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Tidal Marsh Bird Community Profiling and Management Guide for Department of
Defense Installations in the Mid-Atlantic Region

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Abstract

The U.S. Department of Defense supports nearly 9,000 ha of tidal marsh habitat within installation in the mid-Atlantic region that is important for many marsh bird species that are declining and of conservation concern. Because of the broad dissemination of installations within the region, marshes controlled by the DoD exist across a wide range of salinity zones and other conditions that influence marsh bird abundance and distribution. Improving the DoD's capacity to manage marsh bird populations can only move forward through a broad scale assessment to determine the status of this valuable resource so management priorities can be developed. However, direct assessment of DoD marsh birds through field surveys and inventory are not always possible because many of the marsh habitats on military lands are restricted from access due to prior training with incendiary devices and unexploded ordinance. To compensate for this difficulty, this report was inventory tidal marshes of DoD installations and to generate a profile of the tidal marsh bird communities by assembling the best information available and making projections.

Tidal marsh habitats were delineated and mapped at the patch level to inventory the abundance of freshwater/brackish marshes and salt marshes across DoD installations. Population estimates of selected species of marsh birds were projected across installations based on species' habitat requirements for salinity, vegetation, and patch size.

DoD installations appear to support large population of marsh bird species such as the Clapper Rail, Virginia Rail, King Rail, and Marsh Wren. Other species of importance include the Willet, Northern Harrier, Seaside Sparrow, Coastal Plain Swamp Sparrow, and Saltmarsh Sparrow. Tidal marsh birds and their habitats in the mid-Atlantic region are highly vulnerable to the negative effects of sea-level rise, invasive species, development, and certain management practices. Installations that support species of highest concern should be considered top priority for management, monitoring, and research.

Introduction

Emergent tidal marshes are a dominant feature of the Mid-Atlantic estuarine environment and are indispensable to the overall health of these estuaries. Marshes are responsible for providing a substantial amount of trophic production, regulating nutrient cycles, and enhancing water quality by filtering pollutants. These ecological services have obvious biological (e.g., diversity), social (e.g., human health), and economical (e.g., seafood fisheries, recreation) upshots. A significant number of marshes have been lost or degraded over the last 200 years as a result of urban, industrial, and agricultural development. Protective legislation enacted in the 1970's has slowed the rate of loss but marshes continue to be degraded from the invasion of exotic species, poor management practices, encroachment by development, and sea-level rise. The Mid-Atlantic region is experiencing one of the fastest growing human populations in the nation and the highest increases in sea-level that when combined forecast continued degradation of marsh habitats into the future. Information on the status and distribution of the living resources within tidal marshes are critical in plotting a course for future conservation and management.

Tidal marshes in the Mid-Atlantic Region provide essential habitat for a diverse assemblage of avian species during breeding, winter, and migration seasons. This includes numerous species of waterfowl, waterbirds, shorebirds, and landbirds that breed here or emanate from different geographic locations. Among these are a specific set of avian taxa that are entirely restricted to marshes throughout the annual cycle (hereafter "marsh birds"). Marsh bird communities are comprised of species or morphologically distinct forms that rely exclusively on marsh vegetation or the underlying substrate of marsh habitats. These marshes play an obviously increased role in regulating populations for marsh birds compared than any other species. The Mid-Atlantic region harbors nearly 68% of all tidal marshes along the Atlantic Coast and is expected to support a commensurate proportion of breeding population of marsh birds. Additionally, the geographic position of these marshes along the Atlantic Flyway migration corridor, and within the winter ranges of marsh bird populations that breed at more northern latitudes, further suggests that Mid-Atlantic marshes may be responsible for regulating marsh bird populations over broad geographic areas. Some of the species most at risk in this region are marsh birds. This includes species such as , but not limited to; Black Rail, King Rail, Sora, Least Bittern, Henslow's Sparrow, Coastal Plain Swamp Sparrow, and Seaside Sparrow.

Despite the relative importance of the Mid-Atlantic region for marsh birds, information on population research and monitoring has lagged behind other species groups. This is partly due to the difficulty in surveying marsh birds and accessing habitats where they breed. As an indication of the problem, a large number of species are referred to as "secretive marsh birds" because of their infrequent detection and use of inaccessible areas. The most basic demographic parameters for marsh birds are unknown including estimates of population density and abundance. Management prioritization has remained severely limited without this information.

The United States Department of Defense (DoD) controls nearly 9,000 ha (22,230 ac) of tidal marshes in the Mid-Atlantic Region. The extent of DoD tidal marshes in this region are entirely restricted to the Chesapeake Bay. Many of these marshes would be expected to support a number of declining breeding marsh bird populations that are recognized as regional or national conservation priorities. Improving the DoD's capacity to manage marsh bird populations can only move forward through broad scale assessment to determine the status of this valuable resource.

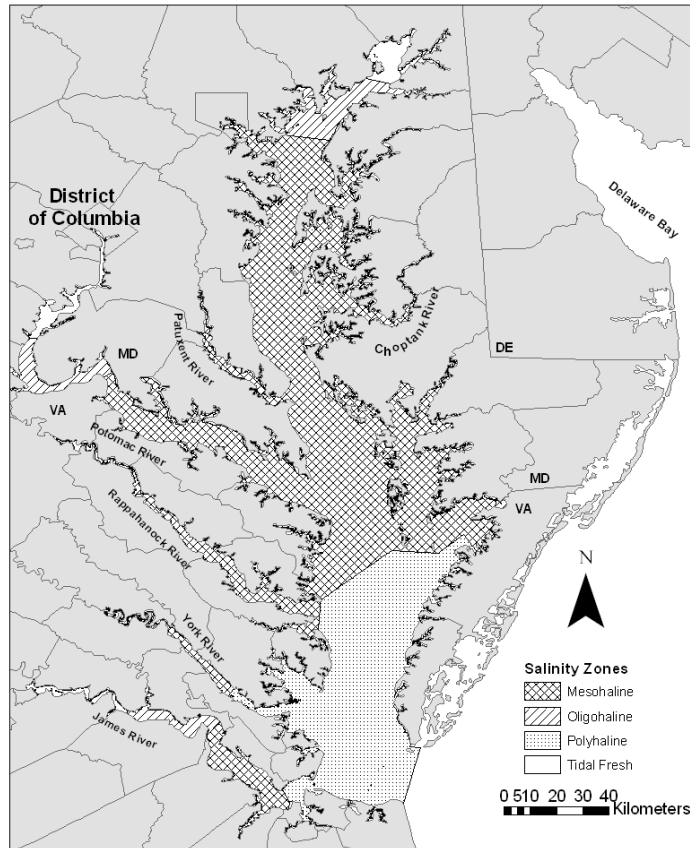
The principal objective of this report is intended to assess the tidal marsh habitats of DoD installations to formulate profiles for the distribution and abundance of marsh bird communities. Direct assessment of DoD marsh birds through field surveys and inventory are not always possible because many of the marsh habitats on military lands are restricted from access due to prior training with incendiary devices and unexploded ordinance. Additionally, it is cost prohibitive to visit every single marsh patch across the many DoD installations for marsh bird inventory purposes. However, marsh bird community profiles and population estimates of selected species can be formulated by assembling the best information known on marsh habitats and how their conditions influence marsh birds. This report formulates patch-specific marsh bird population estimates for selected species and community profiles for each installation that contains tidal marshlands.

Chesapeake Bay Marsh Systems

Marsh elevation and hydrology are the outcome of a long history of sediment deposition, water-levels, and biological interactions. Marshes can only increase in elevation where the vertical accretion of sediments on their surface is greater than the rate of sediments lost from erosion (Stevenson *et al.* 1988). Over time, marshes begin to form elevated terraces sloping upwards from the water edge and towards the terrestrial border. As marshes become elevated, plant species less tolerant of inundation begin to colonize. The final outcome of this process is the development of two distinct elevational wetland plant zones, low and high marsh, that are distinguished by the frequency and duration of tidal flooding (Cowardin *et al.* 1979).

Tidal marshes also vary in salinity, structure, and plant composition according to their geographic position in the Chesapeake Bay. Although these conditions occur as a continuum, marshes can be broadly classified into three categories based on their underlying salinity; salt marsh, brackish marsh, and freshwater/oligohaline marsh (Figure 1). Salt marsh occurs along lower portions of the Chesapeake Bay's polyhaline shoreline. These marshes ultimately give way to brackish and fresh water marshes in the lower salinity waters of the upper Chesapeake Bay and its tributaries.

Figure 1. Salinity zones of the Chesapeake Bay based on the Chesapeake Bay Program Analytical Segmentation Scheme (Data Analysis Working Group 1997).



Salt Marsh - Salt marsh is the most abundant type in the lower Chesapeake Bay. It is distributed along the immediate shoreline of the lower Chesapeake Bay and on the Chesapeake Bay Islands (both areas south of 36° 30' N) (Figure 1). Salt marshes are characterized by the presence of plant communities tolerant of salinity values of 18-30 ppt. Plant communities within salt marshes are distributed into two distinct elevation zones (low marsh and high marsh) based on tidal flood frequency and duration. The low marsh is inundated daily by normal high tides and dominated by saltmarsh cordgrass (*Spartina alterniflora*) (10 cm height) and black needlerush (*Juncus roemerianus*). The high marsh is flooded infrequently by high spring tides and storms that create a boundary between the terrestrial shoreline and the low marsh zone. The high marsh may also be found as elevated hummocks in interior portions of larger marshes. High marsh is dominated by salt meadow hay (*Spartina patens*), Olney's three-square (*Scirpus americanus*), salt grass (*Distichlis spicata*) often interspersed with shrub species such as Marsh

Elder (*Iva frutescens*) or Saltbush (*Baccharis halmifolia*). Most of the high marsh zone can be characterized as a grass-like savannah but can also contain sparsely vegetated areas on hypersaline depressions known as salt pannes.

Brackish Marsh - Brackish marsh occurs primarily within the mesohaline zone of tidal tributaries where salinity ranges from 5.0 to 18.0 ppt. Stevenson *et al.* (2000) estimates that brackish marshes cover approximately 43,953 ha. This generally occurs throughout the upper portions of the Chesapeake Bay (Maryland) and lower portions of tributaries in Virginia. Vegetation within brackish marshes is often more diverse than salt marshes and dominated by dense stands of Giant or Tall Cordgrass (*S. cynosuroides*) with Salt Meadow Hay, Olney's Three-square, and Salt Grass in the high marsh zone and a narrow fringe of Saltmarsh Cordgrass in the lower marsh zone. Black Needlerush is also a common associate of the low marsh.

