Historical Analysis and Map of Vegetation Communities, Land Covers, and Habitats of Ted Harvey Wildlife Area Kent County, Delaware

St. Jones River Watershed

Submitted to:

Delaware Natural Heritage and Endangered Species Program
Delaware Division of Fish and Wildlife
4876 Hay Point Landing Road
Smyrna, DE 19977

Completed by:

Robert Coxe, Ecologist

Delaware Natural Heritage and Endangered Species Program
Wildlife Section, Delaware Division of Fish and Wildlife
Department of Natural Resources and Environmental Control
4876 Hay Point Landing Road
Smyrna, DE 19977

July 30, 2012

Table of Contents

CHAPTER 1: INTRODUCTION AND METHODS

Setting of Ted Harvey Wildlife Area

Ted Harvey Wildlife Area is located in eastern Kent County, Delaware (Figure 1.1). The wildlife area is comprised of four tracts comprising a total of 2,587 acres. All of the tracts; Buckaloo Tract (257 acres), Island Farm (233 acres), Logan Lane Tract (1,875 acres), and Roberts Tract (222 acres) are located in the St. Jones River watershed (Figure 1.1).

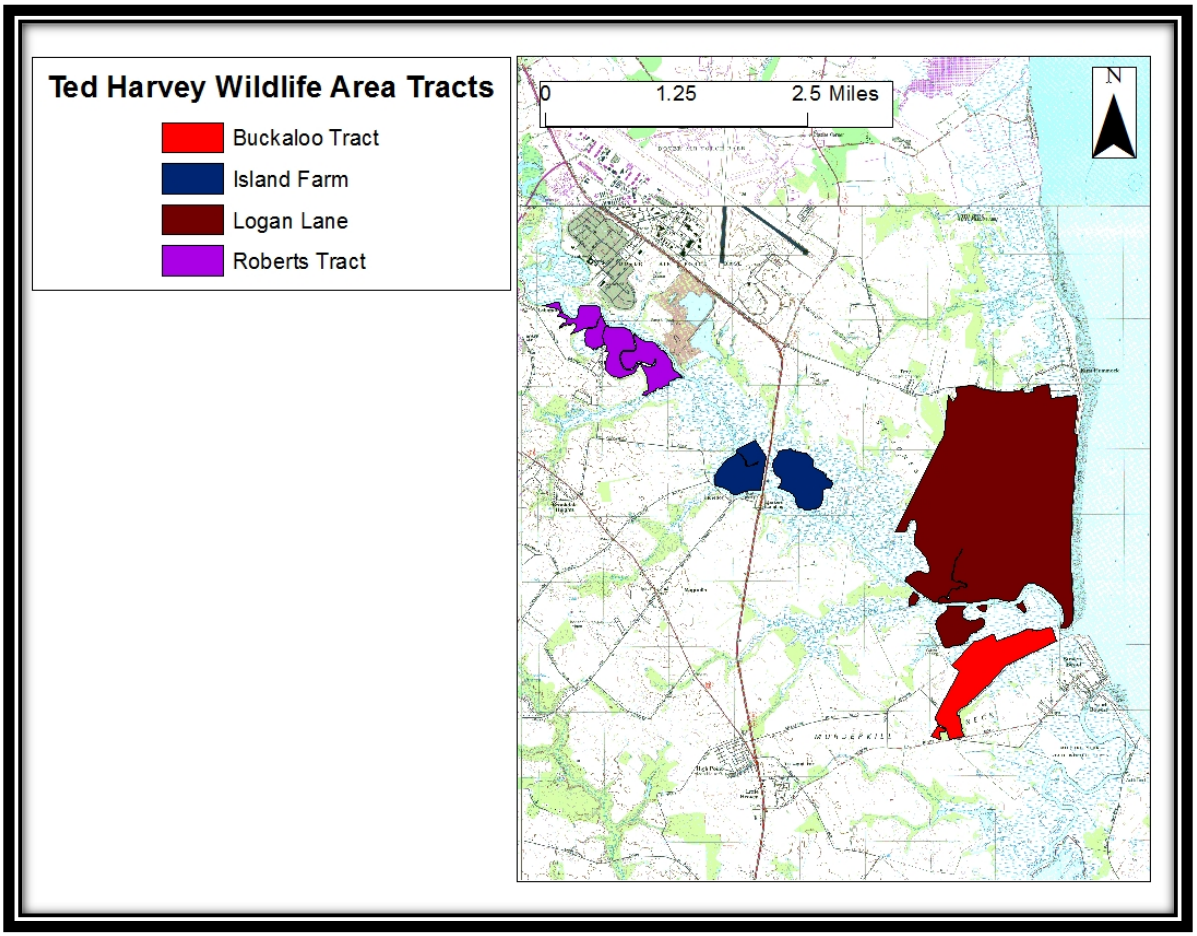


Figure 1.1. Tracts at Ted Harvey Wildlife Area

History and Formation of Ted Harvey Wildlife Area

Early History of the Land

The land that is now Ted Harvey Wildlife Area was first surveyed in 1679 by Cornelius Verhoofe. The surveyed land became the settlement of Towne Point and was 140 acres in size. Edward Pack and John Briggs were the first settlers. John Briggs lived at Kingston upon Hull, a structure still standing today. Edward Pack, a Justice of the Peace, held court at his house in the then St. Jones County, later to become Kent County.

Later in the 1700's the land was acquired by John Dickinson who used it for farming and forestry products. The land remained in the hands of Dickinson descendants, the Logans, until the mid-1900's.

Formation of Ted Harvey Wildlife Area

Ted Harvey was acquired in 1979 as part of a package along with Milford Neck and Nanticoke Wildlife areas. Most of the land that is now part of Ted Harvey Wildlife Area, excluding the Buckaloo and Roberts Tracts, was owned Delaware Wildlands, who was conveyed the property by "Reds" Lofland of the American Antivivisection Society[1].

Soils and Geology of Ted Harvey Wildlife Area

Underlying Geology

Most of Ted Harvey Wildlife Area is underlain by the Scotts Corner Formation. The northwest corner is underlaid by Carolina Bay Deposits. The marshes are underlaid by Marsh Deposits, while the immediate shoreline is composed of Shoreline Deposits, both of which are from the Holocene Period[2].

Soil

Four soils are prominent in the Wildlife Area including Transquaking and Mispillion Soils (in marshes), Nassawango Silt Loam, Sunken Mucky Silt Loam, and Downer Sandy Loam. Other minor soils include Corsica Mucky Loam, Acquango-Beaches Complex, Mattapex Silt Loam, Rosedale Loamy Sand, and Downer Loamy Sand. Elevations range from sea level at the St. Jones River to 20 feet near Kitts Hummock Road at Ted Harvey Wildlife Area.

[1] Jones, William. 2001. Ted Harvey Wildlife Area Five Year Management Plan. Delaware Division of Fish and Wildlife. Unpublished report.
[2] Ramsey, Kelvin W. 2007. Geologic Map of Kent County, Delaware. Delaware Geological Survey. Geological Map Series No. 14.

Buckaloo Tract Soils

Transquaking and Mispillion Soils is the prominent soil in the Buckaloo Tract. Other minor soils include Ingleside Loamy Sand and Sunken Mucky Loam.

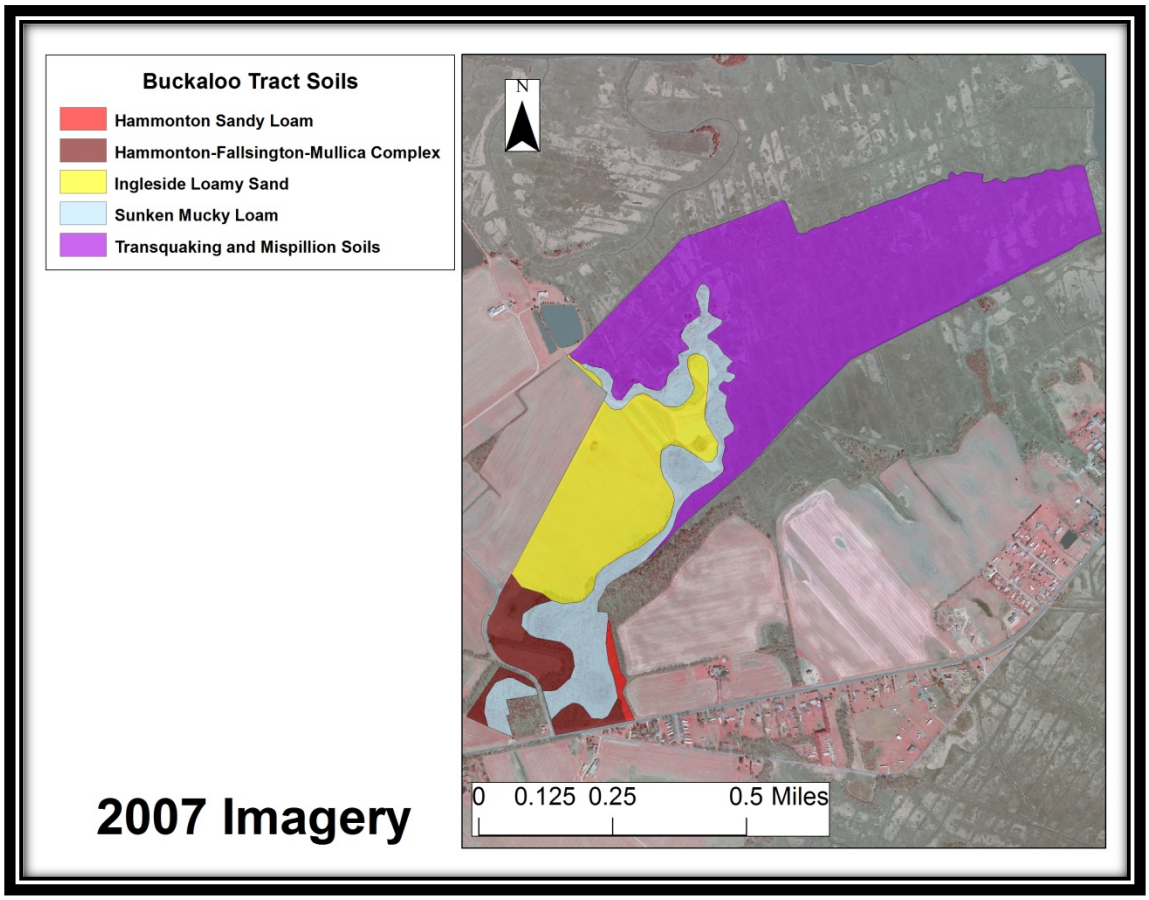


Figure 1.2. Buckaloo Tract Soil Map

Island Farm Tract Soils

Transquaking and Mispillion Soils is the only soil present in the Island Farm Tract.

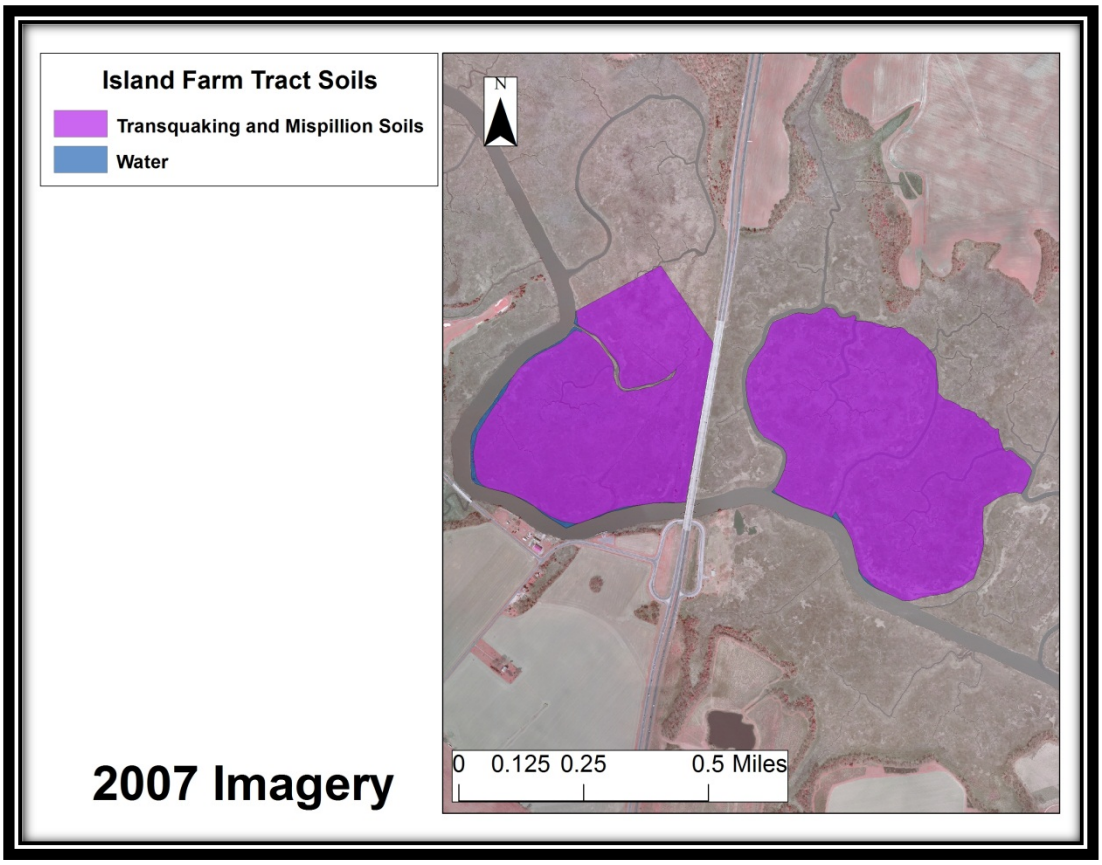


Figure 1.3. Island Farm Tract Soil Map

Logan Lane Tract Soils

Transquaking and Mispillion Soils is the prominent soil in the Logan Lane Tract. Other minor soils include Nassawango Silt Loam, Sunken Mucky Loam, and Downer Sandy Loam.

