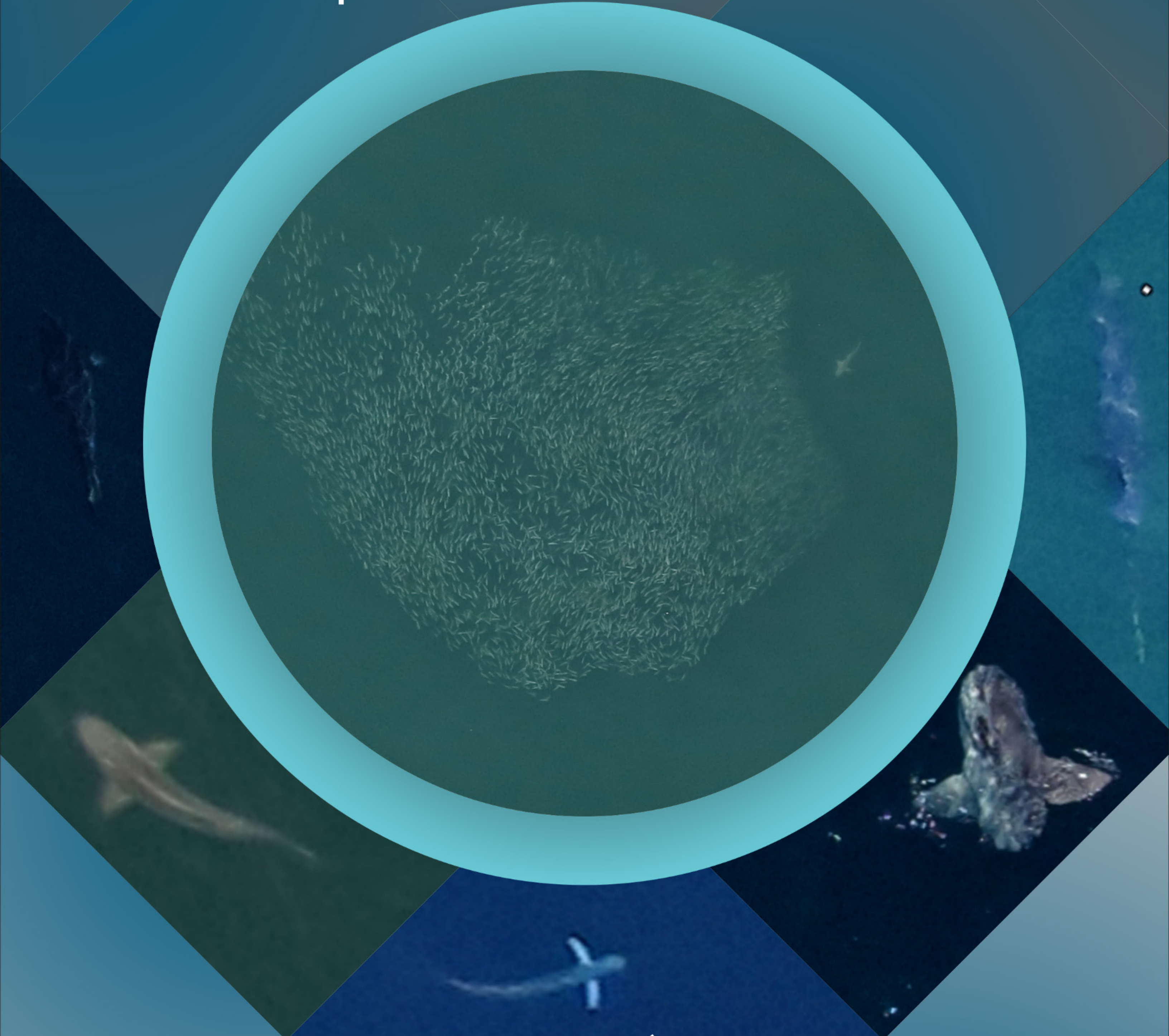
Digital Aerial Baseline Survey of Marine Wildlife in Support of Offshore Wind Energy

2016-2017 Large Bony Fish and Fish Shoal Interim Report



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APEM

Digital Aerial Baseline Survey of Marine Wildlife in Support of Offshore Wind Energy

2016-2017 Large Bony Fish and Fish Shoal Interim Report

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Introduction

The first year of seasonal surveys for the New York Offshore Planning Area (OPA) were started in July 2016. Subsequent surveys occurred in November 2016, March 2017, and May 2017. These surveys are designed to characterize the usage of the area by marine fauna to aid in the planning for offshore wind. Each survey has fully reported birds, turtles, marine mammals, rays, and sharks, and the reports are available on the dedicated data portal remote.normandeau.com on the documents page (see https://remote.normandeau.com/nys_docs.php). However, at the beginning of this project, large bony fish and fish shoals were not part of the analyses scope. It was only after noticing that a large number of detected fish could potentially be identified and mapped that NYSERDA tasked Normandeau with analyzing the first year of data. Large bony fish have been identified and the areal extent of all fish shoals measured. This report summarizes the findings of these additional analyses.

Methods

Data were collected for the OPA including a 300-m buffer. The survey collected imagery covering a 3,168.68 km^2 area of the OPA and 300-m buffer using a transect design, which amounts to approximately 323,600 images per survey. For each survey, approximately 98% of images are blank (showing no animal life of any description). Target extraction identifies objects within imagery collected in the OPA and 300-m buffer survey area. These targets were categorized into seven groups representing avian (birds), marine mammals, turtles, sharks, rays, large bony fish individuals and fish shoals, fixed structures, and vessels. An eighth group for bats has yet to have individuals recorded. For this report, large bony fish and fish shoals from the first year of surveys were assigned to taxonomic experts for identification, and fish shoals were measured for areal extent using a custom designed measuring tool created on NYSERDA's remote.normandeau.com data management system.

Results

All fish and fish shoal identification was completed in February 2018, and areal extent of all fish shoal images were completed in May 2018. All fish and fish shoals were fully georeferenced with exact locations of individuals and shoals available for review on the data portal.

Large Bony Fish

Identification success of large bony fish varied by species and by depth in the water column. All identifications had a level of certainty ascribed to them (e.g., possible, probable, and definite), and were also ranked as "breaching," "near surface," and "significantly submerged." Digital imagery captured from downward rather than angled sensors "sees" through the water column more effectively, and more animals are "observed." However, this improvement in reporting animal presence by downward facing lenses is sometimes at a cost of species identification because of the depth of the animal. Detection and identification of subsurface animals is also dependent on water clarity, which may be affected by sea state and turbidity.

Over the four surveys in 2016–2017, there were 1,565 large bony fish found in the imagery. Appendix 1 provides a full list of fish species encountered in taxonomic order and lists their scientific names. The

1,099 fish identified to species or species group included two species of sunfish (*Mola mola* and *Masturus lanceolatus*), Cobia (*Rachycentron canadum*), Mahi-Mahi (*Coryphaena hippurus*), and Atlantic Bluefin Tuna (*Thunnus thynnus*). There were 466 fish (29%) that couldn't be identified to species or species group. About one third (133) of these were significantly submerged (Table 1).

Large bony fishes were encountered in greatest diversity and numbers in the July 2016 survey when at least five families (at least six species) were observed (Table 2). Encounters were second highest in May 2017 with at least three families and four species present. Sunfishes were the only species identified in November 2016 at total numbers less than a third of the summer numbers. Winter numbers were about 10% of the fall numbers with only the sunfishes being identified. Both species of sunfish were identified in every survey. Sunfish numbers were at their highest during the May 2017 survey (n = 299) and lowest during the March 2017 survey (n = 11), while during July and November 2016 surveys their numbers remained similar (n = 147, n = 167 respectively [Table 2]). Mahi-Mahi and Atlantic Bluefin Tuna were both present in summer 2016 and spring 2017 with higher numbers of both species in the July 2016 survey.

Several factors can affect the ability to identify these large bony fishes to species making seasonal patterns difficult to distinguish definitively. Factors such as water color and turbidity may fluctuate between seasons and thereby affect encounter rates. Some species that appear to remain more deeply submerged, such as billfish, Cobia, Mahi-Mahi, and tuna (Table 1), might be less expected to be visible in imagery when water clarity is reduced. However, the higher abundances in the July 2016 survey fits the general patterns governed by water temperatures reported for these migratory species (Boyce et al. 2008; Collette et al. 2011, 2015; Druon et al. 2016).

Table 1. Large Bony Fish Species Identified

Species	# Individuals in Group	# Individuals	# Significantly Submerged	Percent of Total Submerged
Billfish	11		5	45.45%
species unknown		11		
Cobia	144		134	93.06%
Cobia		144		
Mahi-Mahi	136		68	50.00%
Mahi-Mahi		136		
Sunfish	624		164	26.28%
Ocean Sunfish		566	117	20.67%
Sharptail Sunfish		4	2	50.00%
species unknown		54	45	83.33%
Tuna	184		149	80.98%
Atlantic Bluefin Tuna		164	148	90.24%
species unknown		20	1	5.00%
Not identified	466	466	133	28.54%
Total	**1,565**	**1,686**	**653**	**41.73%**

Table 2. Large Bony Fish Species Identified by Seasonal Survey

Species	# Summer 2016 (July)	# Fall 2016 (November)	# Winter 2016 (March)	# Spring 2017 (May)
Billfish	11	0	0	0
species unknown	11	0	0	0
Cobia	144	0	0	0
Cobia	144	0	0	0
Mahi-Mahi	134	0	0	2
Mahi-Mahi	134	0	0	2
Sunfish	147	167	11	299
Ocean Sunfish	115	164	8	279
Sharptail Sunfish	2	1	0	1
species unknown	30	2	3	19
Tuna	180	0	0	4
Atlantic Bluefin Tuna	160	0	0	4
species unknown	20	0	0	0
Not identified	103	18	5	340
Total	**719**	**185**	**16**	**645**

Relative Abundance

Across all four surveys, Ocean Sunfish was the most frequently encountered species representing 36% of the individuals (Figure 1). This species' behavior of living high in the water column and breaking the surface frequently certainly increases the likelihood of being encountered. Its unique shape and light coloration make this family relatively easy to see and identify – more than 90% of individuals were identifiable to species (Table 1). Atlantic Bluefin Tuna, Cobia, and Mahi-Mahi each contributed 8-10% of the total individuals. About 30% of fishes were not identifiable even to family. Of the unidentifiable individuals, it is reasonable to assume that many were likely to be one of those three species since sunfish are so readily identifiable. If so, then we cannot conclude that these species occur in the project area only in warm conditions. During the summer survey (Figure 2), Atlantic Bluefin Tuna were the most abundant followed by Cobia, Mahi-Mahi, and followed by Ocean Sunfish. For the following two surveys, sunfish dominate, followed by species unknown (Figures 3 and 4); although, in the Spring survey of May 2017, the number of unidentified fish outnumbered the number of sunfish (Figure 5).

To illustrate unidentified fish and look for spatial patterns to assist potential identifications of unknown fish, we have plotted the unidentified fish along with identified fish that were significantly submerged. This is done without including sunfish (Figure 6). Figure 7 shows the distribution of individuals occurring at the surface; few unidentified large bony fish were seen at the surface.

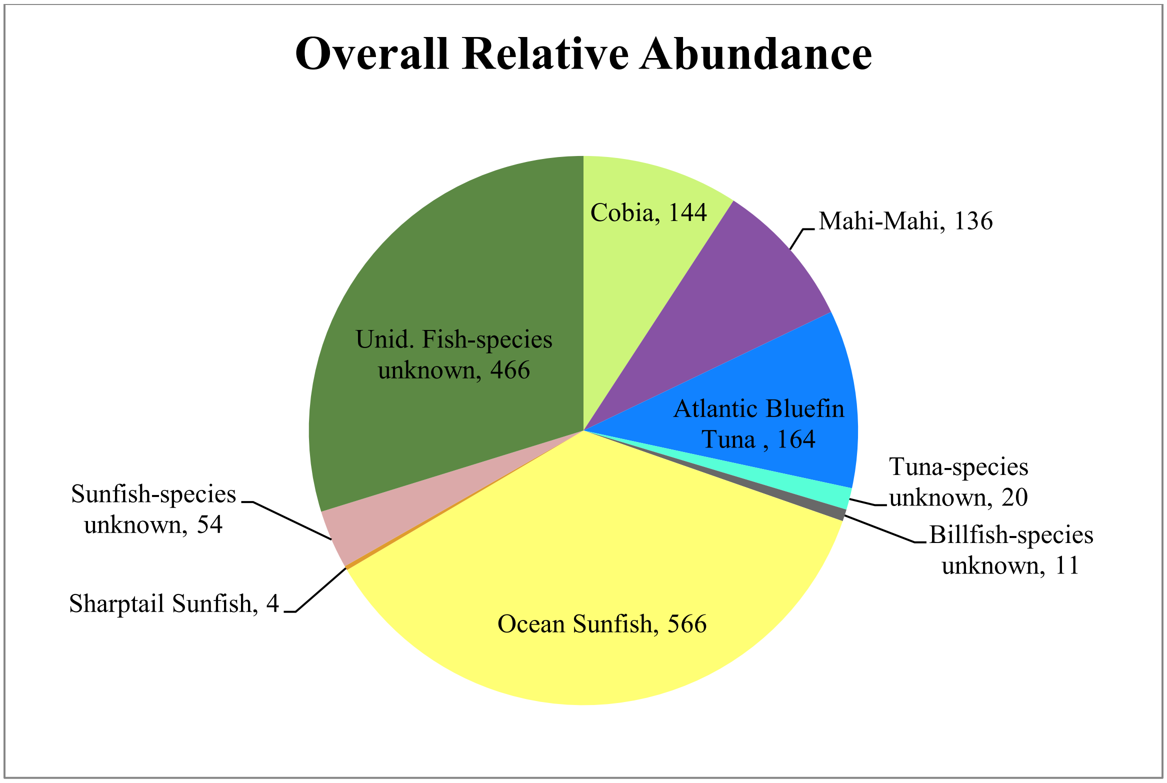

Figure 1. Relative Abundance of Large Bony Fish across All Surveys

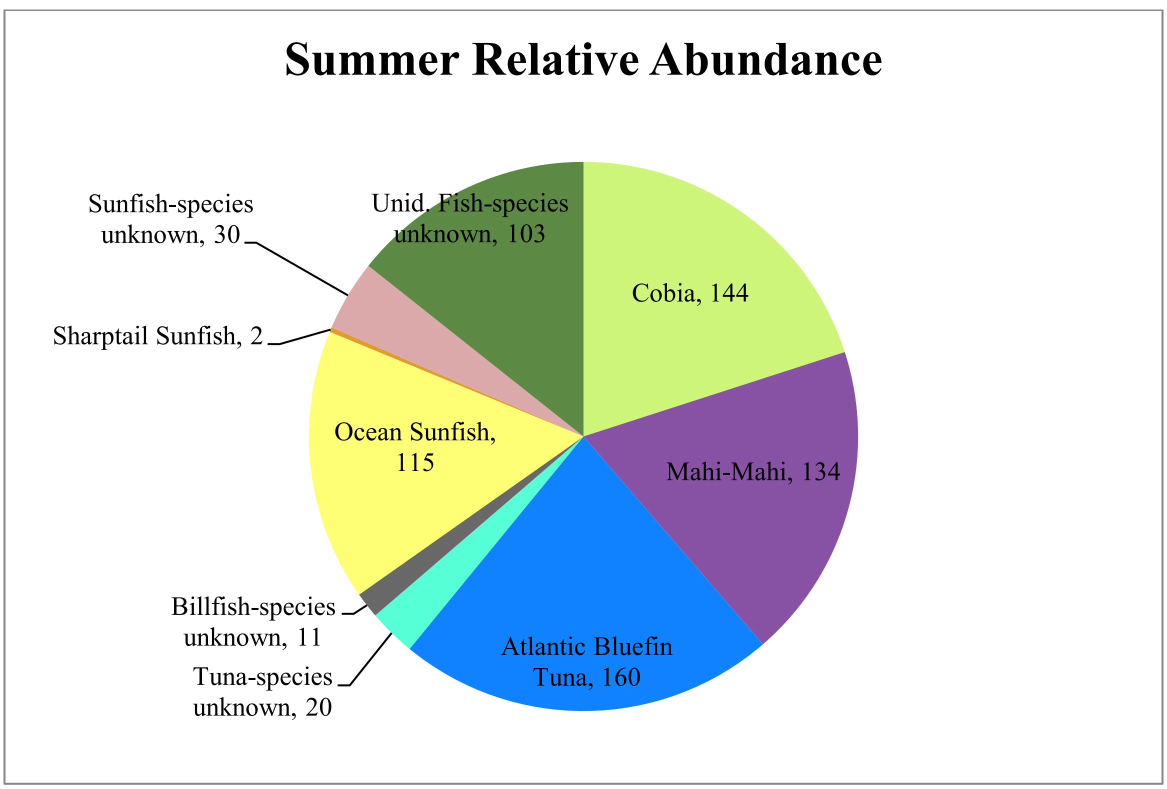

Figure 2. Relative Abundance of Large Bony Fish in July 2016 (Summer)

