Pinniped Behavioral Response Study
Annual Report, 2021-2022

NAVSEA
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NEWPORT

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1 Background and Introduction

1.1 Background

The United States (U.S.) Navy is responsible for compliance with a suite of federal environmental and natural resources laws and regulations that apply to the marine environment, including the Marine Mammal Protection Act (MMPA) and the National Environmental Policy Act. The U.S. Navy complies with these and other laws during routine training and testing events, pier side construction, and range clearance and maintenance operations. In addition, the Navy is required to prepare and implement Integrated Natural Resources Management Plans for each military installation. As such, it is critical for the Navy to have a clear understanding of the protected marine resources in the areas where it operates. Consequently, many studies have sought to address the effects of underwater noise on cetaceans and as a result tagging efforts, tag technology, and tag deployment has primarily concentrated on cetaceans.

Bio-telemetry of pinnipeds emerged during the 1960s as a powerful new tool, or set of tools, for studying seal physiology and behavior, as well as for tracking the animals' movements (Bengtson et al. 1993; McGinnis 1968). ARGOS satellite telemetry is currently one the most widely used methods to track the movements of free-ranging marine and terrestrial animals and is fundamental to studies of foraging ecology, migratory behavior and habitat-use. Satellite tags are frequently used to study pinnipeds in their natural environment, relocate individuals for serial sampling, and track healthy animals released after rehabilitation (Burns et al. 1999; Early et al. 1999; Folkow et al. 1996; Harvey 1991; Jay and Garner 2002; Lowry et al. 1998; Matthiopoulos et al. 2004). A standard means of instrument attachment has been to use quick-setting epoxy to glue the devices to the dorsal hair of recently molted individuals (Heide-Jørgensen et al. 1992; Stewart et al. 1989). Mazzaro and Dunn (2010) concluded that satellite tag attachment and detachment processes were without significant adverse effect, that the tagged seals' behavior was not significantly altered, and that it was likely that their findings would hold true for other phocid seals.

Pinniped studies using recoverable time-depth recorders have been conducted worldwide and have become sufficiently "routine" (Boveng et al. 1996). A preliminary evaluation of tracklines from these studies indicate that seals seasonally inhabiting and transiting through areas could be impacted by military activities including vessel traffic of all sizes, dredging, pile driving, sonar, and other activities. Tracking devices based on Argos, GPS, or VHF have provided insight into horizontal movement patterns, whereas time-depth recorders, alone or integrated in positioning devices, have been used to study dive patterns (Carter et al. 2016). In coastal species, such as gray seals (*Halichoerus grypus*) and harbor seals (*Phoca vitulina*), at-sea behavior has mainly been described on 2D dive profiles, where dive behaviors are classified (Russell et al. 2015; Thompson et al. 1991).

1.2 Types of Commercially Available Pinniped Specific Tags

Satellite tags, such as SPLASH tags (Wildlife Computers, Inc.), are data archiving, Argos satellite transmitting tags designed for tracing vertical and horizontal movements of free-ranging marine mammals. SPLASH tags with FastLoc® GPS technology allow for fine-scale locations on animals that surface and acquires positions every few minutes (to 20 meters with accurate satellite coverage). The SPLASH tag technology can be customized and deployments can be tailored to achieve unique experimental objectives. SPOT tags (Wildlife Computers, Inc.), similar to SPLASH tags, also send out short transmissions to the Argos satellite system, but locations are available with accuracies only as high as

250 meters and SPOT tags do not collect vertical movements. The use of one tag over another is dependent on the research objective. For instance, if the research objective was to determine if the animal is exhibiting foraging behavior, SPOT tags are likely unable to answer this question, but SPLASH tags also have limitations because it is unknown if the animal is foraging on a dive . For that, the inclusion of a different type of sensor would be necessary (e.g., accelerometer or a camera). If a SPOT or SPLASH tag is glued to the fur of a pinniped, they are expected to fall off during the animal's annual molt, so data collection is limited in duration to when the tag is applied to when the animals molt.

Mikkelsen et al. (2019) deployed long-duration audio and 3D movement tags (DTAGs) on three harbor seals and two gray seals in the North Sea during 2015-2016. These tags recorded sound, accelerometry, magnetometry, and pressure. The challenge in high-resolution data (from sound, cameras, or accelerometers) is the large amount of data that cannot be transmitted by radio, thus requiring that the data be stored on the tag itself, which must be physically recovered. Therefore, it is challenging to obtain high-resolution data over longer periods of time and in remote areas. Even when the tags can be recovered, efficient data analysis of complex multi-sensor datasets returned by the devices often require new methods.

1.3 Telemetry Studies on Pinnipeds along the U.S. East Coast

The two most common seals that inhabit coastal and offshore areas along the U.S. East Coast are harbor seals (*Phoca vitulina*) and gray seals (*Halichoerus grypus*). The information gained from studying harbor seal and gray seal site fidelity and movement would not only provide information specific to harbor and gray seals, but could also substitute for a lack of information for other marine species that are more difficult to research, but may also occupy similar ranges. Harbor seals, in particular, appear to be extending their range in the western Atlantic Ocean. Some individuals have been documented traveling over 800 kilometers from Maine to North Carolina, overlapping with several of the Navy's ranges, thereby exposing them to a variety of Navy activities (Ampela et al. 2021; Murray et al. 2021). Since 2018, the National Marine Fisheries' (NMFS) Northeast Fisheries Science Center, the Naval Undersea Warfare Center (NUWC) Division Newport, the Atlantic Marine Conservation Society (AMSEAS), and Marine Mammals of Maine (MMoME), collectively referred to as The Team, have partnered to capture and satellite tag gray and harbor seals to study their movements and health status. To date, telemetry data has been collected on 32 juvenile gray seals (2019-2022) and 23 harbor seals (2018-2022) (Table 4-1). Based on this telemetry work the movements of both harbor seals and gray seals overlaps with Navy Operation Areas or OPAREAS (VACAPES to the Boston OPAREAs)[1], two of the Navy's Living Marine Resources priority geographic regions in the Atlantic, and established and proposed windfarm areas.

1.4 Pinniped BRS

There are three phases to approach this research. The purpose of Phase I is to conduct a pilot study to inform the development of a multi-year program to measure baseline behavior and determine how human sounds, including active sonar signals, affect pinnipeds. The purpose of Phase II is to continue the collection of baseline behavioral information and design the control exposure experiment (CEE). In Phase III, the CEE would be executed and compared to baseline data collected in Phases I and II.

[1] The seals that were tagged in Virginia and in New York, were tagged with either SPLASH or SPOT tags. We intend to continue to add to this body of telemetry data with additional planned deployments from Maine to Virginia.

Although research efforts would concentrate on east coast harbor and gray seals, information would be applicable to all phocid species that overlap with military activities.

1.4.1 2020-2021 Field Season

There were three objectives for Phase I: 1) To assess the feasibility of conducting aerial surveys between New York and Rhode Island; 2) To coordinate aerial surveys with ground, boat, and remote camera surveys in the survey area; and, 3) To assess the feasibility to capture and tag harbor and gray seals in southern New England and New York. In Phase I, completed during the 2020-2021 field season, The Team from NUWC, AMSEAS, NMFS, and MMoME conducted harbor and gray seal aerial surveys (New York to Rhode Island), seal captures to deploy satellite tags (New York), camera surveys (Rhode Island), in-person observations (New York and Rhode Island).