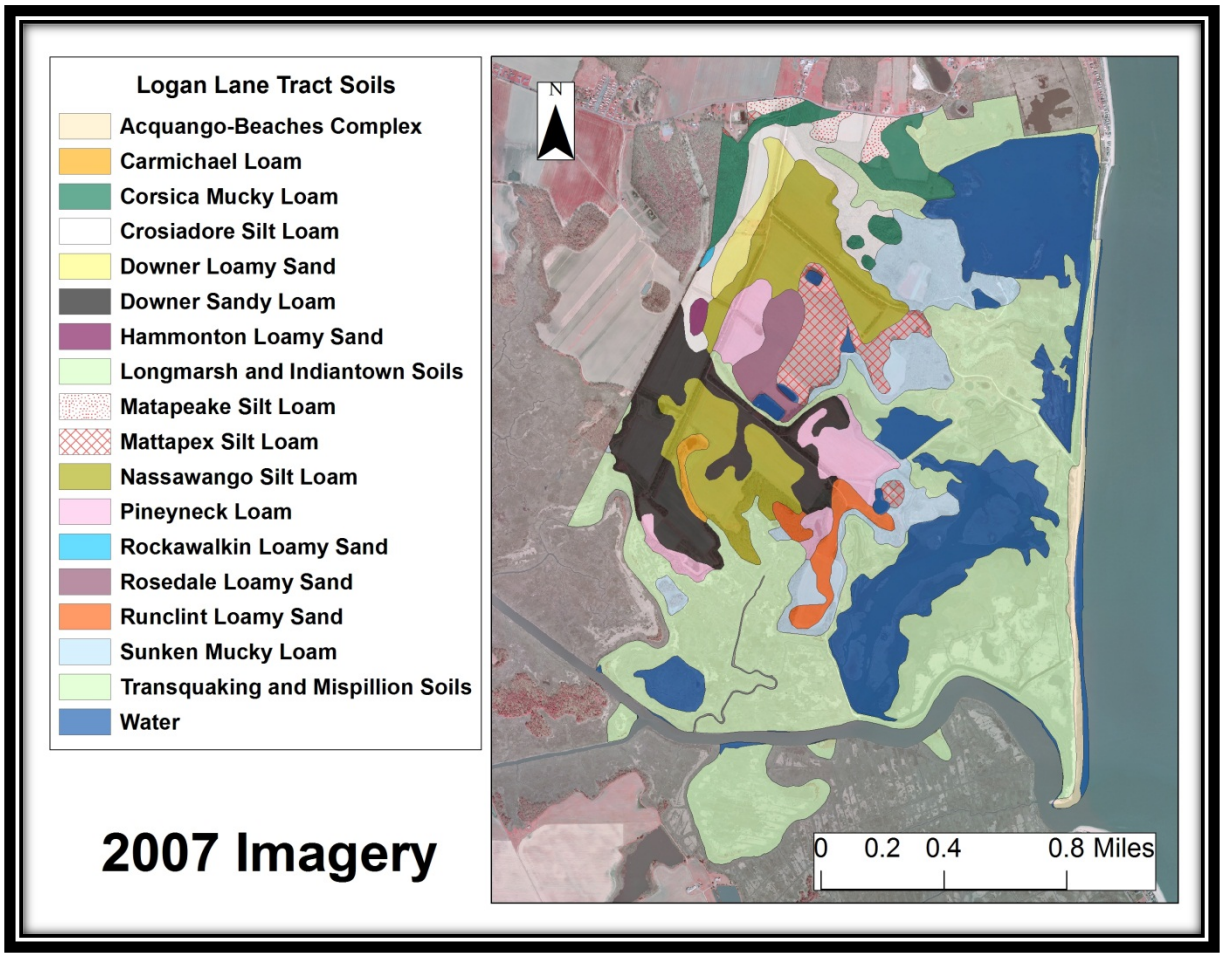


Figure 1.4. Logan Lane Tract Soil Map

Roberts Tract Soils

Transquaking and Mispillion Soil is the most prominent soil in the Roberts Tract. Other, very minor, soils include Sassafras Soils and Manahawkin Muck.

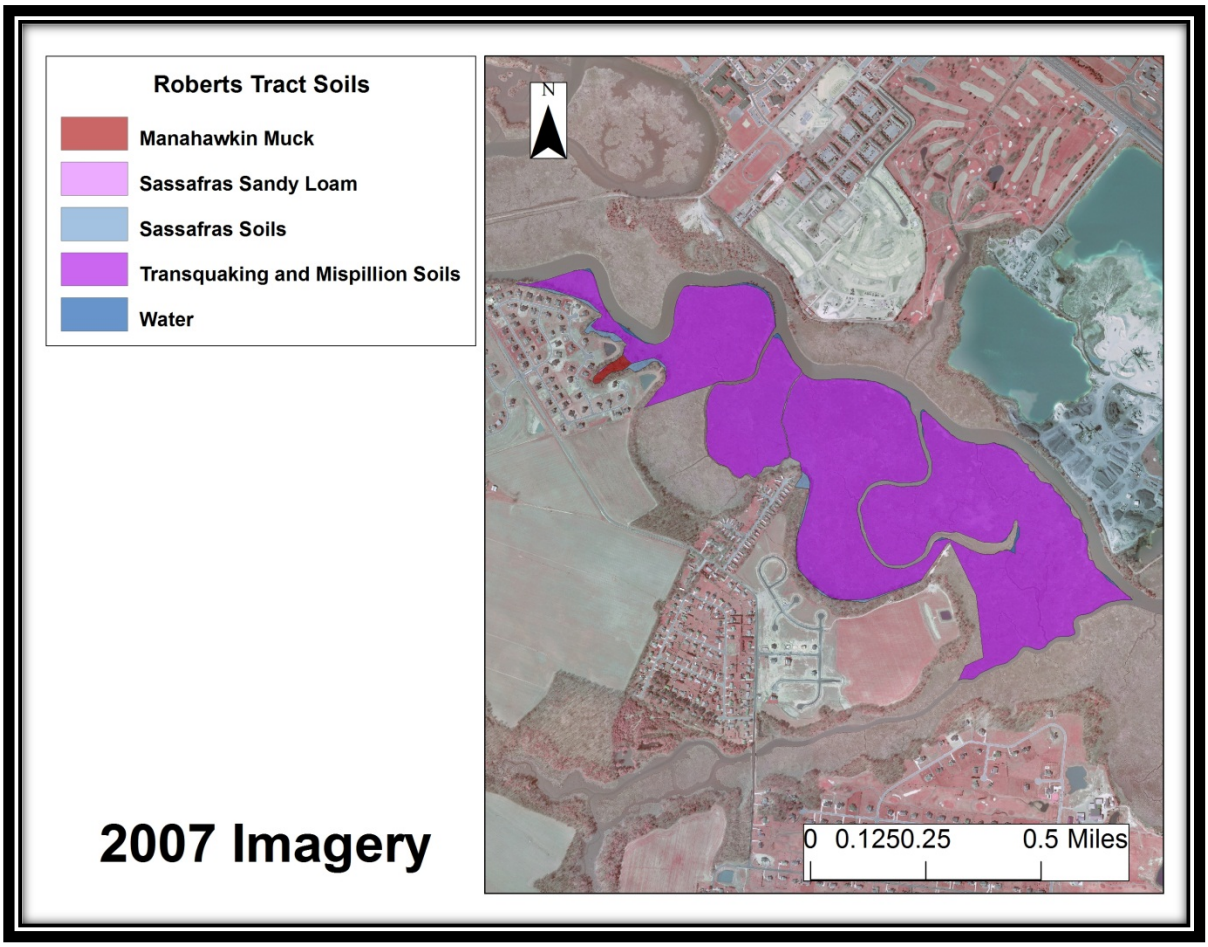


Figure 1.5. Roberts Tract Soil Map

Discussion of vegetation communities in general and why they are important in management

While Natural Communities provide the optimal habitats and structure that are needed for animals to exist, vegetation communities provide an approximation of natural communities. The differences in the vegetation communities are governed by non-biotic factors and biotic factors. Non-biotic factors include things such as geology (soil type, availability of moisture, and exposure), climate, and fire regime. Biotic factors include: number and amount of predators and prey, biodiversity of the community and presence and absence of contributors to ecosystem health such as ants, fungi and bacteria and size of forest blocks. Historically these factors have not changed much other than changes brought about by larger climate shifts. Since the time of modern European settlement of Eastern North America (i.e. from about 1600 A.D.), physical factors such as fire regime and moisture availability have changed and nearly all of the biotic factors have changed resulted in a markedly different landscape today than what the original settlers saw. Today, instead of having Natural Communities, we have Vegetation Communities, which only approximate Natural Communities and are essentially artificial shells of what they could be.

Discussion of Sea-Level Rise and why it may affect the vegetation communities at Ted Harvey Wildlife Area

To understand the effects of sea-level rise on vegetation communities near the coast one can look at what has happened historically. From the late Pleistocene period to 5,000 years ago, sea-level rise was about 3 cm/decade (30 cm/100 years). From 3,000 years to the present time it has been rising 1 cm/decade (10 cm/100 years)[3]. Data from the Reedy Point tidal station (1985-2009) shows the average rate of rise to be 5.4 cm/year and at Lewes (1919-2009), 3.24 mm/year.[4] Historical ground data from the National Aeronautics and Space Administration (NASA) from 1870 to 2000 has shown a sea level rise of 1.7 mm/year or 1.7 cm/decade. Even more recent data from the Jason satellites (1993-present) has shown an increase in rise to 3.28 mm/year or 3.3 cm/decade.[5] This is above the fast rate seen from the Late Pleistocene to 5,000 years ago. Jay Custer in his book Prehistoric cultures of the Delmarva Peninsula states that "Rising sea-level had three major effects on the environments of the Delmarva Peninsula: changes in the availability and distribution of coastal resources, changes in interior water tables, and potential changes in local air mass distributions and weather patterns. Changing availability of coastal resources with sea-level is related both to the rate of sea-level rise and changing shoreline topography. Before 3,000 years ago the rate of sea-level rise was so great that stable estuarine environments did not have time to develop". The slower sea-level rise after this time has allowed estuaries and marshes to increase in size, by lateral erosion.[6] Sea-level rise can also cause water tables to rise, water logging swamps away from the coast, a fact that has been stated in

[3] Belknap, D.F. and J.C. Kraft 1977. Holocene relative sea-level changes and coastal stratigraphic units on the northwest flank of the Baltimore Canyon geosyncline. Journal of Sedimentary Petrology 47 (2): 610-629 in Custer (1989).
[4] Data from Permanent Service for Mean Sea Level website (www.psmsl.org)
[5] NASA Global Climate Change Website (http://climate.nasa.gov/keyindicators) December 12, 2010 update.
[6] Custer, Jay F. 1989. Prehistoric cultures of the Delmarva Peninsula: archaeological study. (Cranbury, NJ: Associated University Presses, Inc.), 447 pp.

elsewhere in the Mid-Atlantic.[7],[8],[9] The rising rate of rise may factor into the difference between the Indian River Inlet and Lewes tidal stations. The Lewes station has been operating longer and has a more complete data set than the Indian River Inlet Station.

Other sources have stated the rise on the Mid-Atlantic Coast to be 3-4 mm/year, while the global average is 1.8 mm/year[10], the difference of which is caused by geological subsidence from the glaciers of the last ice age. The rate of sea-level rise is now equal to the time historically when estuaries and marshes did not have time to develop. Marshes have been accreting about 3 mm/year for the past 100 years[11], but the current rate of sea level rise is above the accretion rate resulting in losses. The rate is projected to go much higher with rates of 10 cm/decade (1 m/100 years) as a median.[12] Kraft and Khalequzzaman project that most of the fringing salt marshes in Delaware will be eliminated in 200-300 years and be extinct in 1,500 to 1,700 years.[13] Other investigators have pointed out that there is a lack of temporal scale to a lot of the studies and that there may a significant time lag between sea level rise and anthropogenic inputs of carbon dioxide.[14] These changes would also impact the fisheries and economy related to it in the area.

Components of Sea Level Rise

There are many factors that all come together to produce the observed rise above. These include Eustatic (rise due to increased water volume), stearic (rise due to increased temperature and salinity), and isostatic (rise due to geological subsidence).

