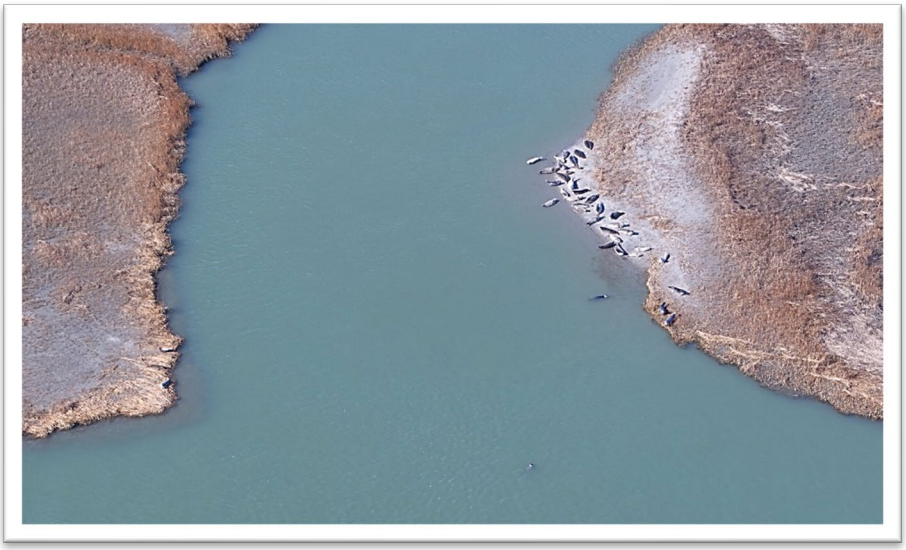
Haul-out Counts and Photo-Identification of Pinnipeds in Chesapeake Bay and Eastern Shore, Virginia

2024/2025

PROGRESS REPORT



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Harbor seals (*Phoca vitulina*) hauled out at a survey site on the Eastern Shore, Virginia. Cover photo taken using an unmanned aircraft system (i.e., drone) by Zak Poulton, The Nature Conservancy, under NMFS General Authorization Permit #19826.

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Acronyms and Abbreviations

ANOVA	analysis of variance
BSS	Beaufort sea state
CBBT	Chesapeake Bay Bridge Tunnel
CI	Confidence Interval
DWR	Virginia Department of Wildlife Resources
°F	degrees Fahrenheit
ft	foot or feet
GA	General Authorization for Scientific Research
ID	Identification or identifier
km	kilometer(s)
kts	knots
m	meter(s)
MLLW	Mean lower low water
mm	millimeter(s)
NAVFAC	Naval Facilities Engineering Systems Command
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
Photo-ID	Photo identification
SAR	Stock Assessment Report
TNC	The Nature Conservancy
U.S.	United States
UAS	Unmanned aircraft systems
UME	Unusual mortality event
USFF	United States Fleet Forces Command

1. Introduction and Background

Harbor seals (*Phoca vitulina*) are one of the world's most widely distributed pinniped species and are found in temperate to polar coastal waters of the northern hemisphere (Jefferson et al. 2015). Gray seals (*Halichoerus grypus atlantica*) are widely distributed over the continental shelf in cold temperate and sub-polar North Atlantic waters (Lesage and Hammill 2001). Both species are year-round coastal inhabitants in eastern Canada and New England and occur seasonally in the mid-Atlantic United States (U.S.) between September and May (Hayes et al. 2022, 2025). Harbor seals move to northern areas for pupping and molting in the spring and summer and return to southerly areas in the fall and winter. Harbor seals generally exhibit a southward movement from eastern Canada and Maine to southern New England and through the mid-Atlantic beginning in the fall (DeAngelis 2023; Rosenfeld et al. 1988). Gray seals inhabit northern areas from Massachusetts to Canada for mating and pupping in the winter and seasonally range as far south as Virginia (Bowen et al. 2007; Hayes et al. 2025; Jones 2024).

Prior to 2019, National Oceanic and Atmospheric Administration (NOAA) Stock Assessment Reports (SARs) indicated U.S. Atlantic gray seal and harbor seal populations ranged from Labrador to New Jersey; with scattered sightings and strandings reported as far south as North Carolina for gray seals and Florida for harbor seals (Hayes et al. 2018). Other researchers have reported that harbor and gray seal distribution along the east coast appears to be expanding or shifting (den Heyer et al. 2021; DiGiovianni et al. 2011; Johnston et al. 2015; DiGiovianni et al. 2018). In Virginia, reports from local anglers, Chesapeake Bay Bridge Tunnel (CBBT) staff, and the Virginia Aquarium & Marine Science Center indicated seals have been using the CBBT rock armor or "islands" to haul out (i.e., rest) on for more than a decade. Additionally, pinniped strandings have generally increased in Virginia since the early 1990s, with numbers ranging from 2-9 stranded individuals per year from 2012-2022 (Epple et al. 2023). The range expansion of the harbor seal is not necessarily indicative of an increasing population; recent population trends and abundance estimates suggest the population is stable (Hayes et al. 2022; Sigourney et al. 2022). Rather, it may be due to rapid growth of gray seal populations in Canada (e.g., Sable Island) and now the northeastern U.S. (den Heyer et al. 2021; Hayes et al. 2025; Wood et al. 2022), which could be causing the displacement of harbor seals at haul-out sites due to physical interference or competitive exclusion (Cammen et al. 2018; Pace et al. 2019; Wood et al. 2019). Substantial increases in gray seal populations in Canada and the United Kingdom have been known to negatively impact harbor seal abundance in those areas (Bowen et al. 2003; Thompson et al. 2019).

Throughout the duration of this study, harbor seals were observed returning seasonally, from fall to spring, to haul-out locations in coastal Virginia, and gray seals were occasionally observed during the winter, but not on a consistent basis (Ampela et al. 2023; Jones 2024). More recently, NOAA SARs indicate the southern range extent for the harbor and gray seal stocks are now North Carolina (Hayes et al. 2022, 2025).

Since this project's commencement, there have been 11 dedicated field seasons of research from 2014-2025. During this time, we expanded the study to include partnerships with The

Nature Conservancy (TNC) and the Virginia Department of Wildlife Resources (DWR), as well as Contractor support from HDR, Inc., which allowed for an increase in survey area coverage beginning in 2016 with the addition of the Eastern Shore, Virginia.

The goal of this study is to document the presence and abundance of seals in Virginia and to gain an increased understanding of the seasonal occurrence, habitat use and haul-out patterns of seals near several important U.S. Navy installations, training and testing areas, and vessel transit routes.

Primary objectives of this project include:

- *assessing occurrence, movement, and haul-out patterns adjacent to Navy training and testing areas;*
- *the use of photo-identification (photo-ID) methods to identify and compare individuals and assess site fidelity among haul-out site locations in the study area; and*
- *the use of mark-recapture, telemetry correction factors, and modeling methods to estimate local population size.*

This report discusses the survey results for the 2024/2025 field season as well as the analyses conducted using count and photo-ID data from the 2014-2025 field seasons. The 2024/2025 field season was the final season for the haul-out counts and photo-ID data collection effort for both the CBBT and Eastern Shore survey areas.

This work is part of the U.S. Navy's Marine Species Monitoring program, supported by U.S. Fleet Forces Command (USFF), and was conducted in accordance with National Marine Fisheries Service (NMFS) General Authorizations (GA) 19826 and 25811. The data collected under this effort will contribute to the analysis of potential impacts that U.S. Navy training and testing activities, installation construction (e.g. pile driving), and vessel-transiting activities may have on pinniped species and could be used to develop mitigation measures, if appropriate.

2. Methods

2.1 Study Area

The study area consists of two general survey locations in southeastern Virginia (**Figure 1**): 1) in the lower Chesapeake Bay along the Chesapeake Bay Bridge Tunnel (CBBT) – from 2014 to present, and 2) the southeastern region of the Eastern Shore – from 2016 to present. The CBBT survey area is comprised of four haul-out sites (referred to as CBBT 1, CBBT 2, CBBT 3, and CBBT 4) along the bridge tunnel that span approximately 10 kilometers (km) from the southern site (CBBT 1) to the most northern site (CBBT 4). The haul-out sites are on rock armor formations (commonly referred to as "islands"), which are intended to protect the tunnels as they go beneath the water (**Figure 2**).

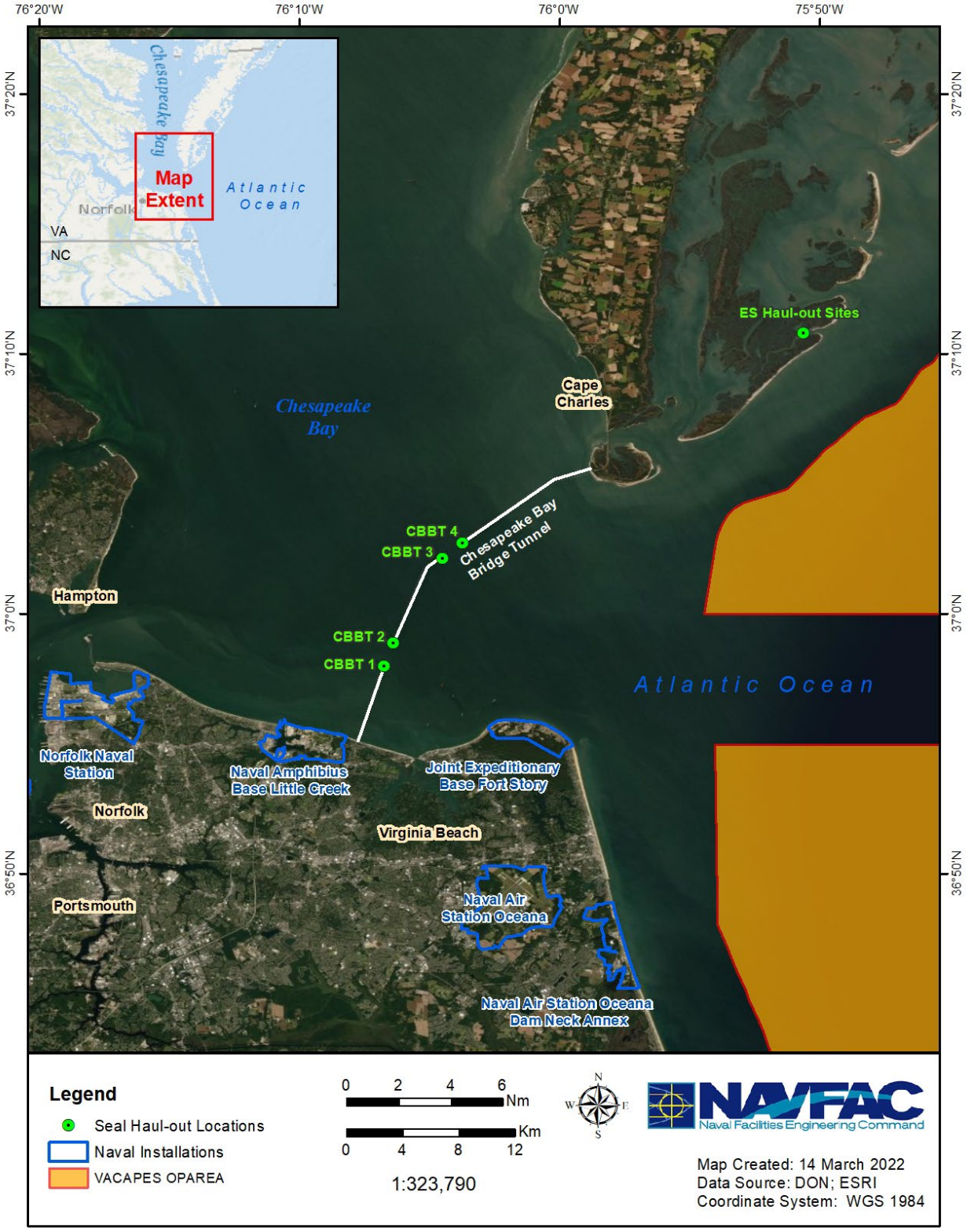

Figure 1. CBBT and Eastern Shore (ES) haul-out locations and their proximity to U.S. Naval Installations. OPAREA = Operating Area; VACAPES= Virginia Capes Range Complex.

Figure 2. Aerial view of a CBBT haul-out site. Seals generally haul out on the tip of the rock armor farthest from the road. Photo by Virginia Aquarium & Marine Science Center Foundation

The survey area on the Eastern Shore of Virginia was added to the project in the fall of 2016 in collaboration with TNC. The Eastern Shore survey area has several haul-out sites (about five main locations: A, B, C, D, and E) where seals have been observed (**Figure 3**). The haul-out sites are within a tidal salt marsh habitat and are mainly comprised of mud banks with vegetation (**Figure 4**).

