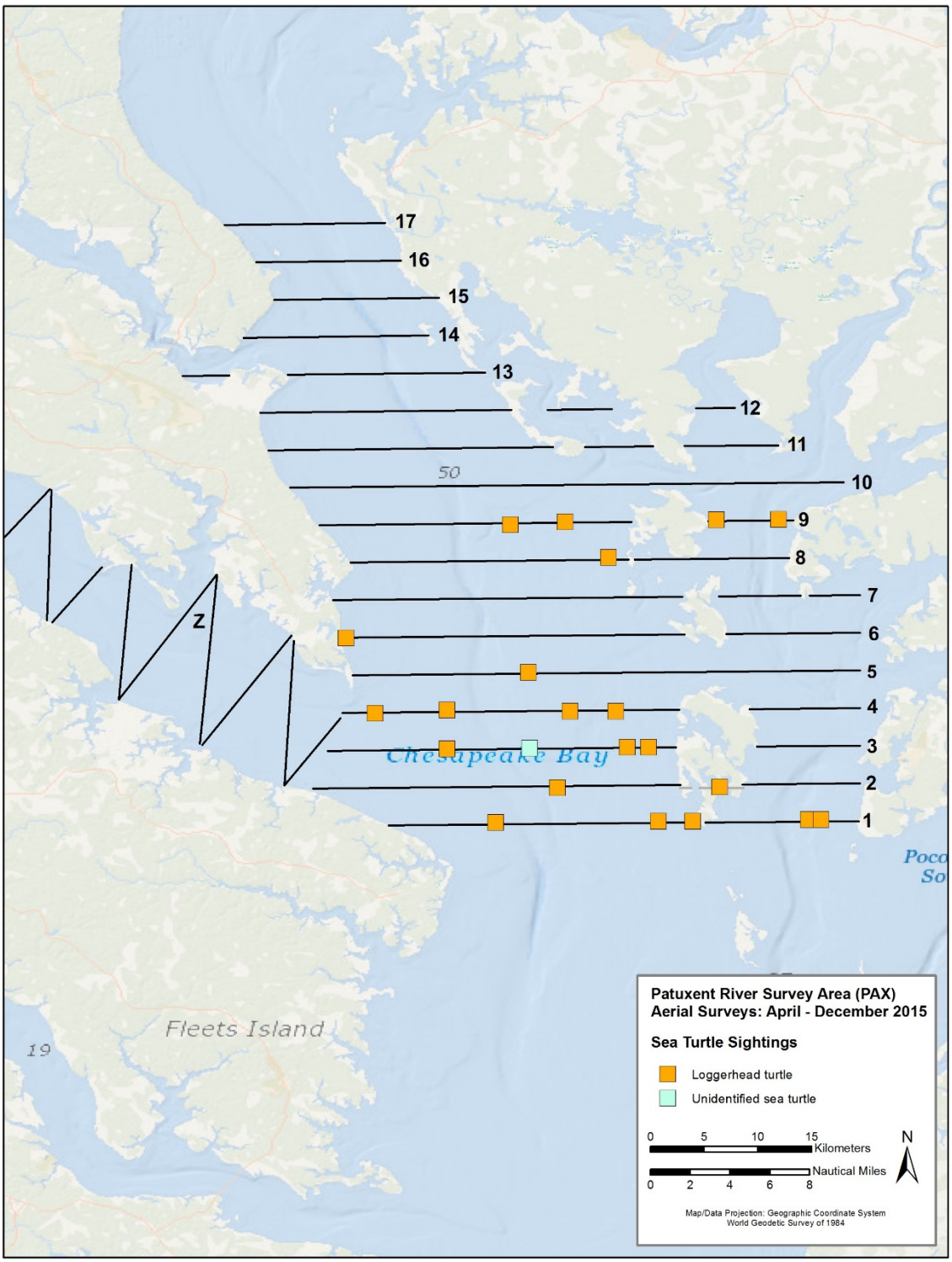

Figure 10. Sea turtle sightings from aerial surveys conducted in the Patuxent River survey area from April through December 2015.

Table 6. Sea turtle sightings from aerial surveys conducted in the Patuxent River survey area from April through December 2015.