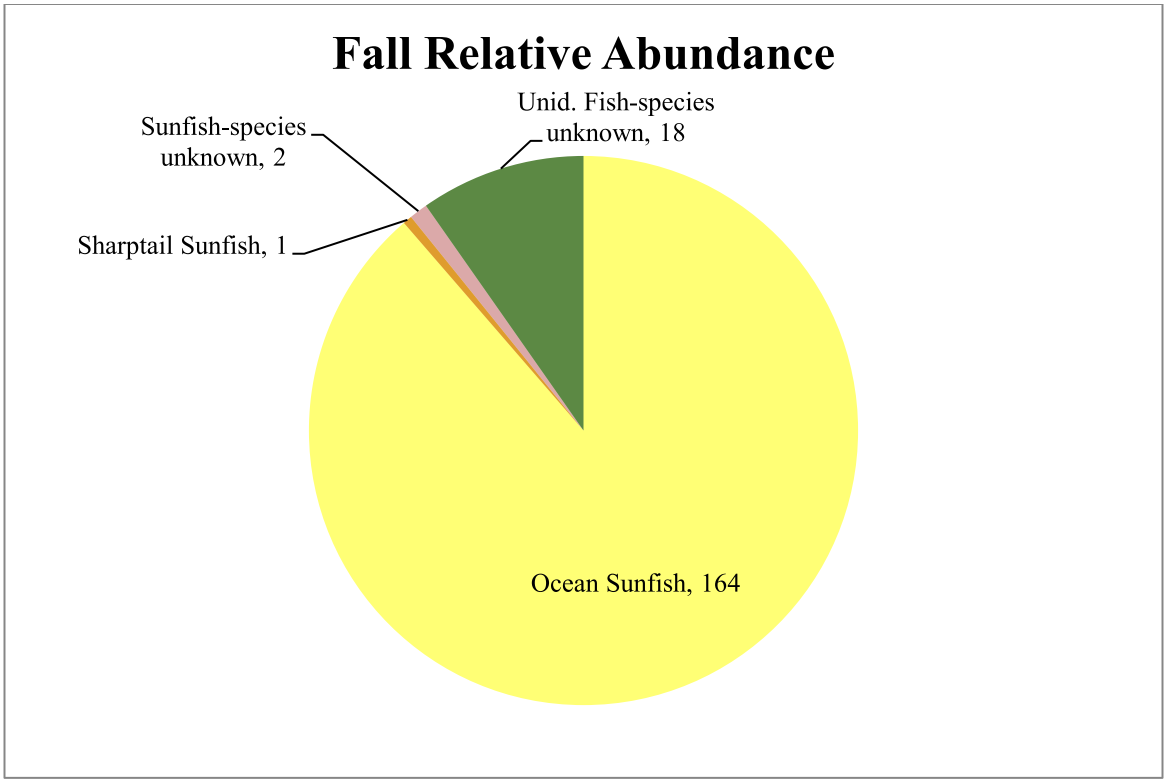

Figure 3. Relative Abundance of Large Bony Fish in November 2016 (Fall)

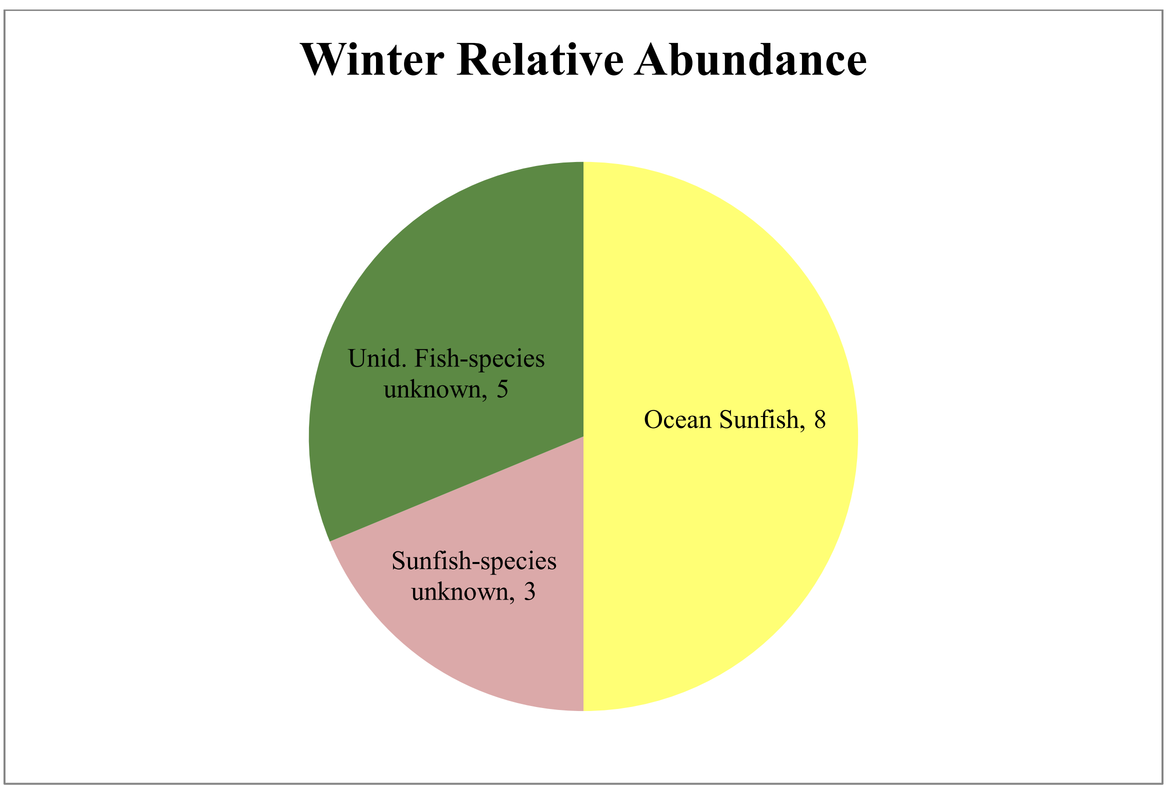

Figure 4. Relative Abundance of Large Bony Fish in March 2017 (Winter)

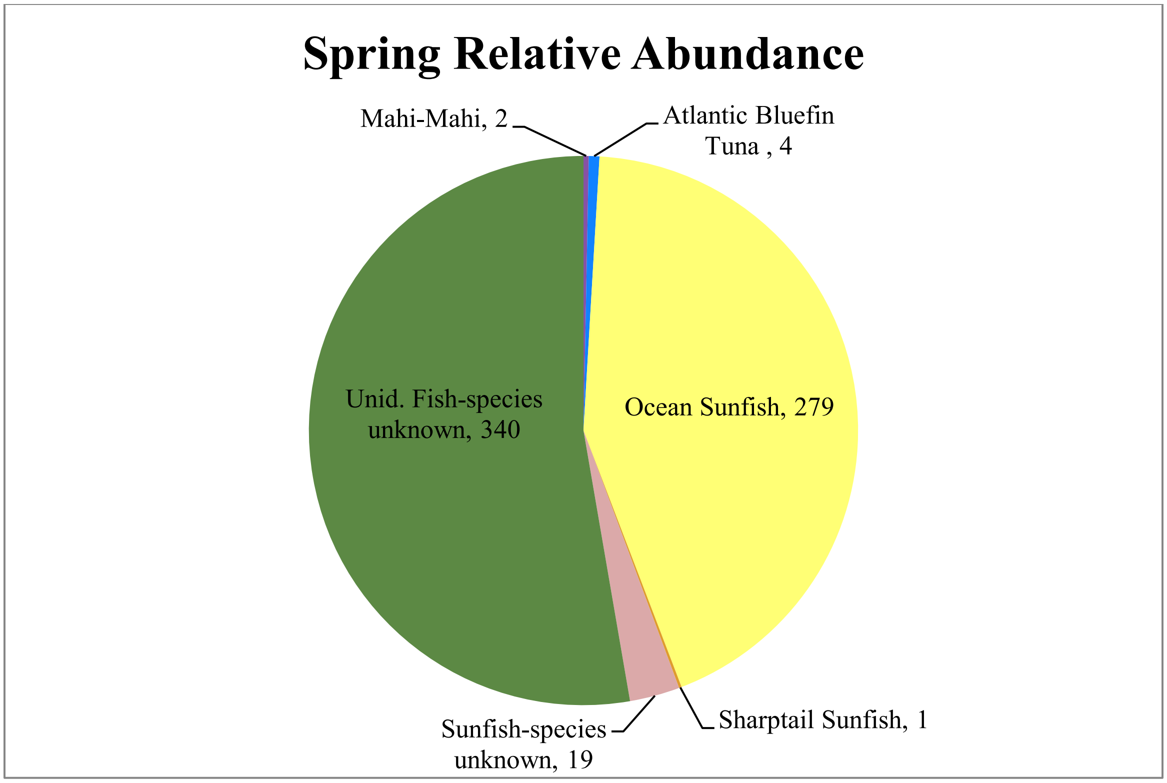

Figure 5. Relative Abundance of Large Bony Fish in May 2017 (Spring)

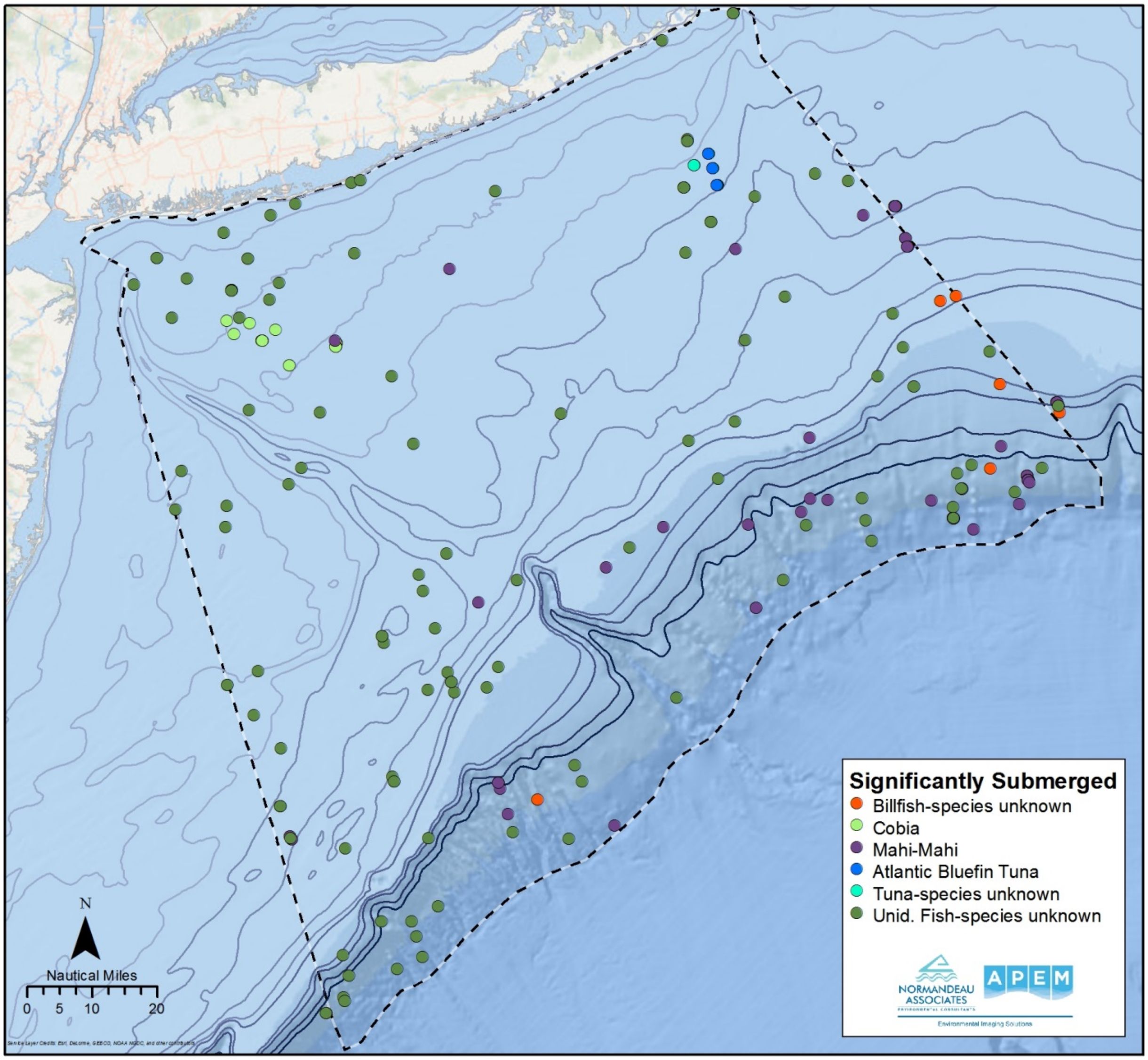

Figure 6. Locations of Identified and Unidentified Large Bony Fish Species (excluding Sunfish) that were significantly submerged.

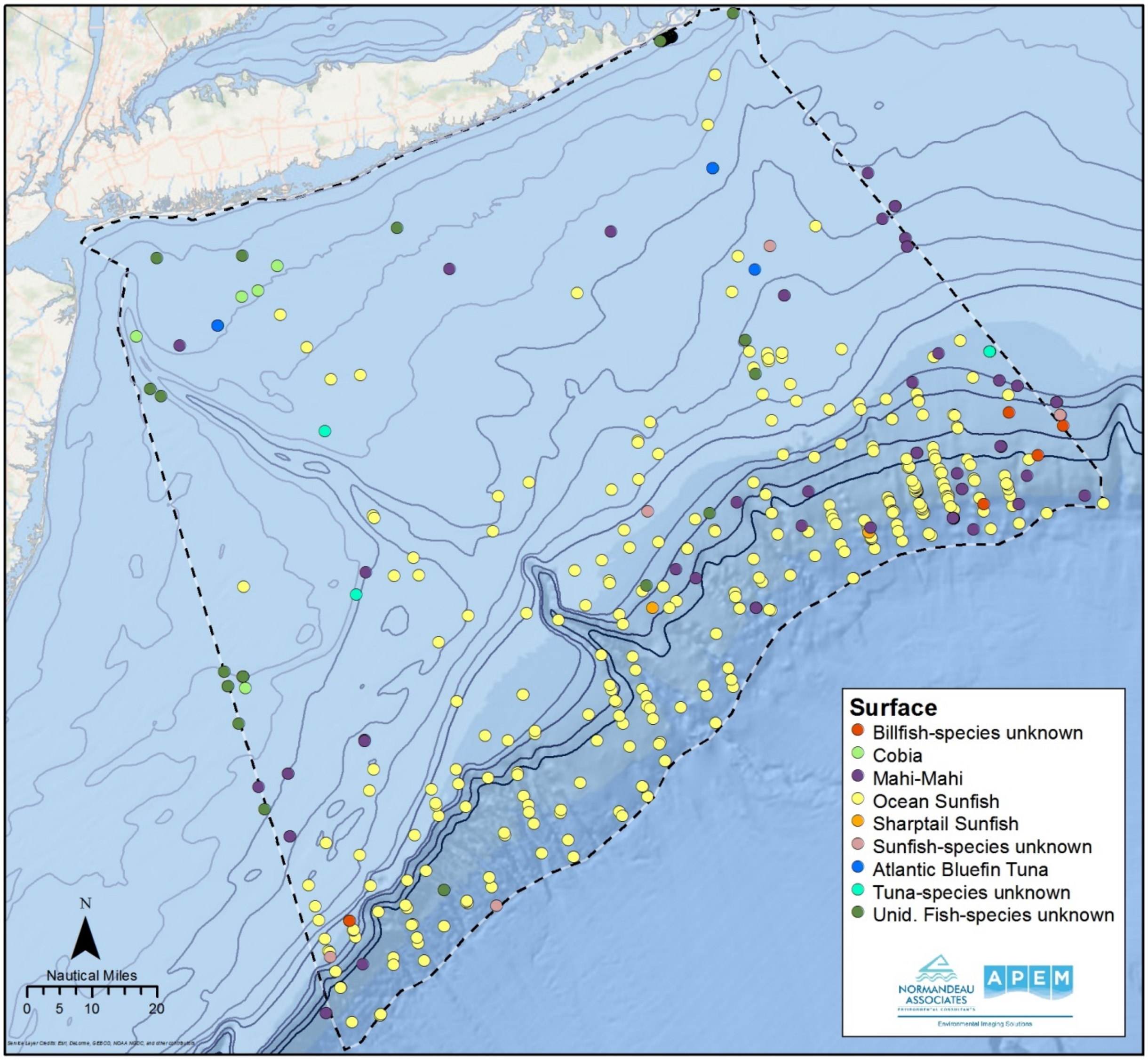

Figure 7. Locations of Identified and Unidentified Large Bony Fish Species (including sunfish) occurring at the surface.