Oligohaline and Tidal Freshwater Marshes - Oligohaline and freshwater marshes are distributed along shorelines of the most upper reaches of the Bay's tributaries where salinity is 0.5 to 5.0 ppt and below 0.5 ppt respectively. Oligohaline marshes are dominated by Tall Cordgrass but also are associated with plants characteristic of both brackish and freshwater marshes. Arrow-arum (*Peltandra virginica*) is a dominant plant of the lower marsh zone as is species more tolerant of higher salinities and flooding, such as Marsh Hibiscus (*Hibiscus spp.*) and Marsh Mallow (*Kosteletzkya virginica*). High marsh zones may be comprised of salt meadow hay and salt grass and are often interspersed with saltbush or marsh-elder particularly near the upland shoreline. Some oligohaline marshes contain dense colonies of Shoreline Sedge (*Carex hyalinolepis*) or Narrow-leaved Cattail (*Typha angustifolia*) (Odum *et al.* 1984).

Chesapeake Bay Marsh Bird Communities

Marsh bird communities can be generally categorized into three groups based on salinity; 1) salt marsh, 2) brackish marsh, and 3) freshwater/oligohaline marsh (Table 1). Similarly, marsh birds are segregated into two groups between low and high marsh. Marsh species also respond, based on their individual requirements, to the conditions of other physical components such as wet sloughs, mudflats, tidal creeks, floristic composition, and the upland habitat matrix.

Marsh bird communities are also organized by marsh size. In general, marsh bird diversity is positively related to marsh area (Watts 1992, 1993). Large marshes (>50 ha) are able support the entire regional suite of breeding salt marsh species. However, marshes from one to five ha may only support 50 % of the breeding species. Marshes < 1 ha in size are not able to support any salt marsh bird species (Watts 1992).

Salt Marsh Breeding Birds - The salt marsh breeding community is distinguished by a set of species that are restricted to the high marsh and a set of species that can utilize both low and high marsh (Table 1). The distribution of some high marsh species are restricted by their specifically large area requirements and high marsh availability. Black Rails, Sedge Wrens, Saltmarsh Sparrows, and Henslow's Sparrows are generally limited to marshes greater than 50 ha (Brinker and Therres 1992; Watts 1992). Only the largest concentrations of marshes in the

Table 1. Salinity and elevational associations of marsh birds in the Chesapeake Bay. Abbreviations for salinity are; s = salt marsh, br = brackish marsh, and fr = freshwater/oligohaline marsh. Abbreviations for elevation are; h = high marsh and l = low marsh. Species with more than one association have abbreviations listed in rank order of affinity.

| Species | Scientific Name | Salinity association | Elevational association |
|-----------------------------|--------------------------------------|----------------------|-------------------------|
| Pied-billed Grebe | <i>Podilymbus podiceps</i> | br, fr | l |
| American Black Duck | <i>Anas rubripes</i> | s, br, fr | h |
| American Bittern | <i>Botarus lentiginosus</i> | fr | l |
| Least Bittern | <i>Ixobrychus exilis</i> | fr, br | l |
| Common Moorhen | <i>Gallinula chloropus</i> | fr | l |
| Virginia Rail | <i>Rallus limicola</i> | s, br, fr | l |
| Clapper Rail | <i>Rallus longirostris</i> | s, br | l |
| King Rail | <i>Rallus elegans</i> | fr | l |
| Sora | <i>Porzana carolina</i> | fr, br | l |
| Black Rail | <i>Laterallus jamaicensis</i> | s, br | h |
| Willet | <i>Catoptrophorus semipalmatus</i> | s, br | h, l |
| Northern Harrier | <i>Cirus cyaneus</i> | s, br | l |
| Sedge Wren | <i>Cistothorus platensis</i> | s, br | h |
| Marsh Wren | <i>Cistothorus palustris</i> | fr, br, s | l |
| Henslow's Sparrow | <i>Ammodramus henslowii</i> | s, br | h |
| Coastal Plain Swamp Sparrow | <i>Melospiza georiana nigrescens</i> | fr, br | h |
| Saltmarsh Sparrow | <i>Ammodramus caudacutus</i> | s, br | h |
| Seaside Sparrow | <i>Ammodramus maritimus</i> | s, br | h, l |

Chesapeake Bay support high marsh patches of appropriate area (Watts 1999). Most species that use the low marsh have relatively smaller area requirements (Watts 1992, 1993). Clapper Rails and Virginia Rails reach a 50 % probability of occupation in marshes 1 ha and 5 ha, respectively. Seaside Sparrows are able to use the high and low marsh more extensively than any other marsh species. They also breed in extremely high densities, thus taken together; they are probably the most abundant marsh bird species in the Chesapeake Bay.

Brackish Marsh Breeding Birds - Brackish marsh communities represent a transition between breeding bird communities of salt marshes and freshwater/oligohaline marshes. This assemblage contains many of the same species that breed in salt marshes and a number of species that breed in freshwater/oligohaline marshes (Table 1). Distribution of individual species in brackish marshes reflects the differential tolerance to salt and associated halophytic

vegetation. The exact combination of species that co-occur in any one marsh depends on marsh size, geographic location, salinity, and available vegetative components. Dominance of Tall Cordgrass in brackish marshes provides greater vertical structure and more homogeneous horizontal cover compared to salt marshes. Species that respond positively to these changes and a reduction in salinity include the Least Bittern (*Ixobrychus exilis*), Virginia Rail, King Rail (*Rallus elegans*), Common Moorhen (*Gallinula chloropus*), and Marsh Wren.

Freshwater / Oligohaline Marsh Breeding Birds - The freshwater/oligohaline marsh bird community in the Chesapeake Bay is characterized primarily by species such as the Pied-billed Grebe, American Black Duck, King Rail, Virginia Rail, Sora, American Bittern, Least Bittern, Marsh Wren, and the Coastal Plain Swamp Sparrow.. Some of these species breed in higher saline marshes but reach their highest abundance within marshes of this type. The Chesapeake Bay is at or near the southern range limits for breeding Soras, American Bitterns, and Coastal Plain Swamp Sparrows. The Coastal Plain Swamp Sparrow is a geographically distinct subspecies of Swamp Sparrow that breeds exclusively in oligohaline marshes of the Chesapeake Bay and Delaware Bay (Beadell *et al.* 2005). In general, certain species that use tidal fresh habitats also use non-tidal emergent wetlands, impounded areas, and even wet ditches so appear to have smaller area requirements than salt marsh species. The King Rail and Least Bittern both reach 50 % incidence rates in marshes between 1 and 5 ha (Wilson and Watts, unpublished data).

Marsh Bird Status and Trends

A large proportion of the breeding marsh birds in the Chesapeake Bay are considered to be of high conservation concern (Watts 1999). Based on a relative ranking of vulnerability (Watts 1999), the suite of species that use high marsh habitats are among the most imperiled. Among these are the American Black Duck, Black Rail, Saltmarsh Sharp-tailed Sparrow, and Henslow's Sparrow. These species have small populations and breed at relatively few sites in the Chesapeake Bay. Their breeding habitats are also among the most at risk of loss and degradation. Brinker *et al.* (2002) found that King Rail in Maryland had declined in many areas where they were historically common. Beadell *et al.* (2003) determined that the Coastal Plain Swamp Sparrow had declined dramatically in the Chesapeake Bay. A targeted survey in Maryland for this globally rare form of Swamp Sparrow indicated that birds were only detected in 5 of 70 historical locations. Most notable, was the loss of breeding sites along the northern shoreline of the Potomac River.

Breeding populations of Pied-billed Grebes, American Bitterns, and Soras in the Chesapeake Bay are near the edge of these species' ranges. Populations of these species appear to be primarily scattered in small numbers along the Patuxent and Choptank rivers in Maryland (Stewart and Robbins 1958; Meanley 1975; Brinker *et al.* 2002).

Methods for Habitat Assessment and Marsh Bird Community Profiling

Marsh Habitat Assessment of Department of Defense Installations

Between 2000 and 2002 an assessment of Partners in Flight partnership lands within the mid-Atlantic Coastal Plain, including those managed by the DoD, was conducted by the Center for Conservation Biology to evaluate the status of priority bird habitats (Watts and Bradshaw 2002). The objective of this project was to summarize a partner by partner stewardship assessment so action plans could be formulated to move bird population habitat objectives among the Partners in Flight collective in an orchestrated manner.

Landcover inventory of DoD installations was conducted by interpreting digital orthophoto quarter quadrangles (DOQQs). DOQQs were the only widespread photo material to conduct such a broad analysis when this assessment was conducted. Source imagery was color-infrared with a resolution of 5m. We used ArcView 3.2 (Environmental Systems Research Institute, Inc © 1992-2000) software for all digital processing and interpretation. Digital shapefiles of property boundaries for each installation were superimposed onto DOQQs and habitats were delineated and mapped. Habitats were identified into categories that were considered critical to the conservation of priority bird species in the mid-Atlantic region. These habitats include pine savanna, barrier and bay island, salt marsh, forested wetland, mixed upland forest, early successional, pine plantation, and fresh/brackish marsh. Where possible, additional habitat subtypes were included in the assessment. Pine plantations were identified by the regular, row spacing of pine trees. Some young pine plantations could have been mistaken for shrubby patches and included in an early successional category. All habitats were mapped to the patch level. A patch is defined here as a contiguous area of relatively homogenous habitat. Patches were delineated from the surrounding landscape by hard boundaries such as roads, rivers, or homogenous areas of other habitat.

Marsh Bird Community Profiling and Population Estimates

Characterization of the marsh bird community was conducted for each DoD installation that contained tidal marsh habitat. Population sizes of selected species were calculated by projecting values of bird density and incidence rates (percentage of patches occupied) from data collected in the Chesapeake Bay (Watts 1992, 1993; Paxton and Watts 2002; Wilson and Watts, unpublished data). These values were projected over the availability of each corresponding marsh habitat type (e.g., freshwater or saltmarsh) and patch sizes required by each species as obtained from GIS coverage from the DoD habitat assessment. Where needed, additional information on marsh patches were obtained from GIS coverage in Maryland (Maryland DNR 2003) and Virginia (Center for Coastal Resources Management 1992). This method over estimates some species because it assumes constant cover across the marsh and does not take into account variation in distribution related to marsh features not measured in the GIS analysis.