Eustatic Rise

Most people think of this factor when they talk about sea level rise. This is the contribution of increased water volume coming from the melting of glaciers, snowpack, and groundwater extraction. Using the figure for Indian River Inlet above this accounts for about 1.2 mm/year of the rise when subtracted from the other factors[15]. Added to this is newer research that shows groundwater depletion

---

[7] Rappleye, L. and W. M. Gardner. 1979. A cultural resources reconnaissance and impact assessment of the Great Dismal Swamp National Wildlife Refuge, City of Suffolk, Chesapeake, and Nansemond Counties, Virginia. Manuscript on file. Department of Anthropology, Catholic University, Washington, DC in Custer (1989).

[8] Whitehead, D.R. 1972. Developmental and environmental history of the Dismal Swamp. Ecological Monographs 42: 301-15 in Custer (1989).

[9] Gardner, W.M. 1978. Comparison of Ridge and Valley, Blue Ridge, Piedmont, and Coastal Plain Archaic Period Site Distribution: An idealized transect (preliminary model). Paper presented at the 1978 Middle Atlantic Archeological Conference, Rehoboth Beach, Delaware in Custer (1989).

[10] Johnson, Zoe Pfahl. 2000. A Sea Level Rise Response Strategy for the State of Maryland. Maryland Department of Natural Resources.

[11] Nikitina, Daria L., James E. Pizzuto, Reed A. Schwimmer, and Kelvin W. Ramsey. 2000. An updated Holocene sea-level curve for the Delaware Coast. Marine Geology 171 (1-4): 7-20.

[12] Barth, M.C. and J.G. Titus. 1984. Greenhouse Effect and Sea Level Rise: A Challenge for this Generation. (New York: Van Nostrand Reinhold Co., Inc.) 238 pp.

[13] Kraft, John C. and Md. Khalequzzaman. 1992. Geologic and human factors in the decline of the tidal salt marsh lithesome: the Delaware Estuary and Atlantic coastal zone. Sedimentary Geology 80 (3-4): 233-246.

[14] Larson, C.E. and I. Clark. 2006. A search for scale in the sea-level studies. Journal of Coastal Research 22 (4): 788-800.

[15] Davis, George H. 1987. Land Subsidence and Sea Level Rise on the Atlantic Coastal Plain of the United States. Environmental Geology 10 (2): 67-80.

is adding 0.8 mm/year to sea level rise[16]. From this you have to subtract the amount of water that has been impounded on land. Chao, et al. states that about 10,800 cubic kilometers has been impounded in the last half century which subtracts about 0.55 mm/year from the rise[17]. When added together, eustatic factors account for 1.45 mm/year of the rise.

Stearic Rise

This factor comes from thermal expansion of ocean water and salinity currents. This factor contributes about 0.9 mm/year of the observed rise[18]. Yin et al states that this factor could account for more than the global mean in the future through a weakening of the meridional overturning circulation in the Atlantic[19], accounting for much more rise than in earlier studies. They go further to say that these contributions in New York City could result in a rise of 15 cm, 20 cm, or 21 cm, under low, medium, and high rates of emissions, respectively[20]. Other studies have pointed out that variations in rise in the Mid-Atlantic can be 20 cm and persist for years due to the North Atlantic Subtropical Gyre[21].

Isostatic Rise

Geological land subsidence adds the most to the rise currently accounting for about 1.6 mm/year[22] in the Mid-Atlantic region. Another study has given an amount ranging from 1.02 to 1.53 mm/year[23]. Liu, et al gives a similar for New York City stating a sea level rise of 2-4 mm/year to which glacio-isostatic factors account for about 40%[24].

All of these factors added together

If we add all of these factors together using the data above we get a range of 3.15 mm to 3.95 mm/year.

E= Eustastic (1.45 mm/yr)
S= Stearic (0.9 mm/yr)
I= Isostatic (1.6 mm/yr-Davis, 1.02-1.53 mm/yr-Engelhart, et al., 0.8 mm-1.6 mm/yr-Liu

[16] Wada, Y., L.P.H. van Beek, C.M. van Kempen. J.W.T. Reckman, S. Vasak, and M.F.P. Bierkens. 2010. Global depletion of groundwater resources. Geophysical Research Letters 37
[17] Chao, B.F., Y.H. Wu, and Y.S. Li. 2008. Impact of Artificial Reservoir Water Impoundment on Global Sea Level. Science 320(5873): 212-214.
[18] Ditto
[19] Yin, Jianjun., S.M. Griffies, M. Schlesinger, R.J. Stouffer. 2010. Regional Sea Level Rise Projections on the Northeast Coast of the United States. American Geophysical Union, Fall 2010 meeting.
[20] Yin, Jianjun, M.E. Schlesinger, R.J. Stouffer. 2009. Model Projections of Rapid Sea Level Rise on the Northeast Coast of the United States. Nature Geoscience 2(4): 262-266.
[21] Hong, Byung-Gi. 1998. Decadal variability in the North Atlantic Subtropical Gyre: Can it explain variability in sea level along the East Coast of the United States. Ph.D. Thesis, The Florida State University, 77 pp.
[22] Davis, George H. 1987. Land Subsidence and Sea Level Rise on the Atlantic Coastal Plain of the United States. Environmental Geology 10(2): 67-80.
[23] Englehart, S.E., B.P. Horton, B.C. Douglas, W.R. Peltier, T.E. Tornqvist. 2008. Spatial variability in the 20th century record of sea level rise along the US Atlantic Coast. American Gophysical Union, Fall 2008 Meeting.
[24] Liu, J., R. Horton. 2007. Impacts of combined sea level rise and coastal subsidence, New York City Metropolitian Area. American Geophysical Union. Fall 2007 Meeting.

Using vegetation communities to map sea level rise and changes in the landscape

One of the first studies in Delaware to use vegetation communities to map human induced changes in the landscape was done by a Victor Klemas at the University of Delaware in the early 1970s[25]. Victor compared aerial imagery from 1954 and 1968 on a qualitative basis and looked at changes in the marshes and other man-made features. He incorporated some multispectral analysis to determine some of the vegetation types. Though he did not refer to specific vegetation communities as we know them now, he did look at vegetation assemblages (Low marsh, high marsh, and salt shrub) that are very similar to the groupings now. No figures were given in his paper regarding the overall changes. He did note, however, that the shoreline at Cape Henlopen had receded 4 to 21 feet per year from 1843 to 1939[26]. Other papers have also used historical aerial imagery to map vegetation change[27],[28] and salinity factors can impact on those changes[29].

More recent studies looking at both changes in tidal marshes[30] and coastal forests[31] have shown that both can suffer effects of a rising sea level. Matthew Kirwan states that a tidal marsh can keep up with sea level rise through accretion if the amount of sediment is adequate, but that reforestation and dam building has restricted the sediment inflows[32]. Shirley and Battaglia come roughly to the same conclusion on the Gulf of Mexico coast, stating that they do not believe the marshes are keeping pace with the aquatic to terrestrial transition, but it is hard to map in the Coastal Plain because of major land use changes[33]. Kimberlyn Williams states that some of the factors leading to forest decline in coastal areas result from; soil flooding—resulting in low oxygen availability and reducing conditions, elevated soil and groundwater salinity, and saltwater intrusion.

One study in the Delaware River Estuary stipulated that freshwater tidal marshes are needed to help the development of brackish and salt marshes[34] in areas where the coast was submerging. The freshwater marshes help produce the environmental conditions later needed by the more saline marshes.

---

[25] Klemas, Vytautas. 1972. Use of remote sensing to determine natural and man-made changes in the coastal zone. Transactions of the Delaware Academy of Science. 2: 13-34.

[26] Vytautas, Klemas. 1972. Use of remote sensing and to determine natural and man-made changes in the coastal zone. Transactions of the Delaware Academy of Science 2:13-34.

[27] Kadmon, R. and R. Harari-Kremer. 1999. Studying the long term vegetation dynamics using digital processing of historical aerial photographs. Remote Sensing of the Environment 68:164-176.

[28] Smith, Carrie, Merryl Alber, and Alice Chalmers. 2001. Linking shifts in historic estuarine vegetation to salinity changes using a GIS. Proceedings of the 2001 Georgia Water Resources Conference.

[29] Earle, J.C. and K.A. Kershaw. 1988. Vegetation patterns in James Bay coastal marshes. III. Salinity and elevation as factors influencing plant zonations. Canadian Journal of Botany 67: 2967-2974.

[30] Kirwan, Matthew L. and A. Brad Murray. 2007. A coupled geomorphic and ecological model of tidal marsh evolution. Proceedings of the National Academy of Science 104(15):6118-6122.

[31] Williams, Kimberlyn, et al. 1999. Sea-level rise and coastal forest retreat on the west coast of Florida, USA Ecology

[32] Kirwan, Matthew L. and A. Brad Murray. 2007. A coupled geomorphic and ecological model of tidal marsh evolution. Proceedings of the National Academy of Science 104(15):6118-6122.

[33] Shirley, Laura and Lorretta L. Battaglia. 2006. Assessing vegetation change in coastal landscapes of the northern Gulf of Mexico. Wetlands 26(4): 1057-1070.

[34] Orson, Richard A., Robert L. Simpson, and Ralph E. Good. 1992. The Paleoecological development of a late Holocene, Tidal Freshwater Marsh of the Upper Delaware River Estuary. Estuaries and Coasts 15(2): 130-146.

Purpose of the Study

This study was conducted with the following goals in mind:

1. Classify and map vegetation communities, land covers, and asses habitat conditions for Species of Greatest Conservation Need (SGCN)[as defined in the Delaware Wildlife Action Plan (DEWAP)] for Ted Harvey Wildlife Area based on 1937, 2002, and 2007 aerial imagery and field observations.
2. Use the maps above to determine changes in the vegetation communities and the effects of sea level rise and to determine the relative rate of sea level rise in the wildlife area.
3. Determine the forest blocks located within or partially within the wildlife area.
4. Produce Ecological Integrity Assessments (EIAs) for vegetation communities that ranked S2 or higher.

Surveys were conducted during 2010 by Robert Coxe, an Environmental Scientist with the Delaware Natural Heritage and Endangered Species Program (DNHESP) within the Delaware Division of Fish and Wildlife, Department of Natural Resources and Environmental Control (DNREC).

Vegetation Community and Land Cover Surveys

Vegetation communities and land covers were determined by qualitative analysis using observations made in the field and aerial photo-interpretation using 1937, 2002 and 2007 aerial imagery. Vegetation communities are named according to the *Guide to Delaware Vegetation Communities* [35]which follows the National Vegetation Classification System (NVCS). The NVCS classifies vegetation on a national scale for the United States and is linked to international vegetation classification. The NVCS helps provide a uniform name and description of vegetation communities found throughout the country and helps determine relative rarity. Descriptions of the vegetation communities are provided in Chapter 5 and of the land covers in Chapter 6. A crosswalk to the Delaware Action Plan (DEWAP) and the Northeastern Habitat Map (NHC) is provided at the top of each individual description.

Analysis of Historical Imagery

Historical imagery of Ted Harvey Wildlife Area from 1937 and 2002 and current imagery from 2007 were examined. A vegetation community map was produced for each year in order to compare vegetation and land cover change over a 5, 65, and 70 year time frame. Changes in the respective vegetation communities and land covers are discussed in the descriptions while broader changes are discussed in the wildlife area discussion. There is more imagery available but these were not used due to registration problems in the image tiles.

Ecological Integrity Assessment (EIA)

An EIA was conducted for those communities in the wildlife area that are ranked S2 or higher in Delaware. EIAs are an analysis being developed by Natureserve to determine the relative quality of vegetation communities across North America. Using Natural Heritage methodology, communities are ranked according to rarity (Appendix I). The vegetation communities at Ted Harvey Wildlife Area included in the EIA analysis are listed in Table 2.2 and depicted in Figure 2.1.

Forest Block Analysis

Current forest blocks within or partially within the wildlife area that are greater than 100 acres were mapped. Each current block is described for current total acres and current forest interior habitat, potential acres, potential forest interior habitat, vegetation communities currently present, and major drainage. A block is defined as contiguous forest habitat that is contained with 30 feet of non-forested and is the method used by the Maryland's Strategic Forest Lands Assessment.[36] Forest interior is forested area that is 100m from a forest edge. Potential blocks were extended out to areas of noncontiguous habitat (such as roads, powerline right-of-ways, and developed areas) that were considered to be immovable. Most of the area that could be reverted to forest is currently old field

[35] Coxe, Robert. 2010. Guide to Delaware Vegetation Communities-Summer 2010 Edition. Unpublished report.
[36] Maryland Department of Natural Resources. 2003. Strategic Forest Lands Assessment. Co-op Project between Maryland Department of Natural Resources, Watershed Services, and Maryland Forest Service. 40 p.

habitat or in agricultural use. These blocks were determined for future planning in regards to improving and increasing forest interior habitat.

Sea Level Rise Analysis

An analysis was performed for the wildlife area as whole, the sections, and the vegetation communities/land covers using the DNREC Sea Level Rise Scenarios. Acreage lost under the various scenarios is estimated for each.

