

Harbor Seals in Virginia: Evidence for a Regular, Winter Haul-out and Seasonal Site Fidelity

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INTRODUCTION

- Harbor seal distribution along the United States (U.S.) Atlantic coast appears to be expanding. New Jersey was previously recognized as the southernmost extent for harbor seals, with occasional sightings reported as far south as Florida. NOAA now reports that a small group of harbor seals haul out seasonally in the Chesapeake Bay and near Oregon Inlet, North Carolina [4].
- Observations from Virginia (VA) by Chesapeake Bay Bridge Tunnel (CBBT) staff and local anglers indicate seals have been using the CBBT islands to haul out on for many years, but that the number of animals appears to be increasing. Additionally, annual pinniped stranding numbers have increased in Virginia since the early 1990s [3].
- During the fall of 2014, we began an investigation of harbor seal presence in the lower Chesapeake Bay, VA (Figure 1). The study is ongoing in 2017-2018 with the following objectives:
 - assess seal occurrence, movement and haul-out patterns in areas adjacent to Navy Training and testing areas, and
 - using photo-identification methods, identify and compare individual seals to assess site fidelity and movement among haul-out locations in the study areas.

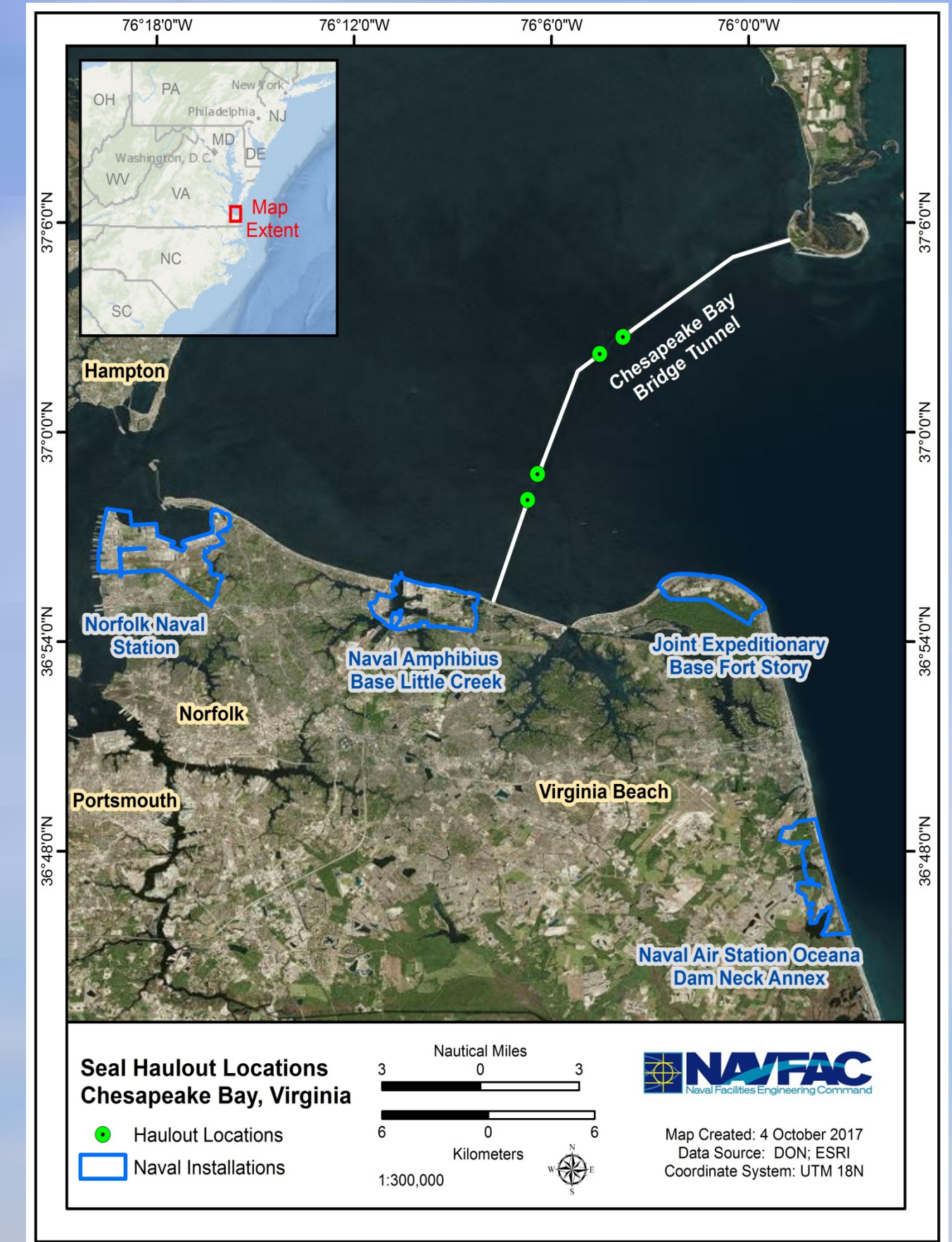


Figure 1. Haul-out sites along the CBBT in Virginia

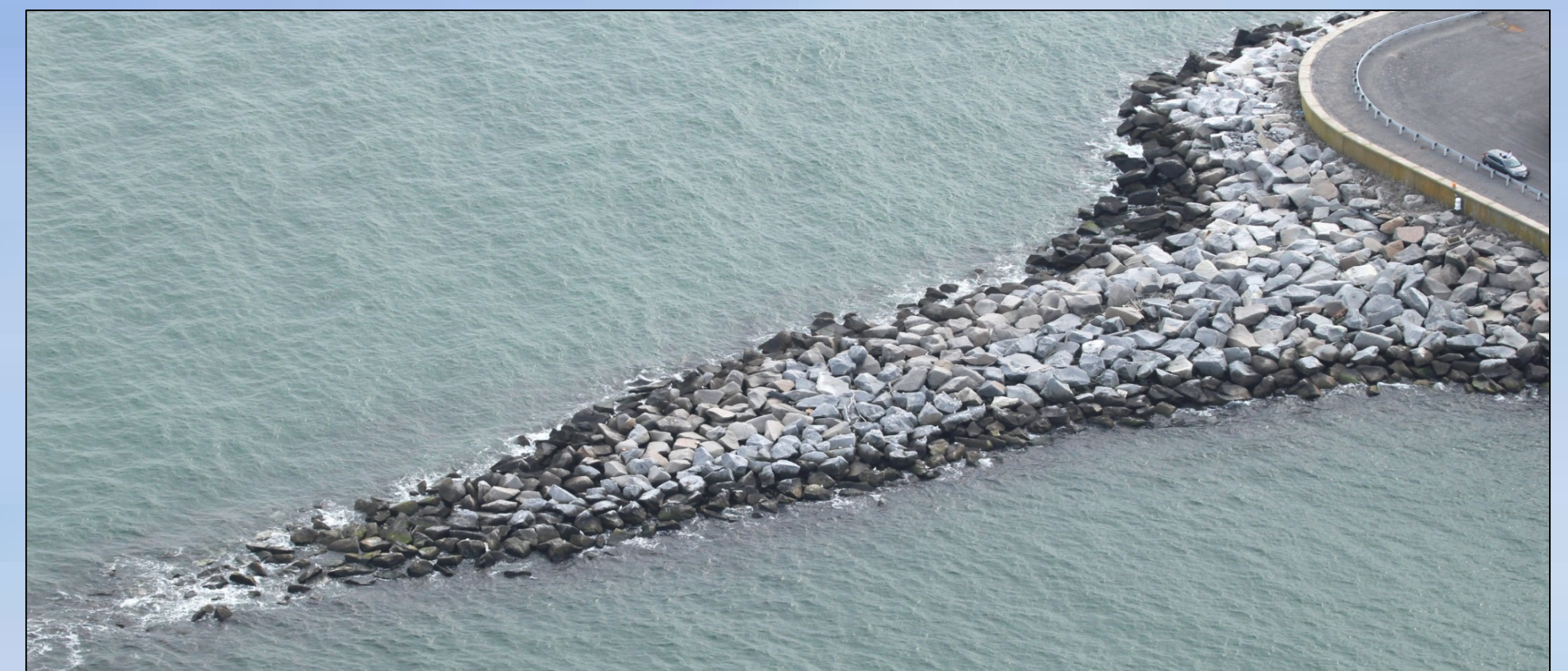


Figure 2. Aerial view of a CBBT haul-out site. Photo © Sarah Mallette, Virginia Aquarium & Marine Science Center