Date	Time	On / Off Effort	Latitude	Longitude	Trackline	Species	Common Name	Group Size
05/23/2015	10:56:49	On	38.176567	76.142949	9	*C. caretta*	Loggerhead Sea Turtle	1
05/23/2015	9:54:02	On	38.017747	76.138852	4	*C. caretta*	Loggerhead Sea Turtle	1
07/19/2015	11:13:27	On	38.173935	76.188774	9	*C. caretta*	Loggerhead Sea Turtle	1
07/19/2015	12:39:01	On	38.146655	76.106575	8	*C. caretta*	Loggerhead Sea Turtle	1
07/19/2015	13:23:22	On	38.019009	76.241886	4	*C. caretta*	Loggerhead Sea Turtle	1
08/16/2015	9:36:47	On	37.924578	76.201294	1	*C. caretta*	Loggerhead Sea Turtle	1
08/16/2015	9:40:01	On	37.925556	76.064672	1	*C. caretta*	Loggerhead Sea Turtle	1
08/16/2015	9:40:42	On	37.925789	76.035968	1	*C. caretta*	Loggerhead Sea Turtle	1
08/16/2015	9:42:59	On	37.926904	75.939115	1	*C. caretta*	Loggerhead Sea Turtle	2
08/16/2015	9:43:14	On	37.926918	75.928397	1	*C. caretta*	Loggerhead Sea Turtle	1
08/16/2015	9:48:37	On	37.954512	76.013382	2	*C. caretta*	Loggerhead Sea Turtle	3
08/16/2015	9:51:52	On	37.953888	76.149536	2	*C. caretta*	Loggerhead Sea Turtle	1
08/16/2015	10:03:29	On	37.986236	76.241837	3	*C. caretta*	Loggerhead Sea Turtle	1
08/16/2015	10:05:07	On	37.986977	76.172691	3	*Unid Sea Turtle*	Unid Sea Turtle	1
08/16/2015	10:07:03	On	37.987719	76.090750	3	*C. caretta*	Loggerhead Sea Turtle	1
08/16/2015	10:07:28	On	37.987812	76.073116	3	*C. caretta*	Loggerhead Sea Turtle	1
08/16/2015	10:18:23	On	38.018012	76.100328	4	*C. caretta*	Loggerhead Sea Turtle	1
08/16/2015	10:29:11	On	38.016266	76.302422	4	*C. caretta*	Loggerhead Sea Turtle	3
08/16/2015	10:29:11	On	38.050299	76.173800	5	*C. caretta*	Loggerhead Sea Turtle	3
08/16/2015	10:47:42	On	38.079053	76.326557	6	*C. caretta*	Loggerhead Sea Turtle	1
08/16/2015	11:26:45	On	38.178221	76.015981	9	*C. caretta*	Loggerhead Sea Turtle	1
08/16/2015	11:27:56	On	38.178686	75.963921	9	*C. caretta*	Loggerhead Sea Turtle	1