Natural Capital Analysis

The natural capital of each vegetation community was determined using a table in Costanza, et al.[37] The values from the table were calculated per acre of the vegetation community or land cover and then adjusted using an inflation calculator (DollarTimes.com) from 1994 values to 2012 values. Using these methods the following values were obtained:

Estuaries (water): $9,247/acre/year

Temperate Forest (Upland forests): $122/acre/year

Wetlands

-General (not as below): $5,988/acre/year

-Tidal Marsh: $4,046/acre/year

-Swamps/floodplains: $7,930/acre/year

Lakes (Impoundments): $3,442/acre/year

Cropland: $37/acre/year

Grassland/fields: $94/acre/year

Open Ocean: $102/acre/year

Values were rounded off to the nearest whole dollar.

[37] Costanza, Robert, et al. 1997. The value of the world's ecosystem services and natural capital. Nature 387:253-260.

CHAPTER 2: RESULTS OF EIAS, FOREST BLOCKS, AND GENERAL OBSERVATIONS

Summary of Findings from this study

1. **Vegetation Communities:** Twenty-two vegetation communities and nine land covers are currently found at Ted Harvey Wildlife Area. North Atlantic Low Salt Marsh (1,073 acres) and Northeastern Old Field (133 acres) are the prominent vegetation communities in the wildlife area. Agricultural Field (431 acres) and Impoundment (267 acres) are the prominent land covers.

2. **Rare Plants:** No rare plants are known to exist in Ted Harvey Wildlife Area and it is unknown whether the wildlife area has been extensively surveyed for rare plants.

3. **Rare Animals:** Three rare animals are known to occur in the wildlife area.

Scientific Name	Common Name	Rank	Last Observed
Cicindela repanda	A Tiger Beetle	S3	1996
Cicindela hirticollis	Beach-dune Tiger Beetle	S2	1996
Lophodytes cucullatus	Hooded Merganser	S1B, S4N	1999

Table 2.1. Rare Animals located at Ted Harvey Wildlife Area

Ecological Integrity Assessment (EIA)

Two vegetation communities, Overwash Dune Grassland and Wax-Myrtle Shrub Swamp, are ranked S2 or higher. These areas are located solely on the Logan Lane Tract and are depicted in Figure 2.1 and summarized in Table 2.2.

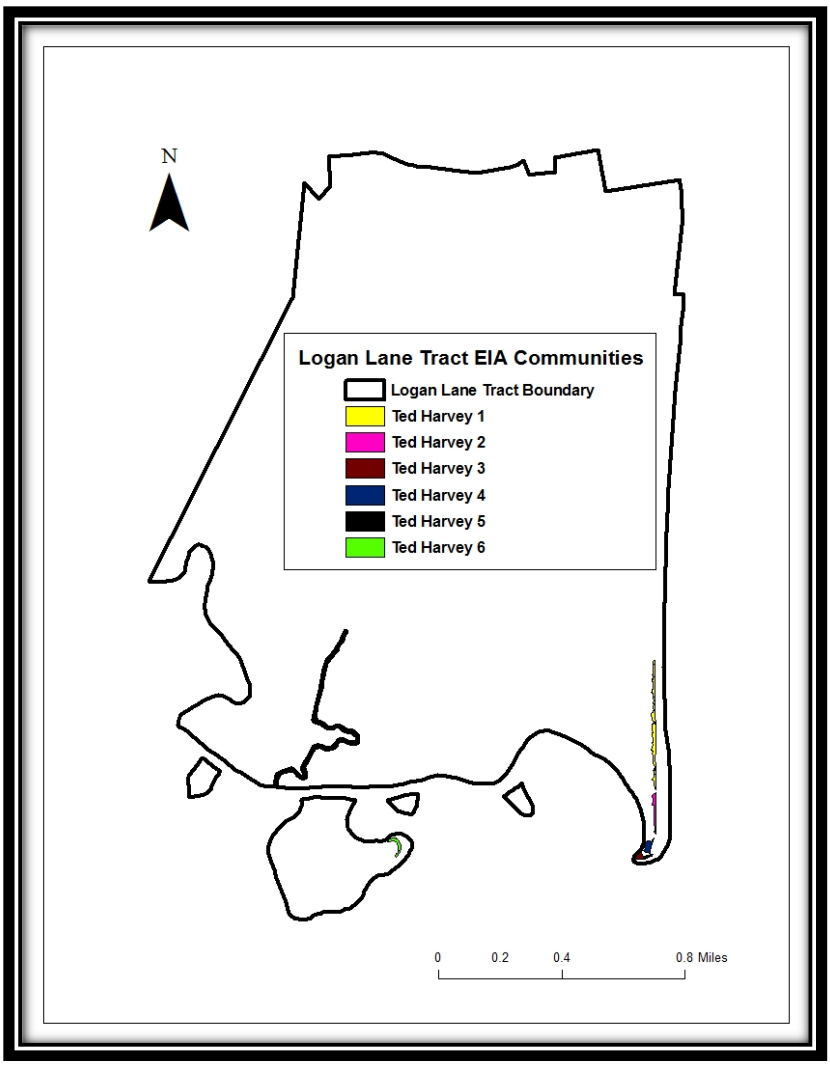
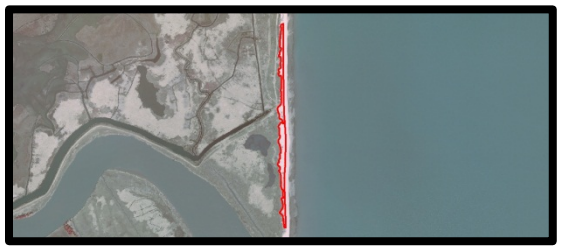
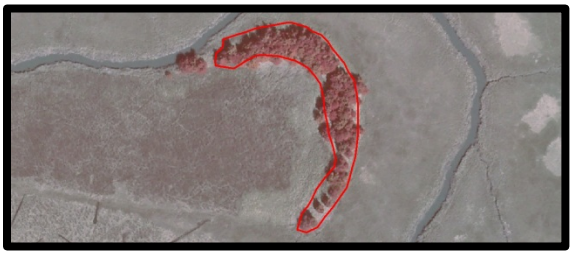


Figure 2.1. Logan Lane Tract EIA Communities (Logan Lane is the only tract with EIAs)

Table 2.2. EIA Vegetation Communities located in Ted Harvey Wildlife Area

Community Map	Community Name/EIA Score	Description
	**Ted Harvey 1** **Overwash Dune Grassland (2 acres)** **EIA = 3.4 (C rank)**	This grassland community is located on landward side of the Delaware Bay beach.
	**Ted Harvey 2** **Overwash Dune Grassland (0.6 acres)** **EIA = 3.1 (C rank)**	This grassland community is located on landward side of the Delaware Bay beach.
	**Ted Harvey 3** **Overwash Dune Grassland (0.3 acres)** **EIA = 2.7 (C rank)**	This grassland community is located on landward side of the Delaware Bay beach.
	**Ted Harvey 4** **Overwash Dune Grassland (0.5 acres)** **EIA= 2.7 (C rank)**	This grassland community is located on landward side of the Delaware Bay beach.
	**Ted Harvey 5** **Overwash Dune Grassland (0.1 acre)** **EIA=2.7 (C rank)**	This woodland community is located on the South Bethany Tract. Like the other woodland examples, it is surrounded by marsh on the west side and DE 1 on the east.

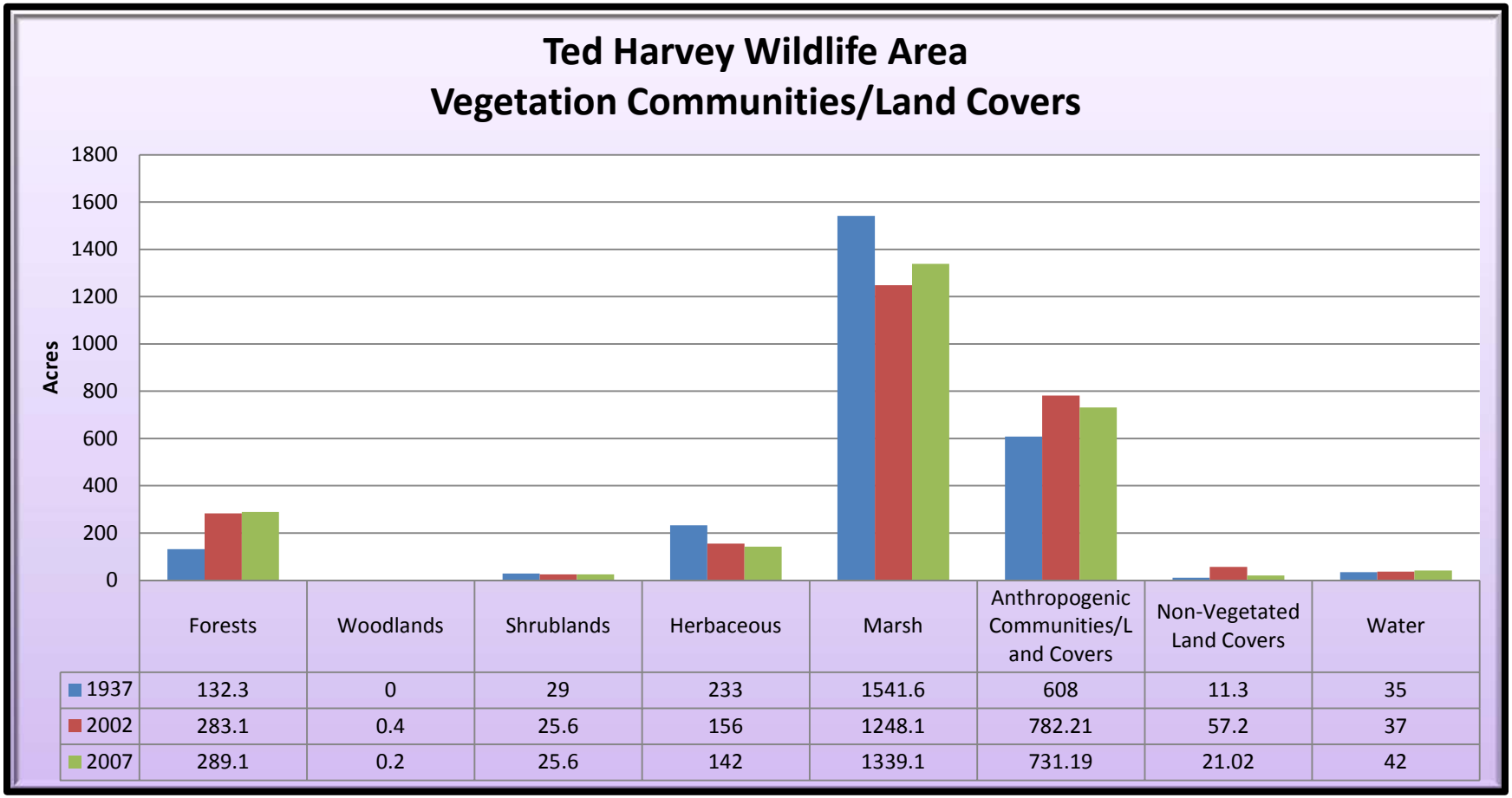
Community Map	Community Name/EIA Score	Description
	**Ted Harvey 6** **Wax-Myrtle Shrub Swamp (0.5 acres)** **EIA=2.9 (C rank)**	This shrubland is located on a small island in the marsh near the mouth of the St. Jones River.

Forest Block Analysis

No forest blocks are located greater than 100 acres are located in Ted Harvey Wildlife Area and therefore a forest block analysis was not performed.

The Natural Progression of vegetation communities on the shores of Delaware Bay

Vegetation communities located adjacent to the shore of Delaware Bay go through natural progression of retreating backwards as sea level rises. For centuries this has meant that as sea level rises the forested communities will progress into shrubland, the shrubland will progress into marsh, and then the marsh will convert to open water, perhaps with a brief period as a mudflat. Further gradations can be noticed via different forests, shrublands, and marshes (high and low), and can be used to map out the effects of sea level rise and increasing salinity in the area. In the recent past (70 years) this natural progression appears to be eroding because of sea levels which are rising too fast for the natural progression to continue. In addition some communities reach a hardened shoreline, rip-rap or some other artificial barrier which prevents the progression.



	Forests	Woodlands	Shrublands	Herbaceous	Marsh	Anthropogenic Communities/Land Covers	Non-Vegetated Land Covers	Water
1937	132.3	0	29	233	1541.6	608	11.3	35
2002	283.1	0.4	25.6	156	1248.1	782.21	57.2	37
2007	289.1	0.2	25.6	142	1339.1	731.19	21.02	42

Figure 3.1. Vegetation Community/Land Cover Categories at Ted Harvey Wildlife Area (1937, 2002, and 2007)

Ted Harvey Wildlife Area Vegetation Communities/Land Covers (Table 3.1): Marsh, followed by anthropogenic communities/land covers, are the most prominent vegetation communities and land covers throughout the entire wildlife area. Herbaceous communities have declined by more than one-half, as they mature into forested communities.