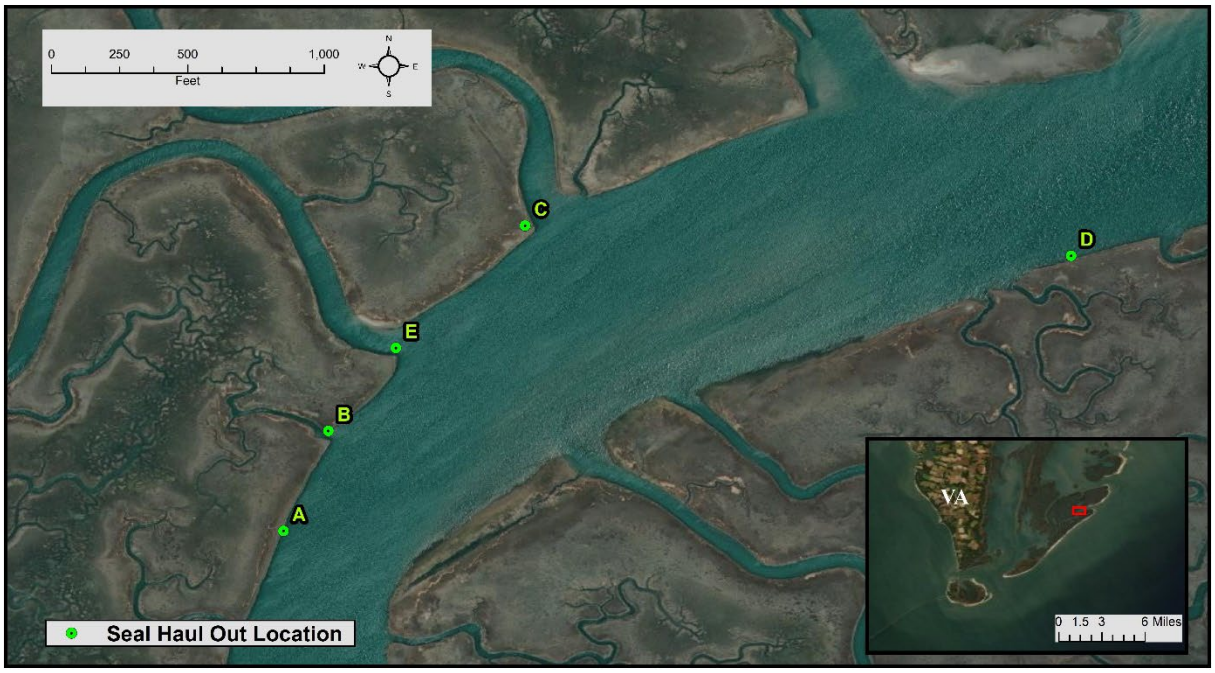

Figure 3. The five main seal haul-out locations on the Eastern Shore of Virginia

Figure 4. Eastern Shore survey area with harbor seals hauled out on a mud bank. Photo by Danielle Jones, NAVFAC Atlantic under NMFS GA Permit #19826

The straight-line distance from the northernmost (i.e., the closest) CBBT haul-out site, CBBT 4, to the Eastern Shore survey area is approximately 27 km. Both survey areas are in close proximity (<100 km) to several major U.S. Navy installations (e.g., Norfolk Naval Station, Naval Amphibious Base-Little Creek, Joint Expeditionary Base-Fort Story, Naval Air Station Oceana, and Naval Air Station Oceana Dam Neck Annex) (**Figure 1**).

2.2 Survey Protocol

Based on sightings/stranding data, seals generally begin to arrive in Virginia in November, and depart the area by May, at the latest. Therefore, for each field season we started dedicated seal haul-out surveys in the fall (October/November) and ended in the spring (April/May), conducting at least one additional survey at each survey area, when possible, after the first recorded absence of seals. This allowed for the documentation of the arrival and departure time period for the season.

For the 2024/2025 field season, systematic vessel-based counts were conducted with support from HDR, Inc. and Atlantic Launch for the CBBT survey area and with TNC for the Eastern Shore survey area. The vessel surveys at the CBBT survey area were conducted using a 42-foot (ft) SeaArk Dauntless, and the vessel surveys at the Eastern Shore survey area were conducted using a 19, or 24-ft Carolina skiff (**Figure 5**). The survey crew consisted of one to two marine mammal observers, one data recorder, and one boat captain.

Figure 5. Observers used a Carolina skiff (vessel) for the Eastern Shore haul-out counts. Photo by NAVFAC Atlantic

We aimed to conduct vessel surveys at the CBBT and Eastern Shore survey areas at least two times per month during the field season. The number of survey days were dependent on weather, tides, and staff/survey vessel availability. Surveys were not conducted at either of the CBBT or Eastern Shore survey areas during inclement weather such as precipitation or high winds. Vessel-based counts at the CBBT and Eastern Shore survey areas were not conducted in Beaufort sea states higher than 3. With vessel access to the Eastern Shore survey area being restricted by tides, we were only able to conduct surveys during tidal heights of 0.1 ft (Mean Lower Low Water [MLLW]) or higher at that location.

Seals were recorded at each haul-out site using point sampling techniques (Raposa and Dapp 2009). The survey period consisted of three separate 2-minute counts (10 minutes apart) at each site to account for seals moving between the water and the haul-out sites or diving during a previous count. Counts were conducted using handheld binoculars (Canon 10x30 IS II Image Stabilizer) or the naked eye. During each sampling period, the data recorder documented the survey start and end times, each count start time, the number of seals present, the species present, photo numbers, standardized animal behaviors and the presence of vessels at the site. The best estimate of seals in the water and hauled out was recorded separately during each count. For analysis purposes, the best total estimate (i.e., the highest count from all three counts) for the overall number of seals sighted (both in the water and hauled out) was used, consistent with similar studies by Grellier et al. (1996) and Pauli and Terhune (1987). Unless otherwise specified, seal count data should be interpreted as the best total estimate of seals present during the survey period.

During the 8-minute between-count breaks, one of the observers obtained images of the seals. A master photo capturing all the seals on a haul-out was taken, along with photos of individual seals. A digital single-lens reflect camera (Nikon D7100 or Canon EOS R7) with a zoom lens

(ranging in size from 18-600 millimeter [mm]) was used to capture photos. Image frame numbers were recorded to be used later for photo-identification (photo-ID). Multiple photos of different views (head/neck region, dorsal, lateral, and ventral) of each seal were taken when possible to obtain quality photos of pelage (fur) patterns. The markings that make up the pelage pattern of harbor seals are asymmetrical and unique to each individual, remaining stable over time (Yochem et al. 1990).

In the 2018/2019 season, we added the use of an unmanned aircraft system (UAS), i.e., drone, for the Eastern Shore survey area to help improve count data collected during vessel-based point counts. Depending on the haul-out site at this survey area, animals may be obscured to observers during vessel-based counts by creek banks, marsh vegetation and other animals, especially as the number of animals present in the survey area increases throughout the winter. The UAS provides a better visual perspective from which to capture photos and video as it allows for visual detection of all animals on a haul-out site during point counts (animals are less likely to be obscured if viewed from above), which should increase the accuracy of counts.

The UAS, a DJI Matrice 300 quadrocopter with a Zenmuse X5 camera and Olympus 14-44mm zoom lens, was piloted by a certified UAS operator from TNC. The UAS was launched from the marsh or survey vessel, which was either idle on the water or anchored on a marsh bank, about 800 meters (m) away from the haul-out survey area. The UAS was flown at an altitude of 60-120 m above ground level and at least 100 m away from a haul-out site. One UAS flight was comparable to a 2-minute count, since the UAS hovered over the haul-out sites and the camera was able to capture the same survey area as the observer team during a count. The UAS was only used in good weather conditions (e.g., no precipitation and winds less than 15 knots [kts]). For surveys where weather conditions were favorable, a count using the UAS was conducted by the pilot first followed by a vessel-based count by the observers. The animal count from the UAS footage was recorded after the vessel-based count to prevent bias in the data. For analysis purposes, the number of seals recorded during a drone count was compared to the counts recorded by the observers during the vessel surveys and considered for determining the best total estimate of the overall number of seals sighted (both in the water and hauled out) during a survey.

Environmental data was recorded prior to the start of each survey at each of the haul-out sites and later downloaded from the National Oceanic and Atmospheric Association's (NOAA) Tides & Currents page (https://tidesandcurrents.noaa.gov/). Data were collected on the following environmental variables: air temperature (˚F), water temperature (˚F), wind speed (kts), wind direction (cardinal and degrees), wind gusts (kts), visibility, tidal height (ft) (MLLW), Beaufort sea state (BSS), glare (%), and cloud cover (%).

Similar to previous field seasons, environmental data, except for visibility, BSS, cloud cover, and glare were acquired from several NOAA weather stations for the 2022-2025 seasons. For the CBBT survey area, environmental data (except for water temperature) were collected from NOAA weather station (ID 8638901) - CBBT, Chesapeake Channel, located at 37.032 N, 76.083 W. Water temperature for the CBBT survey area was collected from NOAA weather station (ID 8632200) - Kiptopeke, Virginia, located at 37.165 N, 75.988 W, or directly from the

survey vessel's transponder, due to the water sensor from the CBBT, Chesapeake Channel station being disabled. Looking at the average monthly water temperatures for the previous field seasons (2014-2017), the averages at the Kiptopeke station differed by only 1-2 degrees compared to the CBBT, Chesapeake Channel station, and so data was representative of the CBBT survey area. For the Eastern Shore survey area, environmental data were collected from the Kiptopeke and CBBT, Chesapeake Channel stations as well as NOAA weather station (ID 8631874) - Smith Island (Coast Guard Station), Virginia (via https://tides4fishing.com), located at 37.117 N, 75.917 W. Environmental data could be used to investigate relationships between seal presence and environmental variables.

2.3 Photo Identification

Upon returning from the field, images were cropped and graded based on photographic quality and distinctiveness of the pelage pattern (**Table 1**). Image criteria were based on image grading methods used by Balmer et al. (2008) and Forcada and Aguilar (2000). This criteria was updated after the 2015/2016 progress report (Rees et al. 2016) to standardize photo identification (photo-ID) methods across similar projects, and to aim to uniquely identify more individual seals. As a result of using these new criteria, the images from the 2014/2015 field season were excluded as they did not meet the quality standards of the updated methods. Therefore, individuals from this study were not identified and cataloged until the 2015/2016 field season. In addition, images were obtained for the years 2010-2015 from Brian Lockwood, Jet Ski Fishing & Adventures. Many seals in these mostly earlier images have been matched to individuals identified in this study, providing valuable historical occurrence and site fidelity information. The Lockwood photos were not utilized in our analyses, as they were not collected under similar standardized survey protocols.

Table 1. Image criteria and grading for photo identification

Image Grade	Criteria
Quality	
Q1	Excellent photo, sharp focus, no glare, animal perpendicular to camera, majority (>/= 75% of) of side of seal captured, and/or fully wet pelage
Q2	Good photo, minimal glare, minor bending of animal, 50-75% of seal captured, and/or mostly wet pelage
Q3	Marginal photo, mediocre focus, moderate glare and bending of animal, 25-50% of seal captured, and/or partially dry pelage
Q4	Poor photo, limited focus, substantial glare, shading, or bending, <25% of animal captured, and/or fully dry pelage
Distinctiveness	
D1	Very distinct, large and numerous marks, visible scars, and/or 3+ very characteristic marks apparent even in poor quality photos
D2	Moderately distinct, 1-2 characteristic marks or some, but limited, distinctive patterning
D3	Indistinct, uniform pelage and no distinct markings

The photographic quality rating (Q1-Q4) focused on clarity, image resolution, glare/lighting, distortion, angle of the animal from the camera, the posture of the animal, and the proportion of the animal's body captured within the image. A Q1 signified an excellent photo fully suitable for manual or computer aided photo identification, whereas, a Q4 represented a photo with a quality too poor to reliably conduct photo-ID using either computer software or through manual matching. The distinctiveness rating (D1-D3) focused on the distinctiveness of pelage patterns and/or unique markings/scarring of an animal.

Using the quality and distinctiveness grades for images, a catalog of uniquely identified seals was compiled. Photos with a Q1-Q3 grade, along with a distinctiveness grade of D1-D2, were given a unique ID number (e.g., CB001) and added to a Microsoft Excel catalog and seal ID database for the study area. The resulting uniquely identified individuals were used to determine population abundance of harbor seals within the study area (Section 2.4.2 [Abundance Estimation]). For each individual's image included in the catalog, standardized descriptions were applied for pelage color patterns (i.e., color phase), which allowed for greater ease in manual matching by creating documented categories of images from which to match. The color phases in which the photos were categorized were the following: light (light background with no to a few/faint spots), intermediate (light background with dark spots), dark (dark background with many light-colored spots/rings), light/intermediate (seal pelage with two distinct light and intermediate color phases), and dark/light (seal pelage with two distinct light and dark color phases).