In winter/spring of 2021, The Team tagged seven harbor seals and one gray seal off Long Island, New York (Chapter 3), as part of a research effort to investigate pinniped behavioral responses[2]. The harbor seals traveled as far south as the southern border of New Jersey, but eventually all traveled to Maine by the summer. The gray seal traveled as far as Nova Scotia and exploited offshore waters primarily off New England. This movement by the gray seal is consistent with the telemetry tracks from gray seal pups in Murray et al. (2021).

Aerial surveys were conducted three times during the 2020-2021 season and a new haul out site was observed (Chapter 3), which further added to the information collected to establish a baseline. In addition to employing a systematic in-person monitoring protocol of know haul out sites, particularly those that might be candidates for capture and tagging, the use of remote (trail) cameras proved to be an efficient and cost-effective method to gather information than what could be conducted with only site visits (Chapter 3). Cameras have been used successfully in numerous studies of terrestrial animals (O'Connell et al. 2010), but only a few, in comparison, have been used to study pinnipeds (Gucu 2009; Koivuniemi et al. 2016; Øren et al. 2018)[3].

1.4.2 2021-2022 Field Season

The aim of the 2021-2022 field season's research, Phase II of the Pinniped BRS, was to continue to obtain data to measure baseline behavior to understand the physical or biotic factors that influence the movement and foraging tactics of harbor and gray seals; the amount of time seals spend in specific areas, paying particular attention to Navy OPAREAS; and, the anthropogenic risks (e.g., noise-producing military activities) seals potentially encounter in nearshore and offshore areas. The tasks for Phase II of this research project included: 1) Continue aerial surveys to document harbor and gray seal haul outs in the Narragansett Bay OPAREA; 2) Coordinate aerial surveys with ground and remote camera surveys; 3) Deploy satellite tags on harbor and gray seals during the late fall through early spring; and, 4) Assess satellite tag data collected from tags deployed on pinnipeds, authorized under the NMFS research permit (NMFS permit # 21719). The information gathered by collecting baseline data is critical to the design of the behavioral response study. The purpose of collecting robust baseline data is to assess the effect of exposure to a controlled acoustic source to compare what happens before and after exposure. Without baseline data, it would be difficult to estimate any changes to demonstrate a response

[2] Funded by the Naval Seas Systems Command NAVSEA 09SE (formerly 04RE).

[3] http://selasetur.is/en/2017/05/30/camera-trap-project/; http://www.nefsc.noaa.gov/news/features/seal_cam/; http://cameratrapcodger.blogspot.com/2007/07/hark-mountain-beaver.html

occurred. Chapters 2 and 3 provide the results of aerial surveys and satellite tag data collected in Phases I and Phase II (field seasons 2021-2022).

Due to poor weather conditions and COVID impacts, we had a shortened capture and tagging season (Chapter 4). The Team did participate in capture and tagging efforts in Virginia for two weeks in February, in support of seal research conducted by Naval Facilities Engineering Systems Command Atlantic (NAVFACLANT) and did successfully capture and tag seals in New York in March 2022. In-person counts and remote camera efforts continued throughout the field season with the use of two trail cameras with cell phone capabilities and a third camera that took photographs at 10 minute intervals (Chapter 3).

In 2022, NMFS was awarded funding from the Bureau of Ocean and Energy Management (BOEM) to support a five year research study to evaluate the potential impact of the installation and initial operation of the Vineyard Wind windfarm in waters off Massachusetts. Figure 1-1 shows the overlap of the 2020-2021 harbor seal tracklines (tagged in Shinnecock Bay, NY) and the Vineyard Wind lease site. This research would be led by NMFS in partnership with NUWCDIVNPT, AMSEAS, and MMoME.

At the end of the capture and tagging season in June 2022, NUWCDIVNPT, NMFS, AMSEAS, and MMoME met to discuss the upcoming field season and scheduling; overarching research program goals; and, individual research projects. Figure 1-2 shows the general concept for projects that are supporting the Seal Research Program on the U.S. East Coast and the integrated relationship between them. The general research themes for the Seal Program are outlined below:

I. Distribution, Displacement, and Habitat Use
   a. Non-windfarm Pinniped Behavioral Response Study
   b. Windfarm Behavioral Response Studies
   c. Seal distribution and foraging research
II. Measuring Sound Exposure Levels
   a. Non-windfarm Pinniped Behavioral Response Study
   b. Windfarm Behavioral Response Studies
III. Population Health Assessment and Life History Monitoring
   a. Non-windfarm Pinniped Behavioral Response Study
   b. Windfarm Behavioral Response Studies
   c. Seal distribution and foraging research
   d. Health Assessment sampling

Table 1-1 shows the seasonal occurrence and age class of harbor seals and gray seals along the East Coast of the United States. This information has been integrated into the capture and tagging schedule.

Table 1-1. Occurrence and age class of harbor seals and gray seals along the East Coast of the United States.

State	Occurrence
Harbor Seal	
Maine	April thru Nov. Seals are there other months but not as many. Adult/Juvenile/Pup
Massachusetts/Rhode Island	Oct thru May - Adult/Juvenile/Pregnant females
New York	Oct thru May. Adult/Juvenile/Pregnant females
New Jersey	Information being gathered
Virginia	Dec thru April. Adult/Juvenile/Pregnant females
North Carolina	Understudied
Gray Seal	
Maine/Massachusetts	year-round. Adult/Juvenile/Pup. Peak Dec - Feb
Rhode Island/New York	Oct thru May (summer reports). Adult/Juvenile/Pregnant females
New Jersey	Few Juveniles, winter, vague
Virginia	Few Juveniles, winter, vague
North Carolina	Unknown

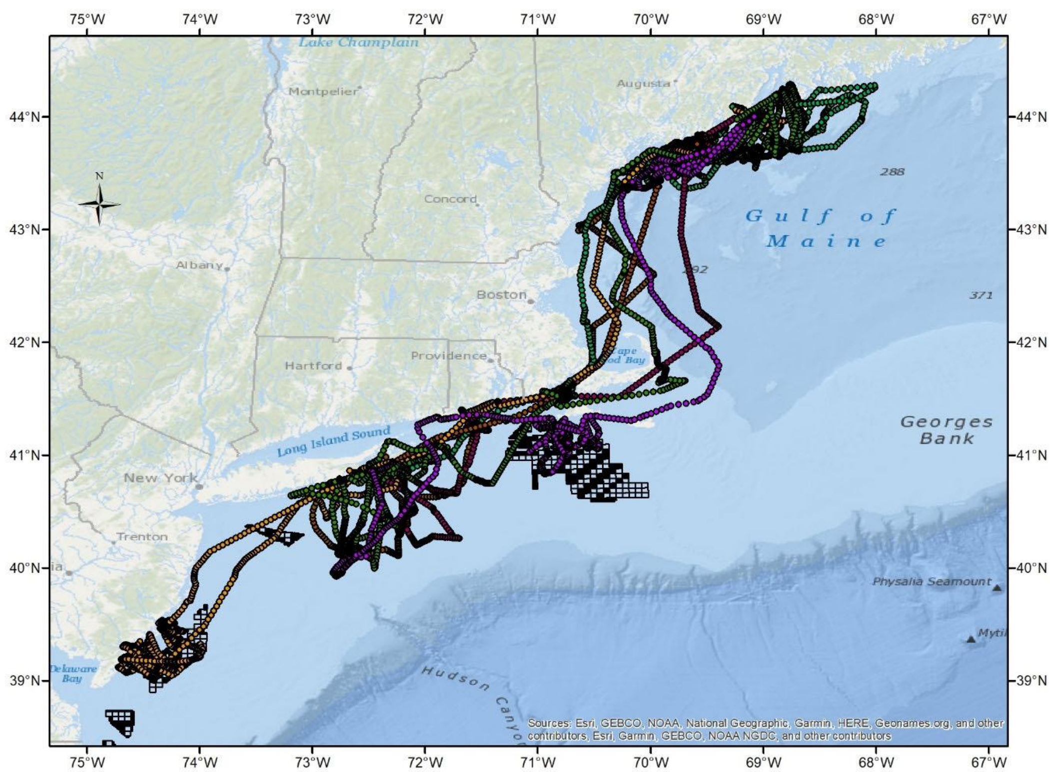

Figure 1-1. Interpolated tracks of harbor seals tagged in Shinnecock Bay, NY in winter and spring 2021 and the Vineyard Wind Windfarm Lease Site.