DNREC Sea Level Rise Analysis (Table 3.1)

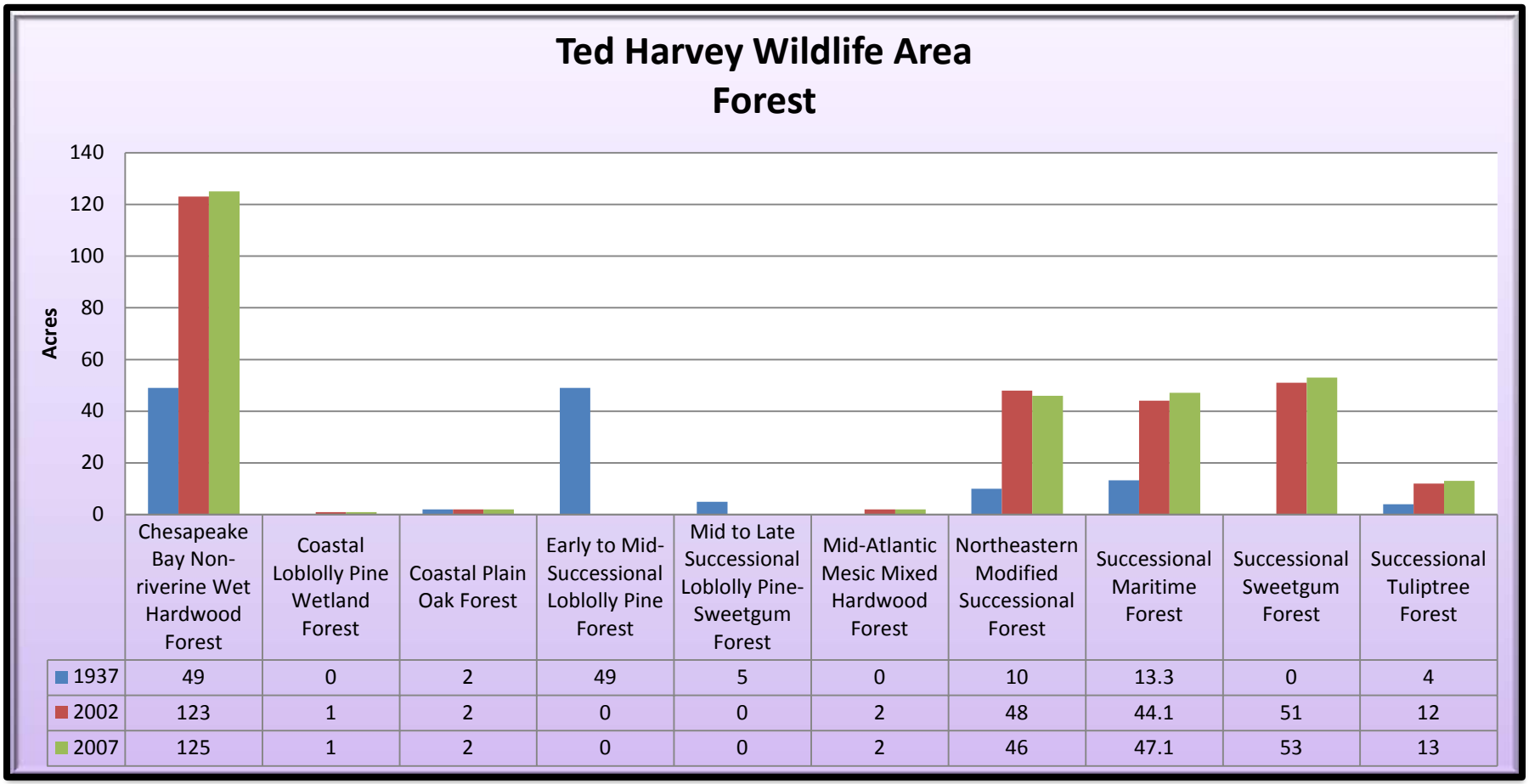
About 81% of the wildlife area will be inundated with 1.5 m of sea level rise. More than half will be flooded with just 0.5 m of sea level rise.

Table 3.1. Projected acres of Ted Harvey Wildlife Area Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	1,480 acres
1 m	1,932 acres
1.5 m	2,101 acres

Natural Capital (Table 3.2)

Natural capital of Ted Harvey Wildlife Area has increased since 1937, but has decreased in the recent period (2002-2007) with losses in herbaceous communities and non-vegetated communities.

Table 3.2. Natural Capital of Ted Harvey Wildlife Area	
Year	**Natural Capital (in 2012 dollars)**
1937	$11,145,722/year
2002	$12,416,649/year
2007	$12,639,303/year



	Chesapeake Bay Non-riverine Wet Hardwood Forest	Coastal Loblolly Pine Wetland Forest	Coastal Plain Oak Forest	Early to Mid-Successional Loblolly Pine Forest	Mid to Late Successional Loblolly Pine-Sweetgum Forest	Mid-Atlantic Mesic Mixed Hardwood Forest	Northeastern Modified Successional Forest	Successional Maritime Forest	Successional Sweetgum Forest	Successional Tuliptree Forest
1937	49	0	2	49	5	0	10	13.3	0	4
2002	123	1	2	0	0	2	48	44.1	51	12
2007	125	1	2	0	0	2	46	47.1	53	13

Table 3.2. Ted Harvey Wildlife Area Forest (1937, 2002, and 2007)

Ted Harvey Wildlife Area Forest (Figure 3.2): Red Maple-Sweetgum Swamp-Alluvial Type is the most common forest community in the wildlife area as a whole followed by Successional Maritime Forest. Most of the successional forests, with the exception of the Successional Sweetgum Forest, have succeeded into more mature forests, which because of the disturbance present in the wildlife area, such as Northeastern Modified Successional Forest.

DNREC Sea Level Rise Analysis (Table 3.3)

About ¾ of the existing forests in Ted Harvey Wildlife Area will be inundated with 1.5 m of sea level rise.

Table 3.3. Projected acres of Ted Harvey Wildlife Area Forest Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	42 acres
1 m	156 acres
1.5 m	213 acres

Natural Capital (Table 3.4)

The capital of forestland in Ted Harvey Wildlife Area has been increasing through time as more successional communities mature into forest.

Table 3.4. Natural Capital of Ted Harvey Wildlife Area Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$642,240/year
2002	$1,578,625/year
2007	$1,603,776/year

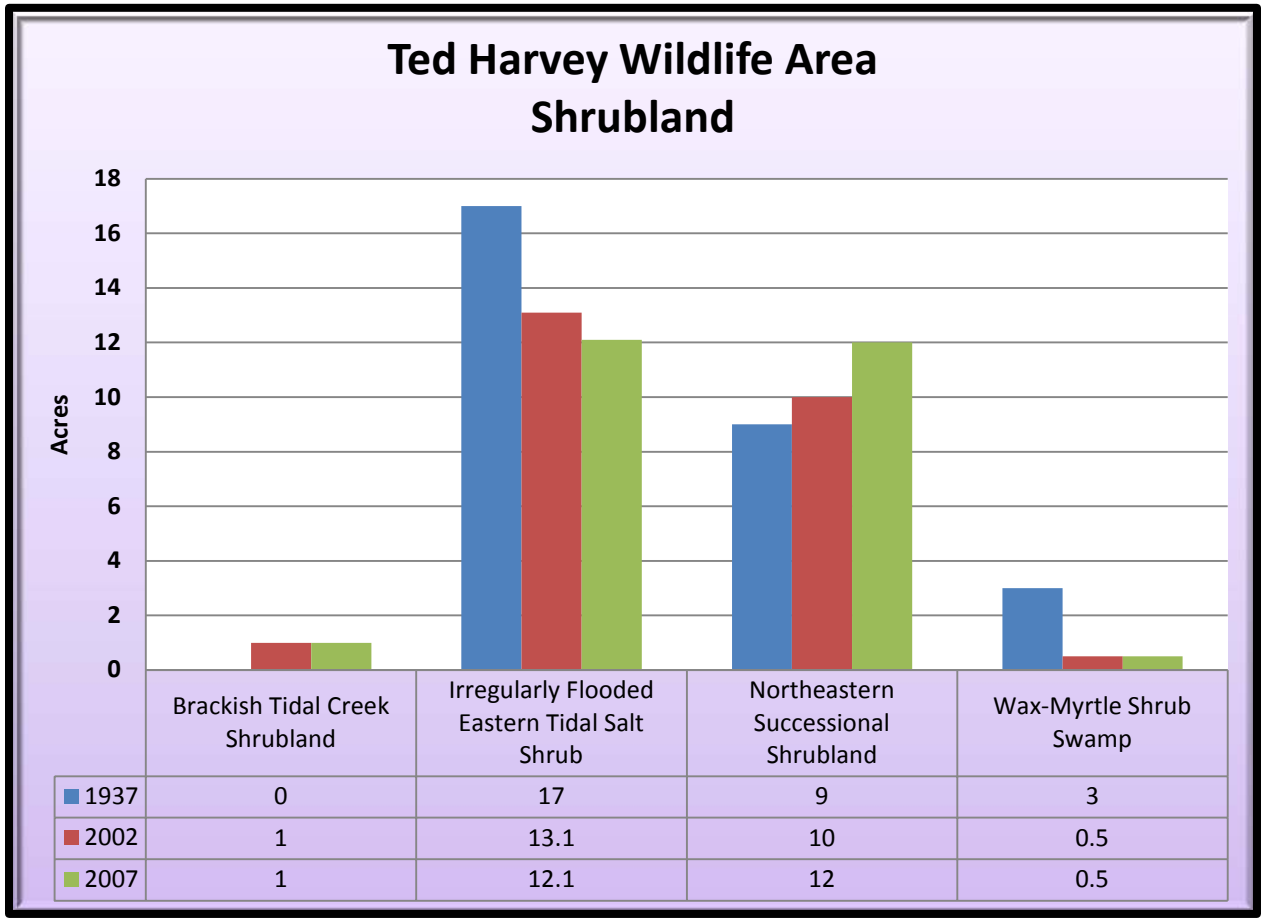


Figure 3.3. Shrubland at Ted Harvey Wildlife Area (1937, 2002, and 2007)

Ted Harvey Wildlife Area Shrubland (Figure 3.3): Irregularly Flooded Eastern Tidal Salt Shrub used to be the most prominent shrubland in the wildlife area, but it has declined while Northeastern Successional Shrubland has increased. A decline in Irregularly Flooded Eastern Tidal Salt Shrub has been seen in other wildlife areas including Assawoman and Milford Neck. Wax-myrtle Shrub Swamp has also experienced a decline, which along with Irregularly Flooded Eastern Tidal Salt Shrub, could be due to brackish effects and water inundation from sea level rise. Brackish Tidal Creek Shrubland populated the wildlife area at some point before 2002 but after 1937 and is present only in small amount.

DNREC Sea Level Rise Analysis (Table 3.5)

A little more than ¾ of the existing shrubland in Ted Harvey Wildlife Area will be inundated with 1.5 m of sea level rise.

Table 3.5. Projected acres of Ted Harvey Wildlife Area Shrubland Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	14 acres
1 m	18 acres
1.5 m	20 acres

Natural Capital (Table 3.6)

Capital of shrubland has decreased in Ted Harvey Wildlife Area with losses in Irregularly Flooded Eastern Tidal Salt Shrub.

Table 3.6. Natural Capital of the Ted Harvey Wildlife Area Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1937	$233,905/year
2002	$168,686/year
2007	$169,269/year

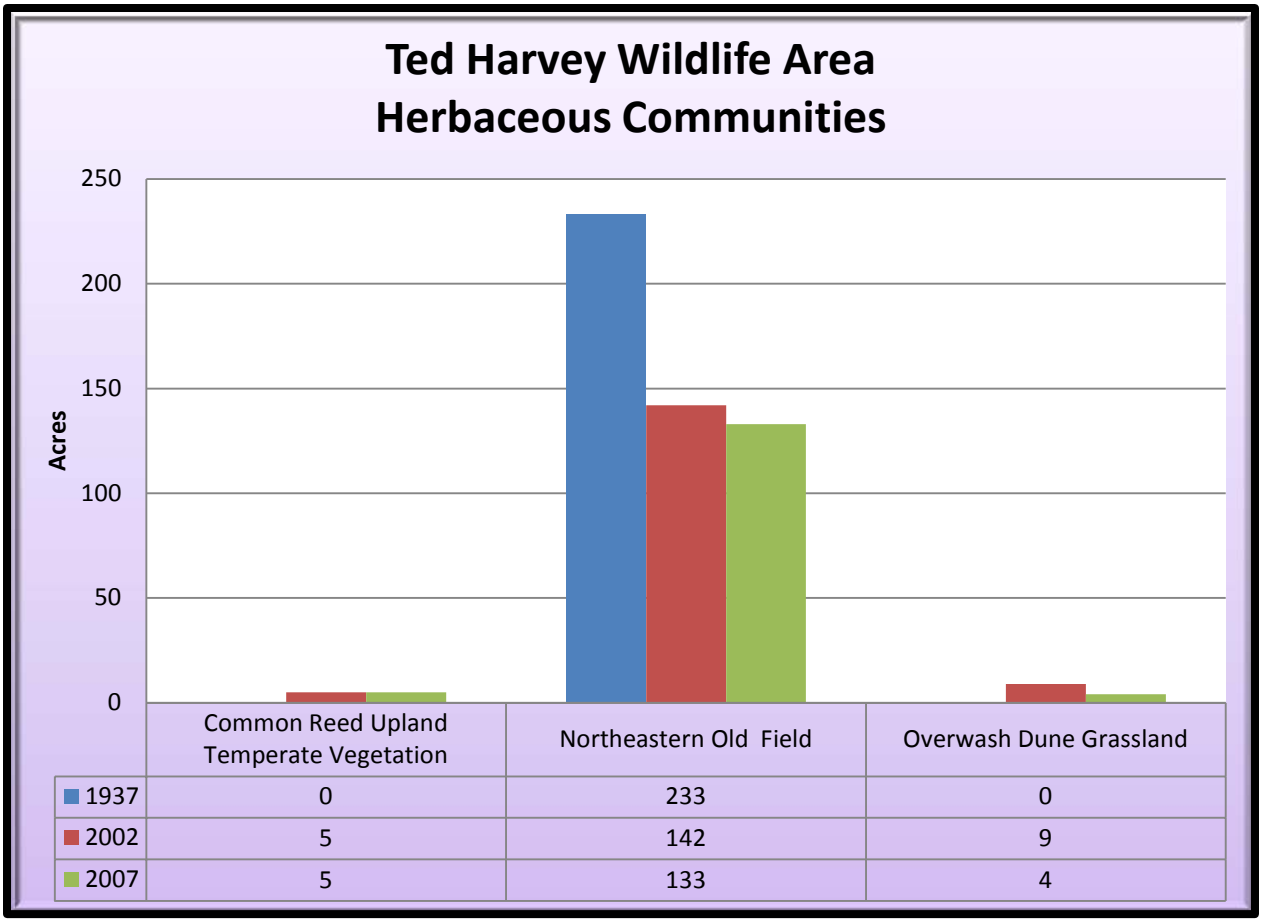


Figure 3.4. Herbaceous Communities at Ted Harvey Wildlife Area (1937, 2002, and 2007)