Fields included within the database are survey date, location, original photo image name, unique seal ID, file name, species, quality rating, distinctiveness rating, aspect (portion of seal's body that was captured), color phase, notable markings, and additional comments. The catalog allows for the sorting and processing of seal photos to compare and identify individual seals, using visual matching, for the mark-recapture portion of the study. Photos were reviewed using this catalog and captured (i.e., marked) and re-captured (i.e., re-sighted) seals were identified and recorded in the seal identification database. Movement of some of the identified seals has been observed between the CBBT and Eastern Shore survey areas. Therefore, mark-recapture data from both survey areas were included to estimate a minimum population size for the region.

2.4 Analytical Methods

2.4.1 Analysis of Seal Presence

Mean seal count was compared between 11 field seasons from 2014-2025 for the CBBT survey area using a one-way analysis of variance (ANOVA). Mean seal count was also compared between nine field seasons from 2016-2025 for the Eastern Shore survey area using a one-way ANOVA. If a significant difference (p-value ≤ 0.05) was found between the mean seal counts for the CBBT and Eastern Shore survey areas, then a Tukey/Kramer multiple comparison test was performed to see which of the mean counts across the individual field seasons were significantly different from each other. Determining the differences between the respective seasonal mean counts was done by calculating the critical value of Q (Q_{cv}) as well as the Q statistic (Q_{stat}) for

each possible pairwise comparison of the mean counts. The *Q* statistic was compared to the critical value for each pair of mean counts; if the *Q* statistic was larger than the critical value, the mean counts for the two separate seasons were statistically different.

2.4.2 Abundance Estimation

To estimate the population abundance (N) of harbor seals for the study area, including both the CBBT and Eastern Shore survey areas, two different approaches were used. After statistical discussions with L. Thomas (personal communication, April 2, 2025) the abundance estimation analyses were revised to utilize the different data sources in a more appropriate way for each approach. For the first approach, mark-recapture data from the photo-ID portion of the study was used to fit a Chapman modified Lincoln-Petersen mark-resight model (see Section 2.4.2.1 [Mark-recapture Approach]). The second approach involved the use of the seal count data and a correction factor from the satellite telemetry data from the 2018, 2020, and 2022 seal tagging efforts on the Eastern Shore (refer to Ampela et al. 2023 for more information on the pinniped tagging project) to produce abundance estimates (see Section 2.4.2.2 [Telemetry Correction Factor Approach]). Seasonal abundance estimates were produced from the haul-out count and mark-recapture data from the 2016-2025 field seasons for both approaches. The data from the 2014-2016 field seasons were excluded from the abundance analyses as surveys were only conducted at the CBBT survey area during these seasons, and therefore, did not capture the full geographic extent of the local population, most likely resulting in an underestimation in abundance. The Eastern Shore survey area was added to the study in 2016. The abundance estimates produced from the telemetry correction factor approach were compared to the respective seasonal abundances estimated using the Chapman modified Lincoln-Petersen mark-resight model.

2.4.2.1 Mark-recapture Approach

The Chapman modified Lincoln-Petersen mark-resight model was fit for each of the nine field seasons from 2016-2025 to estimate seasonal abundance. This type of mark-resight model was selected based on the protocol for the photo-ID portion of the study, as this model assumes 1) a closed population (i.e., no recruitment [birth or immigration] or losses [death or emigration] during the study period), 2) all individuals have the same probability of being caught, 3) capture and marking do not impact catchability, 4) samples are random, 5) marks are not lost between sampling events, and 6) all marks are correctly recorded and reported when recovered in sample two. Absolute abundance for the study area (N) was estimated from the equation:

$$N = ((n_1 + 1) * (n_2 + 1)/(m_2 + 1)) - 1, \text{where}$$

n_1= # of individuals identified during the mark sampling period;
n_2= # of individuals identified during the recapture sampling period;
and m_2= total # of individuals sighted during both mark and recapture periods

For each field season from 2016-2025, sighting histories for all identified individuals were divided into two separate sampling periods, the mark (n_1) and the recapture (n_2), where (n) equals the number of seals with a catalog ID number (e.g., CB001) that were identified during

each sampling period. These primary periods were defined based on the halfway date between the first and last survey days that seals were sighted and therefore, potentially identified. The total number of uniquely identified seals seen during both mark and recapture equals m_2.

2.4.2.2 Telemetry Correction Factor Approach

Seal count data for the 2016-2025 field seasons from the CBBT and Eastern Shore surveys were combined with satellite telemetry data on harbor seal activity in Virginia waters to produce individual abundance estimates for the nine seasons, as well as an average for the nine seasons. This approach for abundance estimation was based on methods used by Huber et al. (2001) and Thompson et al. (1997).

The haul-out data from harbor seals tagged at the Eastern Shore survey area in 2018 (n=7), 2020 (n=2), and 2022 (n=5) were analyzed for the pinniped tracking study for southeastern Virginia (Ampela et al. 2023). All the deployed satellite tags were equipped with wet/dry switches, which reported the percentage of time the seal spent dry (i.e., hauled out) per hour. Histogram data representing the percentage of time an animal spent dry per hour during daylight hours and while in Virginia waters were used to calculate a correction factor that accounted for seals in the water during haul-out surveys, and therefore, potentially not accounted for by observers. The correction factor to account for seals in the water is the reciprocal of the proportion of time that tagged harbor seals spent ashore at haul-out sites. Absolute abundance for the study area (N) was estimated from the equation:

$$N = n/h, \text{ where}$$

n = mean seal count during a field season;
and h = mean proportion of time seals were hauled out during the sampling period

Estimates of n for the nine field seasons from 2016-2025 were based on counts made during “in season” survey days (refer to Section 3.2 [Seal Presence Analysis Results] for a definition of “in season”) at the CBBT and Eastern Shore survey areas. Tagged seals have been recorded at both survey areas within a season from both telemetry and photo-ID data (Ampela et al. 2023; Jones 2024). Therefore, counts for the two survey areas were combined to produce a total mean count for each season for the entire study area. Count data was also combined to increase the sample size for this analysis even though this could result in some individuals being counted more than once if movement between survey areas occurred within a season.

Telemetry data from the duration that tagged seals spent in Virginia waters were used to estimate the proportion of time spent ashore (h). Because the number of seals tagged and tracked during the 2017/2018, 2019/2020, and 2021/2022 field seasons was low, activity data from all of the tagged seals (males and females) for those three seasons were combined and a mean proportion of time spent ashore was calculated. Thus, it was assumed that activity did not vary among years, which allowed for h to be applied to the mean counts for the 2016-2025 field seasons.

3. Results

3.1 Haul-out Counts: 2024/2025 Field Season

Haul-out counts commenced in November 2024 for the 11th field season at the CBBT survey area. Counts were conducted over the course of 11 survey days between 4 November 2024 and 22 April 2025 (**Table 2**). Once seals were sighted in the survey area, animals were recorded on a consistent basis (7 out of 12 [64%] survey days) until departure. Overall, a total (combined in water and hauled out) of 76 seals were sighted across the four CBBT haul-out locations for the season (**Table 2**). Seals were observed more at CBBT 4 than the other CBBT haul-out sites, similar to the 2023/2024 field season. Of the 76 seals sighted, 19 (34%) were recorded at CBBT 3 and 56 (74%) were recorded at CBBT 4. This is the lowest number of seals sighted at CBBT 3 since the start of the haul-out counts in 2014. The total daily number of seals counted ranged from 0-24 seals per survey day. Only harbor seals were identified at the CBBT during this season.

Table 2. Summary of the number of seals sighted for the 2024/2025 field season for the CBBT survey area

Date	Number of Individuals Pv	Number of Individuals Hg
4-Nov-24	0	0
18-Nov-24	0	0
4-Dec-24	2	0
17-Dec-24	9	0
13-Jan-25	12	0
27-Jan-25	24	0
13-Feb-25	7	0
28-Feb-25	15	0
14-Mar-25	7	0
9-Apr-25	0	0
22-Apr-25	0	0
Total	**76**	**0**

Key: Pv = *Phoca vitulina* (harbor seal); Hg = *Halichoerus grypus atlantica* (gray seal)

Haul-out counts commenced in November 2024 for the ninth field season at the Eastern Shore survey area. Counts were conducted over the course of 12 survey days, between 5 November 2024 and 24 April 2025 (**Table 3**). Once seals were sighted in the survey area, animals were recorded on a consistent basis (10 out of 12 [83%] survey days) until departure. Seals were

observed hauled out at two of the five main haul-out sites; C and E (**Figure 3**); and seals did not appear to establish any new haul-out sites. Over the entire season, a total (combined in water and hauled out) of 132 seals were sighted (**Table 3**). The total daily number of seals counted ranged from 0-36 individuals per survey day. Only harbor seals were identified at the Eastern Shore survey area during this season.

Table 3. Summary of the number of seals sighted for the 2024/2025 field season at the Eastern Shore survey area

Date	Number of Individuals Pv	Number of Individuals Hg
5-Nov-24	1	0
19-Nov-24	3	0
9-Dec-24	7	0
18-Dec-24	15	0
3-Jan-25	33	0
17-Jan-25	36	0
5-Feb-25	6	0
24-Feb-25	13	0
11-Mar-25	17	0
28-Mar-25	1	0
14-Apr-25	0	0
24-Apr-25	0	0
Total	**132**	**0**

Key: Pv = *Phoca vitulina* (harbor seal); Hg = *Halichoerus grypus atlantica* (gray seal)

The UAS (i.e., drone) was used to conduct five counts during the 2024/2025 season, specifically from November 2024 to February 2025 **(Table 4**). The UAS was unable to be used during several surveys throughout the season due to high winds and limited availability of UAS operator. The observers recorded more seals (differential ranged from 1-10 animals) from the vessel-based counts compared to the UAS counts during four of the five survey days; the UAS count for the other survey day was only one animal higher than the vessel-based count. There was no significant difference between the mean counts for the UAS compared to the observers (t_{stat} = -0.31, p = 0.77).

Table 4. Comparison of counts recorded from the UAS and observer during vessel-based surveys for the 2024/2025 season at the Eastern Shore survey area

Date	Seal Count from UAS	Seal Count from Observer
5-Nov-24	0	1
19-Nov-24	0	3
18-Dec-24	14	15
17-Jan-25	36	35
24-Feb-25	3	13

3.2 Seal Presence Analysis Results

3.2.1 CBBT Survey Area

A total of 156 survey days were conducted across 11 field seasons at the CBBT survey area. Seals have been consistently recorded from mid-November to early April across field seasons (**Figure 6**). Most sightings (73%) occurred at the CBBT 3 haul-out site during the 11 field seasons followed by 24% of sightings at CBBT 4 and 3% for CBBT 1 and 2 combined. These percentages should be interpreted with caution due to the variation in survey effort across field seasons at the CBBT survey area.

Once seals arrived in the CBBT survey area, animals were recorded on a consistent basis (121 out of 124 [97.5%] survey days) until departure. Based on this and similar observations for the Eastern Shore survey area, we termed the number of survey days between and including the first and last seal observation as “in season” survey effort and included only “in season” data in our analyses for both survey areas (unless otherwise specified). Over 11 field seasons, there has been a fluctuation in seal presence for the CBBT survey area. For the first four field seasons (2014-2018), there was an increasing trend in the total count (sum of all the seals sighted in a season), average number of seals observed per survey day, and maximum count for a single survey day in a season (**Table 5**), followed by a decrease from 2018 to 2020. For the 2020/2021 season, seal presence appeared to rebound with an increase in average seal count and maximum seal count for a single survey day. Seal numbers continued to fluctuate from 2021-2025 with average and maximum count ranging from 10-13 seals and 24-38 seals, respectively.