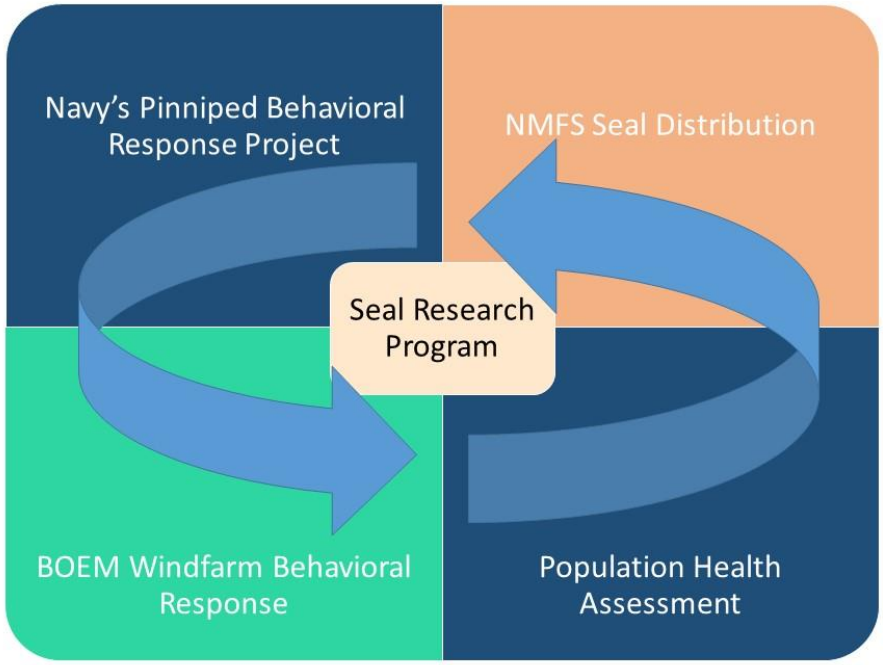

Figure 1-2. Conceptual Framework for Seal Research Supporting a Seal Research Program on the U.S. East Coast.

NUWDIVNPT is working with Lotek, a tag manufacturer, to develop a prototype for an acoustic receiver (accelerometer) tag that could be affixed to the fur of the seal (similar to the satellite tags) that would be placed adjacent to the SPLASH tag. The acoustic receiver tag would detach from the animal by some type of remote trigger and retrieved. The SPLASH tag would remain on the animal until the molt. The acoustic receiver tag would only remain on the animal for a short period of time (1-3 days) and would collect data on the underwater acoustic environment where the animal is at that time. The purpose of including an acoustic receiver tag would be to collect information pre- (ambient sound), during (CEE), and post- (return to ambient sound) exposure to a controlled acoustic sound source. This tag would provide a measurement of the received noise which could then be used to evaluate any behavioral response exhibited by the animal. Once the prototype is available, NUWCDIVNPT intends to conduct trials with the acoustic receiver well in advance of the controlled exposure experiment.

2 Aerial Surveys

NUWC in collaboration with AMSEAS (under contract with NUWCDIVNPT), conducted harbor and gray seal aerial surveys that encompassed an area between New York and Rhode Island that overlapped with the Navy's OPAREAs, specifically the Narragansett Complex. Figure 2-2 shows the aerial survey tracklines flown in Narragansett Bay, Rhode Island and the harbor seal haul out sites. The aerial surveys, followed the methods of Payne and Seltzer (1989) flying within two hours of either side of low tide. When animals were observed, a position (latitude and longitude) was taken and the animals photographed to conduct a post-aerial survey count analysis. The animals were photographed using a digital SLR camera with 400 mm zoom lens. The images were downloaded at the end of the survey and the photos were evaluated for each site (Figure 2-1). A team member would select the best representative photos (e.g., not blurry, good lighting, proper angle and place them in a shared folder to be counted. Two team members would count the animals observed in the photographs independently using a photo editing program. If discrepancies arose with counts or species, these photos were flagged and a third reviewer would independently evaluate these photos.

These surveys flew at 600 feet and surveyed islands and any ledges or rocky areas where seals could haul out. The following haul out sites were surveyed: Moriches Bay, Shinnecock Bay, Montauk Point, Great Gull Island, Little Gull Island, Plum Island, Fort Tyler, Gardner's Island, and Sag Harbor, New York; and Block Island and Narragansett Bay, Rhode Island. Table 2-1 provides the number of animals observed at each haul out site for each aerial survey conducted for the 2021 field season and Table 2-2 provides the same information for the 2022 field season.

On each of the aerial survey days observers were deployed to land-based haul out sites, in Narragansett Bay only, to take ground counts to then compare with counts taken from the aerial survey photographs. This offered insight into the total number of animals actually hauled out on a site versus what is visible from a land-based vantage point and the number of animals potentially missed using one survey technique versus another.

An aerial survey flown on October 22, 2022 observed dolphins and a whale south of the east end of Long Island, but the only seals observed during the flight were in the water. The survey flown on December 30, 2022 documented animals at most of the above listed haul out sites. The data from the December survey is being compiled and analyzed and will then be combined with previous aerial survey data. A report is forthcoming. The variety of data provided from aerial surveys is also used to inform the selection of candidate locations to conduct capture and tagging events.

AMSEAS staff conducted several training sessions for aerial survey procedures. These trainings build capacity within the organization and the organizations partners, like the Navy. In consultation with NUWCDIVNPT, AMSEAS developed these trainings to provide an overview of why an aerial survey is conducted, what sites are documented, how to coordinate data processing post-survey, and how this information contributes to research goals. Throughout the year, AMSEAS Executive Director Robert A. DiGiovanni, Jr., and Research Associate Allison DePerte gave presentations on the aerial survey methods and data collected.

Figure 2-1. Photograph taken during a pinniped aerial survey flight in 2021-2022.