Population estimates for selected species were obtained by the summation:

$$\sum_{x \in S} f(d((r * n)(s)))$$

where: S = the set of marsh patch size classes for habitats assigned to a species; 1) < one ha, 2) one to five ha, 3) five to ten ha, 4) ten to 50 ha, and 5) > 50 ha and,

$d_i = \bar{x}$ bird density (males/ha) for patch size class i

r_i = incidence rate for patch size class i

n_i = number of patches for patch size class i

$s_i = \bar{x}$ patch size for patch size class i

Population estimates could only be performed for species with the appropriate level of underlying data. For species where this level of data does not exist, only qualitative assignments were made regarding their presence / absence on each installation. The probability or level of confidence that a species occurs on a particular installation is described clearly for each installation. All data available were pooled from literature and other sources to make the best inference on the presence / absence of each species within marshes.

Results

Tidal Marsh Assessment of Department of Defense Installations

A total of 132 patches of tidal marsh habitats totaling 8,695 ha (22, 144 acres) were identified during the habitat assessment process (Table 2). Approximately 66 % of this total area was characterized as tidal fresh/oligohaline/brackish marsh and the remaining 34 % as tidal salt marsh. Individual marsh patches ranged in size from 0.4 ha to 2,726 ha (i.e., Bloodsworth Island) (Figure 2).

Marsh Bird Population Estimates

Marsh bird populations were estimated for the Clapper Rail, Virginia Rail, King Rail, Least Bittern, Marsh Wren, and Seaside Sparrow (Table 3). DoD installations are projected to support relatively large populations of these species based on how available habitat corresponds to their requirements. Seaside Sparrow were estimated to be the most numerically dominant species despite the fact that there is much less habitat available to them compared to the other species. This relatively high value reflects the notion that they occur in high densities in appropriate habitat. The range of each species estimate is quite broad and appropriate given error associated with projecting small scale patterns (density in habitat) to large scale habitat availability.

Table 2. Summary of tidal marsh area for Department of Defense Installations in the mid-Atlantic region. Tidal marsh habitat on installations is restricted to the Chesapeake Bay and its tributaries.

| DoD Installation | Number of Patches | Total Area (ha) |
|---|-------------------|-----------------|
| <u>Oligohaline - Freshwater - Brackish Tidal Marsh</u> | | |
| Aberdeen Proving Grounds | 53 | 3,426.0 |
| Blossom Point Proving Grounds, NRL | 3 | 94.5 |
| Camp Peary | 8 | 412.9 |
| Craney Island Fuel Depot | 1 | 5.8 |
| Edgewater Arsenal | 13 | 149.4 |
| Fort Eustis (Langley – Eustis) | 21 | 1,112.4 |
| Marine Corps Base Quantico | 2 | 224.5 |
| Naval Air Station Patuxent | 1 | 9.9 |
| Naval Research Lab - Chesapeake Beach | 1 | 17.4 |
| Naval Station Norfolk - Southern Annex | 3 | 8.2 |
| Naval Surface Warfare Center, Indian Head | 3 | 62.4 |
| Naval Weapons Station Yorktown | 2 | 100.2 |
| Naval Weapons Station Yorktown, Cheatham Annex | 3 | 28.0 |
| NSWC, Dahlgren Division | 4 | 137.4 |
| US Military Reserve | 1 | 0.8 |
| US Naval Shipyard, Portsmouth | 1 | 2.4 |
| US Naval Transmitter Station, Nansemond | 1 | 80.5 |
| Subtotal | 121 | 5,872.7 |
| <u>Tidal Salt Marsh</u> | | |
| Fort Monroe | 5 | 26.1 |
| Langely Air Force Base (Langley – Eustis) | 3 | 271.3 |
| Naval Air Station Patuxent, Bloodsworth Island | 3 | 2,795.3 |
| Subtotal | 11 | 3,092.7 |
| Total for all marsh types | 132 | 8,965.4 |

Figure 2. Frequency distribution of tidal marsh patch sizes on Department of Defense Installations in the mid-Atlantic region.

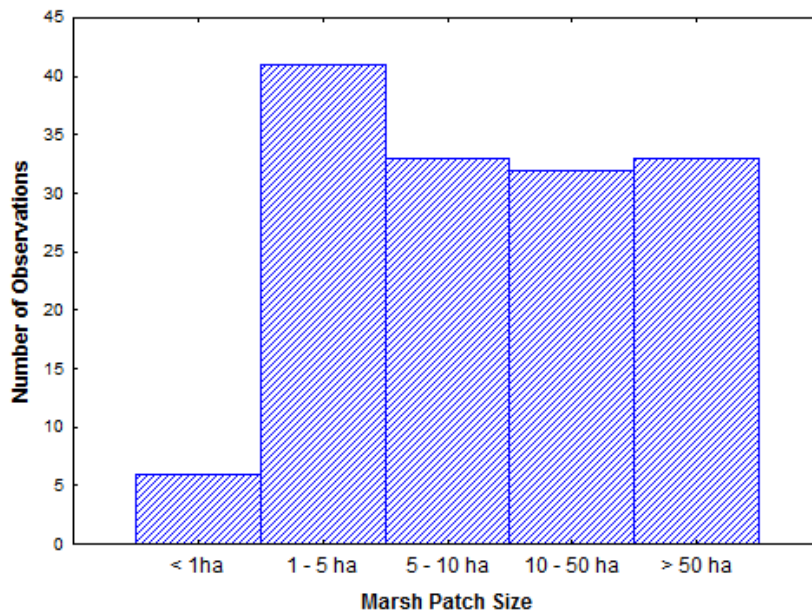
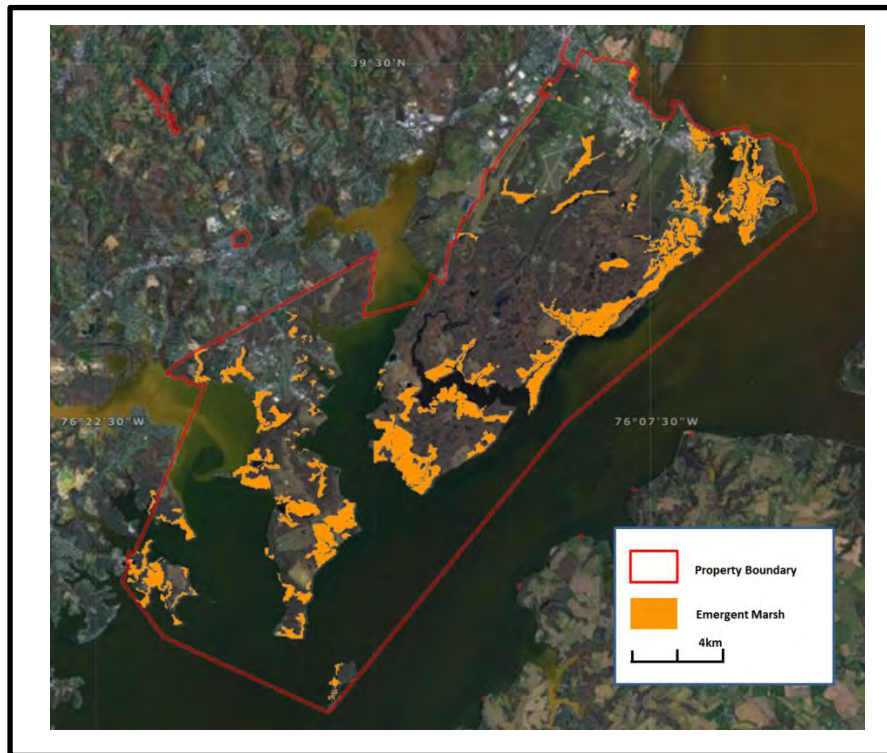


Table 3. Projected population estimates for selected marsh species in tidal marshes of Department of Defense installation in the mid-Atlantic region.

| Species | Marsh size (ha) to reach 50 % incidence | Density Range (birds / ha) | Population Estimate (based on mean density) | Range of Population Estimate (95 % conf. interval of mean) |
|-----------------|---|----------------------------|---|--|
| Clapper Rail | 1.0 | 0.62 – 1.32 | 5,167 | 3,282 – 7,003 |
| Virginia Rail | 1.0 – 5.0 | 0.19 – 0.43 | 4,286 | 2,764 – 5,693 |
| King Rail | 1.0 – 5.0 | 0.25 – 1.01 | 2,311 | 908 – 3,735 |
| Least Bittern | 1.0 – 5.0 | 0.11 – 0.76 | 1,663 | 405 – 2,810 |
| Marsh Wren | 1.0 | 0.22 – 0.85 | 3,650 | 998 – 7,223 |
| Seaside Sparrow | 1.0 – 5.0 | 2.59 – 5.01 | 11,585 | 7,692 – 15,478 |

Marsh Bird Community Profiles and Population Estimates for Individual Installations

Aberdeen Proving Grounds and Edgewater Arsenal



The Aberdeen Proving Grounds and Edgewater Arsenal are located in the oligohaline waters of the Chesapeake Bay. This installation complex supports the largest concentration of tidal marshes among all DoD installations in the mid-Atlantic region. Tidal marshes include a wide array of mixed oligohaline and freshwater plant communities that exist as a gradient from the fringe of the Chesapeake bay to lower saline areas of tidal creeks.

Table 4. Frequency distribution of marsh patch size on Aberdeen Proving Grounds and Edgewater Arsenal.

| Patch Size Category | Number of Patches | Area (ha) |
|---------------------|-------------------|-----------|
| 1-5ha | 14 | 32.3 |
| 5-10ha | 12 | 83.9 |
| 10-50ha | 11 | 287.0 |
| >50ha | 16 | 3,022.7 |
| Total | 53 | 3,425.9 |

A relatively full complement of brackish and freshwater marsh birds species are expected to occur during the breeding season at this site due to the breadth of marsh habitats available. Species such as King Rail, Virginia Rail, Least Bittern, and Marsh Wrens would be expected to occur in large populations. Other species likely to occur include the Pied-billed Grebe, American Bittern, Sora, and Northern Harrier. The Coastal Plain Swamp Sparrow was detected at two locations on Rickett’s Point peninsula by Beadell et al. (2003). The Coastal Plain Swamp Sparrow would be distributed near upland edges, and restricted to high marsh habitats dominated by shrubs such as marsh elder and saltbush.