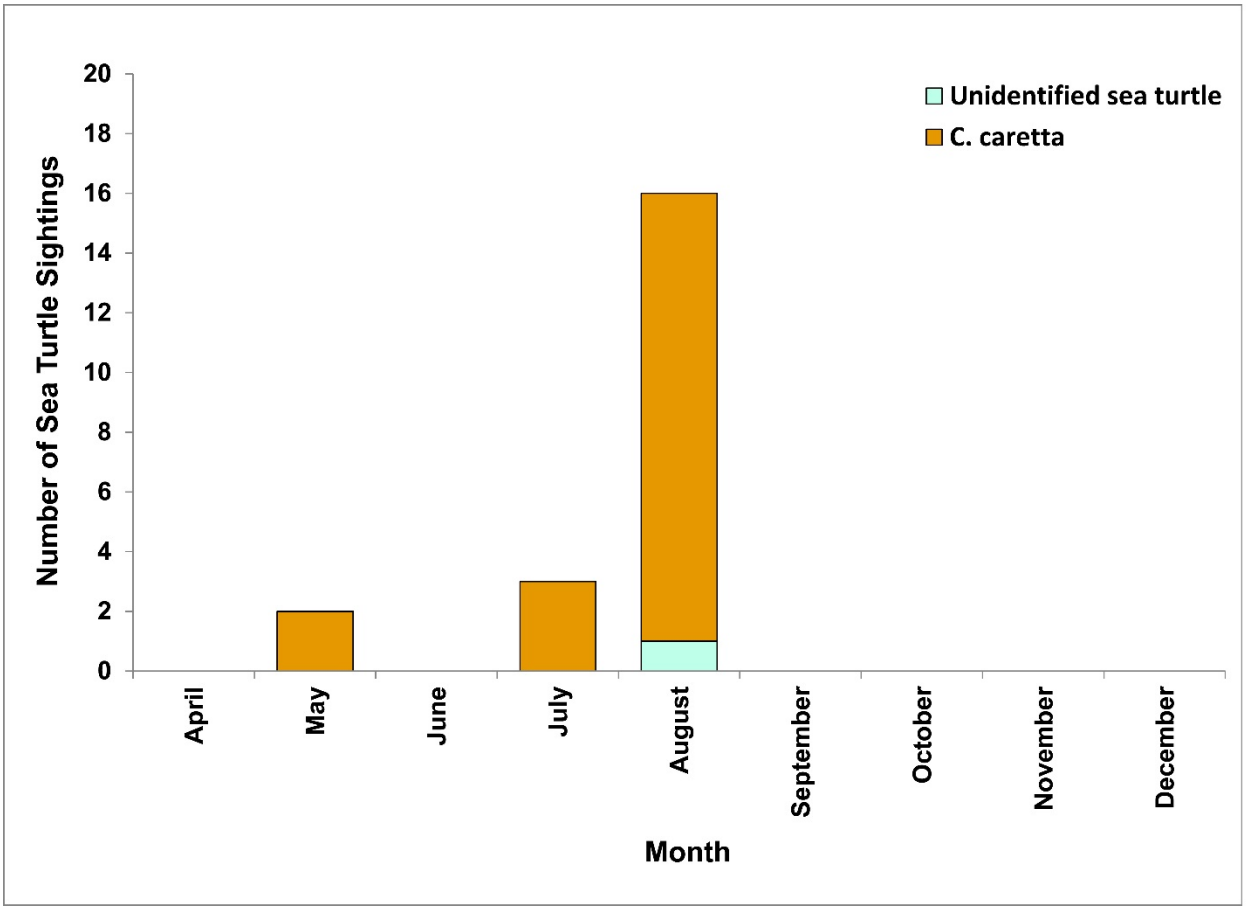

Figure 11. Sea turtle sightings per month from April through December 2015 during aerial surveys in the Patuxent River survey area.