Spatial Distribution of Large Bony Fish

Distributions across the year and by species appear to show some spatial patterns of occurrence. Billfish were only positively identified in the July 2016 Summer survey, but their distribution is largely beyond the 150-m bathymetric contour near the shelf break in the southeast area of the OPA (Figure 8). Cobia were only positively identified in the July 2016 Summer survey and appear to be within the 40-m contour in the northwest corner of the OPA (Figure 9). Mahi-Mahi show a similar pattern to billfish, with the majority of the fish beyond the 150-m bathymetric contour (Figure 10). Sunfish were present throughout the OPA with a tendency to occur beyond the 40-m contour (Figure 11). Tuna were found inshore of the shelf break (Figure 12). Unidentified individuals occurred throughout the survey area (Figure 13). While Mahi-Mahi were distributed throughout the OPA in the summer, those encountered in the spring occurred only along the shelf break (Figures 14 and 15). Sunfish show a similar distribution in the July and November 2016 surveys when they were present throughout the area between the 40 and 150-m contours (Figures 16 and 17). The few sunfish present in the March 2017 survey occurred in deeper waters (Figure 18). In the May 2017 survey, sunfish were concentrated along the deeper edges of the OPA but also occurred farther inshore than in winter (Figure 19). Spatial distributions of both tuna and unidentified species exhibited no apparent seasonal differences other than total numbers (Figures 20 to 25).

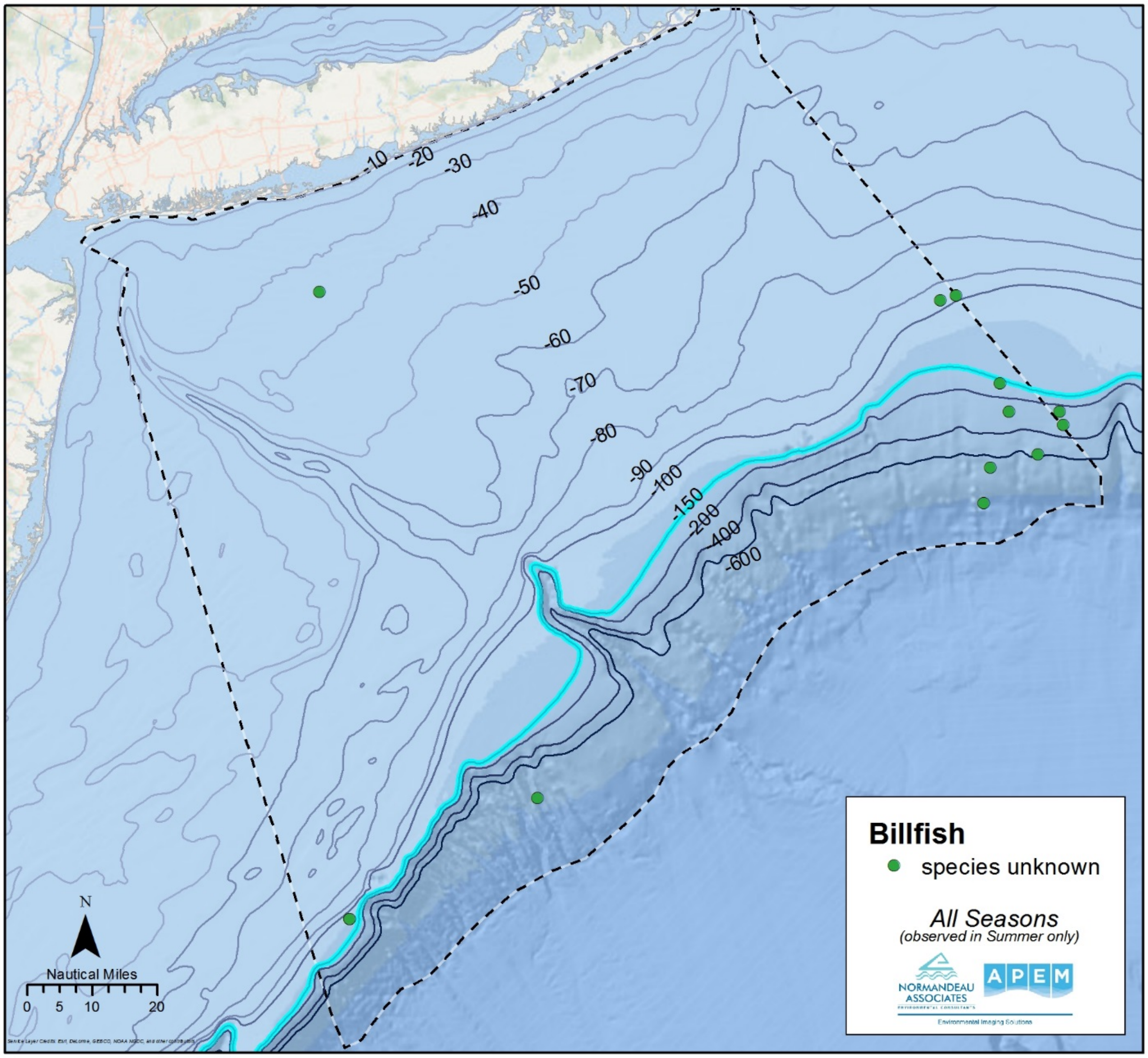

Figure 8. Locations of all Billfish Shown in Relation to the 150-m Bathymetric Mark

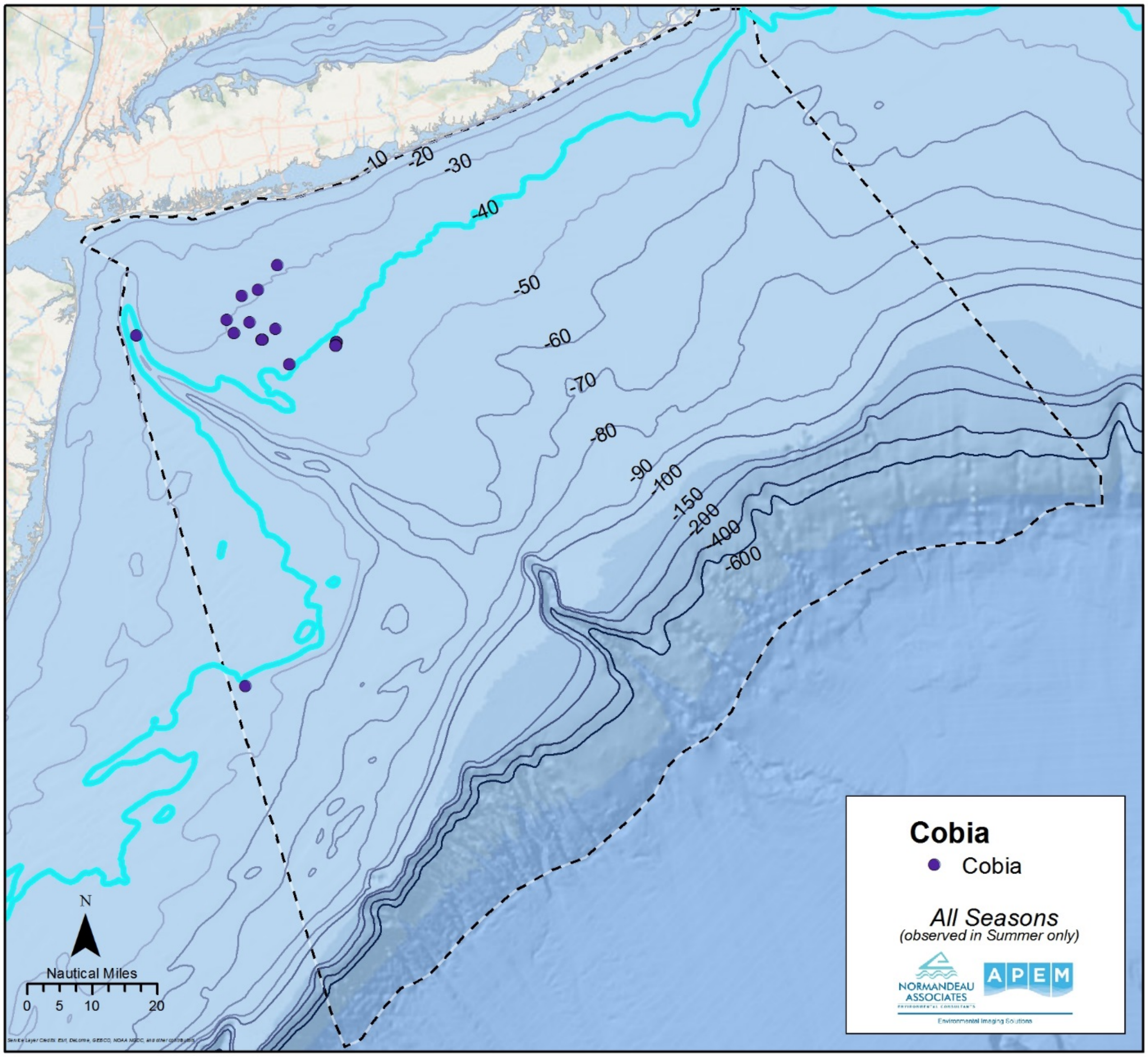

Figure 9. Locations of all Cobia Shown in Relation to the 40-m Bathymetric Mark

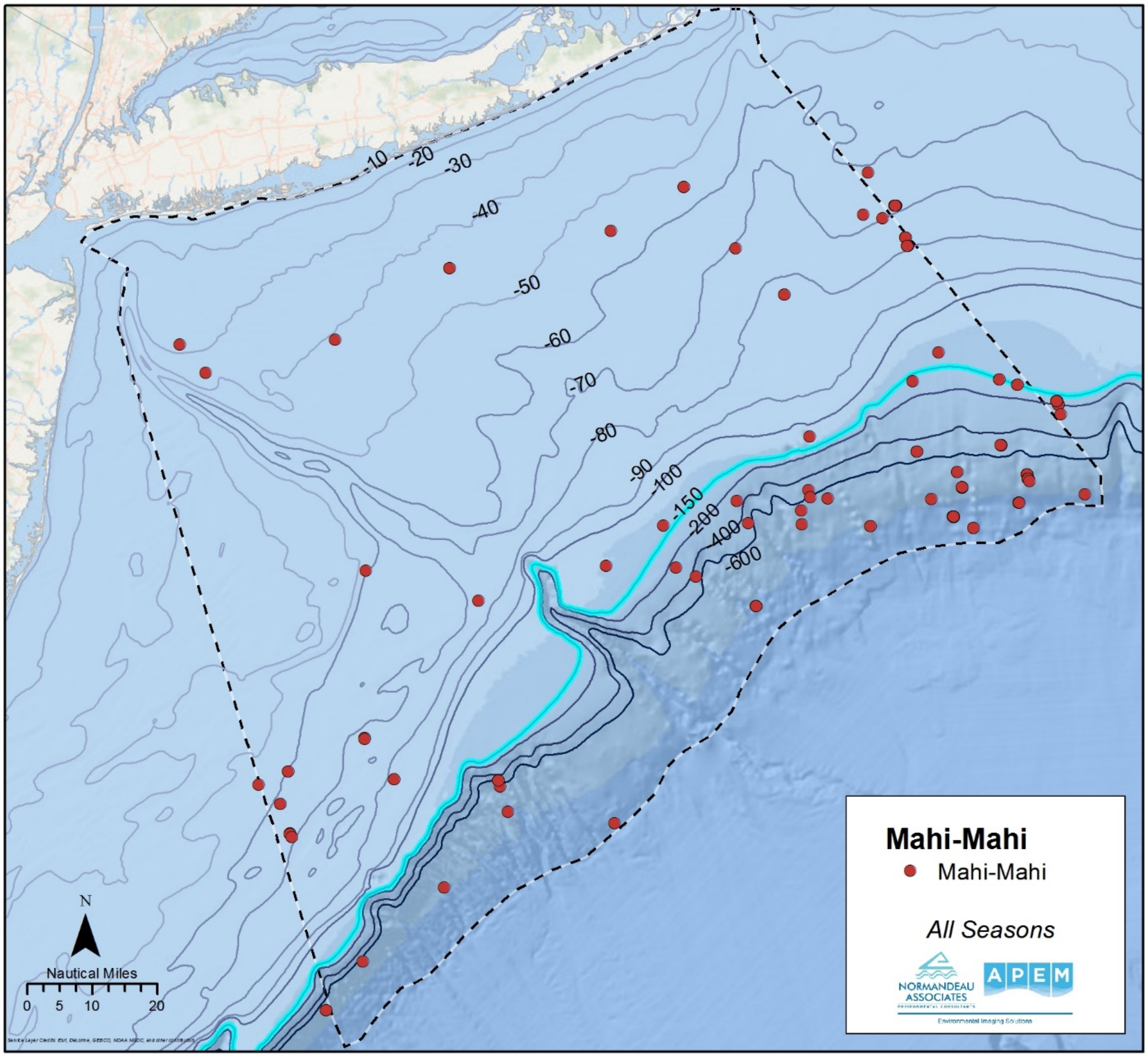

Figure 10. Locations of all Mahi-Mahi Shown in Relation to the 150-m Bathymetric Mark