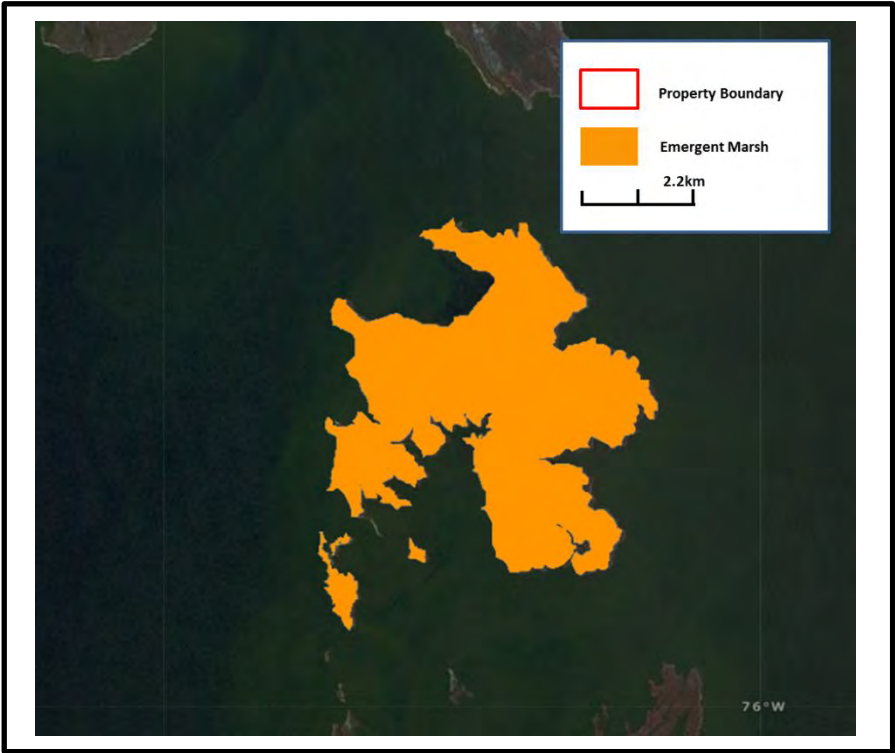
Table 5. Population estimate for selected species in tidal marshes of the Aberdeen Proving Grounds and Edgewater Arsenal.

| Species | Population Estimate (based on avg. density) | Range of estimate (95 % confidence interval) |
|---------------|--|---|
| King Rail | 2,131 | 835 - 3,443 |
| Virginia Rail | 1,709 | 1,106 - 2,279 |
| Least Bittern | 1,534 | 375 – 2,591 |
| Marsh Wren | 1,462 | 368 – 2,891 |

Marsh birds could also be expected to extend their habitat use to small, non-tidal wetlands and depression/swale areas located in open habitats. Small, narrow wetlands are regularly used by King Rail and Virginia Rails throughout their range. The large number of large grassy patches on the installation maintained as training areas provides supplementary habitat for species such as Northern Harriers and likely candidates for occupation by Henslow’s Sparrow. Similarly, although the Black Rail is typically found in salt marshes and brackish marsh, they also can occur in wet meadows and isolated wetlands. Some of the high marshes that exist in grassy savannas could support this species.

The Coastal Plain Swamp Sparrow is a globally rare form of this species that is restricted to tidal oligohaline and freshwater marshes and should receive management priority. Survey and monitoring of high elevation marsh habitats should be conducted to determine the status of this species throughout the installation. Maintaining shrubby areas in high marsh habitats is recommended to provide appropriate habitat.

Patuxent River Naval Air Test Station and Bloodsworth Island



The Patuxent Naval Air Test station contains only 1 tidal marsh that is narrow and long in shape (southeast of airfield). The installation also contains several non-tidal emergent marshes. Taken together, these patches may provide habitat for species such as Clapper Rail, Virginia Rail, King Rail, Least Bittern, and Marsh Wren. It is possible for King Rails to occupy the small non-tidal freshwater marshes during the breeding season.

Bloodsworth Island is dominated by black needlerush with smaller patches saltmarsh cord grass and and small patches of higher elevation areas composed of salt-meadow hay and saltgrass (Department of Navy 2006). Chesapeake Bay marsh islands are generally more susceptible to inundation from sea-level rise compared to marshes fringing the mainland because of lower sediment delivery rates. The marsh bird community of Bloodsworth Island is likely composed of species frequently found in salt marshes. Abundant species would include the Clapper Rais, Virginia Rail, Marsh Wren, and Seaside Sparrows. Small populations of the Saltmarsh Sparrow and Black Rail could occur in the high marsh patches of the island.

Table 6. Frequency distribution of marsh patch sizes of the Patuxent River Naval Air Test Station and Bloodsworth Island.

| Patch Size Category | Number of Patches | Area (ha) |
|---------------------|-------------------|-----------|
| 1-5ha | - | - |
| 5-10ha | 2 | 16.3 |
| 10-50ha | - | - |
| >50ha | 2* | 2,788.9 |
| Total | 4 | 2,805.2 |

*Bloodsworth Island marshes

Table 7. Population estimate for selected marsh species on Bloodsworth Island.

| Species | Population Estimate (based on avg. density) | Range of estimate (95 % confidence interval) |
|-----------------|--|---|
| Clapper Rail | 2,990 | 1,900 – 4,053 |
| Virginia Rail | 1,423 | 921 – 1,898 |
| Marsh Wren | 1,201 | 355 – 2,375 |
| Seaside Sparrow | 10,482 | 6,960 – 14,004 |

Indian Head Naval Support Facility and Stump Neck Annex

Indian Head NSF resides within the oligohaline zone of the Potomac River. Indian Head marshes are represented by brackish plant communities. The three marsh patches on this installation provide habitat for King Rail, Virginia Rail, Sora, Least Bittern, and Marsh Wren during the breeding season.