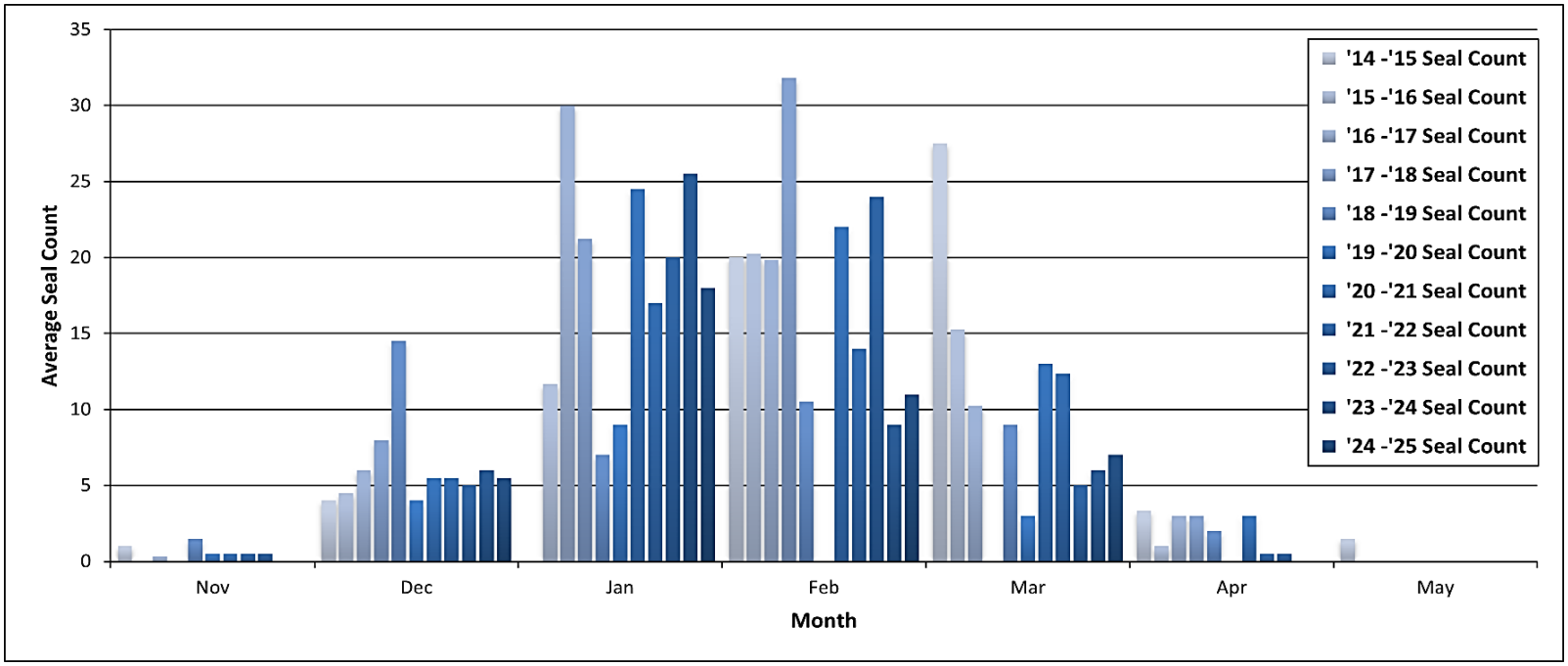

Figure 6. Average seal count by month using "in season" effort for the CBBT survey area. Surveys were only conducted in October for the 2015-2017 seasons (with no seal sightings) and in May for the 2014-2016 and 2021/2022 seasons. Surveys were not conducted in January 2015, March 2018, or February 2020.

Table 5. "In season" survey effort (number of survey days), total seal count (best estimate), effort-normalized average (number of seals observed per survey day), and maximum seal count on a single survey day at the CBBT survey area

Field Season	"In Season" Survey Effort (days)	Seal Counts		
		Total	Average	Maximum
2014-2015	11	113	10	33
2015-2016	14	187	13	39
2016-2017	22	308	14	40
2017-2018*	15	340	23	45
2018-2019	10	82	8	17
2019-2020	6	29	5	9
2020-2021	11	137	12	32
2021-2022	10	98	10	25
2022-2023	11	110	10	31
2023-2024	7	92	13	38
2024-2025	7	76	11	24

* Surveys for the CBBT survey area switched from land-based to vessel-based

The difference between the mean counts across the 11 field seasons was statistically significant (F_{stat}=2.04, p=0.035), with the Tukey/Kramer test results (Q_{cv}=4.64 for df=112) indicating that the mean counts for the 2017/2018 and 2018/2019 seasons (Q_{stat}=4.71) as well as the 2017/2018

and 2019/2020 seasons (Q_{stat}=4.91) were statistically different. This between-season comparison, however, does not take into account the sampling bias for some of the field seasons. For example, the average count (23 seals) and maximum count (45 seals) for the 2017/2018 season are higher than the other seasons, which may be due to a change in sampling methodology (counts being vessel-based instead of land-based). In addition, there was inconsistent survey effort across months for the 2017/2018 and 2019/2020 seasons (e.g., concentrated survey effort from January-February 2018, and no surveys in March 2018 and February 2020). With no statistically significant difference amongst the meant counts for the more recent field seasons (2020-2025 seasons), this could indicate that the local population is relatively stable.

3.2.2 Eastern Shore Survey Area

A total of 106 surveys were conducted across nine field seasons at the Eastern Shore survey area. Seals have been consistently recorded from early November to early April (**Figure 7**).

Similar to the CBBT, animals were recorded consistently once they arrived at the Eastern Shore survey area (84 out of 84 [100%] survey days) until departure. Over nine field seasons, seal presence fluctuated, similar to what was observed for the CBBT survey area. The total count and maximum count for a single survey increased from the 2016-2018 field seasons and again for the 2020-2023 seasons (**Table 6**), followed by a decrease for both summary statistics for the 2023-2025 seasons. The average number of seals observed per survey day increased from 2016-2018 but decreased to 15 seals for the 2018/2019 season. Average seal count increased again after 2019 with some fluctuation over the 2020-2024 seasons. Since the first season, some of the lowest total, maximum, and average seal counts for the Eastern Shore were reported for the 2024/2025 season. The difference between the mean counts across the nine field seasons was not statistically significant (F_{stat} =0.43, p=0.90), which could indicate that the local population is relatively stable. This between-season comparison, however, does not take into account the sampling bias for the first two seasons (2016-2018), which consisted of inconsistent survey effort across months (e.g., no surveys conducted in January 2017, and March and April 2018).

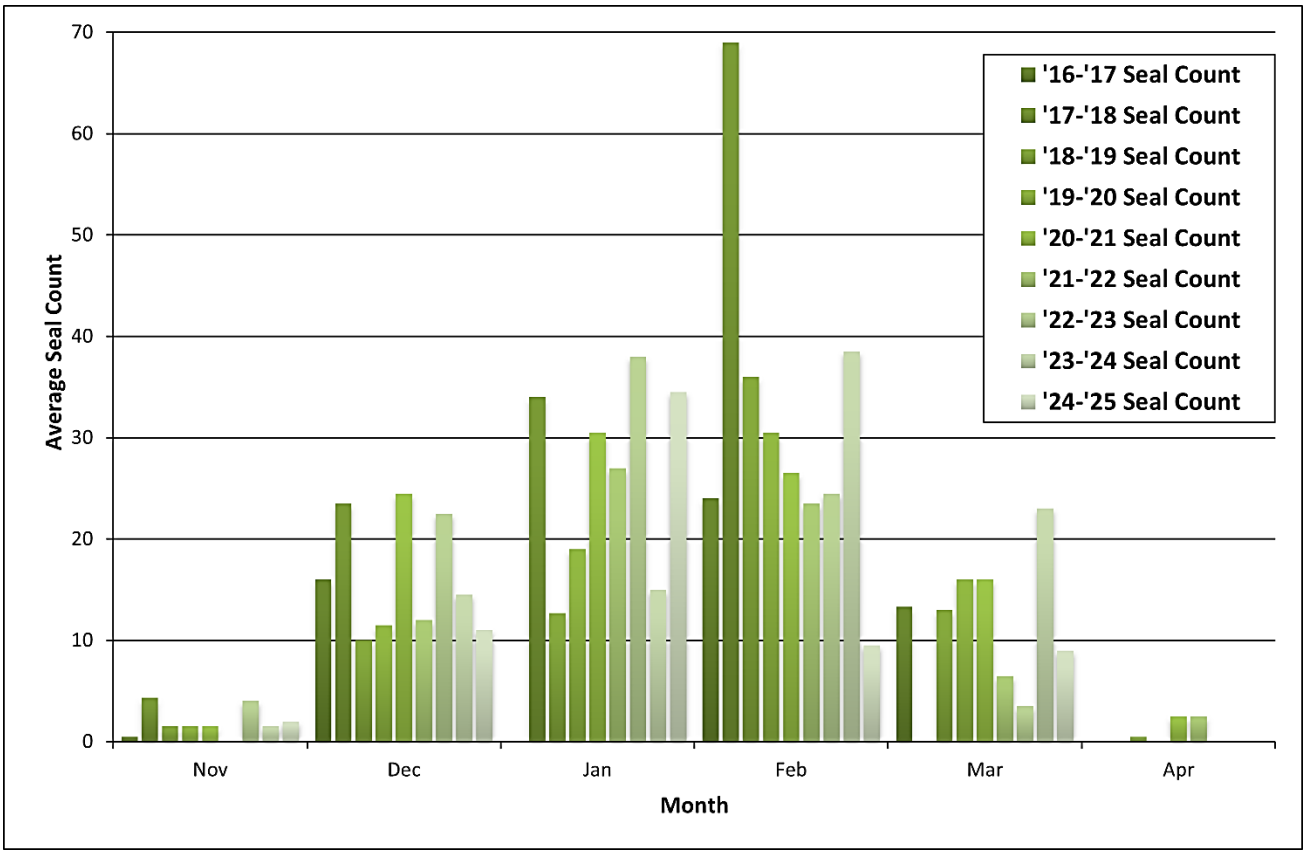

Figure 7. Average seal count by month using "in season" effort for the Eastern Shore survey area. No surveys were conducted in October for the 2016-2025 seasons. Surveys were only conducted in May for the 2020-2022 seasons. No surveys were conducted in January 2017, and March-April 2018.

Table 6. "In season" survey effort (number of survey days), total seal count (best estimate), effort-normalized average (number of seals observed per survey day), and maximum seal count on a single survey day at the Eastern Shore survey area

Field Season	"In Season" Survey Effort (days)	Seal Counts		
		Total	Average	Maximum
2016-2017	7	105	15	24
2017-2018	8	197	25	69
2018-2019	11	160	15	66
2019-2020	9	157	17	39
2020-2021	12	219	18	44
2021-2022	9	143	16	45
2022-2023	9	187	21	68
2023-2024	9	185	21	45
2024-2025	10	132	13	36

3.3 Photo Identification

For the 2023/2024 field season, 43 harbor seals and 1 gray seal were uniquely identified based upon image grading criteria (**Table 1, Table A-1**). The last images used for photo-ID analysis were collected on 12 March 2024. None of the images collected on 26 March 2024 (the last day of sightings for the season) met the quality standards for the study. Of the 43 harbor seals, 14 (33%) were new individuals to the catalog and 29 (67%) were re-sightings of individuals that were identified from previous field seasons (**Figure 8**). Identified harbor seals were sighted at the CBBT and Eastern Shore survey areas, with 21 seals sighted at only the CBBT survey area and 16 seals sighted at only the Eastern Shore survey area. Six harbor seals were sighted at both the CBBT and Eastern Shore survey areas during the season. The one gray seal (CB262) was a new individual to the catalog; it was initially sighted on 8 February 2024 at the Eastern Shore survey area and re-sighted there on 4 March 2024 (**Table A-1**).

For the 2024/2025 field season, 58 harbor seals were uniquely identified based upon image grading criteria (**Table 1, Table A-1**). The last images used for photo-ID analysis were collected on 14 March 2026. None of the images collected on 28 March 2026 (the last day of sightings for the season) met the quality standards for the study. Of the 58 harbor seals, 15 (26%) were new individuals to the catalog and 43 (74%) were re-sightings of individuals that were identified from previous field seasons (**Figure 8**). The highest number of individual re-sights for harbor seals was recorded for this season. Identified harbor seals were sighted at the CBBT and Eastern Shore survey areas, with 15 seals sighted at only the CBBT survey area and 24 seals sighted at only the Eastern Shore survey area. Four harbor seals were sighted at both the CBBT and Eastern Shore survey areas during the season (**Table A-1**).

After reviewing all images from the 2015-2025 field seasons, 221 harbor seals and 5 gray seals were uniquely identified based upon image grading criteria (**Table A-1, Figure 8**). The overall average discovery rate for harbor seals was about 22 new identifications per season. Of the catalogued harbor seals, 100 were observed only once and 121 were re-sighted on more than one survey day from 2015-2025. The number of days between an individual's initial sighting and last re-sighting ranged from 5 days (CB121) to 3,297 days (CB053), which is about 9 years. About half of the identified harbor seals (n=110) were sighted at only the CBBT survey area, with some (n=83) sighted at only the Eastern Shore survey area. Surveys were conducted at the CBBT for more seasons compared to the Eastern Shore, which may account for this difference in the number of identified seals across survey areas. The remaining 28 identified seals were sighted at both survey areas on separate survey days with 16 of these individuals (e.g., CB020, CB053, and CB278) sighted at both survey areas during the same season.