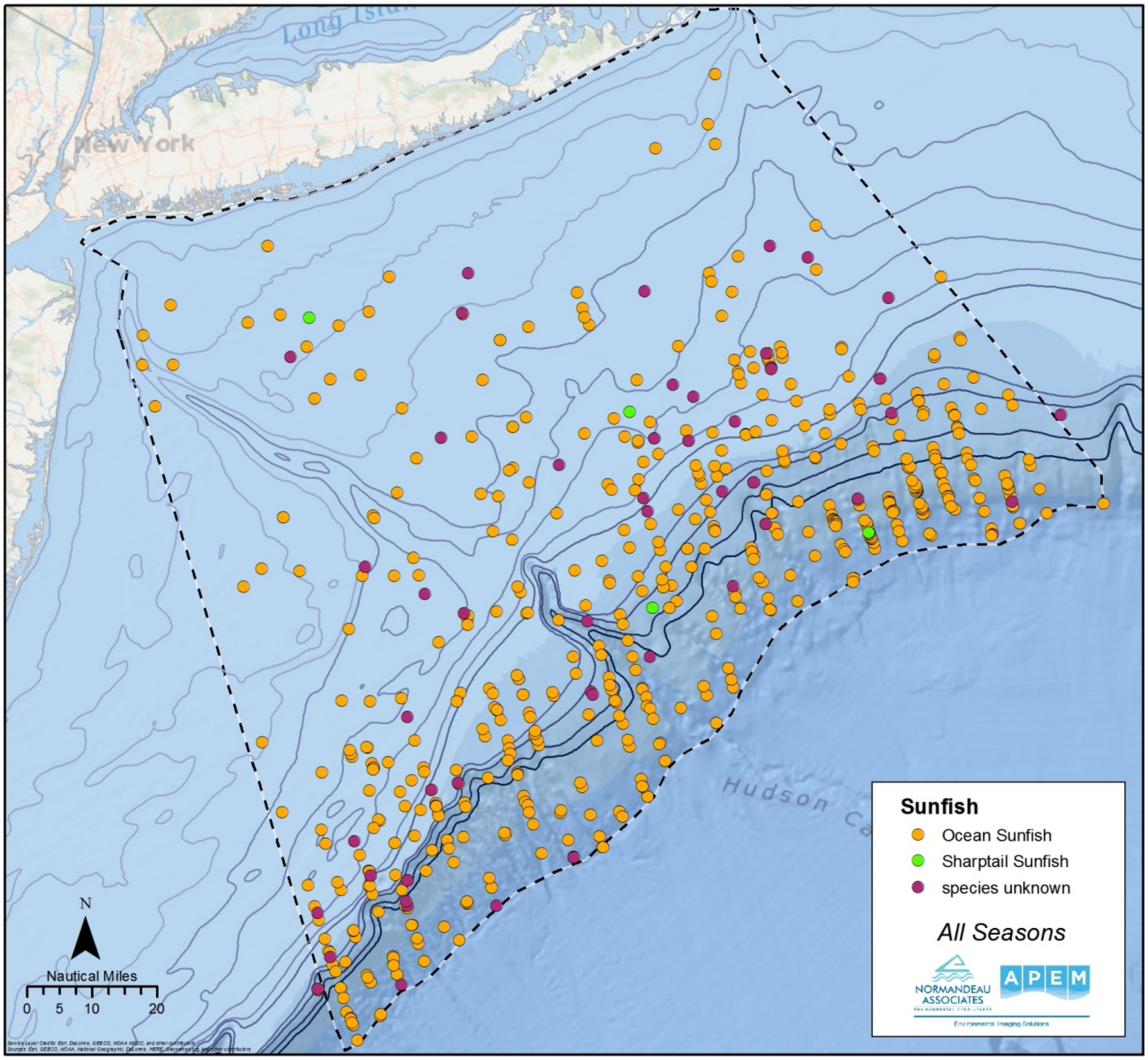

Figure 11. Locations of all Sunfish

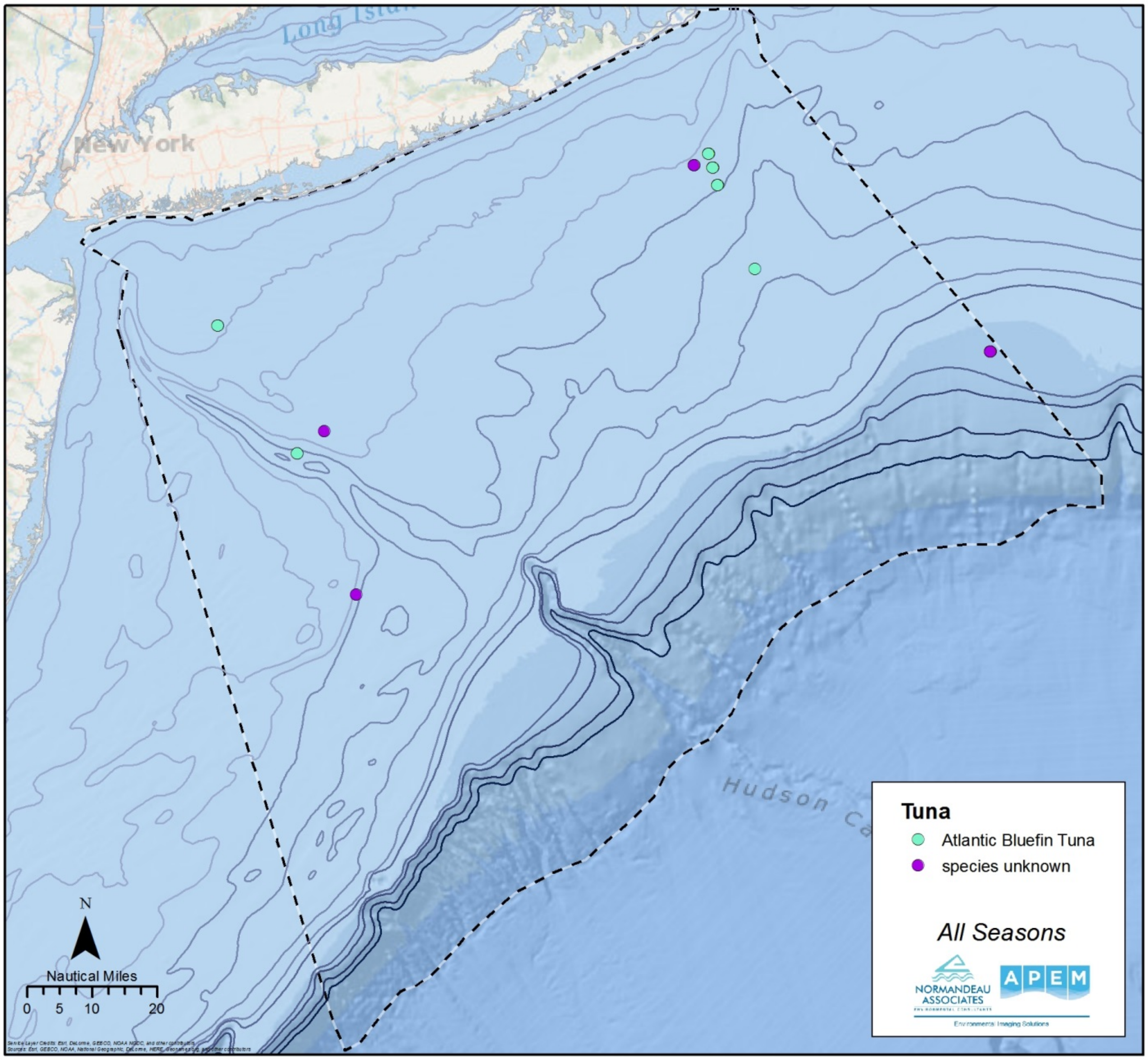

Figure 12. Locations of all Tuna

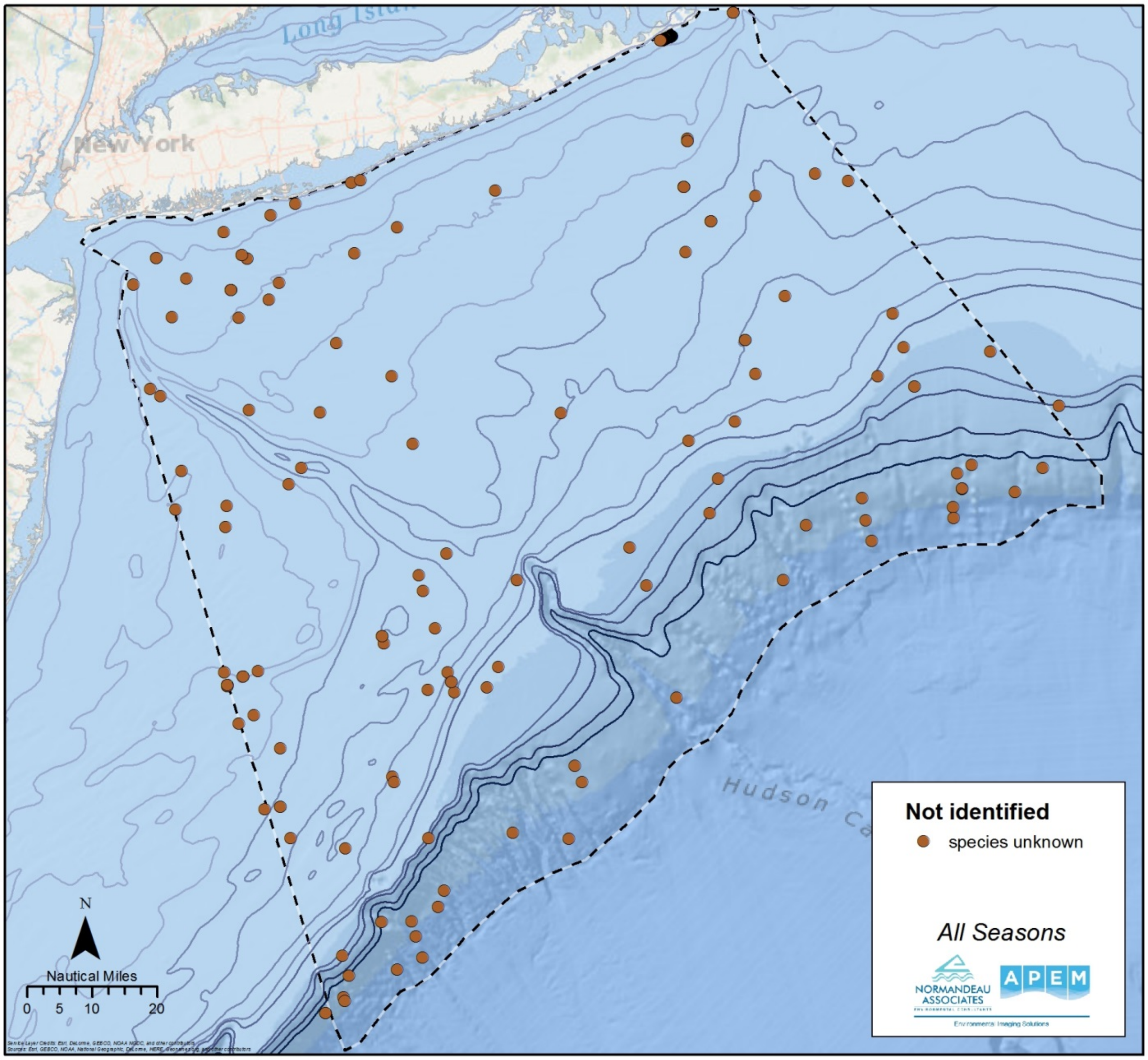

Figure 13. Locations of all Unidentified Large Bony Fish

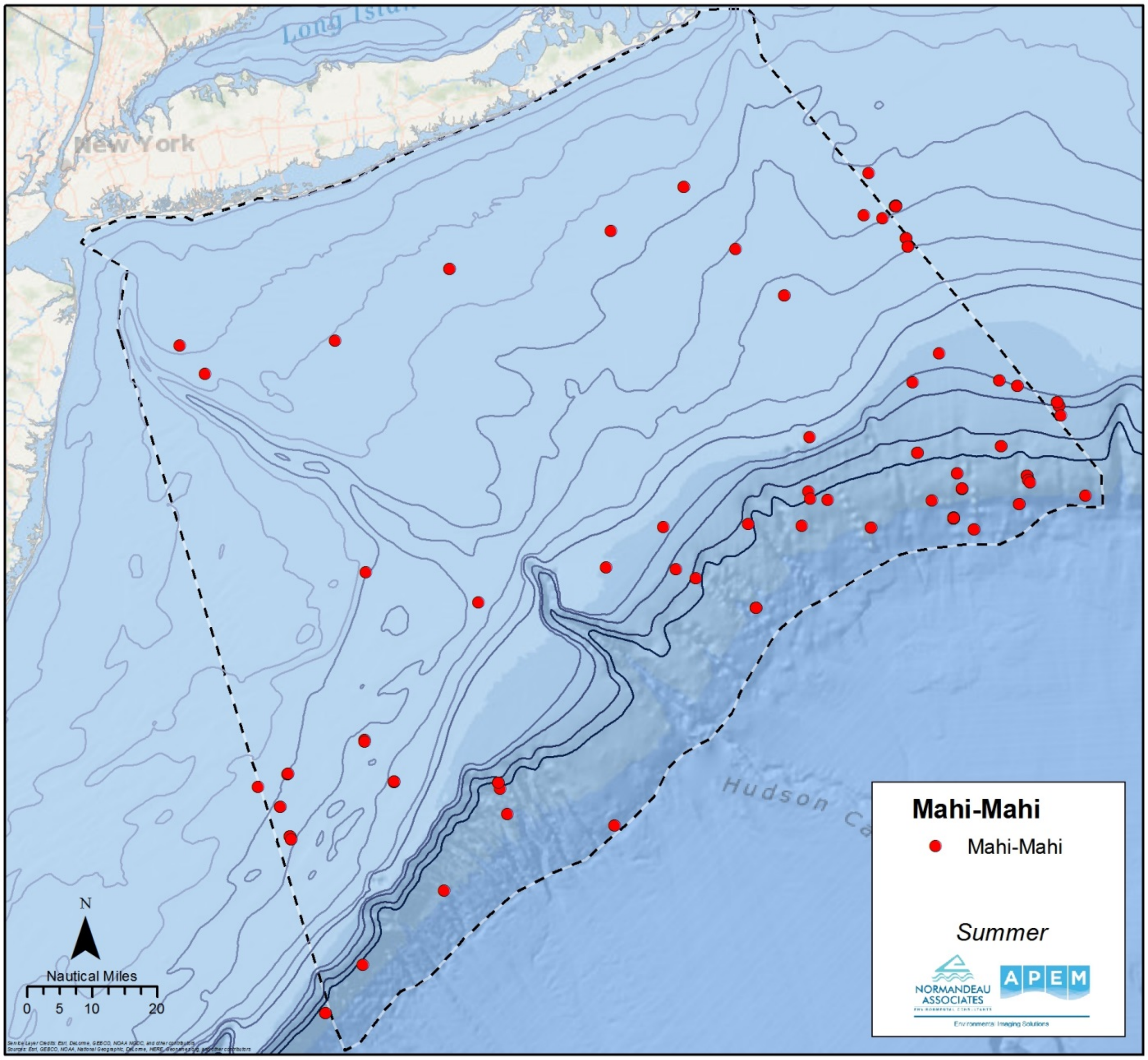

Figure 14. Locations of all Mahi-Mahi in the Summer July 2016 Survey

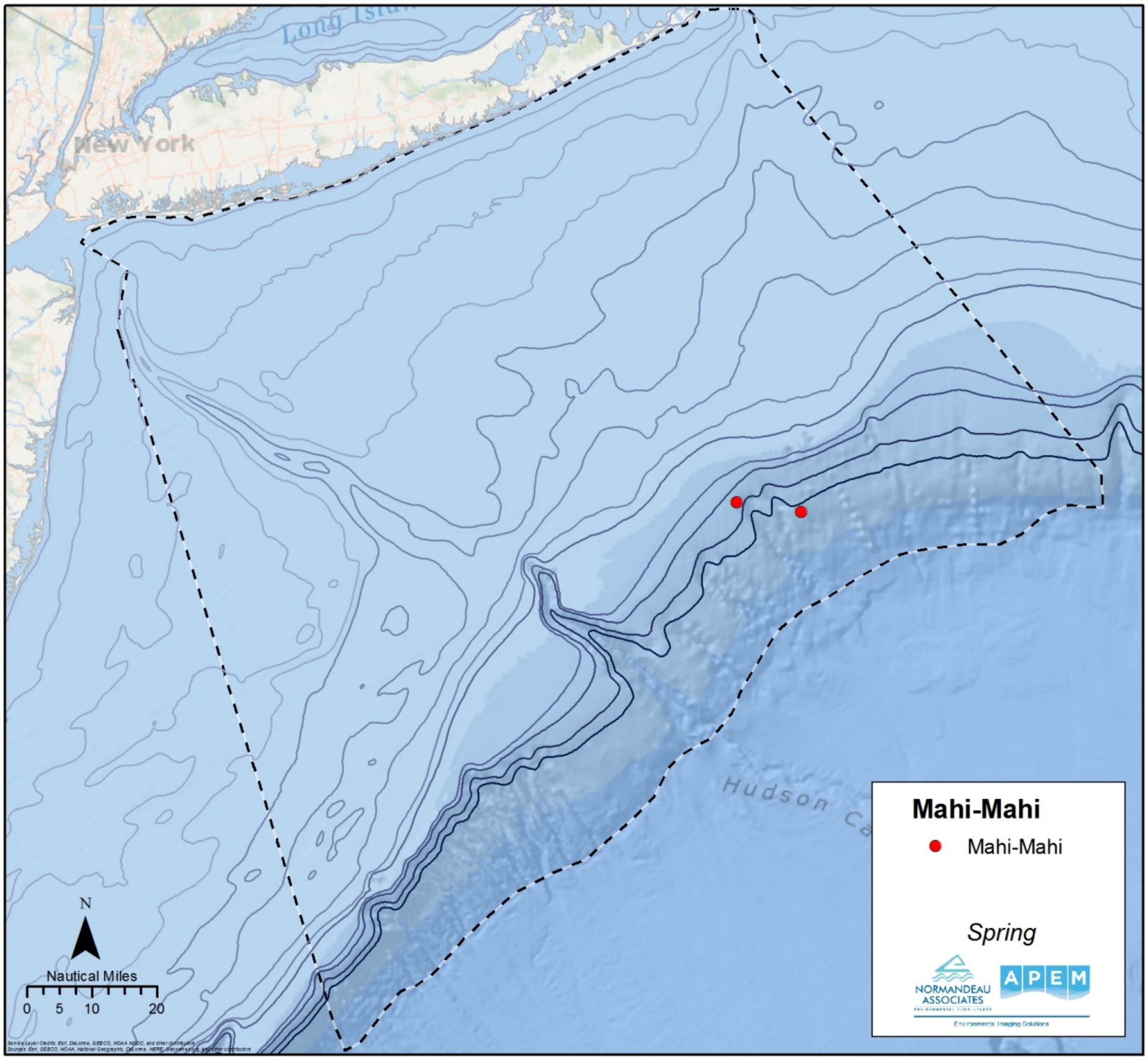

Figure 15. Locations of all Mahi-Mahi in the Spring May 2017 Survey