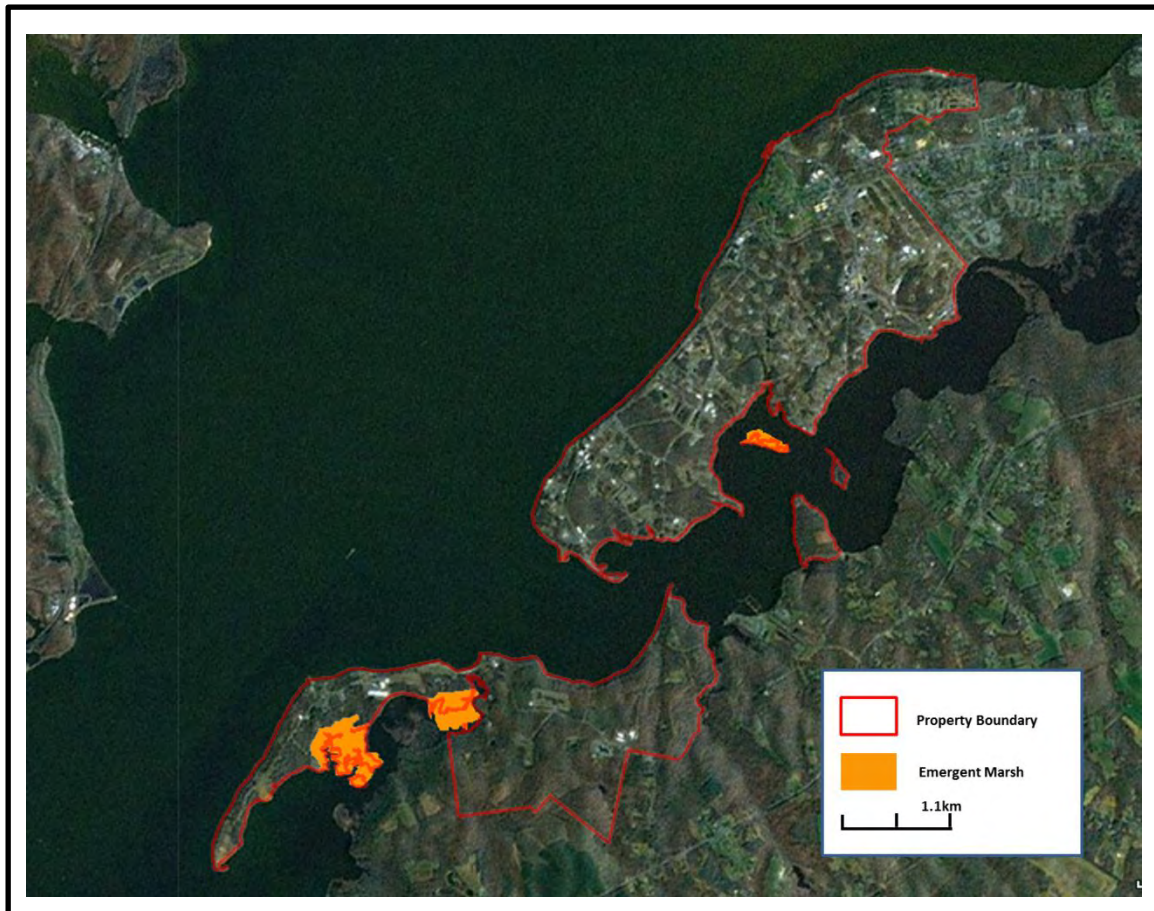


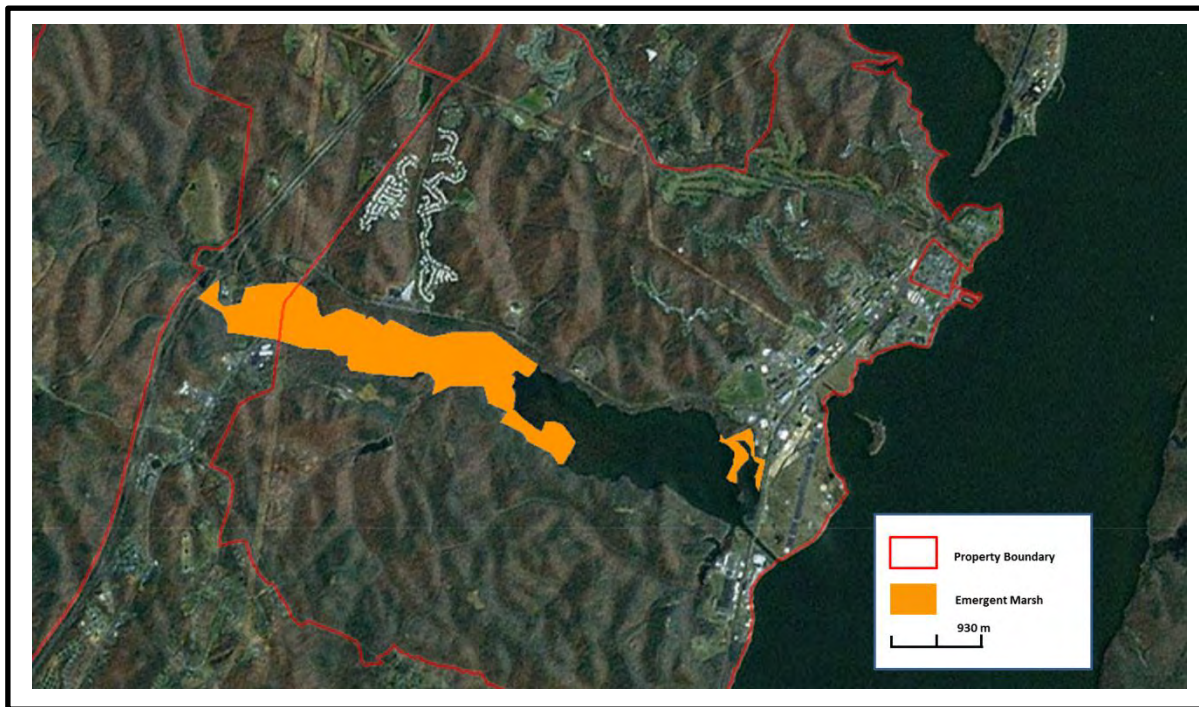
Table 8. Frequency distribution of marsh patch sizes of the Indian Head NSWC.

| Patch Size Category | Number of Patches | Area (ha) |
|---------------------|-------------------|-----------|
| 1-5ha | - | - |
| 5-10ha | 1 | 6.8 |
| 10-50ha | 2 | 91.6 |
| >50ha | - | - |
| Total | 3 | 97.4 |

Table 9. Population estimate for selected marsh species on Indian Head NWSC complex.

| Species | Population Estimate (based on avg. density) | Range of estimate (95 % confidence interval) |
|---------------|--|---|
| King Rail | 38 | 15 - 63 |
| Virginia Rail | 40 | 19 - 30 |
| Least Bittern | 28 | 6 - 47 |
| Marsh Wren | 26 | 10 - 53 |

Quantico – Marine Corps Base

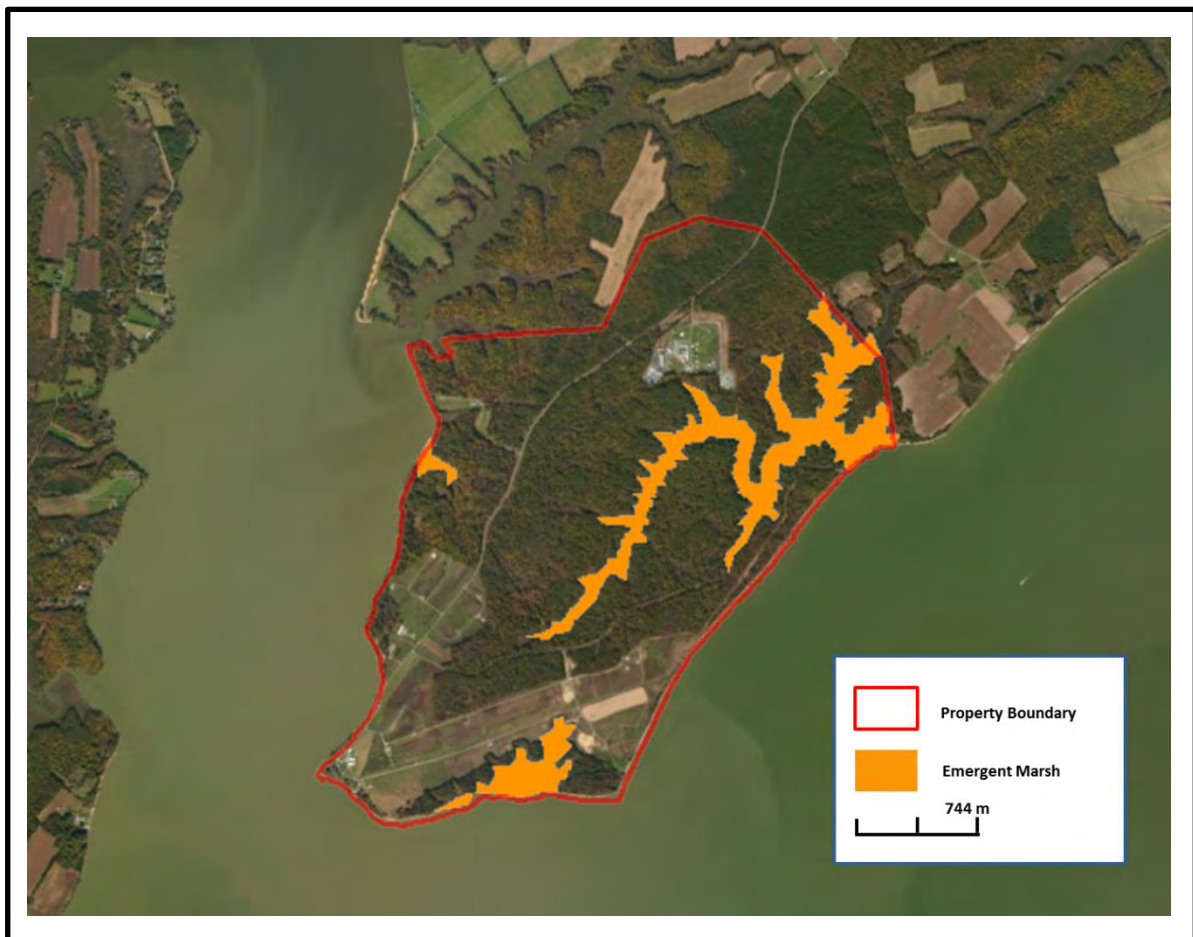


The Quantico Marine Corp Base contains a complex of marshes along Chopawamsic creej that was historically dominated by yellow pond lily (Center for Coastal Resources Management 1992). This creek feeds into the Potomac River. In general this habitat alone does not provide quality habitat for marsh birds because it lacks tall marsh grasses for foraging, and very little dry substrate for nesting.

Table 10. Frequency distribution of marsh patch sizes of the Quantico Marine Corps Base.

| Patch Size Category | Number of Patches | Area (ha) |
|---------------------|-------------------|-----------|
| 1-5ha | - | - |
| 5-10ha | - | - |
| 10-50ha | 1 | 11.3 |
| >50ha | 1 | 213.1 |
| Total | 2 | 224.2 |

Blossom Point Research Facility



The Blossom Point Research Facility is located in the oligohaline zone of the Potomac River. Marshes are dominated by cattails, sedges, and phragmites. Marsh patches on the north end of the installation are surrounded by forested wetland and upland forest. The southernmost marsh is adjacently positioned to a thin forest line and an open, grassy area.

The breeding marsh bird community of this installation is likely represented by King Rail, Virginia Rail, Least Bittern, and Marsh Wren. Because of the dense cattail cover, it is possible that this site also supports the American Bittern.

Table 11. Frequency distribution of marsh patch sizes of the Blossom Point Research Facility.

| Patch Size Category | Number of Patches | Area (ha) |
|---------------------|-------------------|-----------|
| 1-5ha | 1 | 2.8 |
| 5-10ha | - | - |
| 10-50ha | 1 | 16.7 |
| >50ha | 1 | 74.9 |
| Total | 1 | 94.4 |

Table 12. Population estimate for selected marsh species on the Blossom Point Research Facility.

| Species | Population Estimate (based on avg. density) | Range of estimate (95 % confidence interval) |
|---------------|--|---|
| King Rail | 58 | 22 - 93 |
| Virginia Rail | 46 | 30 - 62 |
| Least Bittern | 41 | 10 - 70 |
| Marsh Wren | 39 | 21 - 78 |
| | | |

Dahlgren Naval Surface Weapons Center

Dahlgren NWSC is located in the transitional area between mesohaline and oligohaline zones of the Potomac River. Because of this, marshes can exhibit a range of vegetation conditions including marshes dominated by cattails, mixed brackish plant communities, or those dominated by big cordgrass (Moore 1981). Large areas of high marsh, dominated by mallow and hibiscus are found on the southernmost marsh.

Marsh birds of this installation include King Rail, Virginia Rail, Least Bittern, Northern Harrier, and Marsh Wren. There is also potential for this installation to support a population of Sora. Based on the geographic location, and the high amount of high marsh habitat, this site should be monitored for the presence of the Coastal Plain Swamp Sparrow.