Figure 3. A group of harbor seals hauled out near the tip of one of the CBBT sites. Photo taken under NMFS General Permit # 19826-00

METHODS: HAUL-OUT COUNTS

- Systematic, land-based counts of harbor seals (hauled out and in the water) were conducted at four haul-out sites along the CBBT (Figures 1 and 2) for three field seasons from November 2014-April 2017.
- Each site was surveyed every 1-2 weeks during each season, with the exception of January 2015 (no counts due to inclement weather).
- Environmental data were recorded at the time of observation during each survey to explore relationships between seal presence and environmental variables.

METHODS: PHOTO-IDENTIFICATION

- Photos of seals were collected between counts (Figure 4) and graded based on quality and distinctiveness of the pelage pattern [1]; [2]. Manual matching techniques were used.
- Images taken prior to and during our investigation (April 2010-January 2015) were obtained from a local angler (B. Lockwood), and compared to images obtained during surveys from the 2014-2015 and 2015-2016 seasons.
- A site fidelity index was created [1] so that preliminary patterns could be analyzed.
 - Bin sizes were determined to be: (1) 1 sighting; (2) 2-7 sightings; (3) 8-13 sightings; (4) 14-19 sightings; and (5) 20+ sightings.

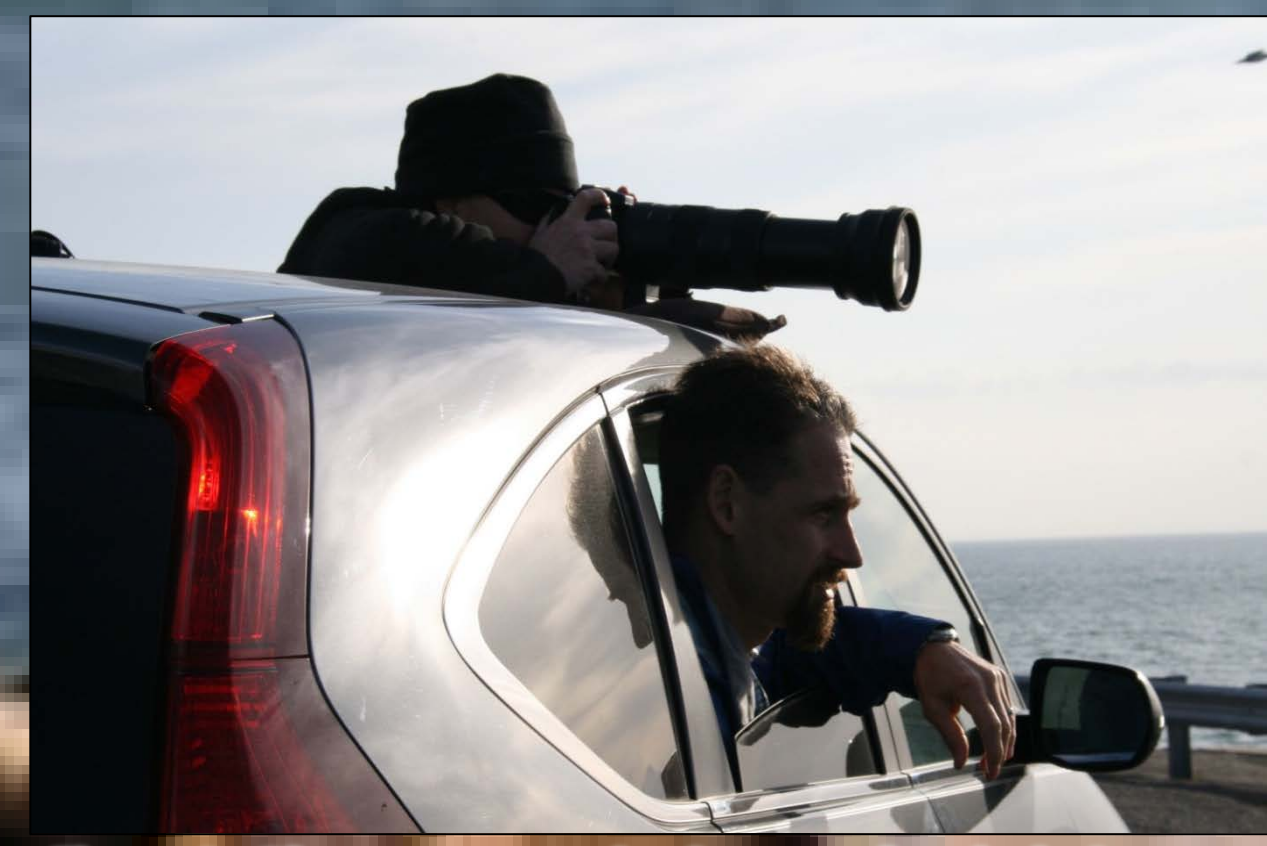


Figure 4. Observers capturing images of seals during a survey

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 [2] Forcadell, J. and Aguilar, A. (2000). Use of photographic identification in capture-recapture studies of Mediterranean Monk seals. *Marine Mammal Science*, 16(4): 767-793.
 [3] Swingle, W.M., Barco, S.G., Bates, E.B., Lockhart, G.G., Phillips, K.M., Rodrique, K.R., Rose, S.A. and Williams, K.M., 2016. Virginia Sea Turtle and Marine Mammal Stranding Network 2015 Grant Report. Final Report to the Virginia Coastal Zone Management Program, NOAA CZM Grant #NA14NOS4190141, Task 49. VAQF Scientific Report 2016-01. Virginia Beach, VA. 47 pp
 [4] Waring, G., Josephson, E., Maze-Foley, K. and Rosel, P. E. (2016). U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments-2015. NOAA Technical Memorandum NMFS-NE-238. Woods Hole, MA: U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Northeast Fisheries Science Center. 501 pp.