Figure 2-2. Aerial Survey Track from February 2021

Table 2-1. Summary of Seal Counts and Means for Aerial Surveys Conducted During the 2021 Field Season

Site	Flight Date	Pv Total on Haul out	Hg Total on Haul out	Total on Haul out	Total # Seals at Site	Flight Date	Pv Total on Haul out	Hg Total on Haul out	Total on Haul out	Total # Seals at Site	Flight Date	Pv Total on Haul out	Hg Total on Haul out	Total on Haul out	Total # Seals at Site
Moriches Bay	1/8/21	163		0	163	2/24/21	188		0	188	4/7/21	162		0	162
Shinnecock Bay	1/8/21	83			83	2/24/21	115		0	115	4/7/21	84			
Montauk Point	1/8/21				0	2/24/21	7			7	4/7/21	10		0	10
Block Island	1/8/21	22		1	23	2/24/21	1	10	0	11	4/7/21	2	27	4	
Sakonnet Point	1/8/21	32			32	2/24/21					4/7/21	64			
Sachuest Point	1/8/21				0	2/24/21					4/7/21				
Gooseberry Island	1/8/21				0	2/24/21					4/7/21				
Brenton Point	1/8/21				0	2/24/21					4/7/21				
The Dumplings	1/8/21				0	2/24/21					4/7/21				
N of Pt. Judith	1/8/21	3			3	2/24/21	NE	NE	NE		4/7/21	NE	NE	NE	
Rose Island (Citing Rock)	1/8/21	33			33	2/24/21	60		0	60	4/7/21	54		0	54
Naval Station Newport	1/8/21				0	2/24/21	33		0	33	4/7/21	47		0	47
Dyer Island	1/8/21				0	2/24/21					4/7/21	13		0	13
T-wharf	1/8/21	17			17	2/24/21	33		0	33	4/7/21	25		0	25
South of Prudence Island	1/8/21				0	2/24/21					4/7/21	70		0	70
Between Patience Island/Prudence Island	1/8/21				0	2/24/21					4/7/21	1			1
Hog Island	1/8/21				0	2/24/21					4/7/21				
Usher Cove	1/8/21	2			2	2/24/21	5			5	4/7/21	NE	NE	NE	
Church Cove	1/8/21				0	2/24/21	38		0	38	4/7/21				
Spar Island	1/8/21				0	2/24/21					4/7/21	NE	NE	NE	

Site	Flight Date	Pv Total on Haul out	Hg Total on Haul out	Total on Haul out	Total # Seals at Site	Flight Date	Pv Total on Haul out	Hg Total on Haul out	Total on Haul out	Total # Seals at Site	Flight Date	Pv Total on Haul out	Hg Total on Haul out	Total on Haul out	Total # Seals at Site
Rumstick Point	1/8/21				0	2/24/21					4/7/21				
Field's Point	1/8/21				0	2/24/21	NE	NE	NE		4/7/21				
Barren Ledge	1/8/21				0	2/24/21	NE	NE	NE		4/7/21	6			6
Rocky Point	1/8/21				0	2/24/21	16		0	16	4/7/21	2			2
Sally Rock	1/8/21				0	2/24/21					4/7/21				
Providence Point	1/8/21	2			2	2/24/21	9			9	4/7/21	4			4
Bear Point	1/8/21				0	2/24/21					4/7/21				
Hope Island	1/8/21	20			20	2/24/21	57		0	57	4/7/21	32		0	32
Cold Spring Rock	1/8/21				0	2/24/21	17		0	17	4/7/21	7			7
Rome Point	1/8/21	53			53	2/24/21	134		0	134	4/7/21	109		0	109
Green Point	1/8/21				0	2/24/21					4/7/21				
Connecticut Shore North	1/8/21	0	0	0	0	2/24/21	68	0	0	68	4/7/21	58	0	0	58
Western Dumpling	1/8/21	14	0	0	14	2/24/21	10	0	0	10	4/7/21	12	0	0	12
Middle Dumpling	1/8/21	4	0	0	4	2/24/21	6	1	0	7	4/7/21	17	0	0	17
East Dumpling	1/8/21	0	0	0	0	2/24/21	2	0	0	2	4/7/21	19	0	0	19
Fisher’s Island	1/8/21	266	0	0	266	2/24/21	477	0	0	477	4/7/21	411	0	0	411
Great Gull Island	1/8/21	27	17	0	44	2/24/21	0	21	0	21	4/7/21	0	12	1	13
Little Gull Island	1/8/21	0	230	0	230	2/24/21	0	425	0	425	4/7/21	0	34	0	34
Plum Island	1/8/21	356	0	0	356	2/24/21	231	0	0	231	4/7/21	246	0	0	246
Fort Tyler-Gardiner’s Point Island	1/8/21	0	0	1	1	2/24/21	0	0	0	0	4/7/21	0	463	0	463

Site	Flight Date	Pv Total on Haul out	Hg Total on Haul out	Total on Haul out	Total # Seals at Site	Flight Date	Pv Total on Haul out	Hg Total on Haul out	Total on Haul out	Total # Seals at Site	Flight Date	Pv Total on Haul out	Hg Total on Haul out	Total on Haul out	Total # Seals at Site
Gardiner's Island	1/8/21	52	0	0	52	2/24/21	68	0	0	68	4/7/21	67	0	0	67
Sag Harbor	1/8/21	6	0	0	6	2/24/21	6	0	0	6	4/7/21	0	0	0	0
Total	**1/8/21**	**1156**	**247**	**2**	**1404**	**2/24/21**	**1581**	**457**	**0**	**2038**	**4/7/21**	**1522**	**536**	**5**	**2063**

Pv = harbor seal; Hg = gray seal; NE = no estimate

Table 2-2. Summary of Seal Counts and Means for Aerial Surveys Conducted During the 2022 Field Season

Site	Flight Date	Pv Total on Haul out	Hg Total on Haul out	Total on Haul out	Total # Seals at Site	Flight Date	Pv Total on Haul out	Hg Total on Haul out	Total on Haul out	Total # Seals at Site
Moriches Bay	1/4/22	28			32	3/18/22	NE	NE	NE	NE
Shinnecock Bay	1/4/22	139		4	145	3/18/22	NE	NE	NE	NE
Montauk Point	1/4/22				0	3/18/22	NE	NE	NE	NE
Block Island	1/4/22	1			1	3/18/22		120		120
Sakonnet Point	1/4/22	NE	NE	NE	0	3/18/22	28			
Sachuest Point	1/4/22	NE	NE	NE	0	3/18/22	NE	NE	NE	NE
Gooseberry Island	1/4/22				0	3/18/22	NE	NE	NE	NE
Brenton Point	1/4/22	57			57	3/18/22	NE	NE	NE	NE
The Dumplings	1/4/22	NE	NE	NE	0	3/18/22	NE	NE	NE	NE
N of Pt. Judith	1/4/22	NE	NE	NE	0	3/18/22	33			33
Rose Island (Citing Rock)	1/4/22	NE	NE	NE	0	3/18/22	13			13
Naval Station Newport	1/4/22	32			32	3/18/22	48			
Dyer Island	1/4/22	12			12	3/18/22	NE	NE	NE	NE
T-Wharf	1/4/22	36			36	3/18/22	NE	NE	NE	NE
South of Prudence	1/4/22	NE	NE	NE		3/18/22	NE	NE	NE	NE
Between Patience	1/4/22					3/18/22				
Island/Prudence Island	1/4/22					3/18/22				
Hog Island	1/4/22				0	3/18/22	NE	NE	NE	NE
Usher Cove	1/4/22	2			2	3/18/22	NE	NE	NE	NE