Ted Harvey Wildlife Area Herbaceous Communities (Figure 3.4): In 1937 Northeastern Old Field was the only herbaceous community present and covering most of the non-forest upland acres that was not being used for agricultural purposes, amounting to 233 acres. It has since succeeded to other more mature wooded vegetation communities. Overwash Dune Grassland and Common Reed Upland Temperate Vegetation have populated the wildlife area since 1937.

DNREC Sea Level Rise Analysis (Table 3.7)

A little less than half of the current herbaceous communities in Ted Harvey Wildlife Area will be inundated with 1.5 m of sea level rise.

Table 3.7. Projected acres of Ted Harvey Wildlife Area Herbaceous Communities Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	7 acres
1 m	37 acres
1.5 m	62 acres

Natural Capital (Table 3.8)

Capital of herbaceous communities has been declining as Northeastern Old Field succeeds to other more mature communities.

Table 3.8. Natural Capital of Ted Harvey Wildlife Area Herbaceous Communities	
Year	**Natural Capital (in 2012 dollars)**
1937	$33,948/year
2002	$22,729/year
2007	$20,689/year

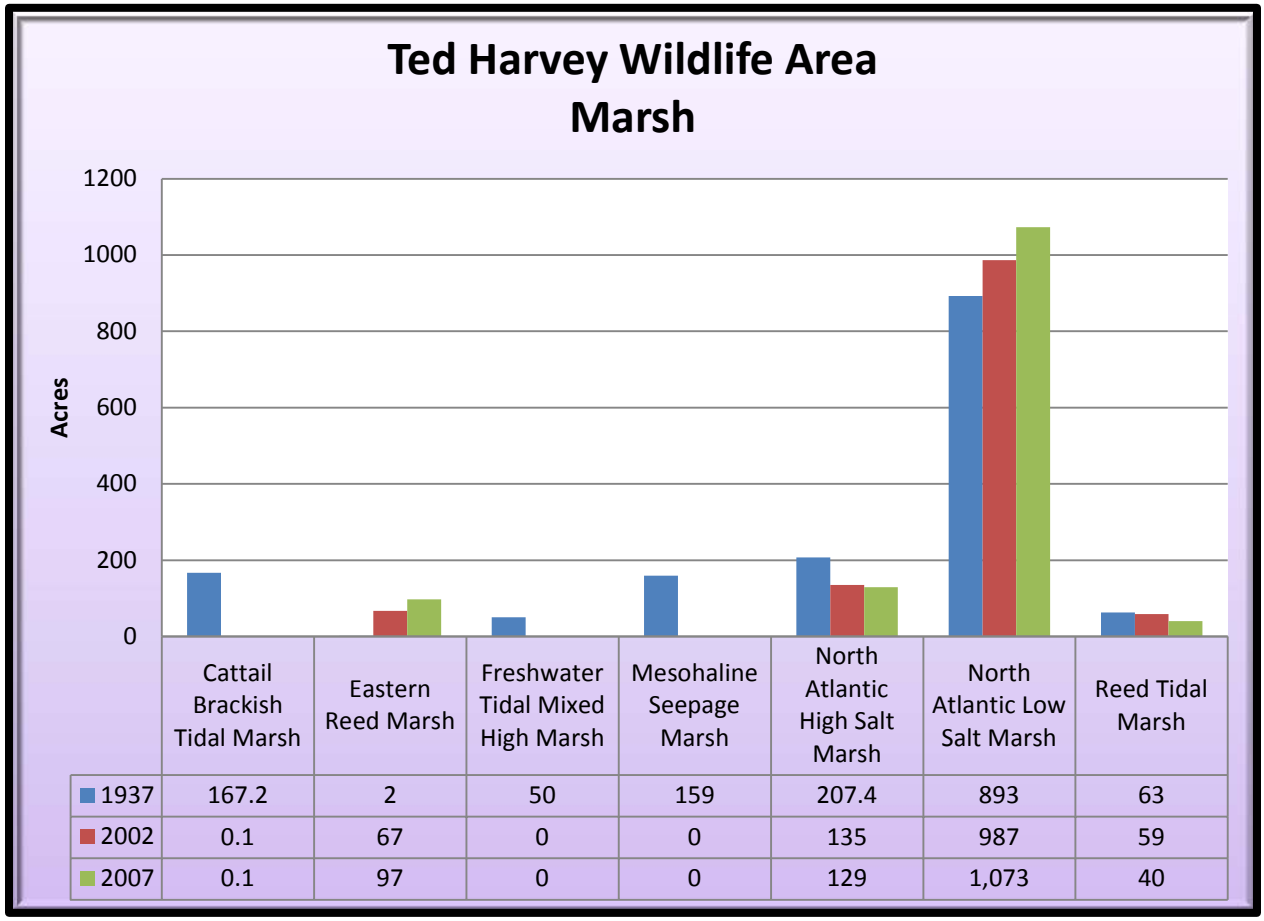


Figure 3.5. Marsh at Ted Harvey Wildlife Area (1937, 2002, and 2007)

Ted Harvey Wildlife Area Marsh (Figure 3.5): North Atlantic Low Salt Marsh is by far the most common marsh in the wildlife area. North Atlantic High Marsh, once the second largest marsh, has experienced declines, reflecting a trend seen throughout the coastal area. Eastern Reed Marsh has come into prominence in recent years and Reed Tidal Marsh has slightly declined, presumably through eradication efforts.

DNREC Sea Level Rise Analysis (Table 3.9)

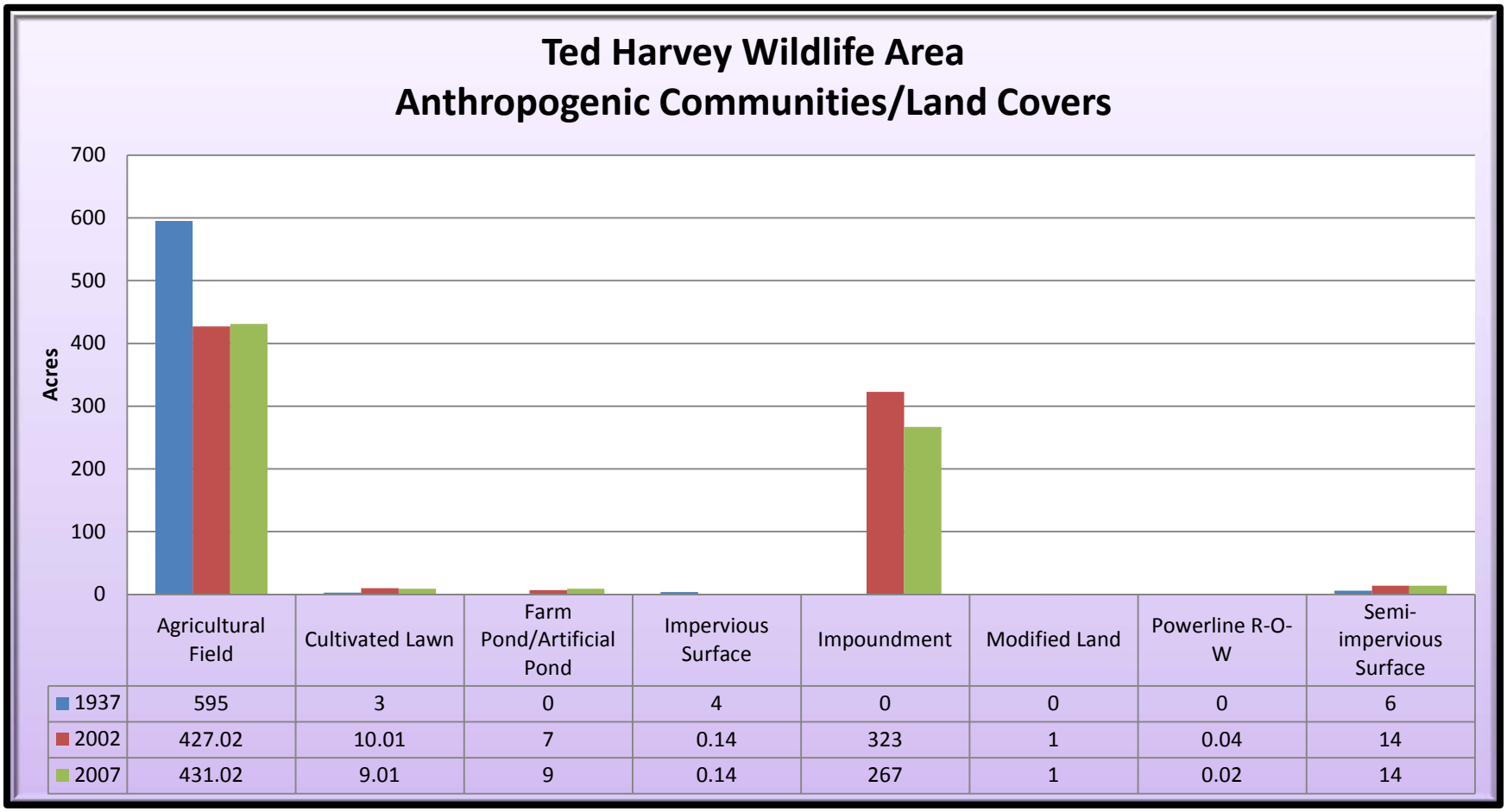
Nearly all of the marshland currently present in the wildlife area will be flooded with 1.5 m of sea level rise. Most of it will be inundated with just 0.5 m of sea level rise.

Table 3.9. Projected acres of Ted Harvey Wildlife Area Marsh Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	1,211 acres
1 m	1,328 acres
1.5 m	1,332 acres

Natural Capital (Table 3.10)

Marshland capital has declined overall since 1937, but has rebounded in the recent period (2002-2007) with gains in North Atlantic Low Salt Marsh. Some of these gains have come at the expense of North Atlantic High Salt Marsh.

Table 3.10. Natural Capital of Ted Harvey Wildlife Area Marsh	
Year	**Natural Capital (in 2012 dollars)**
1937	$9,685,144/year
2002	$8,035,158/year
2007	$8,689,878/year



	Agricultural Field	Cultivated Lawn	Farm Pond/Artificial Pond	Impervious Surface	Impoundment	Modified Land	Powerline R-O-W	Semi-impervious Surface
1937	595	3	0	4	0	0	0	6
2002	427.02	10.01	7	0.14	323	1	0.04	14
2007	431.02	9.01	9	0.14	267	1	0.02	14

Figure 3.6. Anthropogenic Communities at Ted Harvey Wildlife Area (1937, 2002, and 2007)

Ted Harvey Wildlife Area Anthropogenic Communities/Land Covers (Figure 3.6): Agricultural field is the most prominent anthropogenic community followed by Impoundments. Other uses including Cultivated Lawn, Farm Ponds/Artificial Ponds, modified land, and impervious surface have all increased over time, but still account for a relatively small amount of the wildlife area.

DNREC Sea Level Rise Analysis (Table 3.11)

A little more than half of the anthropogenic communities/land covers in the wildlife area will be flooded with 1.5 m of sea level rise.

Table 3.11. Projected acres of Ted Harvey Wildlife Area Anthropogenic Communities/Land Covers Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	149 acres
1 m	326 acres
1.5 m	405 acres

Natural Capital (Table 3.12)

Agricultural field, Farm Pond/Artificial Ponds, and Impoundments are the only anthropogenic communities/land covers with capital value. The value of the capital has gone up greatly with the development of the impoundments since 1937.