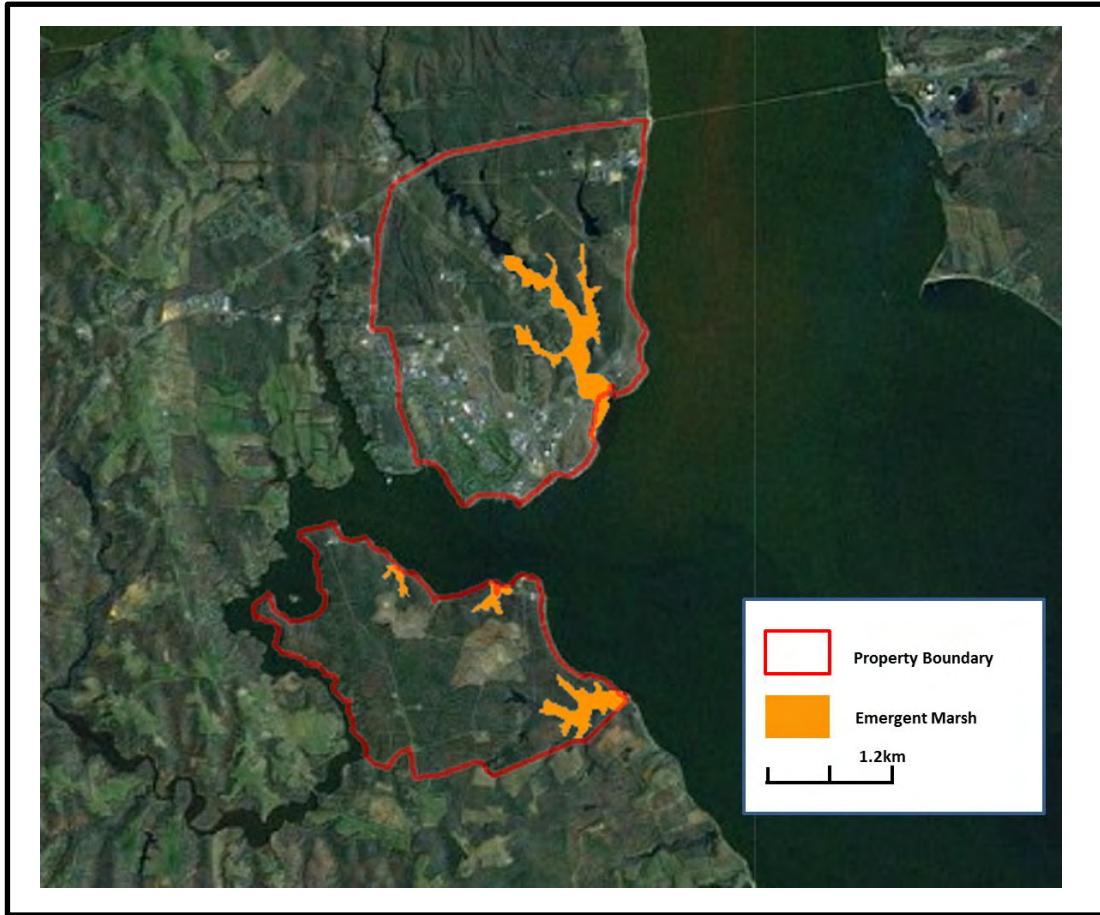


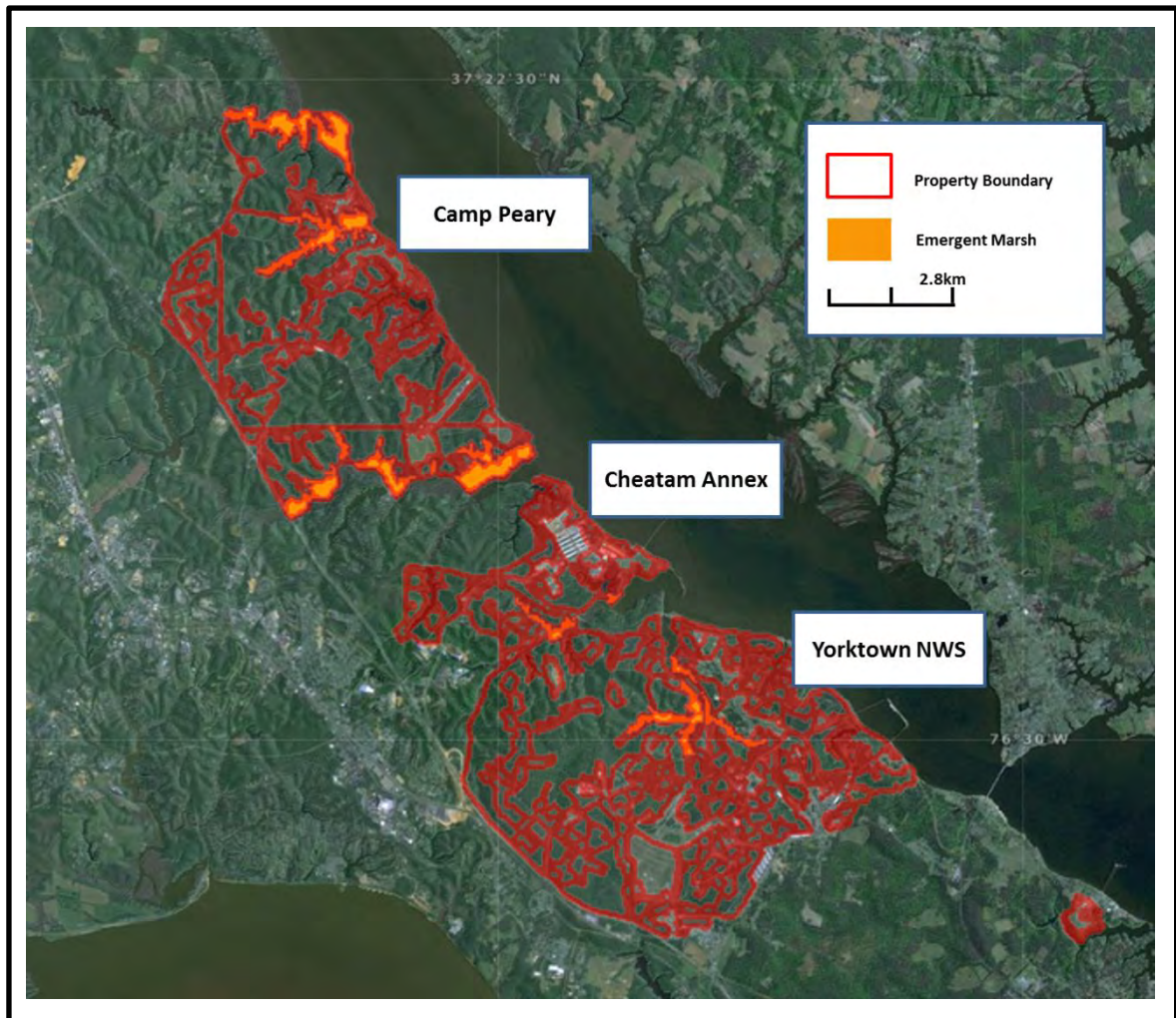
Table 13. Frequency distribution of marsh patch sizes of the Dahlgren NSWC.

| Patch Size Category | Number of Patches | Area (ha) |
|---------------------|-------------------|-----------|
| 1-5ha | - | - |
| 5-10ha | 1 | 4.6 |
| 10-50ha | 1 | 8.8 |
| >50ha | 1 | 36.9 |
| Total | 1 | 50.3 |

Table 14. Population estimate for selected marsh species on the Dahlgren NSWC.

| Species | Population Estimate (based on avg. density) | Range of estimate (95 % confidence interval) |
|---------------|--|---|
| King Rail | 84 | 36 - 136 |
| Virginia Rail | 65 | 42 - 87 |
| Least Bittern | 60 | 14 - 102 |
| Marsh Wren | 57 | 22 - 113 |
| | | |

Camp Peary, Yorktown Naval Weapons Station, and Cheatam Annex



Camp Peary and the Yorktown Weapons Station are located in the polyhaline zone of the York River in Virginia. Most of the tidal marshes in this complex are dominated by saltmarsh cordgrass (Silberhorn 1974) except in some locations when moving up reaches of tidal creeks where vegetation transitions to mixed brackish plant communities. The marshes on the installations are situated along a continual chain of marshes that begin at the mouth of the Chesapeake Bay upstream along the York River.

The community of marsh birds within this three installation complex is represented by birds that use salt marshes. The Clapper Rail, Virginia Rail, Marsh Wren are likely distributed throughout the marsh covered area. In addition, the Willet could occur where higher elevation areas are present.

Table 15. Frequency distribution of marsh patch sizes of Camp Peary

| Patch Size Category | Number of Patches | Area (ha) |
|---------------------|-------------------|-----------|
| 1-5ha | 2 | 4.0 |
| 5-10ha | 1 | 8.0 |
| 10-50ha | 2 | 90.4 |
| >50ha | 3 | 310.3 |
| Total | 8 | 412.7 |

Table 16. Population estimate for selected marsh species on Camp Peary.

| Species | Population Estimate (based on avg. density) | Range of estimate (95 % confidence interval) |
|---------------|--|---|
| Clapper Rail | 440 | 280 - 597 |
| Virginia Rail | 206 | 133 - 275 |
| Marsh Wren | 176 | 28 - 348 |
| | | |

Table 17. Frequency distribution of marsh patch sizes of the Yorktown Naval Weapons Station and Cheatam Annex.

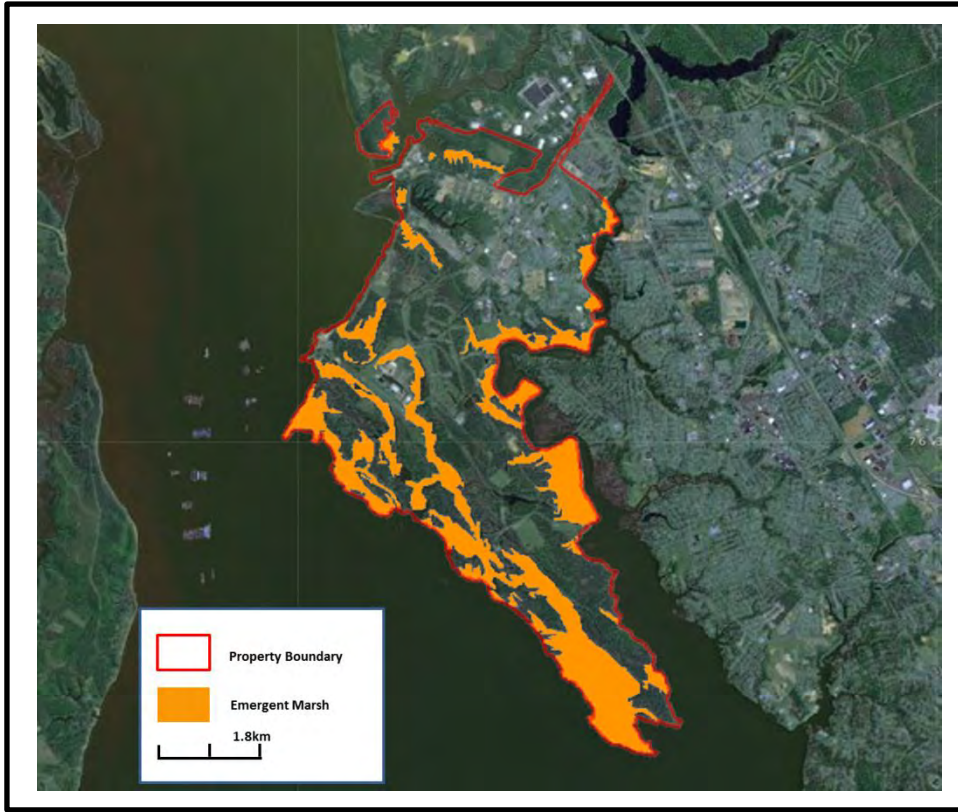
| Patch Size Category | Number of Patches | Area (ha) |
|---------------------|-------------------|-----------|
| 1-5ha | 3 | 16.4 |
| 5-10ha | | |
| 10-50ha | 1 | 20.4 |
| >50ha | 1 | 91.6 |
| Total | 5 | 128.40 |

Table 18. Population estimate for selected marsh species on Yorktown Naval Weapons Station and Cheatam Annex

| Species | Population Estimate (based on avg. density) | Range of estimate (95 % confidence interval) |
|---------------|--|---|
| Clapper Rail | 134 | 85 - 182 |
| Virginia Rail | 58 | 37 - 78 |
| Marsh Wren | 52 | 23 - 103 |
| | | |

Fort Eustis (Langley – Eustis)

Fort Eustis (Langley-Eustis) is located in the mesohaline zone of the James River. The marshes on Mulberry Island that border the James River are dominated by black needlerush (Moore 1977). Other marshes are contain mixed brackish plant communities that contain a dominance of saltmarsh cordgrass and black needlerush to a lesser extent. There are numerous pockets of high marsh containing salt meadow hay and scattered shrubs of saltbush and wax myrtle.