Site	Flight Date	Pv Total on Haul out	Hg Total on Haul out	Total on Haul out	Total # Seals at Site	Flight Date	Pv Total on Haul out	Hg Total on Haul out	Total on Haul out	Total # Seals at Site
Church Cove	1/4/22				0	3/18/22	NE	NE	NE	NE
Spar Island	1/4/22				0	3/18/22	2			2
Rumstick Point	1/4/22				0	3/18/22	NE	NE	NE	NE
Field's Point	1/4/22	NE	NE	NE	NE	3/18/22	NE	NE	NE	NE
Barren Ledge	1/4/22	5			5	3/18/22	NE	NE	NE	NE
Rocky Point	1/4/22				0	3/18/22	8			8
Sally Rock	1/4/22				0	3/18/22				
Providence Point	1/4/22	9			10	3/18/22				
Bear Point	1/4/22				0	3/18/22	3			3
Hope Island	1/4/22	57			57	3/18/22	65			65
Cold Spring Rock	1/4/22	16			16	3/18/22	14			14
Rome Point	1/4/22			4	4	3/18/22	17			17
Green Point	1/4/22	103		0	104	3/18/22				
Connecticut Shoreline	1/4/22	60			60	3/18/22	20			
Western Dumpling	1/4/22	14			14	3/18/22	NE	NE	NE	NE
Middle Dumpling	1/4/22	18			18	3/18/22	NE	NE	NE	NE
East Dumpling	1/4/22	12			13	3/18/22	NE	NE	NE	NE
Fisher's Island	1/4/22	89			89	3/18/22	221			221
Little Gull Island	1/4/22		139	1	140	3/18/22	NE	NE	NE	NE
Great Gull Island	1/4/22	5	1		6	3/18/22		352		352
Plum Island	1/4/22	177		0	177	3/18/22	18			18
Fort Tyler - Gardiner's Point Island	1/4/22	33			35	3/18/22	2			2
Gardiner's Island	1/4/22	38			38	3/18/22	53			

Site	Flight Date	Pv Total on Haul out	Hg Total on Haul out	Total on Haul out	Total # Seals at Site	Flight Date	Pv Total on Haul out	Hg Total on Haul out	Total on Haul out	Total # Seals at Site
Sag Harbor	1/4/22	11			11	3/18/22	14			14
Total	**1/4/22**	**954**	**140**	**9**	**1114**	**3/18/22**	**559**	**472**		**1031**

Pv = harbor seal; Hg = gray seal; NE = no estimate

3 Counts: In person and Remote Cameras

This field season there were three remote cameras set up at Naval Station Newport (NAVSTA) to monitor the seal haul out located just offshore (Figure 3-1). The additional camera (we had two last season) takes pictures at a set interval (every 10 minutes) and was place side-by-side with one of the two cellular-enabled cameras used last field season. The two cellular-enabled cameras are motion activated, so the photos are not necessarily taken at the same time or at any set interval. However, the motion-activated cameras have the capability to send thumbnails of the photo captures via a cellphone app. To increase battery life, these notifications from the cellular-enabled cameras are downloaded once a day (1600). In addition, the cellular-enabled cameras always take a photo at 1600 everyday which allows the user to know that the cameras are still in operation without having to go and constantly check them. These cameras also have a solar panel to extend the battery life. The camera that takes photos at 10 minute intervals does not have any cellular notification, therefore, it needs to be checked more frequently to ensure it is operational. However, the interval camera can store a considerable amount of data on the memory card, far more than the cellular enabled camera and the battery life is at least 3-4 times better than the cellular-enabled cameras.

One of the significant challenges of using multiple photogrammetry platforms across field seasons is developing an effective process to synch the photos from each of the cameras within and between years. However, the amount of information that can be gathered from remote cameras far outweighs the post-processing time. Further, the data from the photos is verified using information collected during in-person observations. While in-person counts are not conducted continuously during daylight hours, like the remote camera captures, these “spot checks” allow for the comparison of counts made by observers, with counts obtained by analyzing the photographs to estimate the number of animals on the haul out site and in the water.

During the summer of 2022, NUWCDIVNPT was supposed to have an intern dedicated to reviewing all of the camera images and all the photos collected since 2020 had been set aside for the intern. Unfortunately, the internship was canceled. We began exploring alternatives for post-processing the photos, including participating in forums with Len Thomas and other Navy colleagues who are collected photographs. Len Thomas is currently working with other pinniped datasets, but if his program is applicable to the haul out images NUWCDIVNPT has been collecting, we will explore the possibility of incorporating his program into our photo analysis. We have also tested Dot Dot Goose and Time Lapse as other methods for sorting our photographs.

Currently photos are manually reviewed to estimate number of seals hauled out, duration of haul out, presence/absence, and note any other factors that could influence seal behavior. In-person observations were conducted primarily on the predicted low tide as that is when the maximum amount of habitat is available for haul out. We combined the in-person observations with the remote camera counts to determine peak number of animals across the field seasons (Figure 3-2). While remote cameras certainly provide more data than could be collected at low tide from in-person observations, the counts from the images were consistently lower than in-person. This is because the cameras may not necessarily capture an animal that is behind another unless it happens to move when the snapshot is taken, whereas an observer present at that time would detect that hidden animal’s movement. Remote cameras were not introduced into the project until 2020, therefore, Figure 3-1 include only in-person counts up to 2020 and then a combination of in-person and remote cameras counts beginning in 2020. In general, harbor seal peak numbers occur in March and then begin to rapidly dwindle in April. As we have seen from the tag data, April is when harbor seals depart their southerly haul out sites to return northward to Maine for pupping, breeding, and molting.

Figure 3-1. Camera set up at Naval Station Newport and Harbor Seal Haul Out

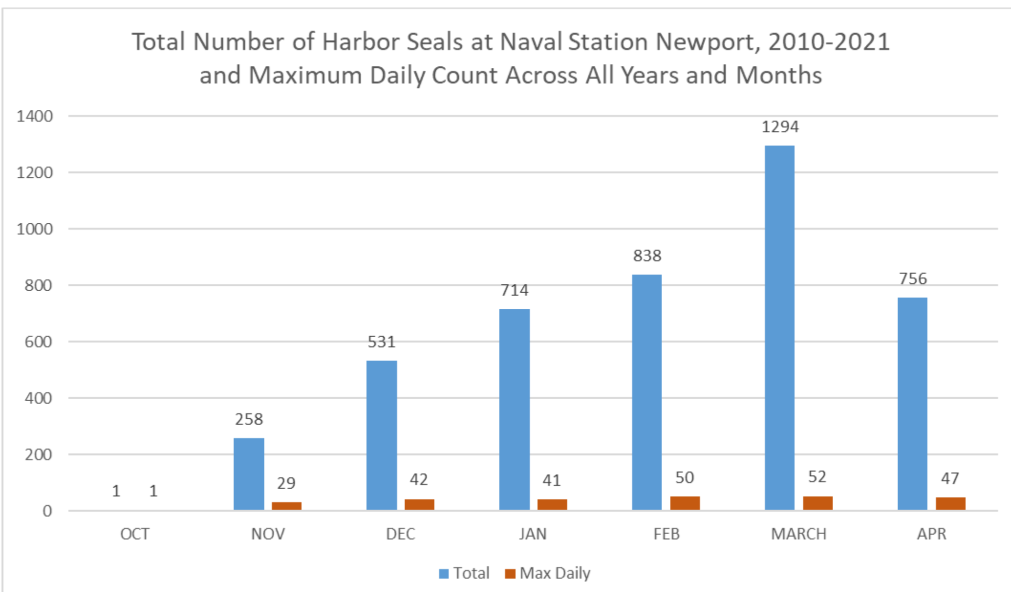

Figure 3-2. Total number of harbor seals counted at the at Naval Station Newport haul out site from 2010-2021 from October-April. Includes the maximum daily count across all years for each month

4 Captures and Tagging Efforts

4.1 Phase I: Field Season 2020-2021

In Phase I, there were four attempts to capture and tag harbor and gray seals in Shinnecock Bay, New York (Figure X). The capture procedure followed Jeffries et al. (1993) using two boats and a 10” stretch tangle net that was ~20’ deep and 600’ in length. The net had a float line and lead line and was deployed off the back of the boat in proximity to the seals and then drawn up onto shore (Figure 4-1). In addition, NUWC designed and developed a restraint board to reduce seal tagger fatigue (Figure 4-2) which proved to be extremely successful. Capture, tagging, and release of captured animals are shown in Figures 4-2 and 4-3).