Table 3.12. Natural Capital of Ted Harvey Wildlife Area Anthropogenic Communities/Land Covers	
Year	**Natural Capital (in 2012 dollars)**
1937	$34,410/year
2002	$1,785,130/year
2007	$1,497,207/year

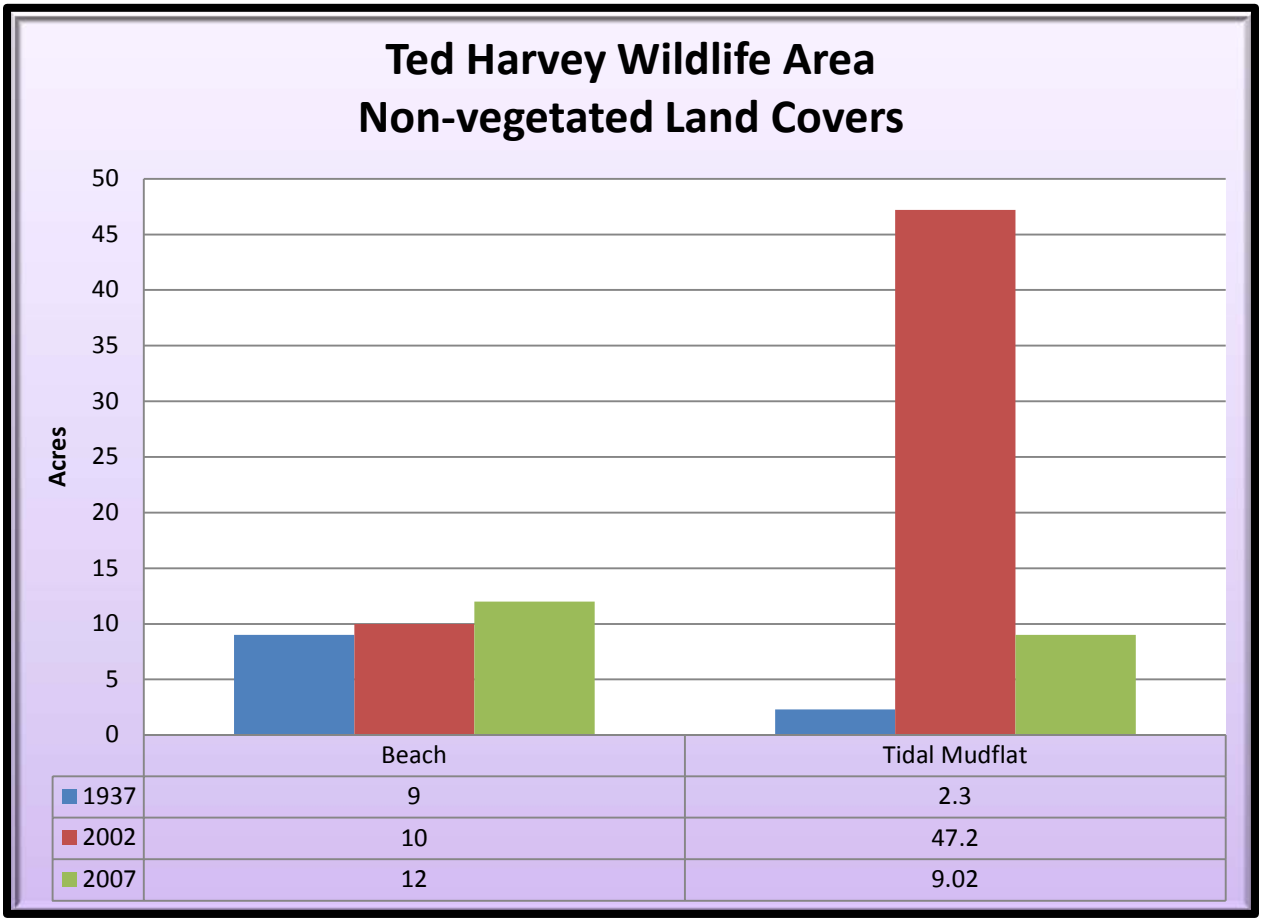


Figure 3.7. Non-vegetated Land Covers at Ted Harvey Wildlife Area (1937, 2002, and 2007)

Ted Harvey Wildlife Area Non-vegetated Land Covers (Figure 3.7): Beach and tidal mudflat are the only non-vegetated communities within the wildlife area and both have increased over time. Both communities are ephemeral and wax and wane over time.

DNREC Sea Level Rise Analysis (Table 3.13)

All of the non-vegetated land covers in the wildlife area will be inundated with 1 m of sea level rise.

Table 3.13. Projected acres of Ted Harvey Wildlife Area Marsh Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	16 acres
1 m	21 acres
1.5 m	21 acres

Natural Capital (Table 3.14)

Tidal mudflat is the only non-vegetated land cover and its value has oscillated with its acreage over time.

Table 3.14. Natural Capital of the Ted Harvey Wildlife Area Non-vegetated Land Covers	
Year	**Natural Capital (in 2012 dollars)**
1937	$14,424/year
2002	$296,005/year
2007	$56,504/year

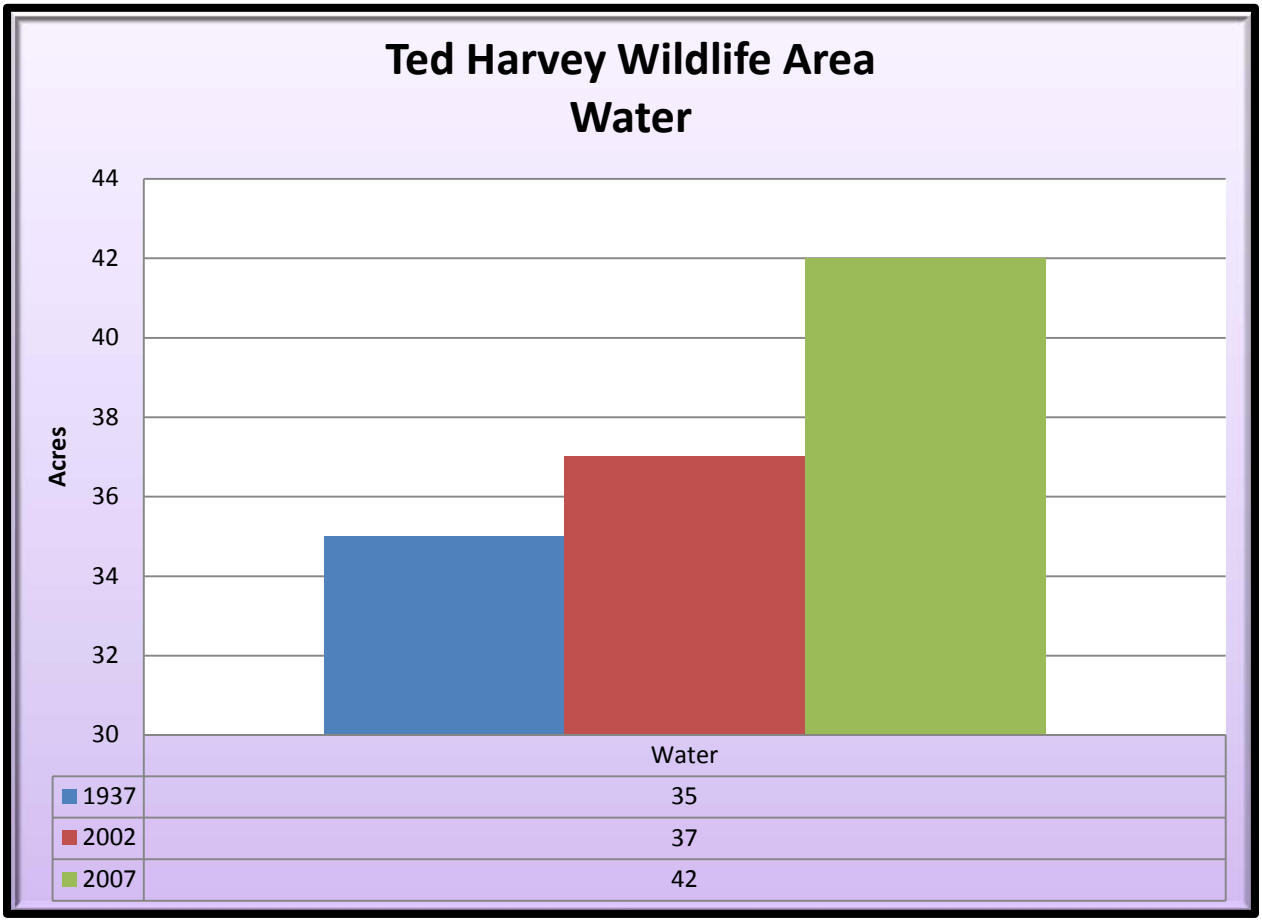


Figure 3.8. Water coverage (non-impoundment) at Ted Harvey Wildlife Area (1937, 2002, and 2007)

Ted Harvey Wildlife Area Water Coverage (Figure 3.8): This category includes tidal water which is subject to sea level rise and not contained in impoundments. This category has increased overall in the wildlife area as whole but not as much as that seen in other wildlife areas such Assawoman or Milford Neck. Some of the tracts in Ted Harvey Wildlife Area have seen decreases in the amount of water, showing that there are regional differences in rate and amount of water inundation.

Natural Capital (Table 3.15)

The value of water has been increasing as sea level rise continues to consume more land.

Table 3.15. Natural Capital of Ted Harvey Wildlife Area Water	
Year	**Natural Capital (in 2012 dollars)**
1937	$501,650/year
2002	$530,315/year
2007	$601,980/year