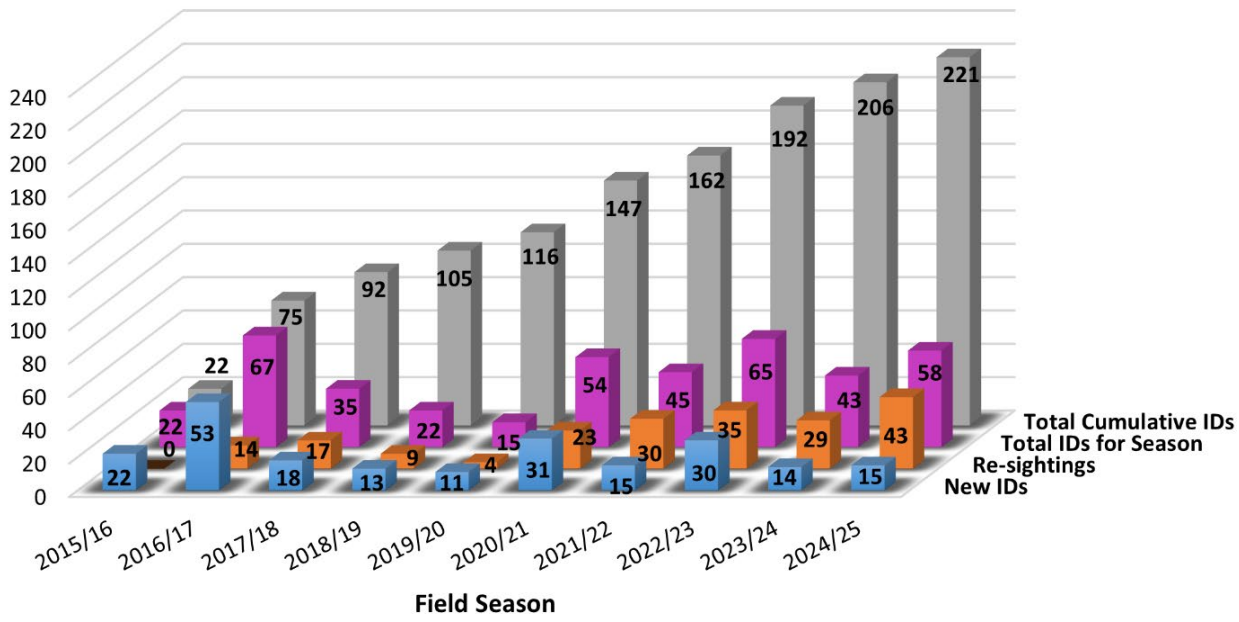

Figure 8. Harbor seal identifications over10 field seasons (2015-2025). The purple bars indicate the total number of IDs for a season, orange bars indicate the number of re-sightings, i.e., those IDs that were seen in previous seasons, and blue bars indicate the number of new IDs added to the catalog. The gray bars indicate the total number of cumulative unique IDs.

Photo-ID data from 10 field seasons have provided additional information pertaining to habitat use patterns and site fidelity for seals, particularly harbor seals. About half of the identified harbor seals (45%) were only sighted once over the course of the study period, indicating no site fidelity. However, the remaining identified harbor seals (55%) were re-sighted on two or more survey days with varying levels of site fidelity (categorization was adopted from Edison et al. 2024) from 48% of individuals showing low (identified on 2 days), 32% showing moderate (identified on 3-5 days), and 20% showing high (identified on 6 or more days) site fidelity. Most of the harbor seals identified on two or more days were re-sighted across 1-4 different field seasons, with a maximum of 9 seasons recorded for one individual, CB053 (**Table 7**). For individuals re-sighted across more than 1 field season, the average number of sighting seasons was 3.03 (SD=1.45). For example, CB047 displayed a high level of site fidelity with multiple re-sightings across 8 seasons from 2016-2025 (**Figure 9A**).

Of the 5 gray seals, three were observed once and two were identified on two survey days. The re-sighting duration ranged from 25 days (CB262) to 685 days (CB188). One individual was re-sighted across 2 seasons (**Table A-1, Table 7**); CB188 was first identified at the Eastern Shore survey area on 17 February 2021 and then re-sighted there again on 3 January 2023 (**Figure 9B**). Overall, the identified gray seals displayed none to low site fidelity for the study area.

Table 7. Number of uniquely identified seals (by species) re-sighted on two or more survey days across one to multiple field seasons from 2015-2025.

Species	1 season	2 seasons	3 seasons	4 seasons	5 seasons	6 seasons	7 seasons	8 seasons	9 seasons
Harbor seal	22	50	23	13	5	5	1	1	1
Gray seal	1	1							

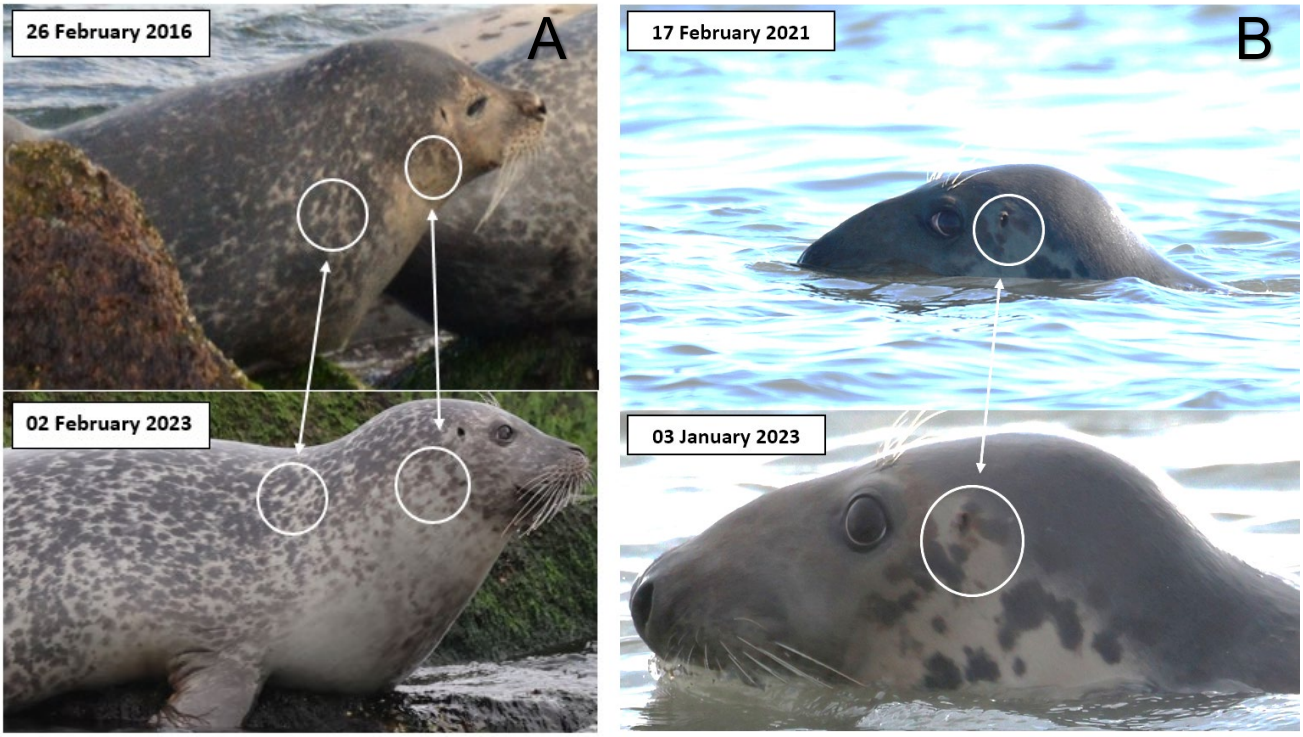

Figure 9. A) Harbor seal, CB047, sighted and re-sighted at the CBBT survey area. B) Gray seal, CB188, sighted and re-sighted at the Eastern Shore survey area. Photos by NAVFAC Atlantic under NMFS GA Permits #19826 and #25811

Not only have individual harbor seals been sighted on more than one occasion whether that is within a season or across seasons, but some individuals have been sighted and re-sighted together. For example, CB076 and CB090 were first sighted together at the same haul-out site (CBBT 3) on 11 January 2017 and then re-sighted together on multiple survey days at the same haul-out sites (CBBT 3 and 4), with the last re-sighting of them recorded on 2 February 2023, which amounts to a 2,213-day span (about 6 years) between sightings.

3.4 Abundance Estimates

The abundance estimates and 95% confidence intervals (CI) calculated from the Chapman modified Lincoln-Peterson model for the 2016-2025 field seasons ranged from 35 (95% CI:

4.56-65.44) to 131 (95% CI: 78.9-182.85) individual harbor seals (**Figure 10**). As previously mentioned in Section 3.3 (Photo Identification), uniquely identified harbor seals were sighted at the CBBT and Eastern Shore survey areas, therefore, mark and re-capture data across both survey areas were used for the abundance estimate calculations. Abundance estimates show a fluctuation across seasons. There was an overall decrease from the 2016-2020 field seasons, with the estimate for the 2019/2020 season being substantially lower (N=35 individuals) compared to the rest of the seasons. After the 2019/2020 season, abundance increased followed by some fluctuation in estimates between 2022-2025. For the 2019/2020 season, the lowest number of marks (or captures) (n=5) and re-captures (n=11) were recorded, which produced the lowest abundance estimate for the study period. These low number of captures and re-captures were most likely a result of less survey effort for this season compared to other field seasons, which reduces the chances of marking and re-capturing individuals via photo-ID. The 2016/2017 season had the highest estimate of 131 individuals. This is mainly due to the substantially higher amount of survey effort for this season compared to the other field seasons, which resulted in the highest number of marks (n=28) and re-captures (n=49) recorded for a season. A regression analysis was conducted for the seasonal abundance estimates to see if there is a potential population trend based on this approach. Results indicated that the slope was not statistically significant (p=0.31), therefore, there does not appear to be a trend in the seasonal abundance estimates.

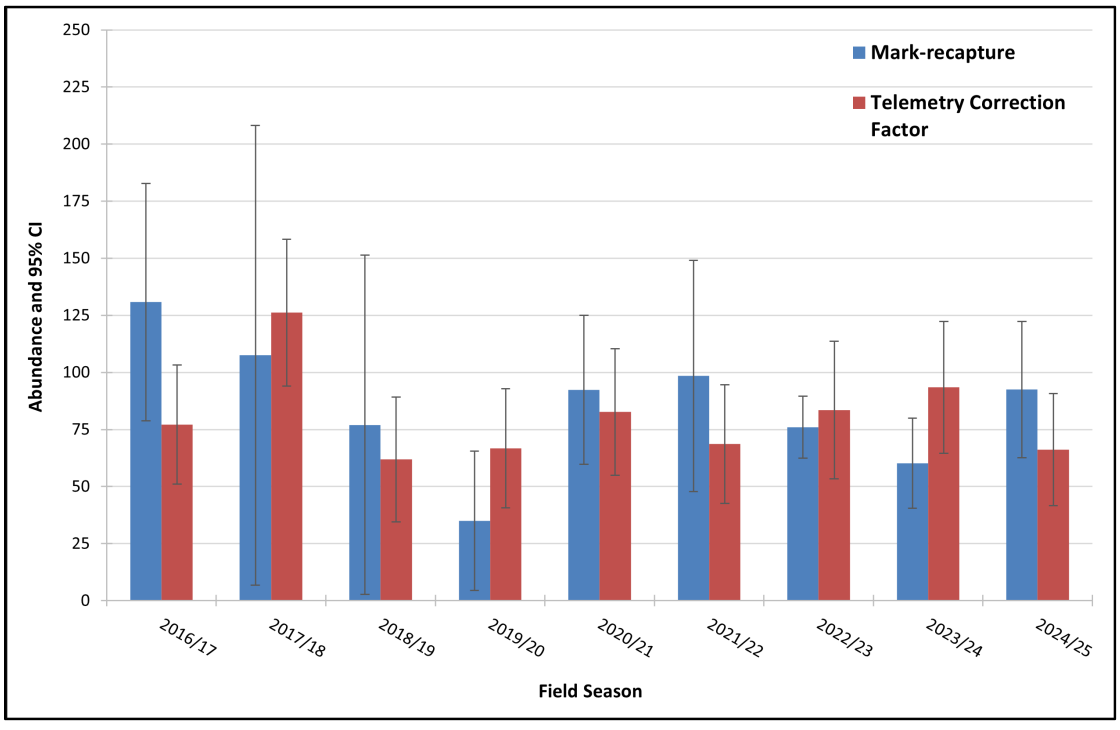

Figure 10. Total abundance estimates and 95% confidence intervals (CIs) for the CBBT and Eastern Shore survey areas combined calculated from the mark-recapture (blue bars) and telemetry correction factor (red bars) approaches for the 2016-2025 field seasons.