A total of eight seals were captured during the 2020-2021 field season: seven harbor seals and one gray seal. All the animals were outfitted with a satellite tag and released. The duration of the tag deployment ranged from three to five months. One animal, tagged January 27, 2021, left the area immediately and headed south to Delaware Bay where it stayed for almost three months. It started moving north on April 12, 2021 and arrived in southern Maine on April 18, 2021 where we continued to track it until the end of June. The grey seal was tagged on April 23, 2021, and left the New York area in May beginning its journey north. This gray seal went up off the southeast tip of Nova Scotia in June and later headed south, arriving in Massachusetts in July. Although the movements varied, all the animals began moving northward in April. Figure 4-4 shows the trackline of a female harbor seal that was tagged at the end of January 2021 through June 2021 and the overlap between the harbor seal’s route, proximity to shore, wind farms, and Navy OPAREAS.

All animals that were satellite tagged were also tagged with two plastic flipper tags in their back flippers. At NMFS’ request, four of the seals who had satellite tags attached were also outfitted with acoustic (VEMCO) tags. These tags are glued to one of the flipper tags that was inserted in to the right rear flipper of the animal. These VEMCO tags were provided by NMFS and are expected to last for up to three years. Once these data are collected[4], the information will be shared collaboratively between NUWC, NMFS, AMSEAS, and MMoME.

[4] Data from the receivers are done in a batch download, so only when the receiver data is accessed would it be known that there is a “hit” from a VEMCO tag attached to harbor seal. The minimum batch download is every 6 months, but is often researchers do not access their receiver data until their experiment has concluded (years).

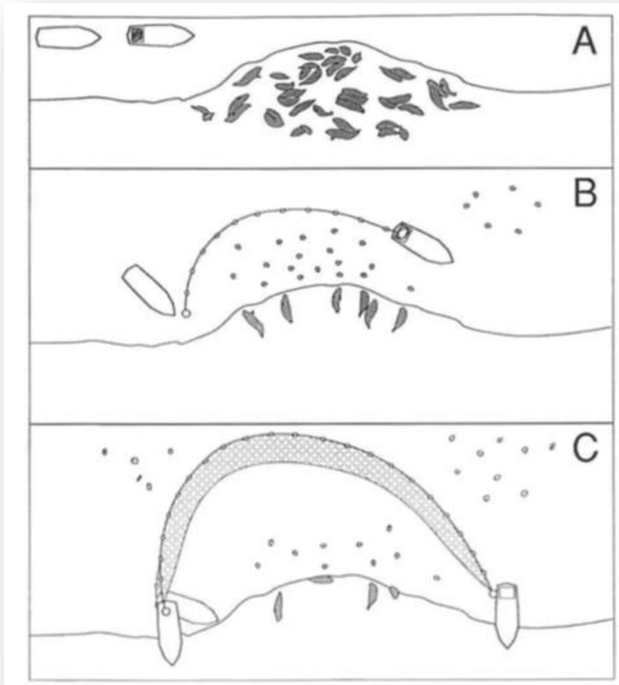

Figure 4-1. Capture Method Using Two Boats to Deploy and Capture Net (Jeffries et al. 1993)

Figure 4-2. Restraint Board with Satellite Tag (near neck) Applied to a Harbor Seal with a Rear Flipper Tag (visible on left rear flipper) (2021) [NMFS permit # 20294]

Figure 4-3. Releasing a Satellite Tagged Harbor Seal into Shinnecock Bay, New York (2021) [NMFS permit # 20294]

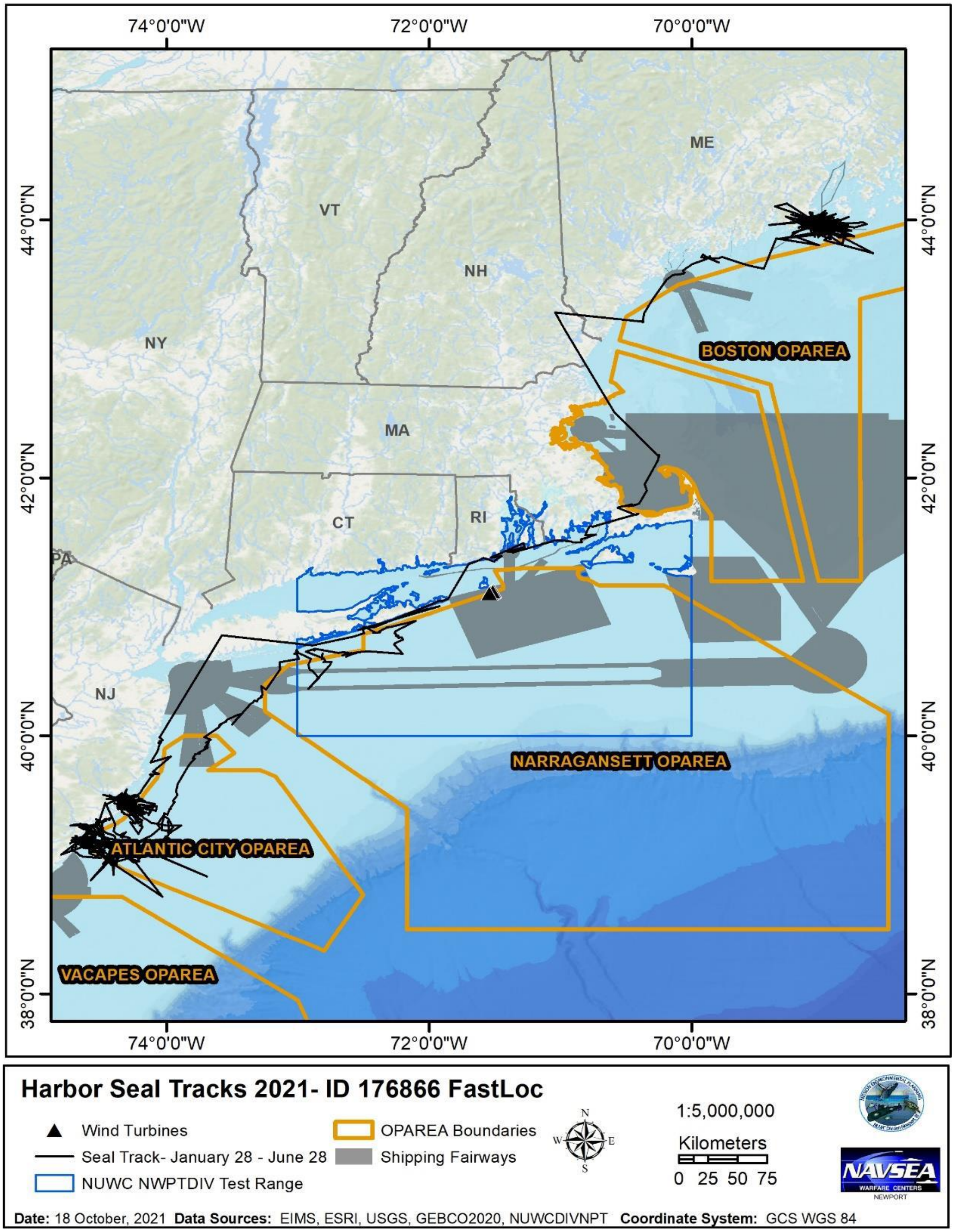

Figure 4-4. Satellite Tag Track of a Female Harbor Seal (tagged January 26, 2021-June 29, 2021) and Navy OPAREAS.