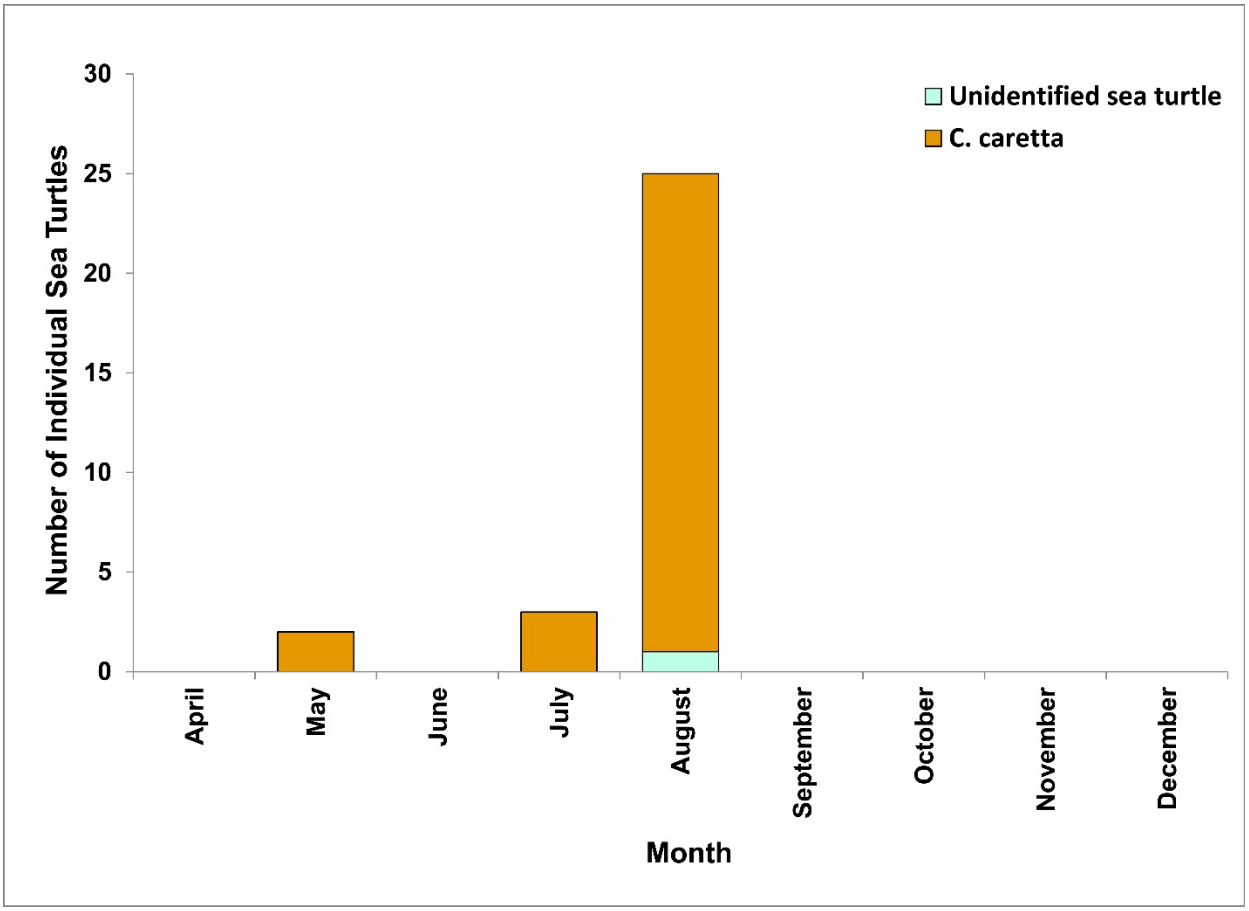

Figure 12. Number of individual sea turtles observed per month from April through December 2015 during aerial surveys in the Patuxent River survey area.