RESULTS: HAUL-OUT COUNTS

- Harbor seals were recorded from mid-November to mid-May, with most (94%) being sighted at the CBBT Island 3 haul-out site.
- Once seals arrived, animals were recorded on a pretty consistent basis (44 out of 47 surveys) until departure. Based on this, we termed the number of survey days between the first and last seal observation as “in season effort” and used this in our analyses.
- Over three field seasons, the total count, average count, and maximum count for a single survey have slightly increased (Table 1).

Table 1. Seasonal survey effort, total seal count (best estimate), max seal count for a single survey, and effort-normalized average seal count (number of seals observed per in season survey day)

| Field Season | In Season Survey Effort | Total Seal Count | Average Seal Count | Max Seal Count |
|--------------|-------------------------|------------------|--------------------|----------------|
| 2014-2015 | 11 | 113 | 10 | 33 |
| 2015-2016 | 14 | 185 | 13 | 39 |
| 2016-2017 | 22 | 307 | 14 | 40 |

- Based on initial data exploration, several environmental variables showed a noticeable relationship with seal count (from CBBT Island 3) (Table 2).
 - Strongest relationship was with water temperature, which appears able to account for a proportion of variation (e.g. for regression between seal count and water temperature, $R^2 = 0.35$, $p < 0.001$).
- Peak counts were recorded between January and March (Figure 4), and seemed to coincide with some of the lowest recorded water temperatures. As water temperatures rose above 55°F, counts decreased.

Table 2. Correlation analysis of “in-season” seal count vs. environmental variables

| Environmental Variables | Correlation (Pearson r) |
|-----------------------------|-------------------------|
| Cloud Cover (%) | 0.15 |
| Glare (%) | 0.27 |
| Beaufort Sea State (BSS) | -0.23 |
| Tidal Height in feet (MLLW) | -0.31 |
| Wind Speed (knots) | -0.25 |
| Wind Gust (knots) | -0.23 |
| Air Temperature (°F) | -0.04 |
| Water Temperature (°F) | -0.59 |