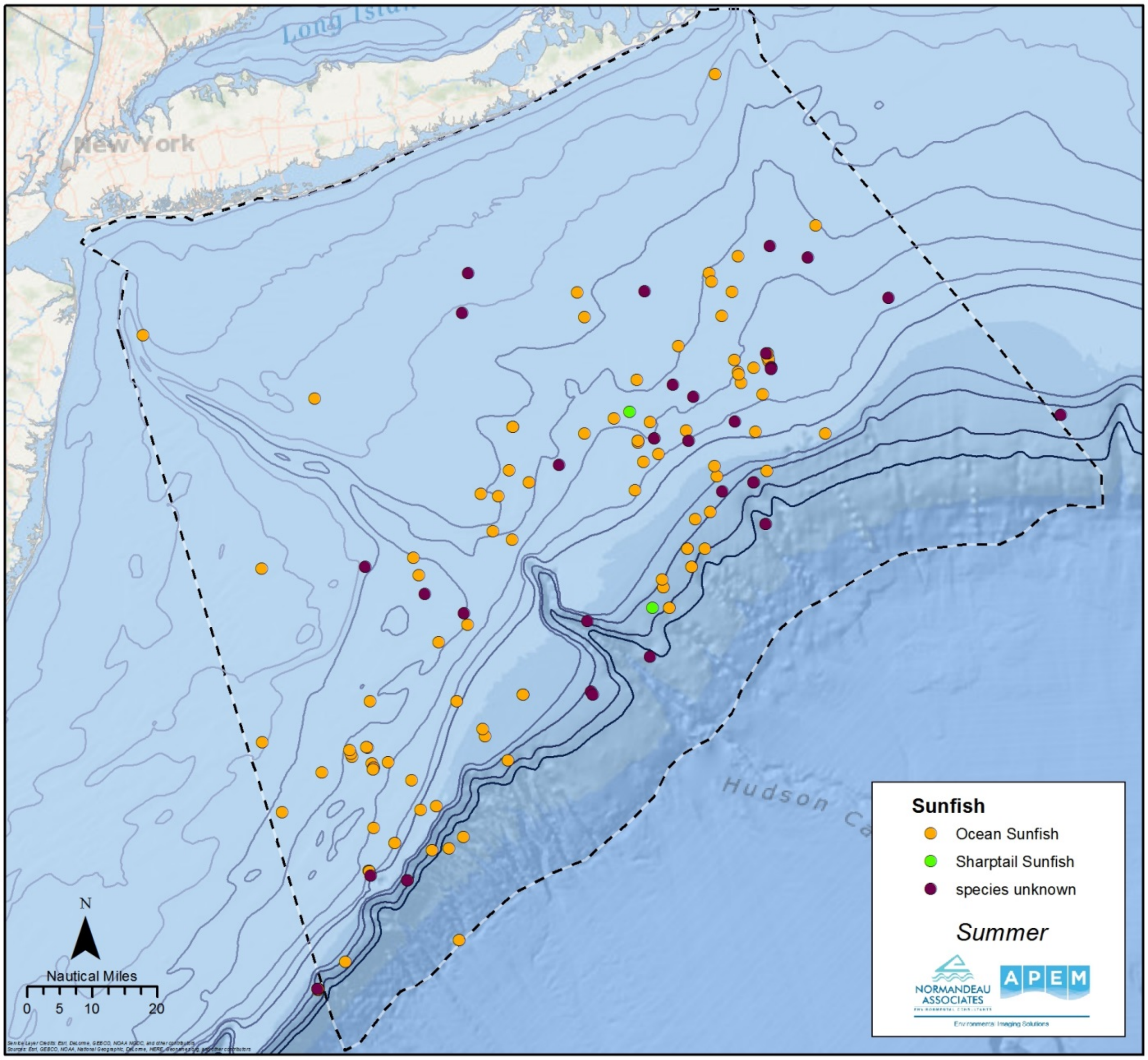

Figure 16. **Locations of all Sunfish in the Summer July 2016 Survey**

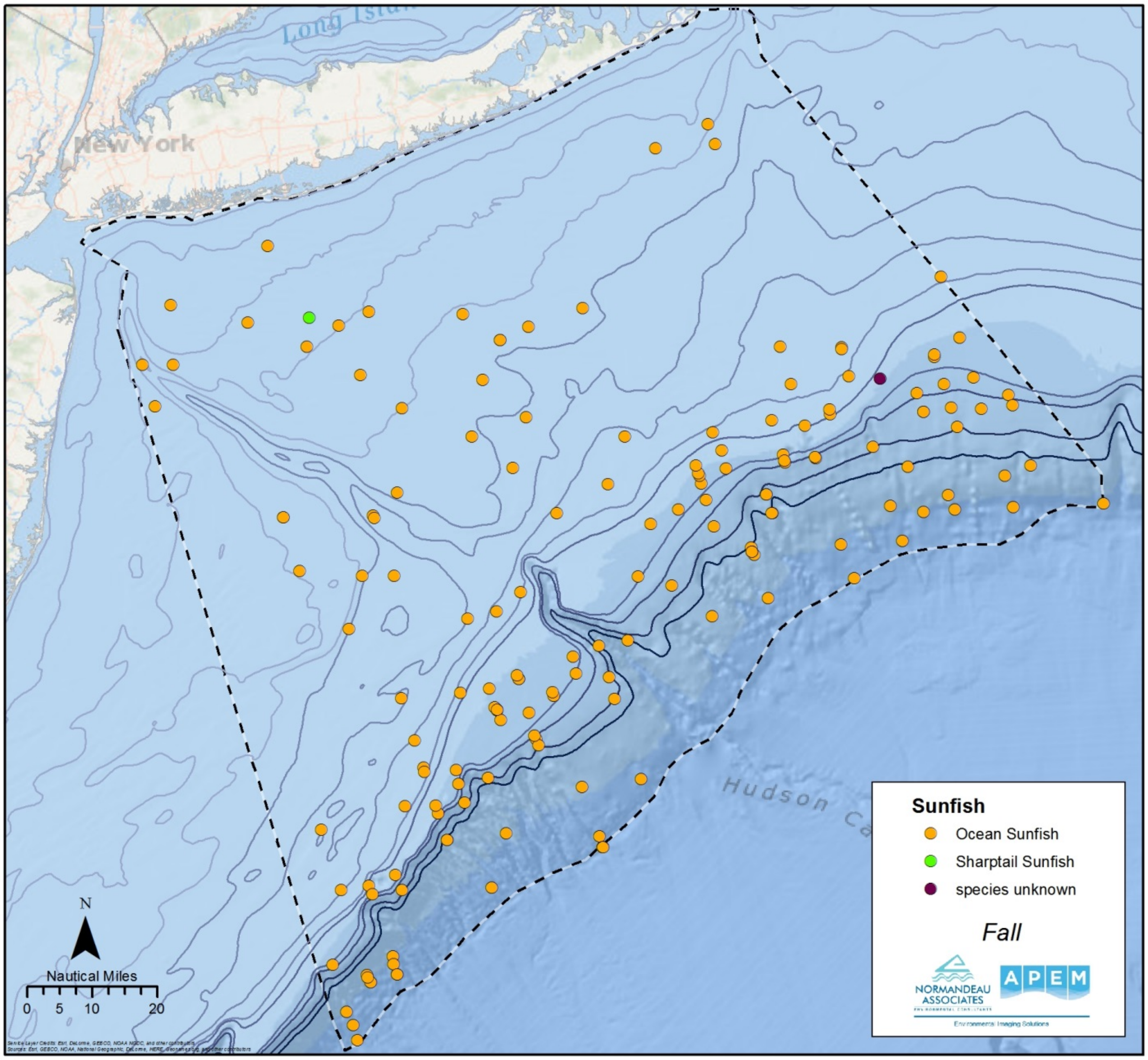

Figure 17. Locations of all Sunfish in the Fall November 2016 Survey

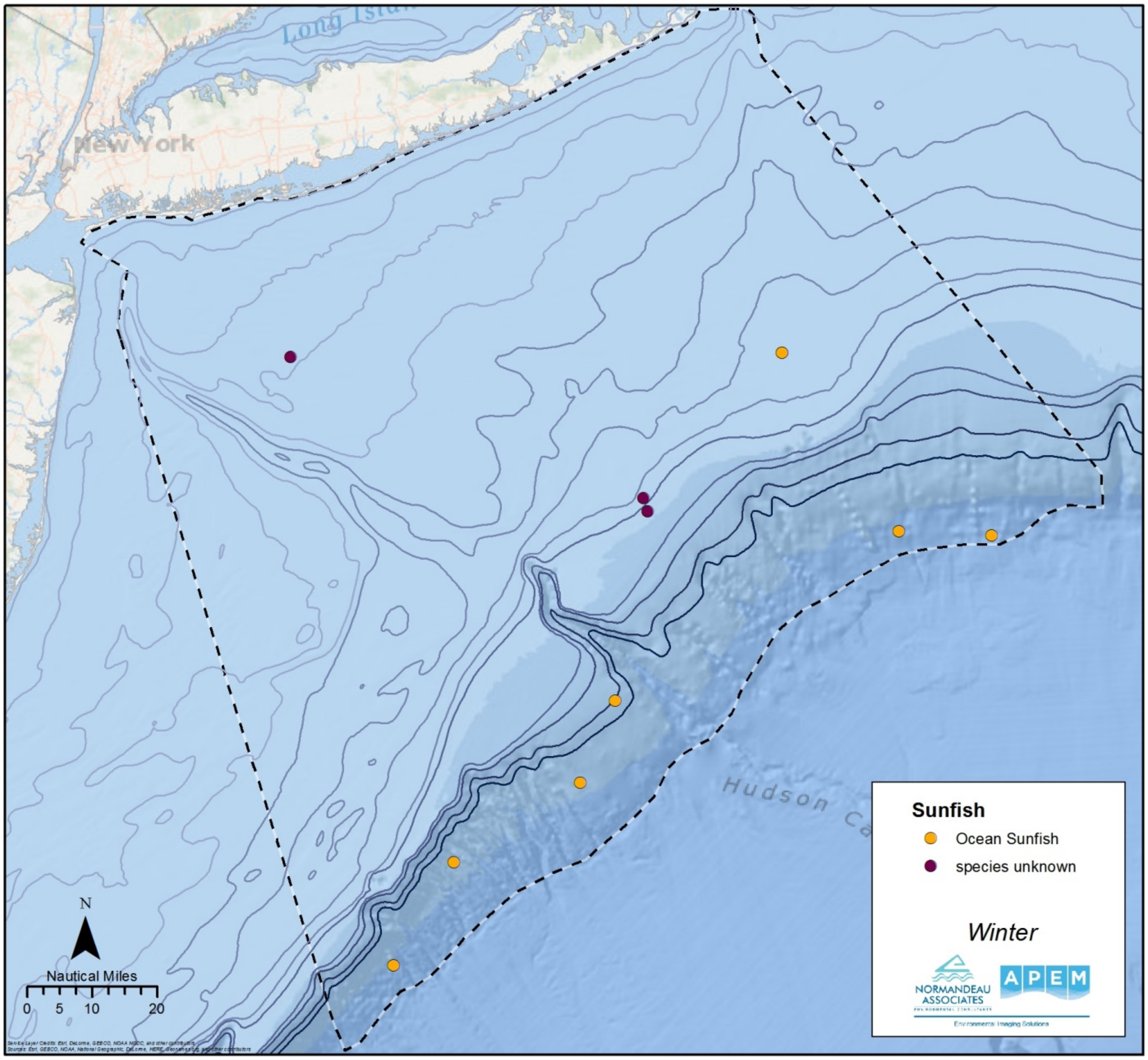

Figure 18. Locations of all Sunfish in the Winter March 2017 Survey

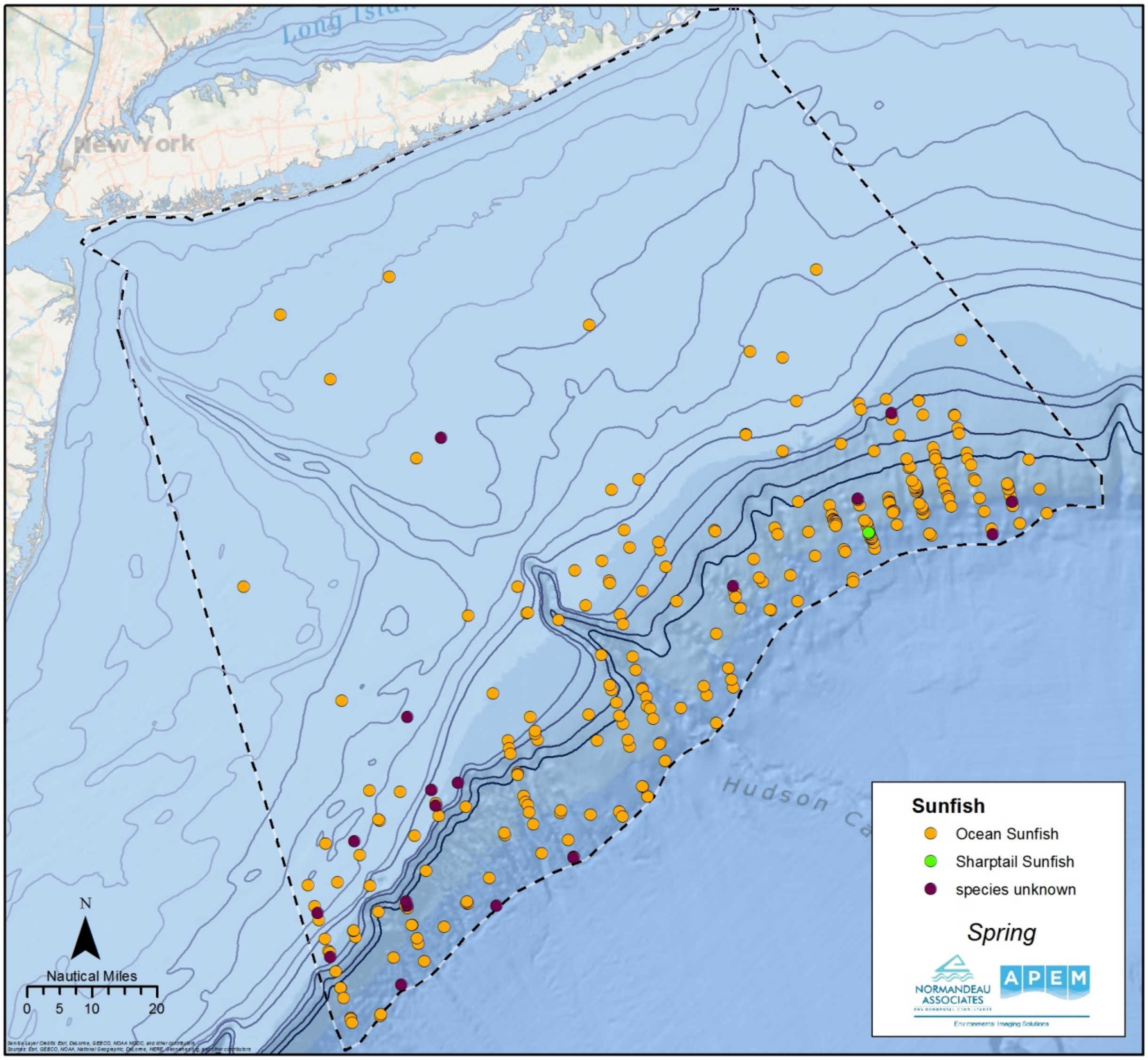

Figure 19. Locations of all Sunfish in the Spring May 2017 Survey