Count data for both the CBBT and Eastern Shore survey areas were combined to produce a total mean count for each season from 2016-2025. Mean counts for each season are presented in (**Table 8**); values ranged from 11.4 (SE=3.1) to 23.3 (SE=3.4). The 2017/2018 season had the highest mean seal count for the study area, and this was also reflected in the mean counts that were calculated for each of the CBBT and Eastern Shore survey areas for this season (see Section 3.2 [Seal Presence Analysis Results]). Mean count showed a fluctuation across seasons, which could be due to a fluctuation in seal presence across seasons or the unequal survey effort across seasons (e.g., there were 15 “in season” survey days for the 2019/2020 season compared to 23 “in season” survey days for the 2020/2021 season).

Based on the 2018, 2020, and 2022 tagging data, harbor seals were found to spend a mean proportion time (h) of 0.18 daylight hours on land (i.e., hauled out) while in Virginia waters.

Table 8. Mean counts of harbor seals at the CBBT and Eastern Shore survey areas for the 2016-2025 field seasons and the resulting abundance estimates calculated for each season using the telemetry correction factor approach. SE= standard error. CI= confidence interval

Field Season	Mean Count (SE)	Estimated Abundance	95% CI for Abundance
2016-2017	14.2 (2.1)	77	51.08 - 103.16
2017-2018	23.3 (3.4)	126	94 - 158.4
2018-2019	11.4 (3.1)	62	34.54 - 89.23
2019-2020	12.3 (3.2)	67	40.72 - 92.86
2020-2021	15.3 (2.8)	83	54.98 - 110.3
2021-2022	12.7 (2.8)	69	42.69 - 94.68
2022-2023	15.4 (3.9)	84	53.44 - 113.57
2023-2024	17.3 (3.6)	93	64.52 - 122.31
2024-2025	12.2 (2.5)	66	41.71 - 90.81

From the equation in Section 2.4.2.2 (Telemetry Correction Factor Approach), and using the mean proportion of time that tagged seals spent ashore (h=0.18), the abundance estimates for the 2016-2025 seasons ranged from 62 (95% CI: 34.54-89.23) to 126 (95% CI: 94-158.4) individual harbor seals (**Table 8**, **Figure 10**). Similar to the abundance estimates calculated from the Chapman modified Lincoln-Peterson model (presented above), the abundance estimates calculated using the telemetry correction factor showed a fluctuation across seasons. After a sharp decrease in abundance after the 2017/2018 season, abundance steadily increased until the 2020/2021 season followed by a fluctuation in estimates from 2021-2025. The 2018/2019 season had the lowest abundance estimate of 62 individuals, whereas the abundance estimate calculated for this season using the Lincoln-Peterson model was 77 individuals. The 2017/2018 season had the highest abundance estimate of 126 individuals, whereas the abundance estimate calculated for this season using the Lincoln-Peterson model was 108 individuals. The highest maximum and average seal counts were reported for both the

CBBT and Eastern Shore survey areas for the 2017/2018 season, which resulted in an overall, higher mean count for the study area and therefore, higher abundance estimate. A regression analysis was also conducted for these seasonal abundance estimates; similar to the results for the mark-re-capture-based estimates, there appears to be no trend (p=0.57), therefore, the local population may be stable.

With the abundance estimates produced from this approach also showing a fluctuation across seasons and no discernable trend, a mean abundance estimate was calculated. The average abundance estimate for the 2016-2025 seasons was 82 individuals (95% CI: 53.55-109.68).

4. Discussion

The results from this study indicate that seals, specifically harbor seals, regularly occur in southeastern Virginia from fall to spring. Harbor seals have been consistently recorded at the CBBT and Eastern Shore survey areas from November to April. This finding is reflected in the count data collected across 11 field seasons. A complimentary project has been investigating seal occurrence and haul-out patterns using time-lapse remote cameras at both the CBBT and Eastern Shore survey areas (Guins and Rees 2025). The camera surveys also demonstrated that harbor seals were present in the study area from fall to spring, with peak numbers from January-March, similar to the haul-out survey results presented in this report. Seals were also recorded on the cameras at both survey areas until May for the 2020-2024 seasons (Guins and Rees 2025). Seals have not been recorded in May during the vessel-based surveys since 2015. Results from the camera surveys show that this type of monitoring is an effective means at collecting count data throughout the day and across the field season, thereby providing a more robust investigation of seal occurrence in Virginia.

Since the start of the study, there has been a fluctuation in seal presence across the study area. For the CBBT survey area, there was an increasing trend in the average seal count per survey day and maximum seal count for a single survey day from 2014-2018. A sharp decrease in these summary statistics occurred from 2018 to 2020, followed by an increase for the 2020/2021 season. Seal numbers appeared to be relatively stable from 20121-2025. A similar fluctuation in seal presence was observed for the Eastern Shore survey area, over nine field seasons. The average and maximum seal count increased for the first two field seasons (2016-2018) and again for the 2020-2024 seasons, with a decline in numbers for the 2024/2025 season. Since the first season for each survey area, some of the lowest total, maximum, and average seal counts for the CBBT and Eastern Shore were reported for the 2018-2020 seasons as well as the 2024/2025 season. Additionally, there was a statistically significant difference between the average seal counts across the 11 field seasons for the CBBT survey area. The drop in seal count statistics for the Eastern Shore survey area was not as substantial compared to the CBBT survey area for these seasons, and the difference between average seal counts across the nine field seasons (2016-2025) for this survey area was not statistically different.

The observed fluctuation in seal presence for maximum and average seal count as well as overall seal sightings may be due to several factors including two unusual mortality events

(UMEs) along the U.S. east coast that occurred during the study period, seasonal differences (e.g., pupping season) in haul-out behavior, sampling bias in survey effort, and/or changes in habitat use in terms of haul-out site preference.

A Northeast U.S. Pinniped UME was declared from 2018-2019 based on elevated harbor and gray seal stranding numbers (mainly across Maine, New Hampshire, and Massachusetts) as well as seals testing positive for pathogens (e.g., phocine distemper virus and avian influenza virus). The UME encompassed all seal strandings from Maine to Virginia (NOAA 2020) and is now closed (NOAA 2022). Three harbor seals captured and tagged on the Eastern Shore during the 2017/2018 field season tested positive for the avian influenza virus (Costidis et al. 2019). Another Northeast U.S. Pinniped UME was declared from June-July 2022 based on elevated numbers of sick harbor and gray seals that were testing positive for avian influenza along the Maine coast; this UME is now closed (NOAA 2024). Several of the harbor seals tagged at the Eastern Shore survey area from 2018-2022 displayed northward movements to Maine in the spring (Ampela et al. 2023). Therefore, both UMEs may have been a factor in the observed fluctuation in count numbers across the study area from 2018 to 2025, as impacts from UMEs (e.g., mortality of individuals from Virginia's seasonal population) could have persisted after summer 2022.

The lower seal counts recorded for the 2018-2020 and 2024/2025 seasons could also be a result of harbor seals spending less time hauled out and more time at sea, resting or foraging, during surveys. Russel et al. (2015) found that outside of the molting and pupping seasons, the amount of time that harbor seals spend hauled out is reduced and variable, resulting in more time spent at sea. The probabilities of resting on land were estimated to be about 0.10-0.33 for harbor seals that were satellite tagged in Britain (Russel et al. 2015). Harbor seals migrate to Virginia in the fall from New England after the molting and pupping seasons. Similar to the probabilities reported by Russel et al. (2015), harbor seals tagged at the Eastern Shore survey area (Ampela et al. 2023) spent a mean proportion of 0.18 daylight hours resting on land (i.e., hauled out) while in Virginia. This leads to a higher probability of some animals spending more time at sea, and therefore, lower seal counts were possibly recorded during haul-out surveys.

For both the CBBT and Eastern Shore survey areas, the number of "in season" survey days conducted has varied each season and has varied by month within a season. Caution needs to be taken when comparing these numbers across seasons and when drawing conclusions due to a change in sampling methodology (e.g., vessel-based counts vs. land-based counts) for the CBBT survey area and variable survey effort across the 2014-2025 seasons for both survey areas, leading to sampling bias. In addition, the incorporation of the UAS with the vessel-based counts on the Eastern Shore may have helped to improve counts, especially when seals frequently exhibited movement from the haul-out site into the water as the survey vessel approached closer to the haul outs for counts and photographs.

The fluctuation in seal presence that was observed in more recent field seasons could also be due to a change in the seals' habitat use patterns within the study area. Based on the count data from this study, the average seal count per survey day for the study area (i.e., combining the CBBT and Eastern Shore survey areas) has not varied much between the 2020-2025

seasons, with the average count ranging from 12-17 seals. However, looking at the count summary statistics for each of the survey areas, the average seal count and maximum seal count for a single survey day has been higher than 15 and 40 seals, respectively, since 2020 for the Eastern Shore, with the exception of the 2024/2025 season (**Table 6**). Whereas, both average and maximum seal count for the CBBT have been below those values since the 2018/2019 season (**Table 5**). Looking at the haul-out count data from the camera surveys, results also show a higher monthly average at the Eastern Shore survey area compared to the CBBT for the 2019-2024 seasons (Guins and Rees 2025). Additionally, the abundance estimates calculated for this study were relatively stable from 2020-2024 (**Figure 10**). Therefore, there may have been a shift in habitat use amongst the survey areas in recent seasons, with more seals utilizing the Eastern Shore for haul-out habitat. This potential shift in habitat use could be due to the remoteness and limited accessibility of the Eastern Shore site, which results in less vessel traffic and human disturbance occurring in this area. There has also been construction activity, including pile driving, at the CBBT (mainly islands 1 and 2) since 2017, which may have influenced seal occurrence within the area due to the types of disturbance (e.g. underwater and airborne noise) produced from these activities.

Prior to this pinniped haul-out study, there was no population abundance estimate for harbor seals in southeastern Virginia. For this study, seasonal abundance was estimated for this region using count, photo-ID and telemetry data. Mark-recapture data from the photo-ID was used to fit a Chapman modified Lincoln-Petersen model. A correction factor was applied to the count data, which was based on telemetry data on harbor seal haul-out activity in Virginia waters. Abundance estimates calculated from the Lincoln-Peterson model and telemetry correction factor approach for the 2016-2025 seasons ranged from 35 (95% CI: 4.56-65.44) to 131 (95% CI: 78.79-182.85) and 62 (95% CI: 34.54-89.23) to 126 (95% CI: 94-158.4) individuals, respectively. General trends for both approaches show an initial decrease in abundance from 2016-2019, followed by an increase and then a fluctuation in estimates between 2021-2025. Fluctuation in abundance across seasons is expected due to variation in survey conditions and animal behavior, which can influence how many seals are visible during surveys. The abundance estimates produced from the mark-recapture data were slightly higher in comparison for several of the seasons and overall, the range of values was wider with a larger margin of error (i.e., 95% CI values) produced using this approach. Using the telemetry correction approach, a mean abundance of 82 individuals (95% CI: 53.55-109.68) was estimated for the 2016-2025 seasons. Given the small range of the CI, this estimate may be a reliable representation of the number of harbor seals using the study area. Thomas (2024) estimated monthly harbor seal abundance using camera trap counts of hauled out seals at the Eastern Shore survey area and the telemetry data from Ampela et al. (2023). February estimates (which is when peak counts were recorded for most seasons) for the 2019-2023 seasons ranged from 48-90 individuals (Thomas 2024). However, these estimates were only based on count data from the Eastern Shore site and not the CBBT, therefore, this most likely underestimates the local population of harbor seals for the overall study area.

Regression analysis results indicate no statistically significant trend in abundance estimates across seasons, therefore, the local population of harbor seals utilizing the lower Chesapeake

Bay and Eastern Shore, Virginia may be relatively stable. Results from the seal presence analysis (Section 3.2) also support the possibility of this local population being stable as there has been no significant difference among mean counts for both the CBBT and Eastern Shore survey areas since the 2019/2020 field season. Other harbor seal populations in New England are also considered stable. Seasonal counts of harbor seals hauled out throughout Narragansett Bay, Rhode Island have fluctuated from year to year since 2009, but the count data has demonstrated that the population is mostly stable (Save The Bay 2025). The harbor seal population in Maine is also considered stable due to the minor changes in abundance that were observed between 2012 and 2018 (Hayes et al. 2022; Sigourney et al. 2022).