4.2 Phase II: Field Season 2021-2022

Similar to Phase I, the capture procedure followed Jeffries et al. (1993) using two boats and a tangle net. In March 2022, three harbor seals were tagged with SPLASH tags with FASTLOC technology in Shinnecock Bay, New York. The Team also tagged five harbor seals in Virginia in February 2022 in collaboration with NAVFACLANT. Biological samples were collected from each animal that was tagged and samples were provided to network partners to assess presence of disease and diet analysis.

4.3 Tag Analysis

Anyone working under NMFS permit # 20294 is encouraged to share their data, which anyone collecting data for the Pinniped BRS does, and the data is also uploaded to the Animal Telemetry Network[5]. Table 4-1 provides the number of seals tagged along the U.S. East Coast under NMFS' permit. In reviewing the data from the 2021 tags from seals captured in Shinnecock Bay, NY, it became apparent that pooling tag data would be beneficial for NUWC's, NMFS', AMSEAS', and MMoME's research goals. The Team is currently developing protocols on how to effectively and efficiently pool these data to reduce duplicative efforts and ensure consistency. Currently, a continuous-time correlated random walk model (Johnson et al. 2008) is applied to the raw data for state space modeling (Figure 4-6 is an example of interpolated tracklines where this model was applied). However, as part of the Pinniped BRS, we have initiated discussions with subject matter experts to generate a "standard" filtered dataset prior to any data analysis and intend to apply this model to all of the tag data collected to estimate a baseline.

Table 4-1. Seals Tagged Under the NMFS Research Permit between 2018-2022

Year	Species	Location	Number
2018	Harbor seals	Virginia	7
2019-2020	Gray seals	New England	31
	Harbor seals	Virginia	2
2021	Gray seals	Shinnecock Bay, NY	1
	Harbor seals	Shinnecock Bay, NY	7
2022	Harbor seals	Virginia	5
		Shinnecock Bay, NY	3

Dive data collected from the 2021 SPLASH tags (satellite tags) deployed on harbor seals was analyzed to better understand seals' use of the water column, dive behavior, and potential foraging behavior (Figure 4-5). Based on these results, there is a definite concentration of dives at depths below 70-80 meters. Harbor seals can dive as deep as 500 m, but harbor seals are considered as both pelagic and benthic foragers and have been described using different predatory tactics depending on the prey type and its location in the water column. The duration of a dive's bottom phase may differ between benthic and pelagic dives and may depend on a dive's maximum depth, the depth of the foraging area, generating variation in vertical foraging indices.

However, there were quite a few dives at deeper depths, but because the tag settings have a finite number of bins where dive depth ranges are defined, fine scale information of deeper depths (anything greater than 130 meters) is missing. The three animals that were tagged in Shinnecock Bay, NY in 2022 and the animals that were tagged in Virginia in 2022 used new bin definitions to try and capture more fine scale data at these deeper depths. The integration of the previous tag settings (prior to 2022) and

[5] Animal Telemetry Network: https://ioos.noaa.gov/project/atn/

the new bin definitions is ongoing and results are not available at the time of the writing of this report. These tag settings with the new bin definitions have been shared with other researchers and the manufacturer to ensure consistency. An example of how tag data can be interpolated for male and female gray seal pups was presented in Murray et al (2021) (Figure 4-6). These gray seal data will be included in this research projects cumulative tag data analysis.

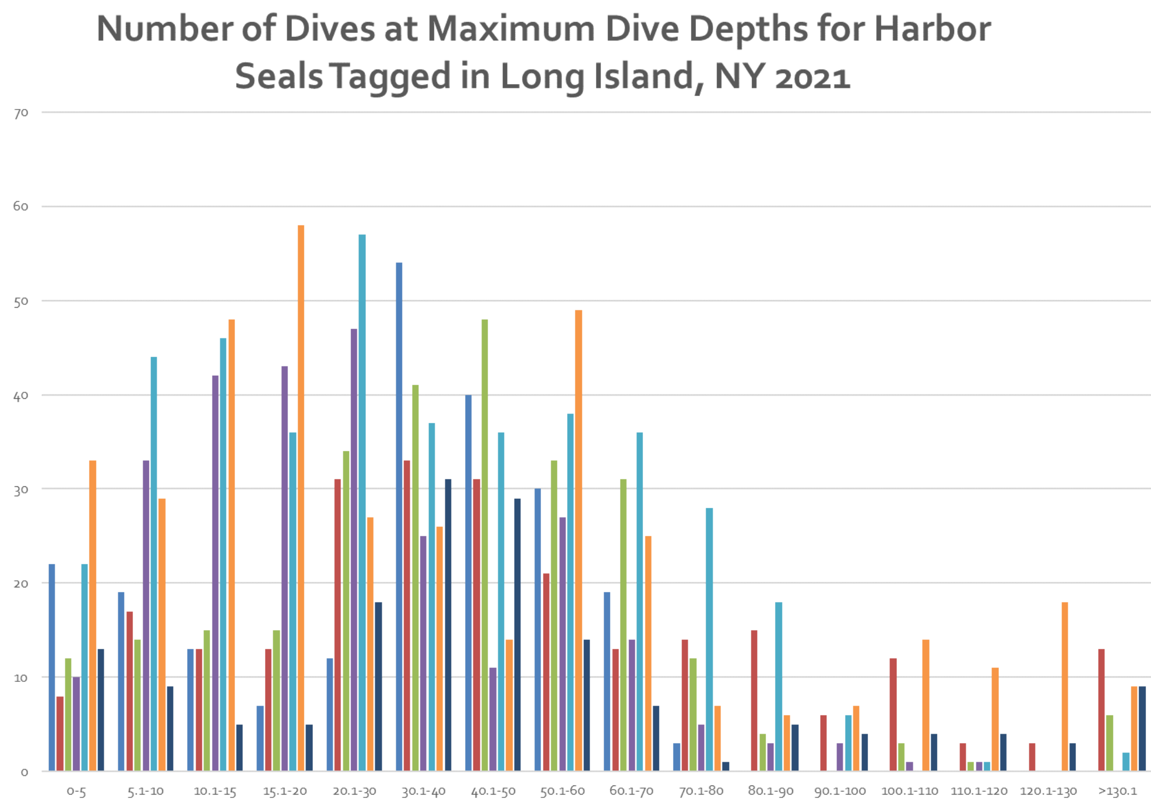

Figure 4-5. Maximum dive depths for all harbor seals tagged in Shinnecock Bay, New York.