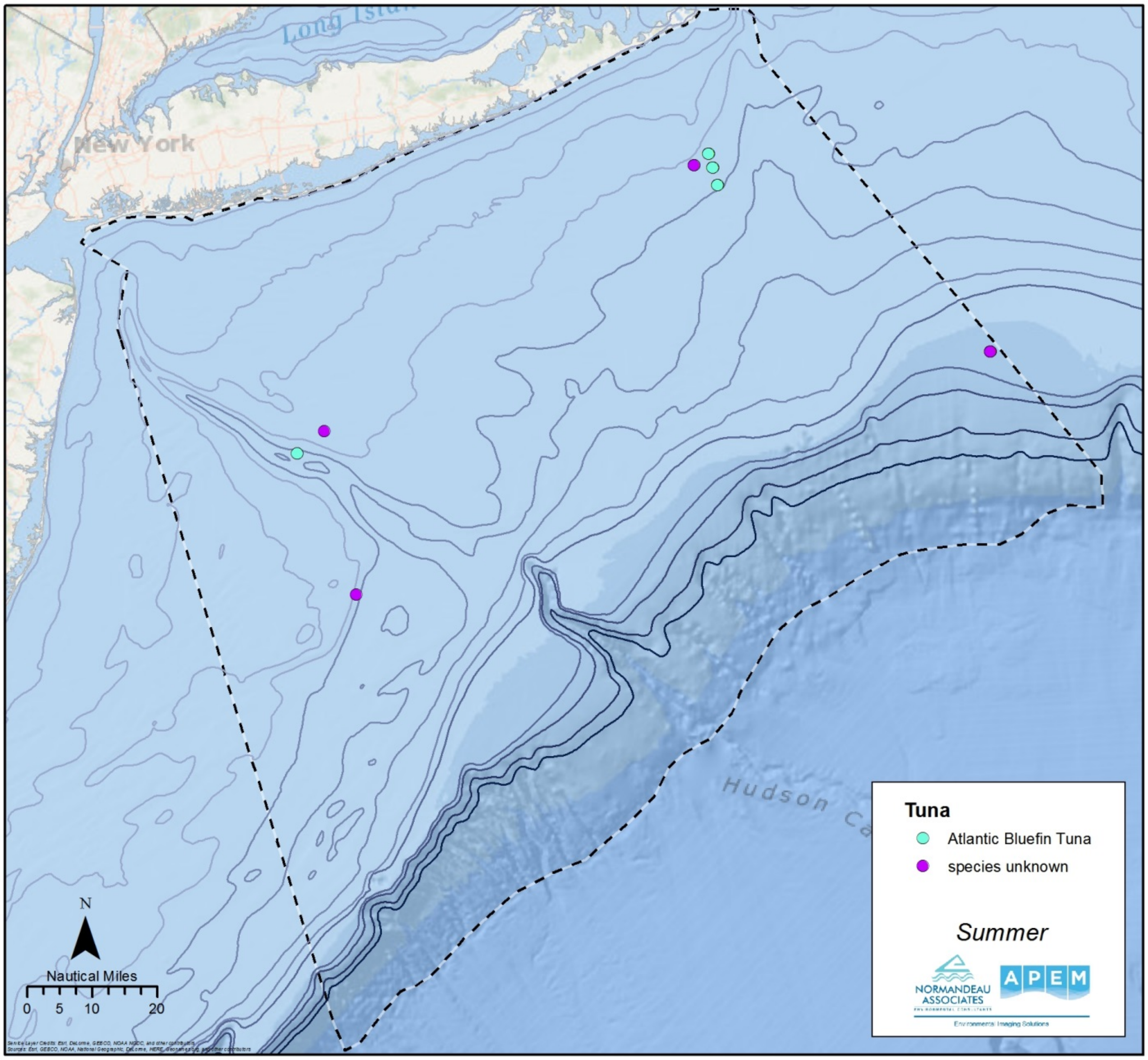

Figure 20. Locations of all Tuna in the Summer July 2016 Survey

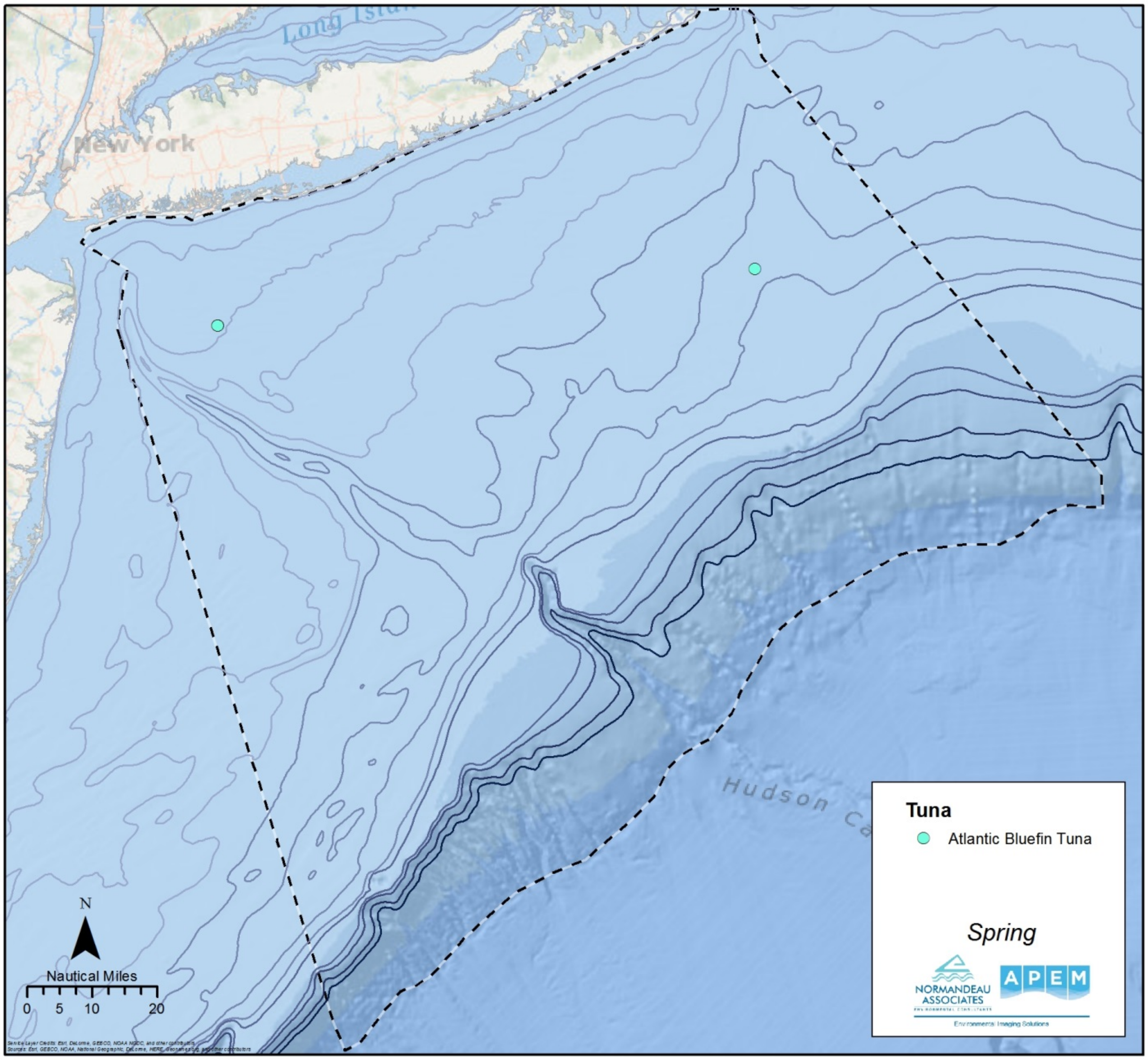

Figure 21. Locations of all Tuna in the Spring May 2017 Survey

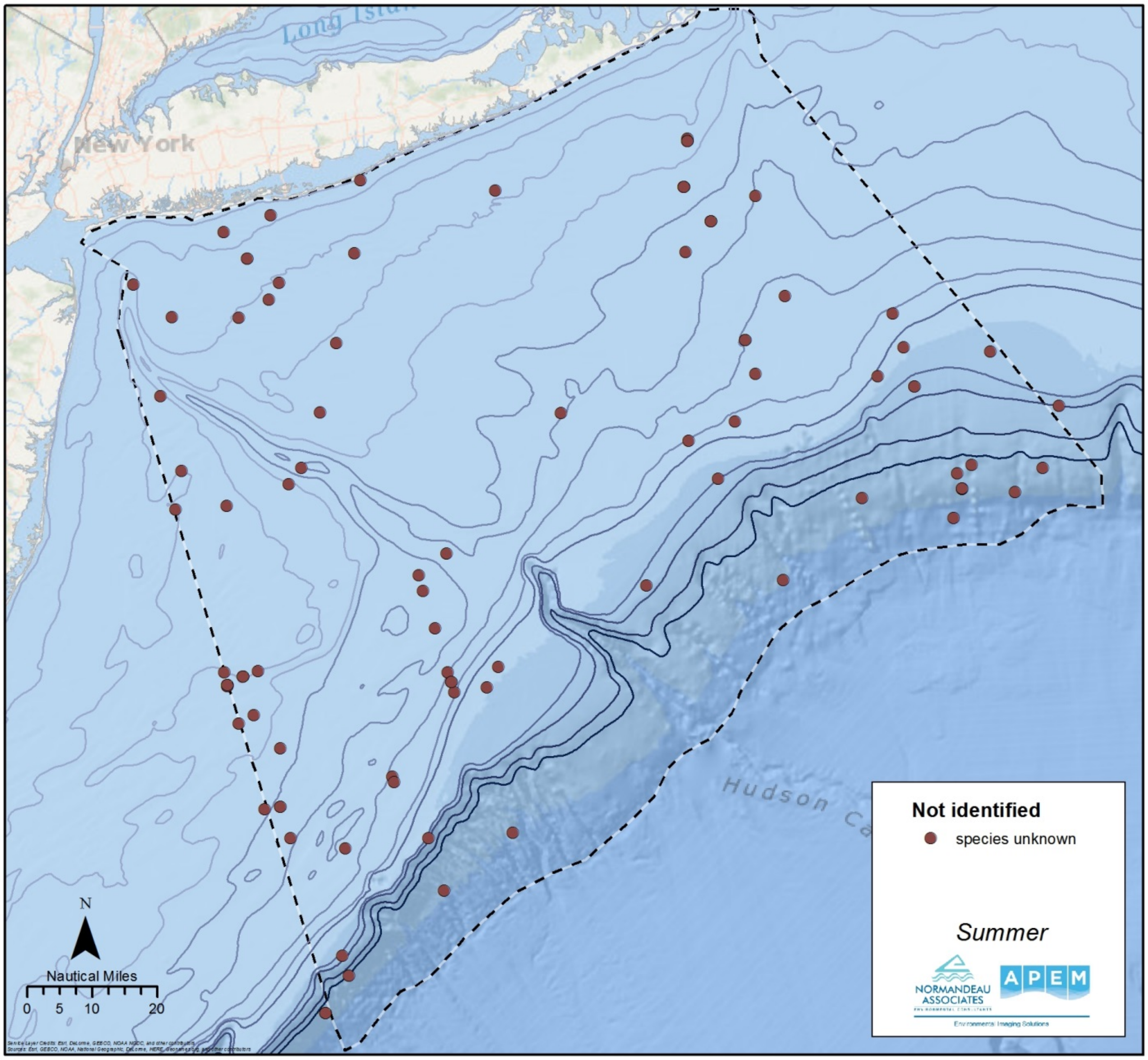

Figure 22. Locations of all Unidentified Large Bony Fish in the Summer July 2016 Survey

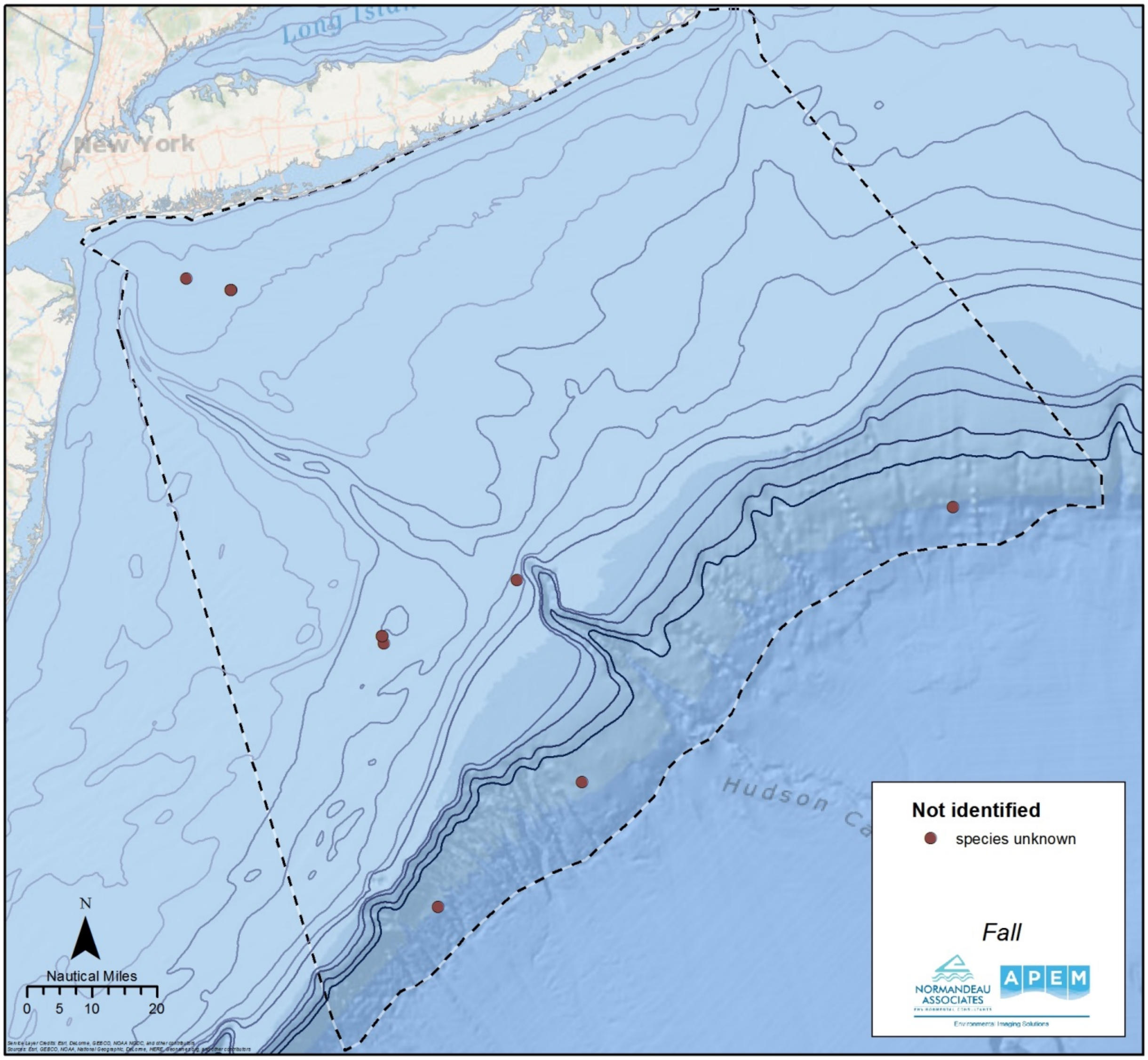

Figure 23. Locations of all Unidentified Large Bony Fish in the Fall November 2016 Survey