Based on the photo-ID analysis, results indicate that some harbor seals are returning to the same southerly haul-out locations in Virginia across multiple seasons. Photo-ID conducted via visual matching for the 2015-2025 field seasons has shown that some individuals (121 out of 221 uniquely identified seals) sighted at the study area have been re-sighted within a season and across seasons, indicating a degree of site fidelity within the lower Chesapeake Bay and coastal Virginia waters. Of those 121 harbor seals, 39 displayed a moderate level of site fidelity to the study area and 24 displayed a high level of site fidelity (**Table A-1**). Most of the individuals with high site fidelity were re-sighted regularly across seasons after their first sighting. For example, 13 identified seals have now been sighted across five or more seasons since 2015. Identifiable re-sightings across the study period have spanned as far as about 108 months, and some of these identified harbor seals have utilized the CBBT haul-out sites for longer than our study period (based on images taken in years prior to 2014 and provided by B. Lockwood, a local angler). Based on these contributed citizen photographs, we have been able to determine that some of the individuals have been occurring seasonally in the region since 2011 (CB005 and CB006) and 2012 (CB056). These findings further prove that this region serves as an important resource for harbor seals by providing regular, seasonal haul-out sites for these animals. Automated photo-ID tools and computer-assisted seal recognition software (e.g., Seal Codex or SealNet) have been developed to assist in seal pelage pattern and facial recognition, and matching individuals (Birenbaum et al. 2022; Langley et al. 2021). These software advancements could be used to enhance the photographic mark-recapture potential of this study; automated matching may improve the frequency of matches and photo-matching time, as well as abundance estimation for the local harbor seal population.

Using photo-ID, we have also been able to collect more information on movement and habitat preference within the region. About half of the identified harbor seals have been sighted at only the CBBT survey area, with some (38%) being sighted at only the Eastern Shore survey area. However, 28 individuals were re-sighted at both survey areas on separate survey days within a season and across seasons. Most of the individuals that showed high site fidelity to the study area were only sighted at the CBBT. The individuals with moderate site fidelity displayed more variation in habitat usage between the two survey areas. These results indicate that harbor seals make localized movements throughout the region during their seasonal occupancy and that while some seals may be utilizing a particular haul-out site within a given season, others may utilize multiple haul-out sites within or across seasons. The pinniped tracking study for southeastern Virginia confirms that seals make localized movements throughout the region

(Ampela et al. 2021 and 2023). Nine of the 14 harbor seals captured and tagged at haul-out sites in the Eastern Shore survey area from February 2018 to February 2022 displayed movements between the Eastern Shore and CBBT survey areas before departing Virginia to head north towards New England.

Although most sightings within the study area were of harbor seals, occasional sightings of gray seals were recorded at both the CBBT and Eastern Shore survey areas between December and March across seasons. Gray seal sightings have not been recorded consecutively between field seasons for the CBBT survey area since the start of the study. However, 1-2 gray seal sightings were consistently recorded for the Eastern Shore during the 2017-2024 seasons, with 4 of the 5 identified gray seals sighted at this survey area. During the study period, one identified gray seal (CB188) was sighted across two seasons at the Eastern Shore. Additional surveys would be required to verify whether gray seal distribution is expanding south of Massachusetts and Long Island, New York, where there are established haul-out sites for this species.

Results from this study confirm that a small harbor seal population occurs seasonally within southeastern Virginia. These findings contributed towards the geographic range for harbor seals of the Western North Atlantic stock being updated in the NOAA SAR (Hayes et al. 2022). Both the harbor and gray seal previously formed large colonies (prior to subsistence hunts and government-supported bounties) from Labrador, Canada to Cape Hatteras, North Carolina (Johnston et al. 2015). The observed fluctuation in seal count numbers across the study period as well as the Virginia abundance estimates calculated for this study reflect claims that harbor seals are beginning to re-occupy substantial portions of their previous range (Johnston et al. 2015). Several researchers report that harbor and gray seal distribution along the U.S. Atlantic coast appears to be expanding or shifting (den Heyer et al. 2021; DiGiovianni et al. 2011; DiGiovianni et al. 2018; Johnston et al. 2015; Pepper et al. 2024; Sieswerda and Kopelman 2018), which could explain the fluctuation observed in seal occurrence at the CBBT and Eastern Shore survey areas since this study began in 2014. A large southward shift in gray seal pup production occurred by 2016, with more than 90% of production occurring south of the Gulf of St. Lawrence in Canada, and some parts of the Gulf of Maine have seen as much as a 26% increase in gray seal populations (den Heyer et al. 2021; Wood et al. 2019 and 2022). An increase in gray seal pupping (Wood et al. 2019 and 2022) and overall, abundance, in the northeastern U.S. (Pace et al. 2019) could create interspecific competition for the two species, whether that is for habitat and/or prey resources, thus leading to changes in species distribution. In some areas of the U.S. east coast where gray and harbor seals overlap (e.g., southeastern Massachusetts), harbor seal counts have declined since 2009, and gray seals appear to have displaced harbor seals from some of their former haul-out locations (Pace et al. 2019). Annual seal counts on Block Island, Rhode Island, have increased since 2019, driven mainly by an increase in gray seal sightings and less harbor seal sightings at this site (Save The Bay 2025). And over the past couple of decades, harbor seals have been regularly observed in areas south of Virginia, particularly the Outer Banks of North Carolina, from December to April (North Carolina Division of Parks and Recreation 2023 and Pepper et al. 2024). Haul-out surveys have been conducted at Oregon Inlet since 2010, with 35 harbor seals being the largest single group count recorded during a survey (Pepper et al. 2024). Overall, this study has provided valuable

baseline information for the future assessment of seal movement, site fidelity and abundance in the mid-Atlantic region.

5. Conclusions

This research has documented the regular, seasonal presence of harbor seals and occasional sightings of gray seals within the lower Chesapeake Bay and Eastern Shore, Virginia. With 11 seasons of haul-out count and photo-ID data, we have been able to evaluate patterns of seasonal residency and habitat use and establish a baseline for the future assessment of harbor seal site fidelity and population abundance with the region. However, more research is necessary to determine the level of site fidelity and whether harbor seal abundance is potentially increasing, decreasing, or is stable within the Chesapeake Bay and coastal Virginia waters, and as to what factors may be influencing the observed fluctuation in counts and overall, abundance. Data collected from the time-lapse camera surveys will continue to be examined for any emerging patterns of habitat utilization and residency time, as well as local population trends. The results from this project not only provide additional information on the distribution of pinniped species along the U.S. east coast but also provide information critical to the development of effective protective measures during military readiness activities, which will help the Navy with ongoing environmental compliance and conservation efforts.

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Appendix A

Sighting History Tables

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Table A-1. Sighting history (by number of days seen per season) of uniquely identified harbor and gray seals at the Chesapeake Bay Bridge Tunnel (CBBT) and Eastern Shore (ES): December 2015-March 2025

NAVFAC Catalogue ID	Season 2 Dec 2015-Mar 2016	Season 3 Dec 2016-Apr 2017	Season 4 Nov 2017-Feb 2018	Season 5 Dec 2018-Mar 2019	Season 6 Dec 2019-Mar 2020	Season 7 Dec 2020-Apr 2021	Season 8 Nov 2021-Apr 2022	Season 9 Nov 2022-Mar 2023	Season 10 Nov 2023-Mar 2024	Season 11 Nov 2024-Mar 2025	Location	Total No. Days Seen	Total No. Seasons Seen	Max No. Days Seen within a Season
Harbor Seals														
CB004		1	1								CBBT 3	2	2	1
CB005	1	3	2								CBBT 3	6	3	3
CB006	1	3	2			3		3		1	CBBT 3/4	13	6	3
CB017	1	1									CBBT 3	2	2	1
CB020	1	1	1				1	3	1		CBBT 3 & ES	8	6	3
CB021	1				1						CBBT 3 & ES	2	2	1
CB022		3	1			1	1				CBBT 3/4	6	4	3
CB023	1	2							1		CBBT 3/4	4	3	2
CB035	2										CBBT 3	2	1	2
CB036	1	1						3	1	2	CBBT 3/4	8	5	3
CB037	1										CBBT 3	1	1	1
CB038	2										CBBT 4	2	1	2
CB041	1										CBBT 3	1	1	1
CB042	1										CBBT 4	1	1	1
CB043	1										CBBT 4	1	1	1
CB044	1	1									CBBT 3/4	2	2	1
CB045	1	1									CBBT 3	2	2	1
CB046	1	1				3	2	1	1	3	CBBT 3/4	12	7	3
CB047	2	1		1		3	4	4	3	1	CBBT 3/4	19	8	4
CB048	1	1									CBBT 3	2	2	1
CB051	1										CBBT 3	1	1	1

NAVFAC Catalogue ID	Season 2 Dec 2015-Mar 2016	Season 3 Dec 2016-Apr 2017	Season 4 Nov 2017-Feb 2018	Season 5 Dec 2018-Mar 2019	Season 6 Dec 2019-Mar 2020	Season 7 Dec 2020-Apr 2021	Season 8 Nov 2021-Apr 2022	Season 9 Nov 2022-Mar 2023	Season 10 Nov 2023-Mar 2024	Season 11 Nov 2024-Mar 2025	Location	Total No. Days Seen	Total No. Seasons Seen	Max No. Days Seen within a Season
Harbor Seals (continued)														
CB053	4	2	2	1		1	6	4	2	2	CBBT 1/3/4 & ES	24	9	6
CB056				1	1	1					CBBT 3	3	3	1
CB057		1	1								CBBT 3 & ES	2	2	1
CB062	1		1	1			1				CBBT 3/4	4	4	1
CB064	1						1	1			CBBT 3/4	3	3	1
CB066		1				1	4	3	3	6	CBBT 3 & ES	18	6	6
CB067		1									CBBT 3	1	1	1
CB069		9	1								CBBT 3/4	10	2	9
CB071		4						2			CBBT 3	6	2	4
CB072		1						1	1		CBBT 3	3	3	1
CB073		1		1					1	1	CBBT 3 & ES	4	4	1
CB074		1									CBBT 3	1	1	1
CB076		1				2	1	2	2		CBBT 3/4	8	5	2
CB078		1									CBBT 3	1	1	1
CB079		1									CBBT 3	1	1	1
CB080		1				1				1	CBBT 3 & ES	3	3	1
CB081		1									CBBT 3	1	1	1
CB083		2	1								CBBT 3	3	2	2
CB084		1									CBBT 3	1	1	1
CB085		2									CBBT 3	2	1	2
CB086		3									CBBT 3	3	1	3

NAVFAC Catalogue ID	Season 2 Dec 2015-Mar 2016	Season 3 Dec 2016-Apr 2017	Season 4 Nov 2017-Feb 2018	Season 5 Dec 2018-Mar 2019	Season 6 Dec 2019-Mar 2020	Season 7 Dec 2020-Apr 2021	Season 8 Nov 2021-Apr 2022	Season 9 Nov 2022-Mar 2023	Season 10 Nov 2023-Mar 2024	Season 11 Nov 2024-Mar 2025	Location	Total No. Days Seen	Total No. Seasons Seen	Max No. Days Seen within a Season
Harbor Seals (continued)														
CB087		1	1								CBBT 3 & ES	2	2	1
CB088		1									CBBT 3	1	1	1
CB089		1									CBBT 3	1	1	1
CB090		2		1		1	1	4		1	CBBT 3/4	10	6	4
CB091		1					1		1		CBBT 3/4 & ES	3	3	1
CB092		2									CBBT 3	2	1	2
CB095		1						1			CBBT 3	2	2	1
CB096		1				1					CBBT 3	2	2	1
CB097		1									CBBT 3	1	1	1
CB099		1	1								CBBT 3	2	2	1
CB100		3	2								CBBT 3	5	2	3
CB101		1		2				5		2	CBBT 3/4	10	4	5
CB102		1									CBBT 3	1	1	1
CB103		1									ES	1	1	1
CB104		2	2			1					ES	5	3	2
CB105		1				1		1	1		ES	4	4	1
CB106		1		1		2	2				ES	6	4	2
CB107		1									ES	1	1	1
CB110		1									CBBT 3	1	1	1
CB111		1									CBBT 3	1	1	1
CB112		1		1							CBBT 3 & ES	2	2	1