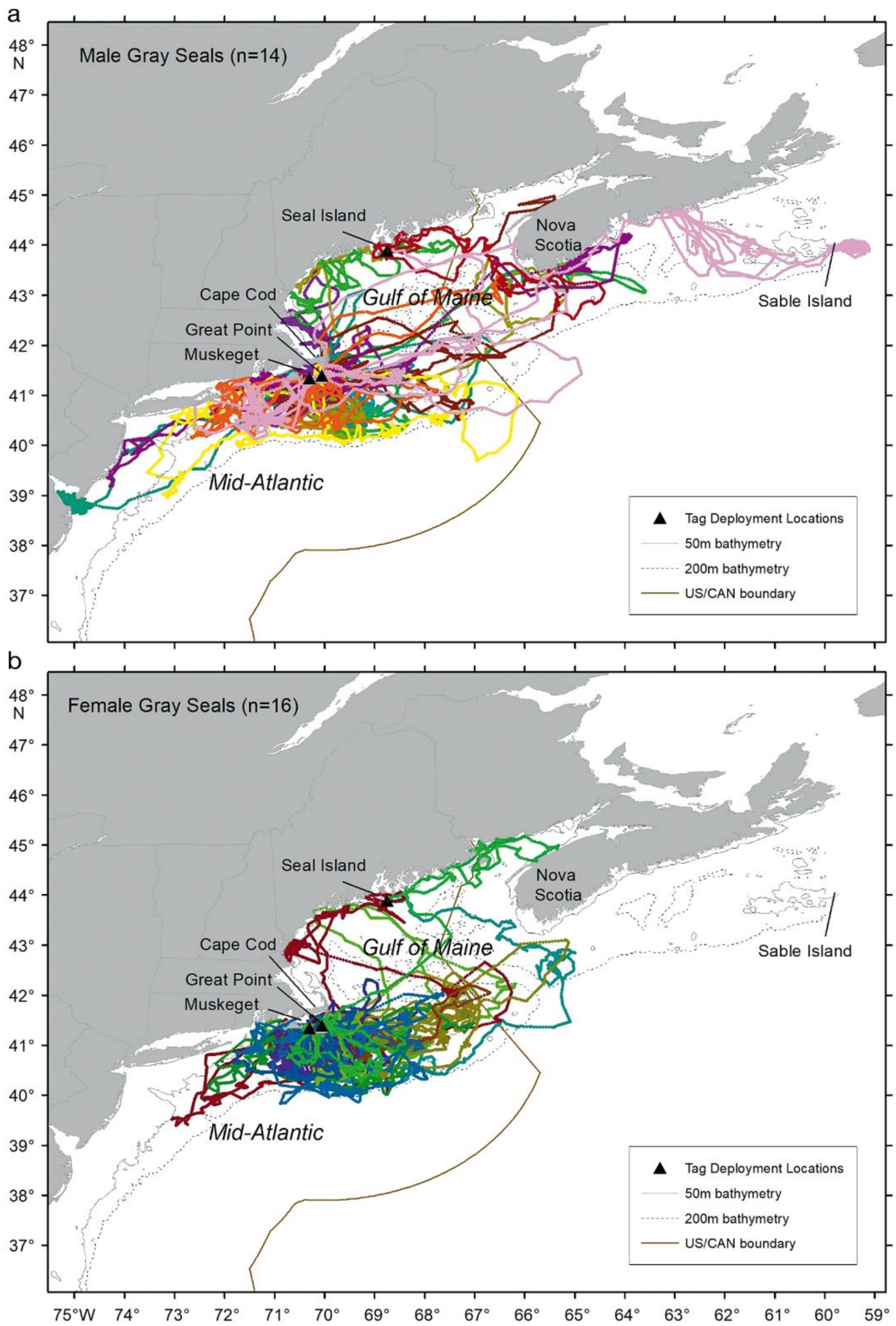

Figure 4-6. Interpolated telemetry tracks from (a) 14 male gray seal pups and (b) 16 female gray seal pups, 2019-2020 (Murray et al. 2021).

4.3.1 Future Tagging Efforts

NUWC intends to deploy up to 10 additional satellite tags to evaluate diving, haul out, and foraging behavior to establish a baseline. Concurrently, NUWC will be testing the prototype for the accelerometer tag to quantify behavioral states (see Section 1.4) for the Behavioral Response Study and in preparation for the controlled exposure experiment (CEE) mimicking military sonar and other acoustic sound sources to determine if animals demonstrate a behavioral response. NMFS proposes to deploy 15 additional Wildlife Computer SPLASH tags and Vemco acoustic tags over the next two years on either harbor or gray seals as part of their cross-taxa research effort to evaluate Marine Protected Areas and for the BOEM windfarm study. AMSEAS intends to deploy an additional 15 satellite tags as part of their research effort investigated the health of gray and harbor seal populations along the New England coast. Although each group has a different research objective, the satellite tags would provide data applicable to each of these research objective. By working collaboratively and by pooling our resources and data, a minimum of 40 satellite tags and could be deployed over the next three to four years. This reduces the number of tags that need to be purchased, the number of animals that would be captured when compared to what each individual group would do to accomplish their research objectives, and builds a core team of subject matter expertise on seal capture and tagging. We intend to tag in the early fall in Maine to try and get a better understanding of where animals go when they depart Maine and we also plan to continue to tag at known haul out locations south of Maine, so that we can get a more complete picture of the seals' distribution, dive patterns (to be integrated in to the Navy's Acoustic Effects Model), overlap with military activities and other anthropogenic activities, and haul out behaviors.

4.3.2 Training

Two training sessions were also conducting for seal captures in 2022 at the AMSEAS office in Long Island, NY. These training sessions were conducted by AMSEAS, NUWCDIVNPT, NMFS, and MMoME. AMSEAS staff involved with capture and tagging were trained on all the equipment used during seal capture and tagging. During the first training session, the team laid out the capture net at the AMSEAS facility and simulated conditions experienced when out in the field (

Figure 4-7). Different methods of retrieving seals from the nets and safe seal handling procedures were demonstrated (Figure 4-8).

After the simulation, the trainees reviewed all of the protocols (Figure 4-9) and then practiced the techniques learned in the simulation out in field conditions. Utilizing the boats and all capture gear, they deployed the capture net in the vicinity of the haul-out location but not near seals, and hauled in the net. They were able to get the net free from impediments on the bottom and surveying the net from land and the boats to bring all the net onto land safely.

NUWCDIVNPT, AMSEAS, NMFS, and MMoME will be including 1-2 day training sessions before any capture and tagging events, in particular at any new location or with any new team member. These trainings would include anyone that may be participating in seal captures for that season and if someone has not participated in the training, their participation for that field season would come under review. We will be basing the structure of those trainings on this first training event that was conducted with AMSEAS staff, interns, and volunteers. Having a trained team is not only extremely important for safety reasons, but it builds trust, allows for members to switch roles should the need arise during a capture event, and each team member is informed about the research goals.

Figure 4-7. Seal capture equipment at the AMSEAS facility for simulated capture procedure training.

Figure 4-8. The team uses a “seal model” to practice disentanglement techniques.

Figure 4-9. Reviewing seal sampling supplies before boarding research vessels for the field training exercise.

Another added benefit of providing training and prospective tagging locations, such as Long Island, NY was the ability to expose new staff, interns, and students to the research. AMSEAS was asked to participate in the Rockaway Initiative for Sustainability and Equity (RISE)'s *Rockaway Environmentor Program*, in Summer 2021. AMSEAS consulted with NUWCDIVNPT before participating with this program. The students from the Rockaway, NY area worked directly with AMSEAS biologists to learn about the research process. Students analyzed aerial survey photos and counted the number of seals at each haul out for their program project. They conducted a literature review of aerial survey methods and created charts, graphs, and data products that were presented at the New York Science Symposium in August 2021. These final products will be included in our data analysis.

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