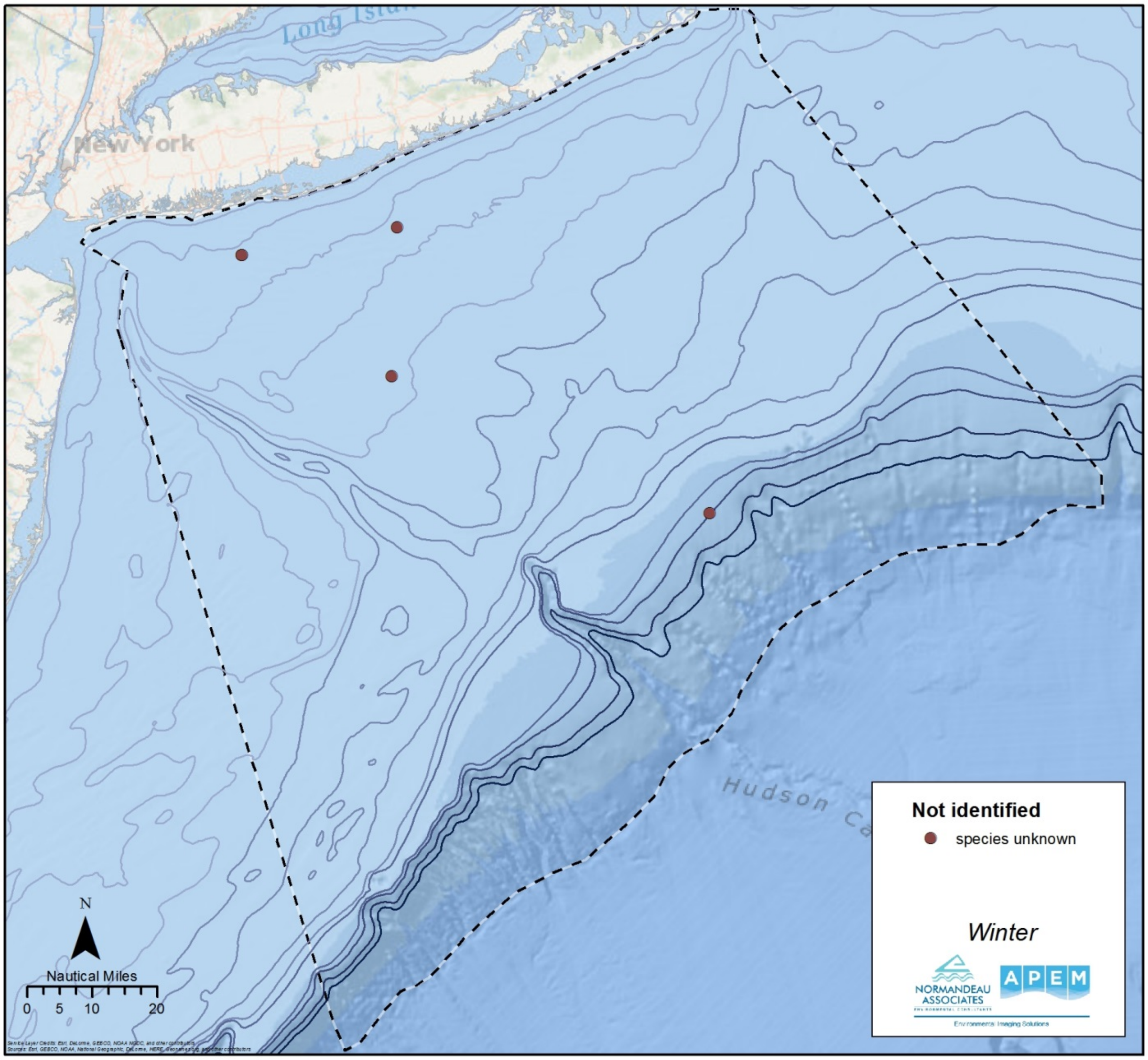

Figure 24. Locations of all Unidentified Large Bony Fish in the Winter March 2017 Survey

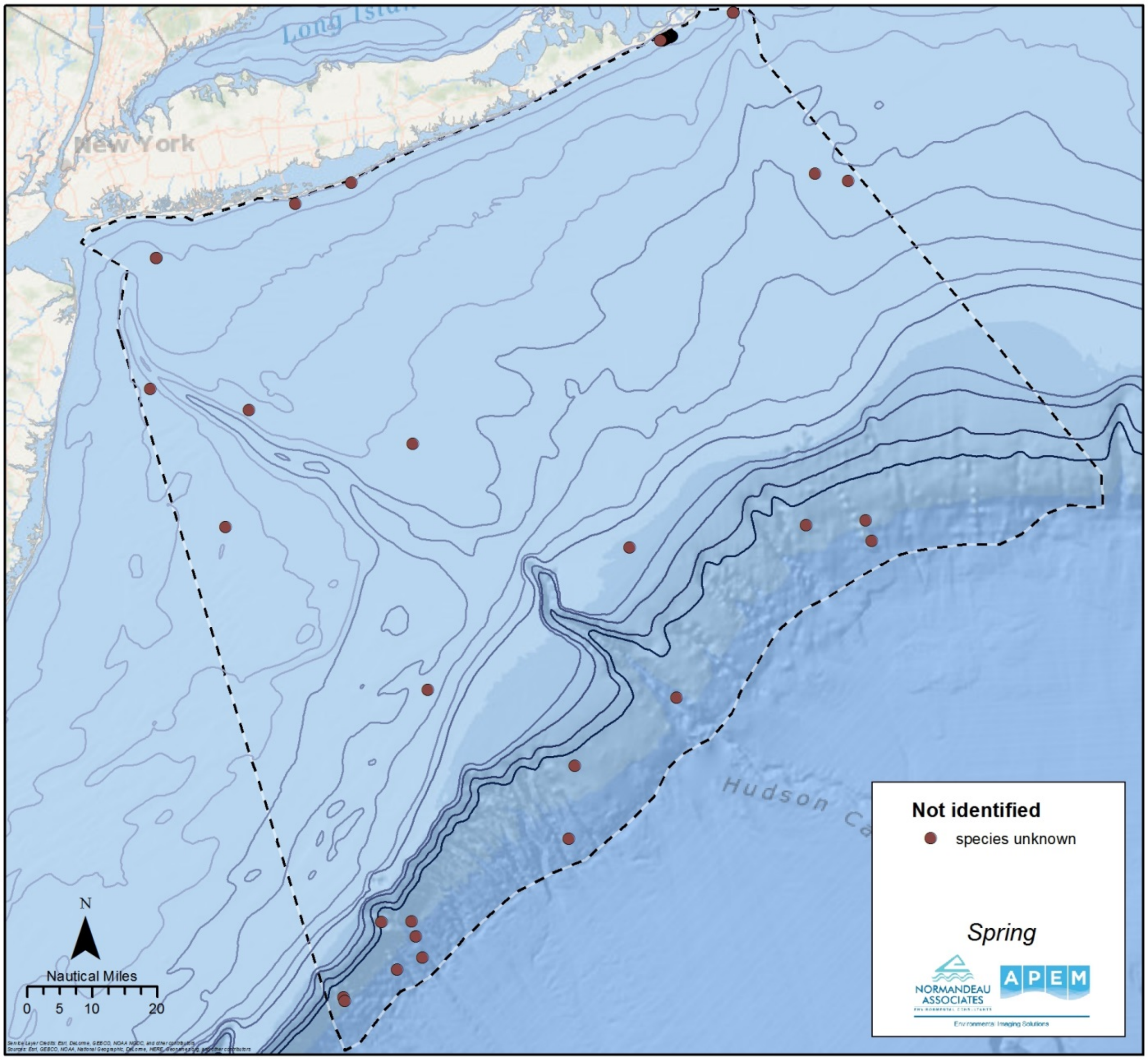

Figure 25. Locations of all Unidentified Large Bony Fish in the Spring May 2017 Survey

Fish Shoals

Over 3,900 fish shoals were recorded in the Summer July 2016 survey, 172 in the Fall November 2016 survey, one in the Winter March 2017 survey, and 51 in the Spring May 2017 survey (Table 3). These differences s between surveys do reflect the seasonal pattern exhibited by schooling species such as Atlantic Menhaden and Atlantic Mackerel (Stone et al. 1994; Studholme et al. 1999) that could comprise some of the shoals observed. However, as explained earlier, detection and identification of subsurface animals is dependent on factors such as water clarity, sea state and turbidity, and these conditions may contribute to apparent differences among seasons.

Maximum, minimum, and mean shoal sizes appear to vary by season with the largest aggregations seen during the Fall November 2016 survey (Table 4). It is possible the smaller mean size of the summer aggregations reflects localized disturbances that broke up larger aggregations. It was not uncommon to observe sharks in the vicinity of these shoals in the summer and the presence of a predator could easily influence the configuration of the shoal.

Table 3. Fish Shoals Measured and Identified by Seasonal Survey

Season	# Fish Shoals	Total Area (m^2)
Summer 2016 (July)	3,948	188,112.08
Fall 2016 (November)	172	178,488.78
Winter 2016 (March)	1	13.53
Spring 2017 (May)	51	6,439
Total	**4,172**	**373,053.40**

Table 4. Maximum, Minimum, and Mean Fish Shoal Measurements by Seasonal Survey

Season	Mean Area (m^2)	Min Area (m^2)	Max Area (m^2)
Summer 2016 (July)	47.65	0.91	4,457.00
Fall 2016 (November)	1,037.73	4.17	8,651.18
Winter 2016 (March)	13.53	13.53	13.53
Spring 2017 (May)	126.25	8.00	1,211.00

Spatial Distribution and Hot Spots for Fish Shoals

Figure 26 shows the locations of fish shoals by season. Figure 27 shows the relative density of fish shoals in the Summer July 2016 survey based on the measured areal extent of fish shoals encountered. Figures 28 to 31 show overall activity hotspots for fish shoals based on number of shoals and areal extent. With few exceptions, shoals were most prevalent in nearshore waters.

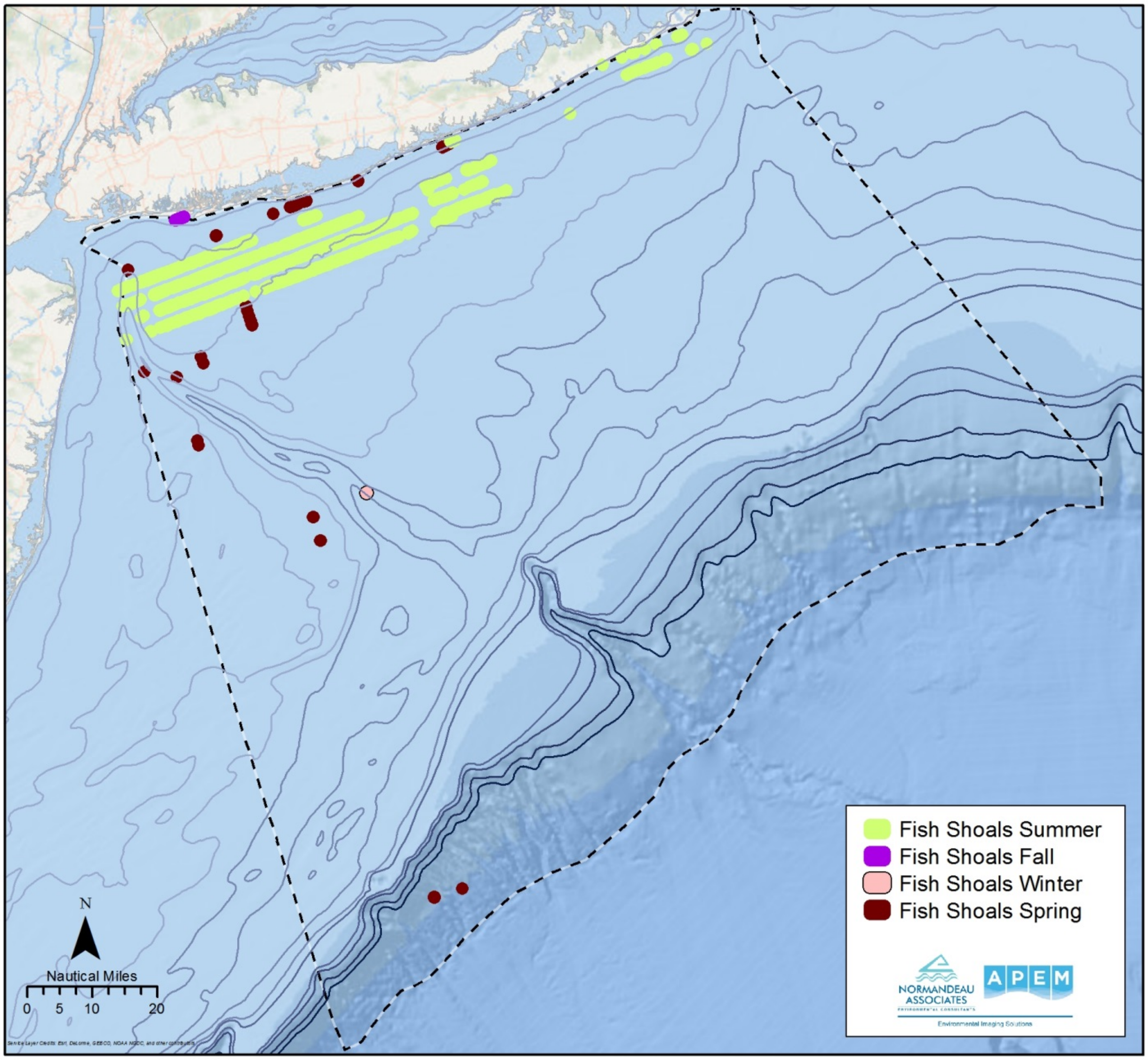

Figure 26. Locations of Fish Shoals by Season

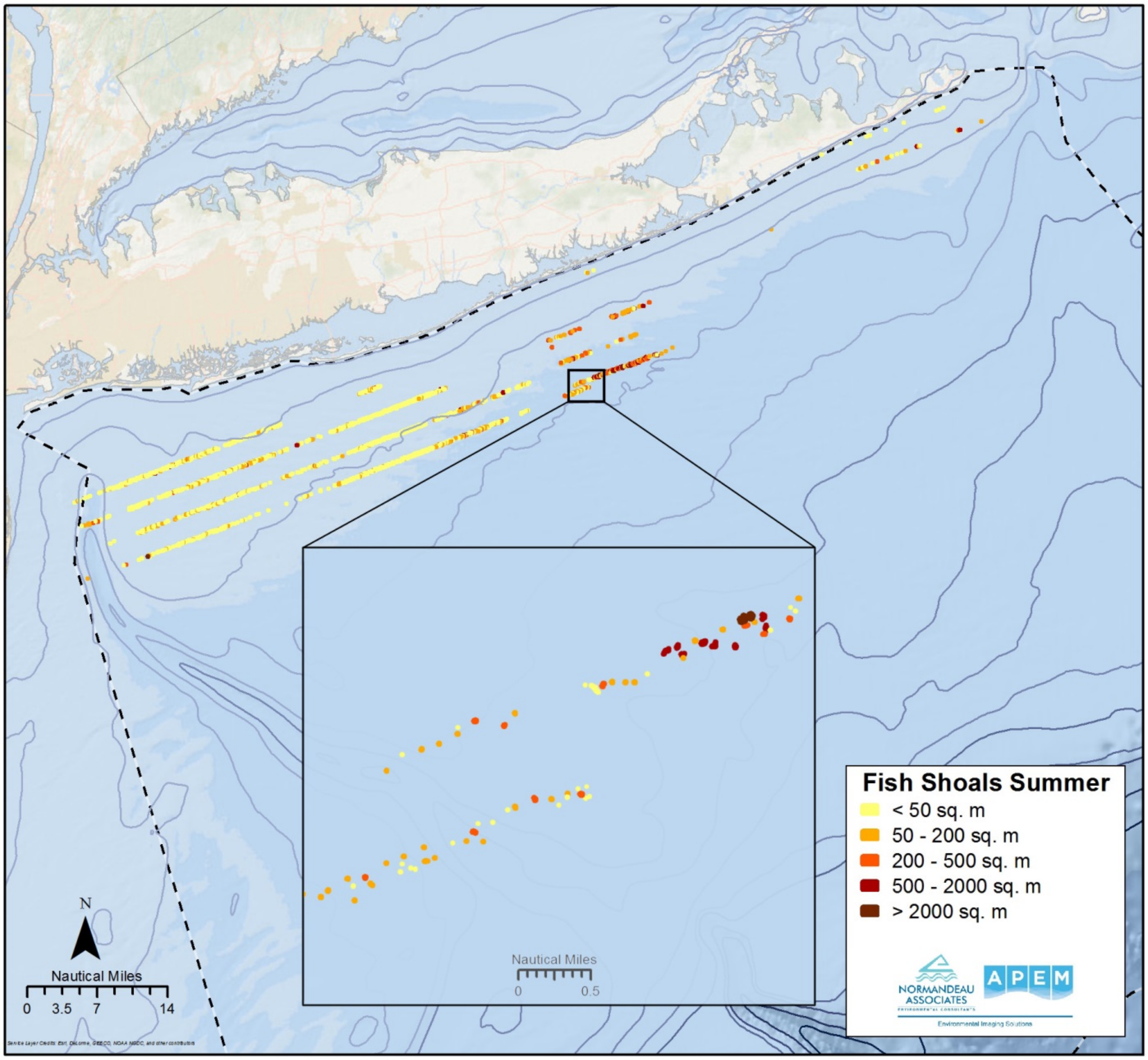

Figure 27. Relative Density of Fish Shoals in the Summer July 2016 Survey based on the Measured Areal Extent of Shoals Encountered