NAVFAC Catalogue ID	Season 2 Dec 2015-Mar 2016	Season 3 Dec 2016-Apr 2017	Season 4 Nov 2017-Feb 2018	Season 5 Dec 2018-Mar 2019	Season 6 Dec 2019-Mar 2020	Season 7 Dec 2020-Apr 2021	Season 8 Nov 2021-Apr 2022	Season 9 Nov 2022-Mar 2023	Season 10 Nov 2023-Mar 2024	Season 11 Nov 2024-Mar 2025	Location	Total No. Days Seen	Total No. Seasons Seen	Max No. Days Seen within a Season
Harbor Seals (continued)														
CB113		1									ES	1	1	1
CB114		1	1								ES	2	2	1
CB115		1									ES	1	1	1
CB116		2									ES	2	1	2
CB117		1									ES	1	1	1
CB118		1									CBBT 3	1	1	1
CB119		1									CBBT 3	1	1	1
CB120		1		1							CBBT 3 & ES	2	2	1
CB121		2									CBBT 3 & ES	2	1	2
CB122		1									ES	1	1	1
CB123		1	1								ES	2	2	1
CB124		1									ES	1	1	1
CB125		1									ES	1	1	1
CB126		1	1								ES	2	2	1
CB127		1				1					ES	2	2	1
CB128*			1								ES	1	1	1
CB129			1				1	3			CBBT 3 & ES	5	3	3
CB130			1								CBBT 3	1	1	1
CB132			1			3		2		3	CBBT 3/4	9	4	3
CB133			1								CBBT 3	1	1	1

*CB128 found stranded/dead at the Eastern Shore survey area on 9 April 2019

NAVFAC Catalogue ID	Season 2 Dec 2015-Mar 2016	Season 3 Dec 2016-Apr 2017	Season 4 Nov 2017-Feb 2018	Season 5 Dec 2018-Mar 2019	Season 6 Dec 2019-Mar 2020	Season 7 Dec 2020-Apr 2021	Season 8 Nov 2021-Apr 2022	Season 9 Nov 2022-Mar 2023	Season 10 Nov 2023-Mar 2024	Season 11 Nov 2024-Mar 2025	Location	Total No. Days Seen	Total No. Seasons Seen	Max No. Days Seen within a Season
Harbor Seals (continued)														
CB134			1								CBBT 3	1	1	1
CB135			1								CBBT 3	1	1	1
CB136			1							1	CBBT 3/4	2	2	1
CB137			1								CBBT 3	1	1	1
CB138			1								ES	1	1	1
CB139			1			1			2	1	ES	5	4	1
CB140			1								ES	1	1	1
CB141			1								ES	1	1	1
CB143			1								ES	1	1	1
CB144			1							1	ES	2	2	1
CB145			1								ES	1	1	1
CB146			1								ES	1	1	1
CB147			1								ES	1	1	1
CB148				1							ES	1	1	1
CB149				1				1			ES	2	2	1
CB150				1	1	2	1		2	1	CBBT 3 & ES	8	6	2
CB151				1							CBBT 3	1	1	1
CB152				1							CBBT 3	1	1	1
CB153				1		1		2			CBBT 3 & ES	4	3	3
CB154				2			1				CBBT 4 & ES	3	2	2
CB156				1							ES	1	1	1

NAVFAC Catalogue ID	Season 2 Dec 2015-Mar 2016	Season 3 Dec 2016-Apr 2017	Season 4 Nov 2017-Feb 2018	Season 5 Dec 2018-Mar 2019	Season 6 Dec 2019-Mar 2020	Season 7 Dec 2020-Apr 2021	Season 8 Nov 2021-Apr 2022	Season 9 Nov 2022-Mar 2023	Season 10 Nov 2023-Mar 2024	Season 11 Nov 2024-Mar 2025	Location	Total No. Days Seen	Total No. Seasons Seen	Max No. Days Seen within a Season
Harbor Seals (continued)														
CB157				1	1						ES	2	2	1
CB158				1			1	1	2	1	CBBT 3 & ES	6	5	1
CB159				1							ES	1	1	1
CB160				1							CBBT 2	1	1	1
CB161					2						ES	2	1	2
CB162					1		1				ES	2	2	1
CB163					1	1				1	ES	3	3	1
CB164					1		1			1	ES	3	3	1
CB165					1						ES	1	1	1
CB166					1						ES	1	1	1
CB167					1						ES	1	1	1
CB169					1						ES	1	1	1
CB170					2	1				1	ES	4	3	2
CB171					1	1		1			CBBT 4	3	3	1
CB172					1						CBBT 4	1	1	1
CB173						3				1	CBBT 3/4	4	2	3
CB174						2					ES	2	1	2
CB175						1					ES	1	1	1
CB176						2					ES	2	1	2
CB177						2	1	2			CBBT 3/4	5	3	2
CB178						2					CBBT 3/4	2	1	2

NAVFAC Catalogue ID	Season 2 Dec 2015-Mar 2016	Season 3 Dec 2016-Apr 2017	Season 4 Nov 2017-Feb 2018	Season 5 Dec 2018-Mar 2019	Season 6 Dec 2019-Mar 2020	Season 7 Dec 2020-Apr 2021	Season 8 Nov 2021-Apr 2022	Season 9 Nov 2022-Mar 2023	Season 10 Nov 2023-Mar 2024	Season 11 Nov 2024-Mar 2025	Location	Total No. Days Seen	Total No. Seasons Seen	Max No. Days Seen within a Season
Harbor Seals (continued)														
CB179						3	1	3	1	1	CBBT 3/4	9	5	3
CB180						1	1				CBBT 3	2	2	1
CB182						2	1	1	4	1	CBBT 3 & ES	9	5	4
CB183						1	1				CBBT 3/4	2	2	1
CB184						2		1	1		CBBT 3	4	3	2
CB185						1					CBBT 3	1	1	1
CB186						1	1	2		2	CBBT 3/4	6	4	2
CB187						2	2	4	1		CBBT 3/4	9	4	4
CB189						1		2			CBBT 3/4	3	2	2
CB190						1		2	1		CBBT 3 & ES	4	3	2
CB192						1		2		2	CBBT 3/4 & ES	5	3	2
CB193						1	1	1	1		ES	4	4	1
CB194						1		1		2	CBBT 3 & ES	4	3	1
CB195						1			1		CBBT 4	2	2	1
CB197						1	1		2	1	ES	5	4	1
CB198						1	1				CBBT 4	2	2	1
CB199						2					CBBT 4	2	1	2
CB200						1					CBBT 3	1	1	1
CB201						1	1				ES	2	2	1
CB202						1			1	1	ES	3	3	1
CB203						1	1		1	1	CBBT 4	4	4	1

NAVFAC Catalogue ID	Season 2 Dec 2015-Mar 2016	Season 3 Dec 2016-Apr 2017	Season 4 Nov 2017-Feb 2018	Season 5 Dec 2018-Mar 2019	Season 6 Dec 2019-Mar 2020	Season 7 Dec 2020-Apr 2021	Season 8 Nov 2021-Apr 2022	Season 9 Nov 2022-Mar 2023	Season 10 Nov 2023-Mar 2024	Season 11 Nov 2024-Mar 2025	Location	Total No. Days Seen	Total No. Seasons Seen	Max No. Days Seen within a Season
Harbor Seals (continued)														
CB204						1					CBBT 2	1	1	1
CB205						1					CBBT 2	1	1	1
CB206						2				3	CBBT 4 & ES	5	2	3
CB207						1					ES	1	1	1
CB208							1	1			CBBT 3	2	2	1
CB209							1	1			CBBT 3/4	2	2	1
CB210							1	2		2	CBBT 4	5	3	2
CB211							1				ES	1	1	1
CB212							1				ES	1	1	1
CB213							1		1		CBBT 3/4	2	2	1
CB214							1				CBBT 2	1	1	1
CB215							1	1		3	ES	5	3	3
CB216							2				CBBT 4 & ES	2	1	2
CB217							1				CBBT 4	1	1	1
CB218							1				CBBT 2	1	1	1
CB219							1				ES	1	1	1
CB220							1				ES	1	1	1
CB221							1				ES	1	1	1
CB222							1				ES	1	1	1
CB223								3			ES	3	1	3
CB224								4	2	4	CBBT 3/4 & ES	10	3	4

NAVFAC Catalogue ID	Season 2 Dec 2015-Mar 2016	Season 3 Dec 2016-Apr 2017	Season 4 Nov 2017-Feb 2018	Season 5 Dec 2018-Mar 2019	Season 6 Dec 2019-Mar 2020	Season 7 Dec 2020-Apr 2021	Season 8 Nov 2021-Apr 2022	Season 9 Nov 2022-Mar 2023	Season 10 Nov 2023-Mar 2024	Season 11 Nov 2024-Mar 2025	Location	Total No. Days Seen	Total No. Seasons Seen	Max No. Days Seen within a Season
Harbor Seals (continued)														
CB225								1			ES	1	1	1
CB227								1	1		CBBT 4	2	2	1
CB228								2			CBBT 3	2	1	2
CB229								1		1	ES	2	2	1
CB230								1			ES	1	1	1
CB231								5		1	CBBT 4	6	2	5
CB232								2		3	CBBT 3/4	5	2	3
CB233								2			CBBT 3/4	2	1	2
CB234								1			CBBT 3	1	1	1
CB235								1			ES	1	1	1
CB236								1			ES	1	1	1
CB237								1			ES	1	1	1
CB238								1		1	ES	2	2	1
CB239								1			ES	1	1	1
CB241								1			CBBT 4	1	1	1
CB242								1			CBBT 3	1	1	1
CB243								1			CBBT 3	1	1	1
CB244									1	1	CBBT 4 & ES	2	2	1
CB245								1			ES	1	1	1
CB246								1		1	ES	2	2	1
CB247								1			ES	1	1	1

NAVFAC Catalogue ID	Season 2 Dec 2015-Mar 2016	Season 3 Dec 2016-Apr 2017	Season 4 Nov 2017-Feb 2018	Season 5 Dec 2018-Mar 2019	Season 6 Dec 2019-Mar 2020	Season 7 Dec 2020-Apr 2021	Season 8 Nov 2021-Apr 2022	Season 9 Nov 2022-Mar 2023	Season 10 Nov 2023-Mar 2024	Season 11 Nov 2024-Mar 2025	Location	Total No. Days Seen	Total No. Seasons Seen	Max No. Days Seen within a Season
Harbor Seals (continued)														
CB248								1			ES	1	1	1
CB249								1			CBBT 4	1	1	1
CB252								2			CBBT 4	2	1	2
CB253								1			CBBT 2	1	1	1
CB254								1			ES	1	1	1
CB255									3		ES	3	1	3
CB256									2		CBBT 4	2	1	2
CB257									1		CBBT 4	1	1	1
CB258									1		CBBT 3	1	1	1
CB259									3	1	CBBT 3 & ES	4	2	1
CB260									1	1	ES	2	2	1
CB261									1	1	ES	2	2	1
CB263									1		ES	1	1	1
CB264									1		ES	1	1	1
CB265									1	1	ES	2	2	1
CB266									1	1	CBBT 3 & ES	2	2	1
CB267									1		CBBT 4	1	1	1
CB268									1		CBBT 4	1	1	1
CB269										2	ES	2	1	2
CB270										1	ES	1	1	1
CB271										1	ES	1	1	1

NAVFAC Catalogue ID	Season 2 Dec 2015-Mar 2016	Season 3 Dec 2016-Apr 2017	Season 4 Nov 2017-Feb 2018	Season 5 Dec 2018-Mar 2019	Season 6 Dec 2019-Mar 2020	Season 7 Dec 2020-Apr 2021	Season 8 Nov 2021-Apr 2022	Season 9 Nov 2022-Mar 2023	Season 10 Nov 2023-Mar 2024	Season 11 Nov 2024-Mar 2025	Location	Total No. Days Seen	Total No. Seasons Seen	Max No. Days Seen within a Season
Harbor Seals (continued)														
CB272										1	CBBT 4	1	1	1
CB273										1	CBBT 4	1	1	1
CB274										1	ES	1	1	1
CB275										2	ES	2	1	2
CB276										1	ES	1	1	1
CB277										1	CBBT 4	1	1	1
CB278										2	CBBT 4 & ES	2	1	2
CB279										1	CBBT 4	1	1	1
CB280										1	CBBT 4	1	1	1
CB281										1	CBBT 4	1	1	1
CB282										1	ES	1	1	1
CB283										1	ES	1	1	1
Totals	**28**	**97**	**40**	**24**	**17**	**77**	**60**	**114**	**61**	**86**				
Gray Seals														
CB168					1						ES	1	1	1
CB188						1		1			ES	2	2	1
CB240								1			CBBT 4	1	1	1
CB250								1			ES	1	1	1
CB262									2		ES	2	1	2
Totals	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**3**	**2**	**0**				