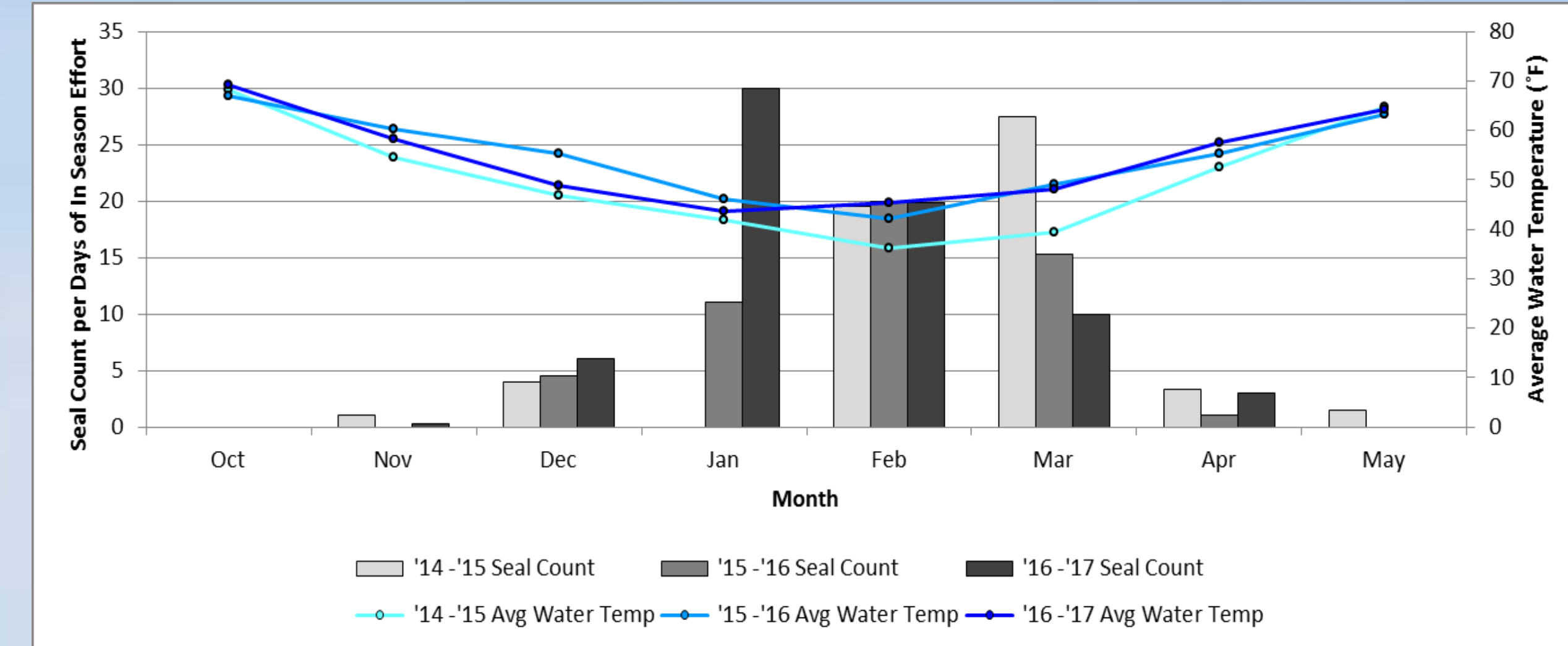


Figure 4. Average harbor seal count by month with corresponding average monthly water temperature (°F)

PRELIMINARY RESULTS: PHOTO-IDENTIFICATION

- Fifty-two unique harbor seals were identified.
- Site fidelity findings: 88% ($n=46$) of the 52 harbor seals were observed only once in the study area, and 12% ($n=6$) were observed 2-7 times.
 - Five seals were observed 2 times. Three of these seals had re-sightings that spanned over more than one year (Figure 5).
 - One seal was observed 5 times within the 2015-2016 season.