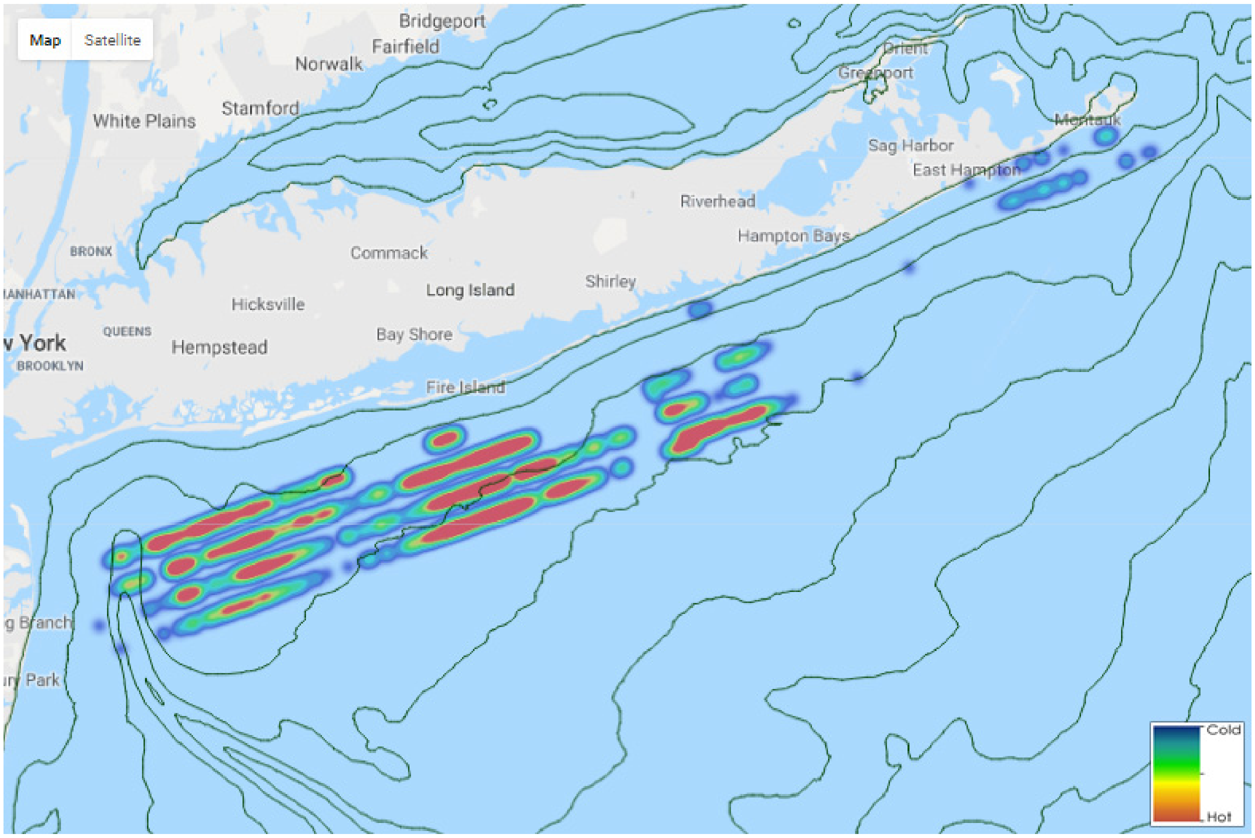

Figure 28. Overall Activity Hotspots for Fish Shoals based on Number of Shoals and Areal Extent in the Summer July 2016 Survey

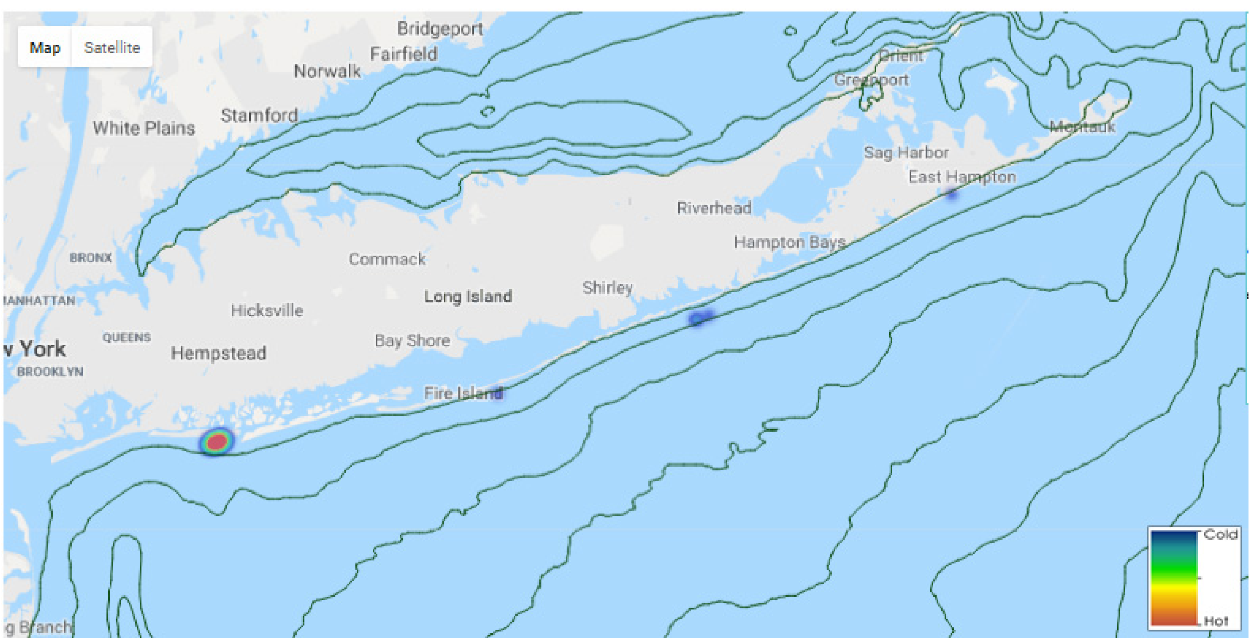

Figure 29. Overall Activity Hotspots for Fish Shoals based on Number of Shoals and Areal Extent in the Fall November 2016 Survey

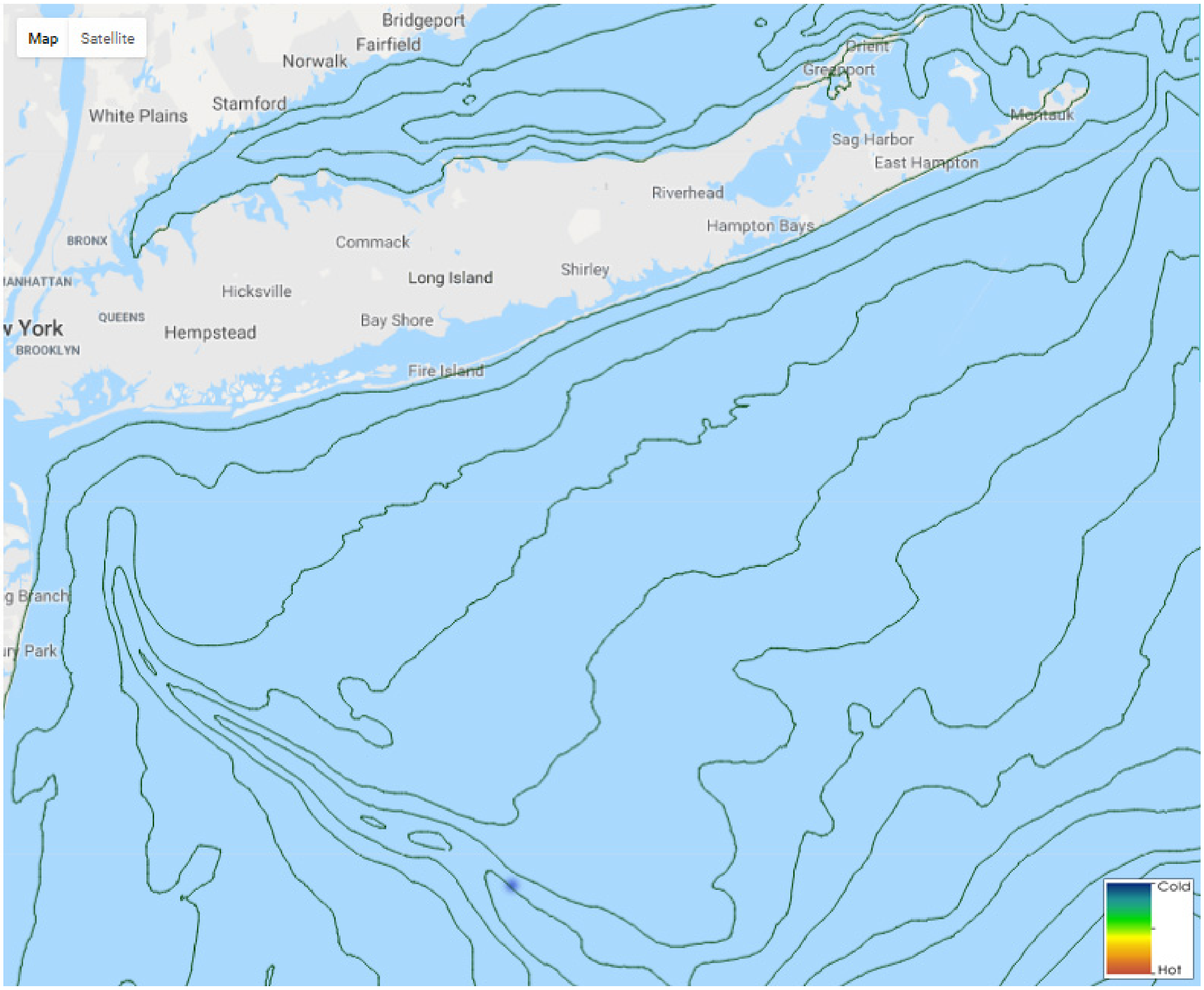

Figure 30. Overall Activity Hotspots for Fish Shoals based on Number of Shoals and Areal Extent in the Winter March 2017 Survey.

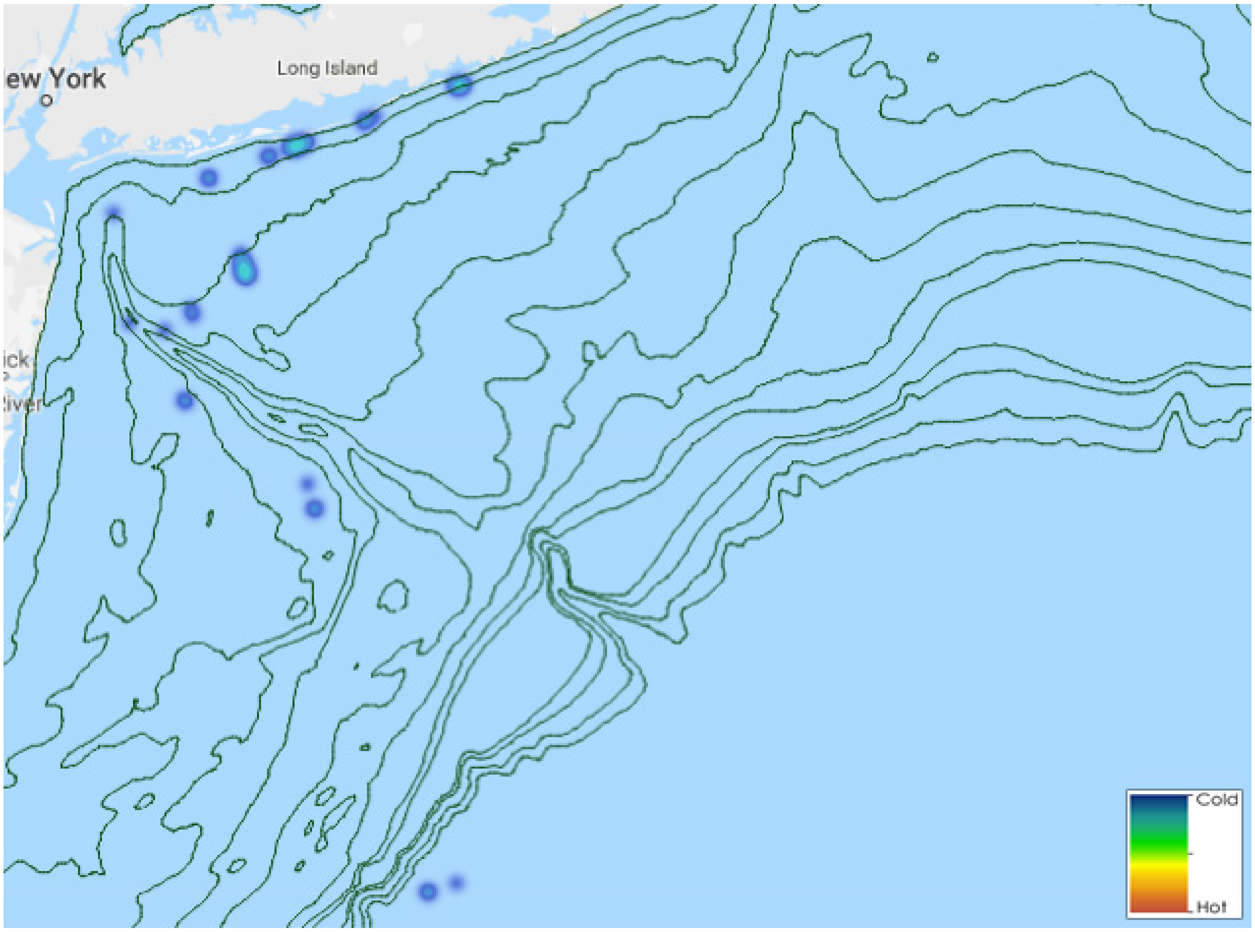

Figure 31. Overall Activity Hotspots for Fish Shoals based on Number of Shoals and Areal Extent in the Spring May 2017 Survey

Citations

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Studholme, A.L., Packer, D.B., Berrien, P.L., Johnson, D.L., Zetlin, C.A., Morse W,W. 1999. Essential Fish Habitat Source Document. Atlantic Mackerel, *Scomber scombrus*, Life History and Habitat Characteristics. NOAA Technical Memorandum NOFS-NE-141. 35 p.

APPENDIX: List in Taxonomic Order of Fish Species Found

Common Name	Scientific Name	Class	Family
Cobia	*Rachycentron canadum*	Actinopterygii	Rachycentridae
Mahi-Mahi	*Coryphaena hippurus*	Actinopterygii	Coryphaenidae
Atlantic Bluefin Tuna	*Thunnus thynnus*	Actinopterygii	Scombridae
Tuna-species unknown		Actinopterygii	Scombridae
Billfish-species unknown		Actinopterygii	Xiphiidae/Istiophoridae
Ocean Sunfish	*Mola Mola*	Actinopterygii	Molidae
Sharptail Sunfish	*Masturus lanceolatus*	Actinopterygii	Molidae
Sunfish-species unknown		Actinopterygii	Molidae