This installation supports a typical salt marsh / brackish marsh bird community that includes the Clapper Rail, Virginia Rail, and Marsh Wren. High marsh patches were surveyed for the presence of the Black Rail in 2007 but was not detected (Wilson et al. 2009).

Table 19. Frequency distribution of marsh patch sizes of Fort Eustis

| Patch Size Category | Number of Patches | Area (ha) |
|---------------------|-------------------|-----------|
| 1-5ha | 3 | 7.6 |
| 5-10ha | 5 | 35.2 |
| 10-50ha | 8 | 181.7 |
| >50ha | 5 | 888.0 |
| Total | 21 | 1,112.5 |

Table 20. Population estimate for selected marsh species on Fort Eustis

| Species | Population Estimate (based on avg. density) | Range of estimate (95 % confidence interval) |
|---------------|--|---|
| Clapper Rail | 1,188 | 755 – 1,610 |
| Virginia Rail | 554 | 358 - 739 |
| Marsh Wren | 475 | 122 - 940 |

Langley Air Force Base

Langley Air Force Base is located on the Back River that flows outwards over a distance of only 2 km away into the mainstem of the Chesapeake Bay. The installation’s marshes form an integral part of a collection of marshes in branches of the Back River to the mouth of the Chesapeake Bay. Tidal marshes are composed of salt and mixed brackish communities dominated by saltmarsh cordgrass. There are several expansive high marshes dominated by salt meadow hay and salt bush. Many of the marsh patches on Langley Air Force base are highly vulnerable to loss from sea-level rise because of the geographic position near the Bay proper, and because many adjacent upland areas are developed. Impermeable surfaces such as roads, and parking lots, and buildings are positioned directly adjacent to existing marsh patches. Hard surfaces will prevent many marshes from migrating across land with rising sea levels. High Marshes are particularly susceptible to sea level increases and will likely be transformed into low marsh before being squeezed out against hardened shorelines.

The marshes of this installation support typical salt marsh bird communities that include species such as Clapper Rail, Virginia Rail, Willet, Marsh Wren, and Seaside Sparrow. The Saltmarsh Sparrow is not known to occur there, however surveys should be conducted to determine its presence in the many high marsh zones available here.

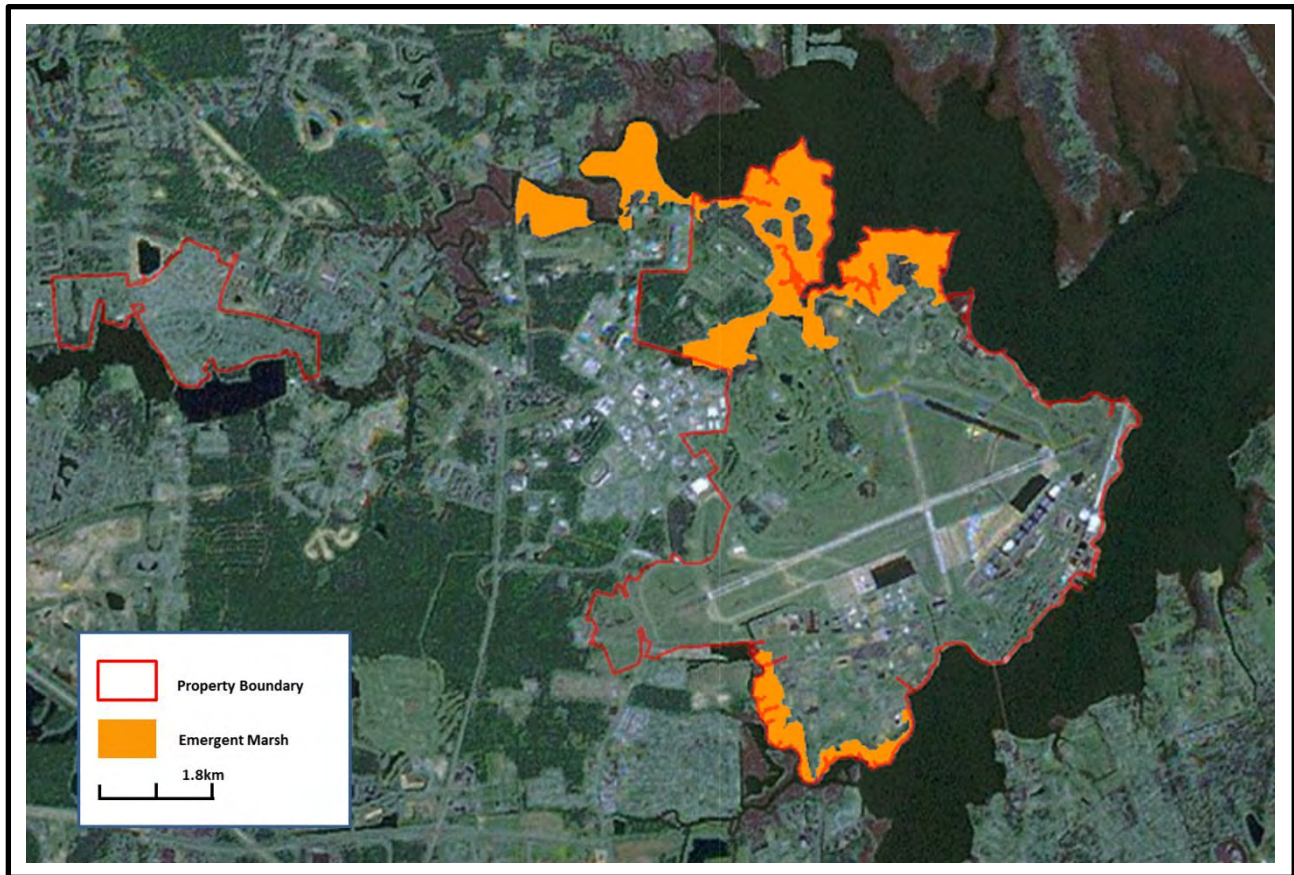


Table 21. Frequency distribution of marsh patch sizes of the Langley Air Force Base

| Patch Size Category | Number of Patches | Area (ha) |
|---------------------|-------------------|-----------|
| 1-5ha | - | - |
| 5-10ha | - | - |
| 10-50ha | 2 | 63.4 |
| >50ha | 1 | 208.0 |
| Total | 3 | 273.4 |

Table 22. Population estimate for selected marsh species on Langley Air Force Base

| Species | Population Estimate (based on avg. density) | Range of estimate (95 % confidence interval) |
|-----------------|--|---|
| Clapper Rail | 290 | 184 – 393 |
| Virginia Rail | 138 | 89 - 184 |
| Marsh Wren | 116 | 35 - 230 |
| Seaside Sparrow | 1,017 | 675 – 1,359 |

Fort Monroe



Fort Monroe is located on the mainstem of the Chesapeake Bay so resides in a polyhaline salinity zone. Marsh patches are distributed in Mill Creek, an embayment shielded from the Chesapeake Bay by Old Point Comfort peninsula. The tidal salt marshes of Fort Monroe are dominated by saltmarsh cordgrass with about 30 % of the marsh area at higher elevation and covered by saltmeadow hay (Center for Coastal Management Resources 1992). These marshes are highly vulnerable to sea level rise because of their proximity to the bay, associated low topography, and adjacent hardened area of the installation.

Marshbirds at Fort Monroe include the Clapper Rail, Virginia Rail, Marsh Wren, and Seaside Sparrow. Willets likely breed in low numbers on the installation as well. Although Fort Monroe lies south of the known range of the Saltmarsh Sparrow, the relatively large quantity of high marsh available should be monitored for any presence of this species.

Table 23. Frequency distribution of marsh patch sizes of Fort Monroe

| Patch Size Category | Number of Patches | Area (ha) |
|---------------------|-------------------|-----------|
| 1-5ha | 2 | 3.0 |
| 5-10ha | 3 | 23.1 |
| 10-50ha | - | - |
| >50ha | - | - |
| Total | 5 | 26.1 |

Table 24. Population estimate for selected marsh species on Fort Monroe

| Species | Population Estimate (based on avg. density) | Range of estimate (95 % confidence interval) |
|-----------------|--|---|
| Clapper Rail | 27 | 17 – 36 |
| Virginia Rail | 6 | 3 - 7 |
| Marsh Wren | 10 | 2 -20 |
| Seaside Sparrow | 86 | 57 - 115 |

Craney Island Fuel Depot (U.S. Naval Reservation)



The Craney Island Fuel Depot is located on the Elizabeth River in Virginia. This installation supports a fringing marsh dominated by saltmarsh cordgrass. This patch has low value for salt marsh birds because of its small size, and relative isolation from other marshes in the immediate vicinity. The Clapper Rail and Marsh Wren are the only two species that would be predicted to be present with any confidence.