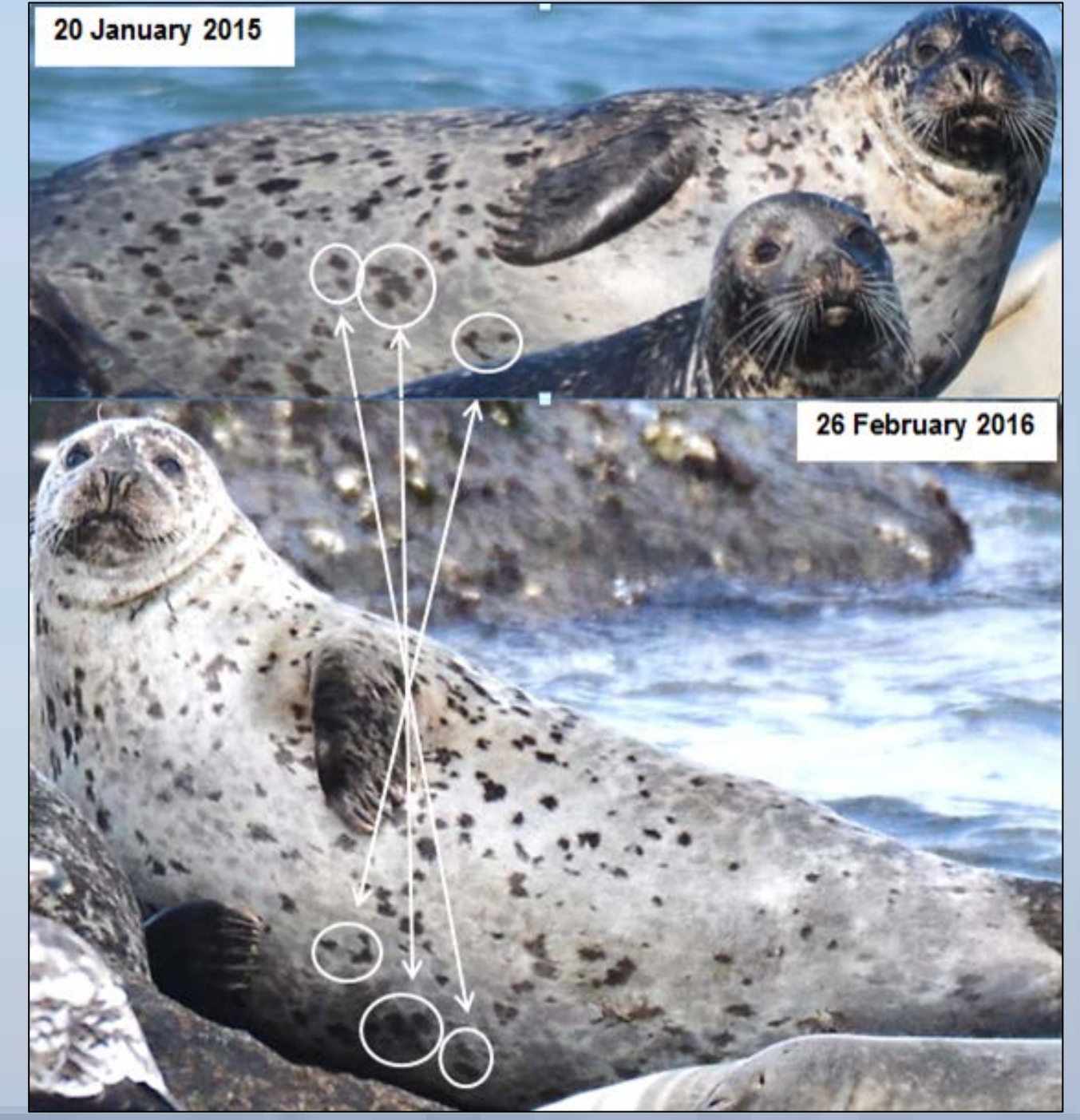


Figure 5. A harbor seal first captured on 20 January 2015 (above) and then recaptured on 26 February 2016 (below)

DISCUSSION

- Results indicate that harbor seals regularly occur in VA from November to April.
 - Water temperature may be an environmental predictor of peak seal occurrence in the lower Chesapeake Bay.
- Number of sightings appear to have slightly increased. Further surveys and mark-recapture efforts are required before making inferences.
- Preliminary analysis confirms the presence of matches in the photo database, indicating a degree of site fidelity, with some seals possibly being seasonal residents to VA.
 - Identified seals have also been observed near haul-out sites located in the southern part of VA’s Eastern Shore.
- Investigation of harbor seal presence in a previously undocumented habitat area allows for additional insight into migratory behaviors and habitat utilization that will help the Navy with ongoing environmental compliance and conservation efforts.

FUTURE WORK

- Analyze photographs of seals taken at the CBBT and the VA Eastern Shore during the 2016-2017 season.
- Evaluate available software, e.g. Extract-Compare, to compare and identify individual seals for a mark-recapture study.
- Aim to quantify the relationships between seal count and environment using a robust multiple regression modeling framework.
- Deploy satellite tags on wild-caught harbor seals to collect baseline data on habitat use, movement, and haul-out patterns.

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