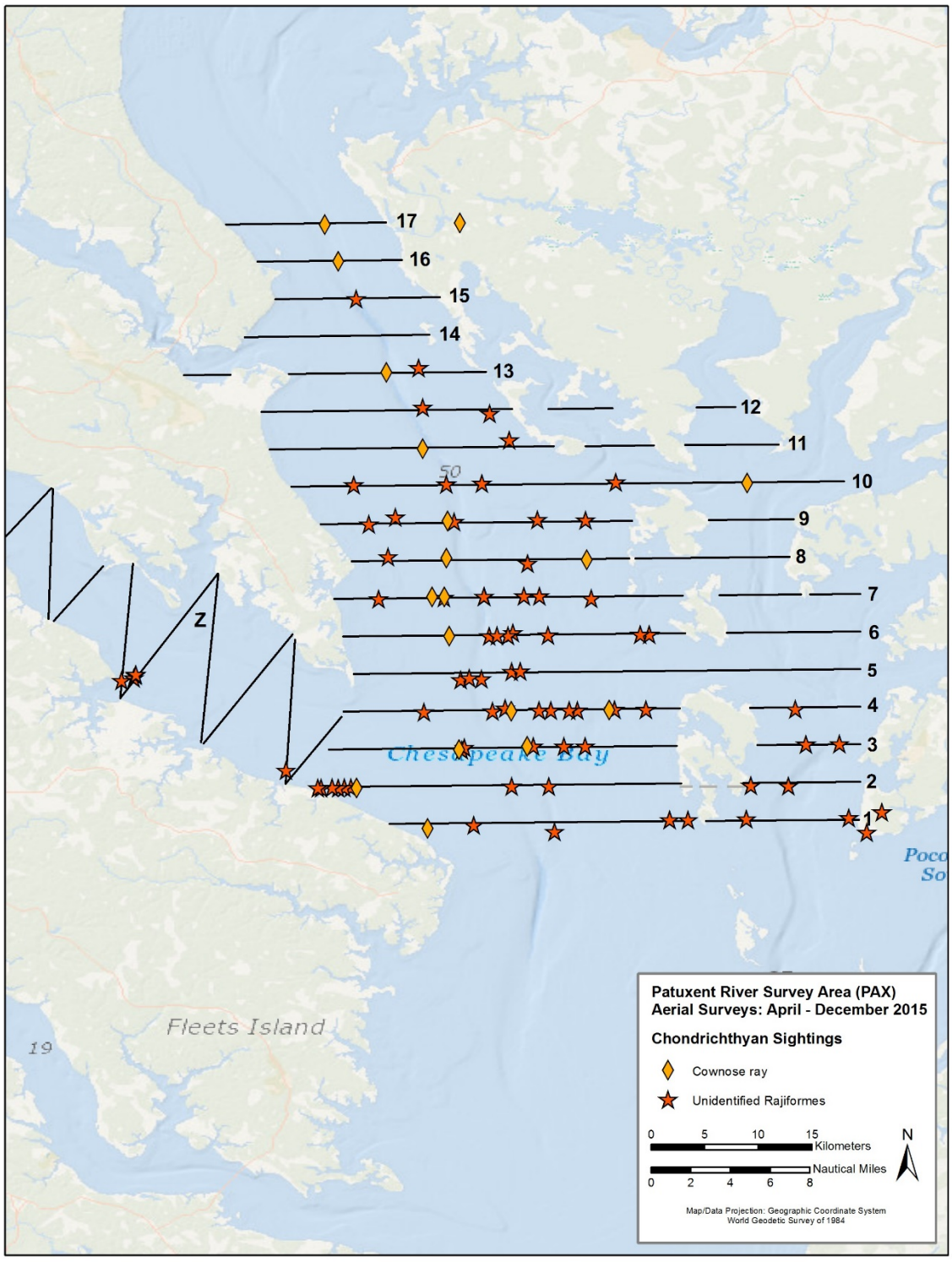

Figure 13. Chondrichthyan sightings from aerial surveys conducted in the Patuxent River survey area from April through December 2015.

Table 7. Cownose ray sightings from aerial surveys conducted in the Patuxent River survey area from April through December 2015.

Date	Time	On / Off Effort	Latitude	Longitude	Trackline	Species	Common Name	Group Size
05/23/2015	14:29:44	On	38.426525	76.231811	17	*R. bonasus*	Cownose Ray	6
05/23/2015	14:33:48	On	38.394528	76.333792	16	*R. bonasus*	Cownose Ray	16
05/23/2015	14:50:05	On	38.301227	76.293318	13	*R. bonasus*	Cownose Ray	3
06/28/2015	9:24:13	On	37.918460	76.258686	1	*R. bonasus*	Cownose Ray	55
06/28/2015	9:57:21	On	37.952304	76.318524	2	*R. bonasus*	Cownose Ray	10
06/28/2015	10:10:36	On	37.984476	76.232340	3	*R. bonasus*	Cownose Ray	13
06/28/2015	10:18:35	On	37.987381	76.175172	3	*R. bonasus*	Cownose Ray	6
06/28/2015	10:32:49	On	38.017861	76.106289	4	*R. bonasus*	Cownose Ray	12
06/28/2015	10:34:50	On	38.016980	76.188668	4	*R. bonasus*	Cownose Ray	25
06/28/2015	10:59:47	On	38.079702	76.240483	6	*R. bonasus*	Cownose Ray	27
06/28/2015	11:04:50	On	38.112616	76.255126	7	*R. bonasus*	Cownose Ray	8
06/28/2015	11:05:05	On	38.112713	76.244607	7	*R. bonasus*	Cownose Ray	60
06/28/2015	11:20:17	On	38.143835	76.124996	8	*R. bonasus*	Cownose Ray	30
06/28/2015	11:23:29	On	38.145208	76.242961	8	*R. bonasus*	Cownose Ray	15
06/28/2015	11:29:55	On	38.176415	76.242037	9	*R. bonasus*	Cownose Ray	14
06/28/2015	14:48:36	On	38.237232	76.262939	11	*R. bonasus*	Cownose Ray	30
07/19/2015	10:02:10	On	38.425396	76.345038	17	*R. bonasus*	Cownose Ray	70
09/20/2015	10:01:07	On	38.208217	75.990547	10	*R. bonasus*	Cownose Ray	15

This page intentionally left blank.

4. Literature Cited

Engelhaupt, A., Aschettino, J., Jefferson, T.A., Richlen, M., and Engelhaupt. D. 2016. Occurrence, Distribution, and Density of Marine Mammals Near Naval Station Norfolk & Virginia Beach, VA: 2015 Annual Progress Report. Prepared for U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command Atlantic, Norfolk, Virginia, under Contract No. N62470- 10-3011, Task Orders 031 and 043, issued to HDR Inc., Virginia Beach, Virginia. 01 March 2016.

This page intentionally left blank.