Table 25. Frequency distribution of marsh patch sizes of Craney Island Fuel Depot.

| Patch Size Category | Number of Patches | Area (ha) |
|---------------------|-------------------|-----------|
| 1-5ha | - | - |
| 5-10ha | 1 | 5.8 |
| 10-50ha | - | - |
| >50ha | - | - |
| Total | 1 | 5.8 |

Table 26. Population estimate for selected marsh species on the Craney Island Fuel Depot.

| Species | Population Estimate (based on avg. density) | Range of estimate (95 % confidence interval) |
|--------------|--|---|
| Clapper Rail | 6 | 3 - 8 |
| Marsh Wren | 2 | 0 - 4 |

Norfolk Naval Air Station South Annex and New Gosport, and U.S. Naval Shipyard - Portsmouth



The marshes of this installation complex are located on Paradise Creek, just west of the Elizabeth River. These relatively, narrow fringing salt marshes are dominated by saltmarsh cordgrass (Center for Coastal Management Resources 1992). These marshes do not provide quality habitat for marshbird communities because of their small size and the fact that they are

surrounded by human development. Typically, marshes in high intensity development have lower diversity and bird abundance. The probability of occupation by marsh birds is low for marshes within this complex of installations. Only the Clapper Rail has a high enough probability to consider a population estimate for this site.

Table 27. Frequency distribution of marsh patch sizes of Norfolk Naval Air Station South Annex and New Gosport and the U.S. Naval Shipyard – Portsmouth.

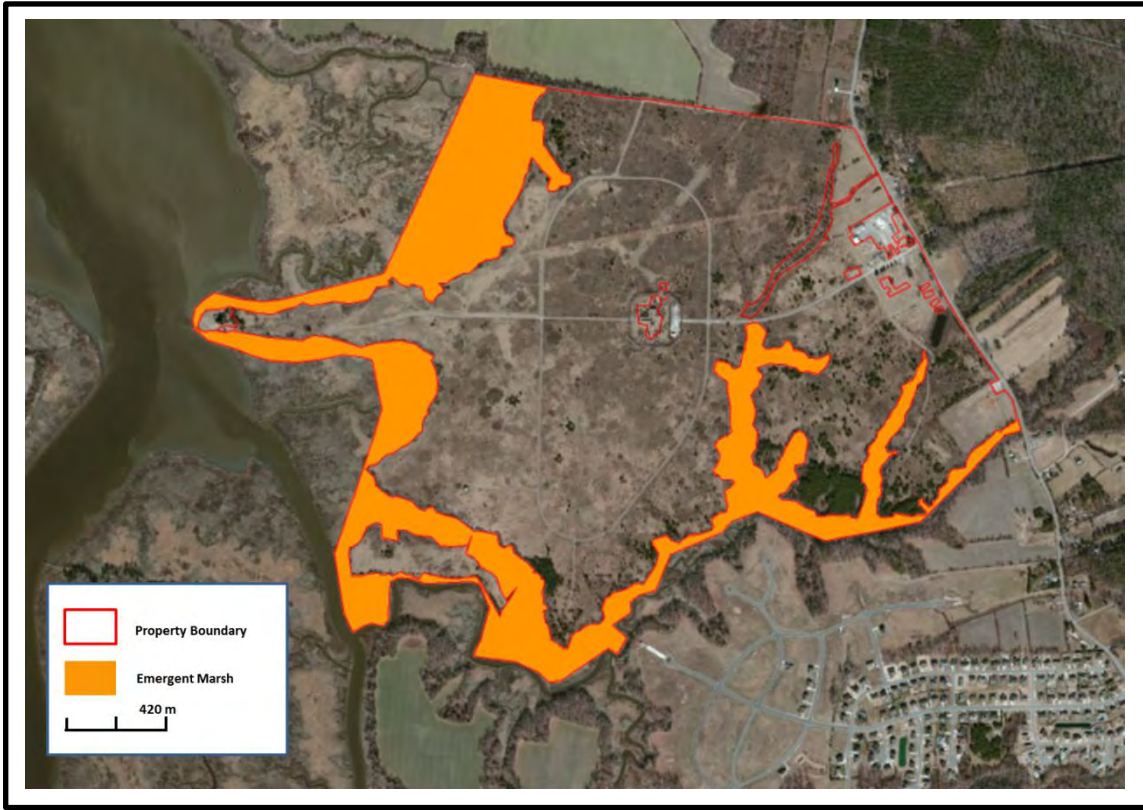
| Patch Size Category | Number of Patches | Area (ha) |
|---------------------|-------------------|-----------|
| 1-5ha | 5 | 12.7 |
| 5-10ha | - | - |
| 10-50ha | - | - |
| >50ha | - | - |
| Total | 5 | 12.7 |

Table 28. Population estimate for selected marsh species on Norfolk Naval Air Station South Annex and New Gosport and the U.S. Naval Shipyard – Portsmouth.

| Species | Population Estimate (based on avg. density) | Range of estimate (95 % confidence interval) |
|--------------|--|---|
| Clapper Rail | 6 | 4 - 8 |

Naval Transmitter Station - Nansemond

The Nansemond Naval Transmitter Station is located along the Nansemond River in southeastern Virginia. The property boundaries only include a part of a much larger complex of salt marshes. Salt marshes are dominated by saltmarsh cordgrass and a significant area is composed of higher elevation salt meadow hay community (Center for Coastal Resources Management 1992).



Salt marsh birds expected to occur at this installation include the Clapper Rail, Virginia Rail, and Marsh Wren. The large amount of high marsh in association with open grassland that is immediately adjacent to these marshes would also increase the chances of Northern Harrier at this site. The high marsh area of this installation was surveyed in 2008 to determine the status of the Black Rail using a special technique for this species but no birds were detected (Wilson et al. 2009)

Table 30. Frequency distribution of marsh patch sizes of Nansemond Naval Transmitter Station.

| Patch Size Category | Number of Patches | Area (ha) |
|---------------------|-------------------|-----------|
| 1-5ha | - | - |
| 5-10ha | - | - |
| 10-50ha | - | - |
| >50ha | 1 | 80.0 |
| Total | 1 | 80.0 |

Table 31. Population estimate for selected marsh species at the Nanesmond Naval Transmitter Station.

| Species | Population Estimate (based on avg. density) | Range of estimate (95 % confidence interval) |
|---------------|--|---|
| Clapper Rail | 86 | 54 - 116 |
| Virginia Rail | 41 | 26 - 54 |
| Marsh Wren | 34 | 12 - 68 |

Summary of Marsh Bird Threats and Management Considerations

The loss of marsh habitat from sea-level rise likely poses the greatest long-term threat to marsh birds in the Chesapeake Bay and throughout the mid-Atlantic region. The Chesapeake Bay is undergoing a rise in sea-level at twice the global rate (Kearney 1996). As sea levels rise, one way marshes can keep pace with rising waters is moving landward to claim adjacent upland areas. However, the hardening of adjacent area with impermeable surfaces such as roads, parking lots, and buildings prevents the landward transgression of marshes that will essentially squeeze marshes out of existence. Similarly, the hardening of shorelines with bulkheads, rip-raps, and reventments to halt rising waters can disrupt sediment delivery that marshes require to maintain elevation above regular tides. A high percentage of marshes on DoD installations appear to remain unabated to landward movement. A smaller number of marshes are located adjacent to sites with impermeable surfaces and likely will be lost in the future. The prevention of hardening surfaces on both the water and landward side of marshes is required to maintain them into the future.

The influence of sea-level rise on wetland changes is spatially variable throughout the Chesapeake Bay. Salt marshes are generally more susceptible to loss and transformation from rising sea-level compared to oligohaline – freshwater marshes due to the location relative to the mainstem of the Bay and associated accretion rates that may keep pace with water level increases. The Bay island marshes (such as Bloodsworth Island) are considered the most threatened because they do not accrete sediments at the same rate as marshes along tributaries. Overall, sea-level rise is predicted to create a net-loss in tidal marshes of the Bay. Moreover, projections indicate a state change where an overwhelmingly amount of high salt marsh areas become inundated and transformed to low marsh. Because of this, species that rely on the high marsh are some of the most threatened by sea-level rise. Where present, high marsh areas should be allowed to migrate into the uplands by maintaining natural habitats in areas adjacent to these marshes.

Another leading threat to marsh bird communities is the rapid spread of the invasive common reed (*Phragmites australis*). *Phragmites* is a noxious, fast growing plant that can quickly dominate marshes after invading by usurping native marsh plants for space and nutrients. *Phragmites* invasion is commonly associated with disturbed marshes, dredge material areas, and artificially constructed wetlands. The plant seems most successful at colonizing the high marsh due to its preference for areas that are irregularly flooded. Based on historical rates of invasion, significantly large portions of marshes could be transformed within the next few decades. Marsh bird abundance and diversity responds negatively to *Phragmites* colonization (Paxton and Watts 2002) indicating a need to prevent continued invasion. However, methods to control *Phragmites* are typically short lasting and not successful over the long term. A primary management recommendation for control is to prevent physical disturbance to marshes that promotes *Phragmites* colonization. Special consideration for *Phragmites* control should be undertaken in areas where rare high marsh species exist. Monitoring the condition of areas where the globally rare Coastal Plain Swamp Sparrow occurs is certainly a must for proactive conservation of this species form. Coastal Plain Swamp Sparrows are known to occur within high marsh zones of the Aberdeen Proving Grounds. These marshes should be made a priority for conservation and management.

The influence of nest predators on the demography of marsh birds is poorly known in the Chesapeake Bay. Nest predation is considered to be a leading factor contributing to the population decline of American Black Ducks and its effect on other species is often suggested to be significant. Species that use the high marsh may be particularly susceptible nest predation due to the the proximity of these habitats to upland populations of mammalian predators, such as raccons (*Procyon lotor*), and the general ease for predators to traverse the drier high marsh. Studies on the nest predation rates of marsh birds in the mid-Atlantic are recommended to provide insight on whether management intervention is needed.

The effect of management practices on marsh bird communities is poorly known. The use of prescribed fire to control vegetative condition of marshes is a growing practice. The burning of marshes during the breeding season can destroy nests and young. Likewise, burning just prior to the breeding season can remove required nesting and foraging cover. Most marsh grasses regrow quickly after fire but regrowth of shrubby vegetation required by many high marsh species may take an entire season or longer. Burning of shrubby vegetation can negatively affect high marsh species such as the Black Rail, Coastal Plain Swamp Sparrow, Saltmarsh Sparrow, and Henslow's Sparrow if conducted at the wrong time. More research is needed to understand best management practices for the timing and frequency of prescribed fire and other vegetation control techniques.

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