CHAPTER 4: VEGETATION COMMUNITIES BY TRACT

1. Buckaloo Tract

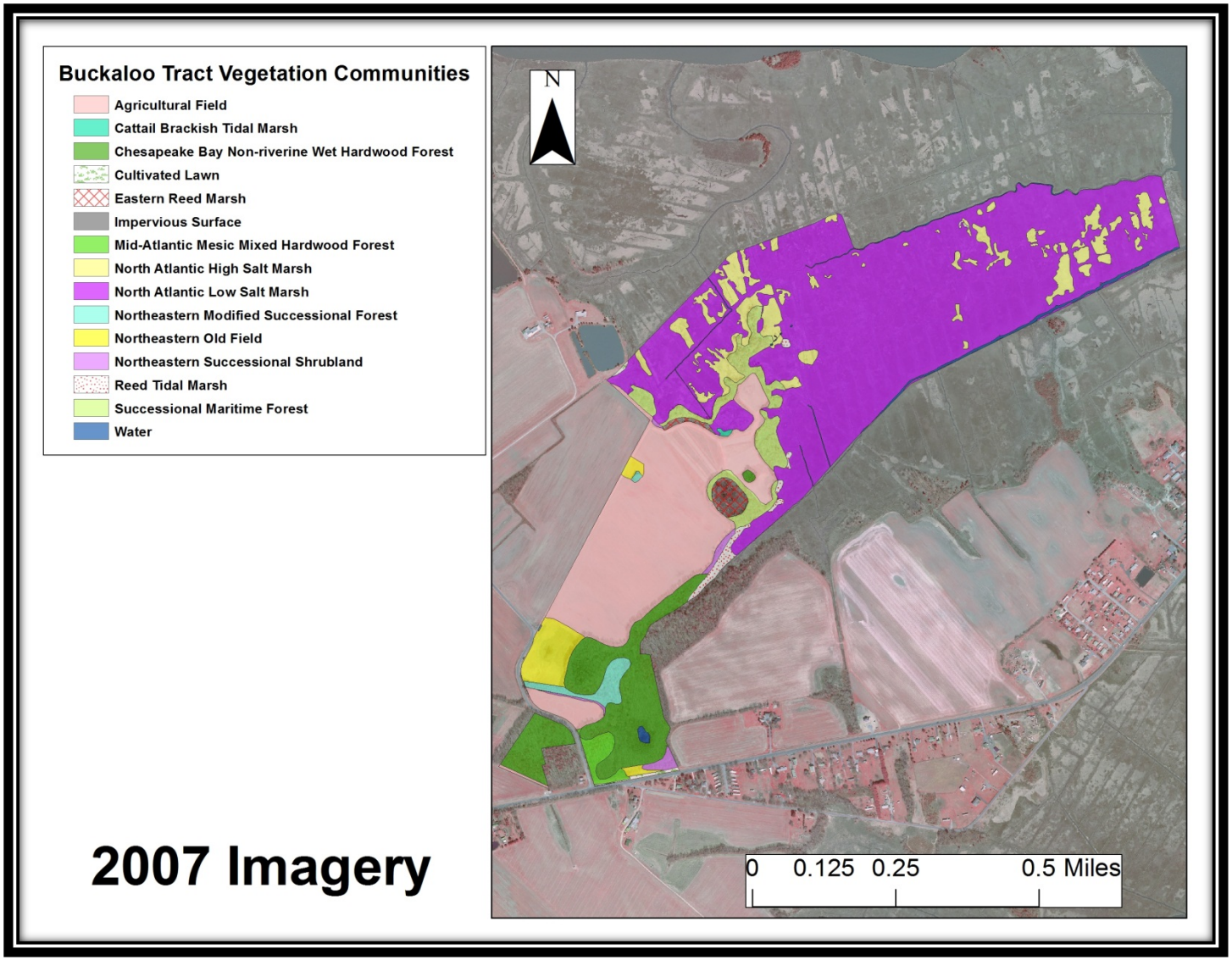


Figure 4-1.1. 2007 Vegetation Community Map of the Buckaloo Tract

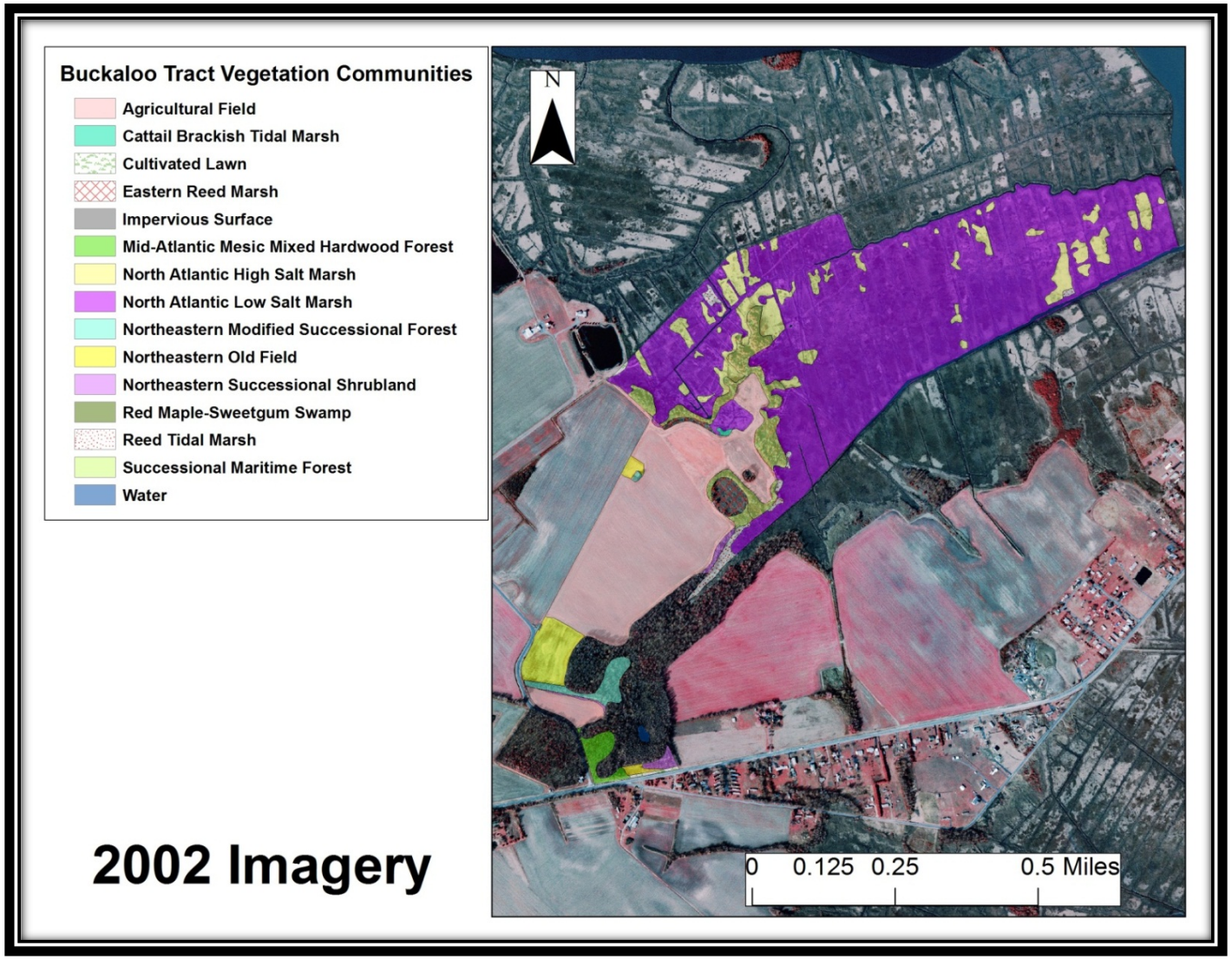


Figure 4-1.2. 2002 Vegetation Community Map of the Buckaloo Tract

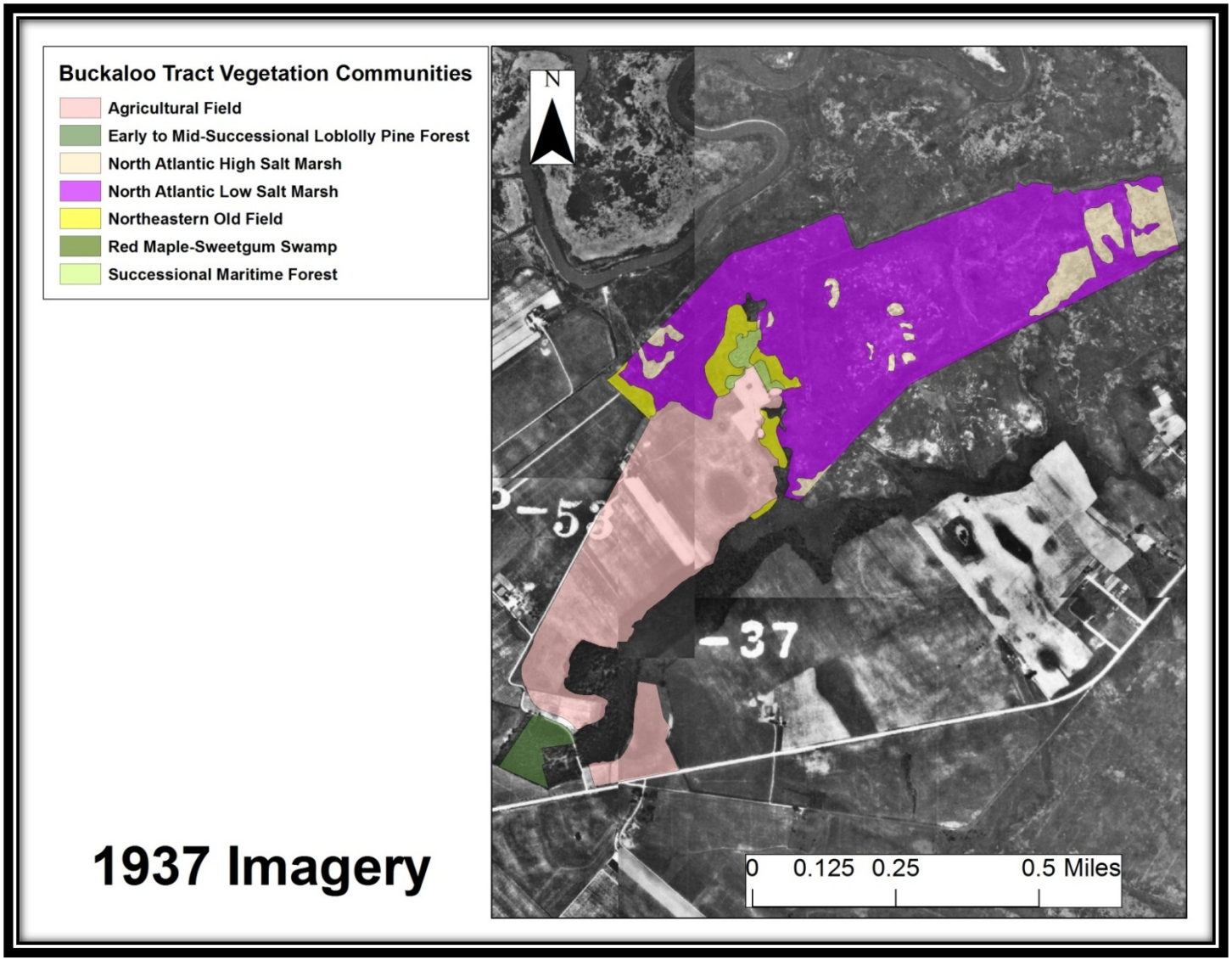
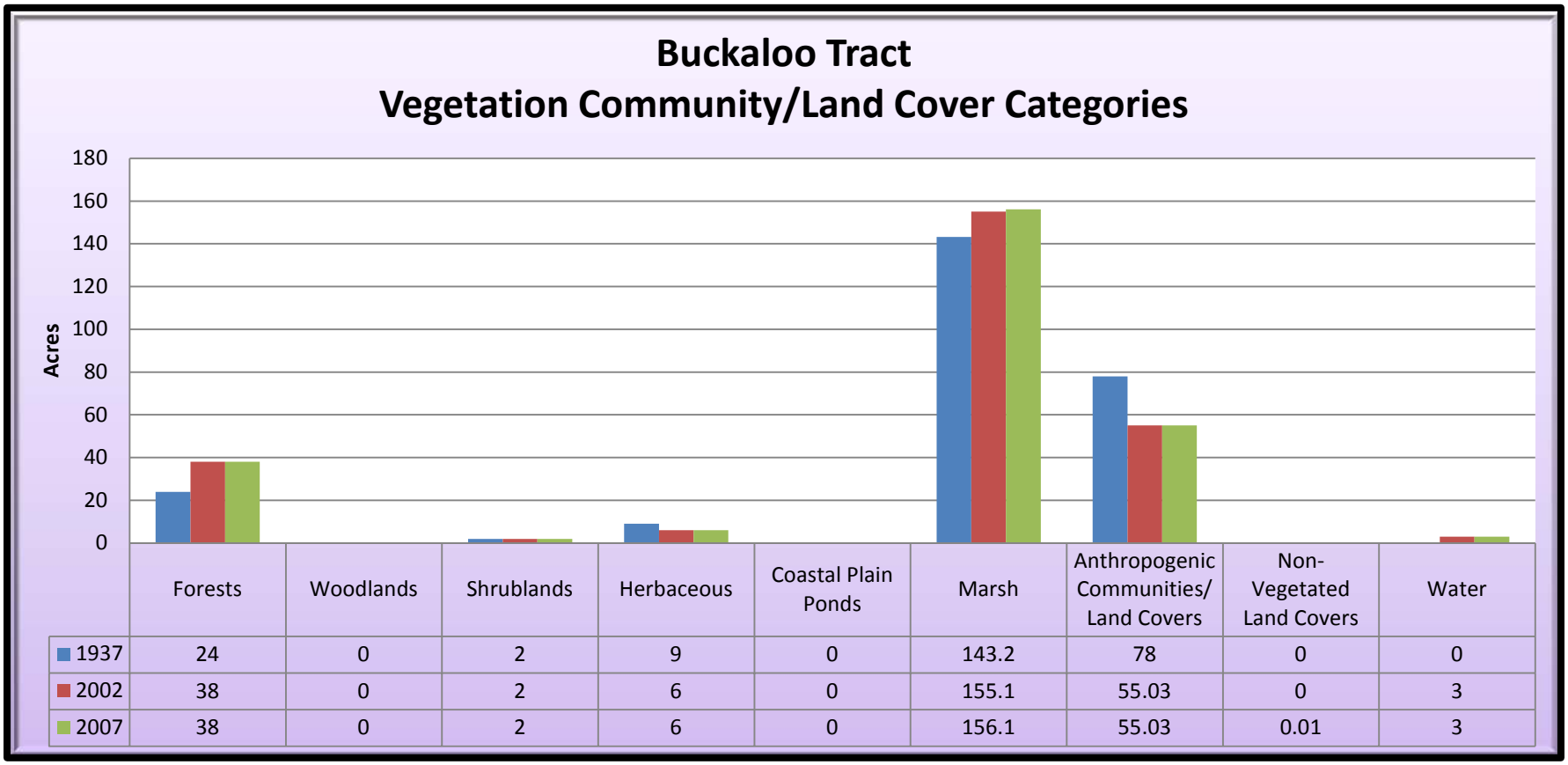


Figure 4-1.3. 1937 Vegetation Community Map of the Buckaloo Tract



	Forests	Woodlands	Shrublands	Herbaceous	Coastal Plain Ponds	Marsh	Anthropogenic Communities/ Land Covers	Non-Vegetated Land Covers	Water
1937	24	0	2	9	0	143.2	78	0	0
2002	38	0	2	6	0	155.1	55.03	0	3
2007	38	0	2	6	0	156.1	55.03	0.01	3

Figure 4-1.4. Buckaloo Tract Vegetation Community/Land Cover Categories (1937, 2002, and 2007)

Buckaloo Tract Categories (Figure 4-1.4): Marshland is the most prominent vegetation community in the Buckaloo Tract, followed by Anthropogenic communities and forests.

DNREC Sea Level Rise Analysis (Table 4-1.1)

More than half of the Buckaloo Tract will be inundated by water with 0.5 m of sea level rise. Another 0.5 m of rise to 1 m of total rise will inundate 20 more acres and 1.5 m of rise will inundate 206 acres out of 260 acres in the tract.

Table 4-1.1. Projected acres of the Buckaloo Tract Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	164 acres
1 m	184 acres
1.5 m	206 acres

Natural Capital (Table 4-1.2)

Capitalization of the Buckaloo Tract has been going up with increases in marsh and water coverage. This trend is expected to continue in the short-term with added water coverage.

Table 4-1.2. Natural Capital of the Buckaloo Tract	
Year	**Natural Capital (in 2012 dollars)**
1937	$1,137,945/year
2002	$1,314,511/year
2007	$1,320,782/year

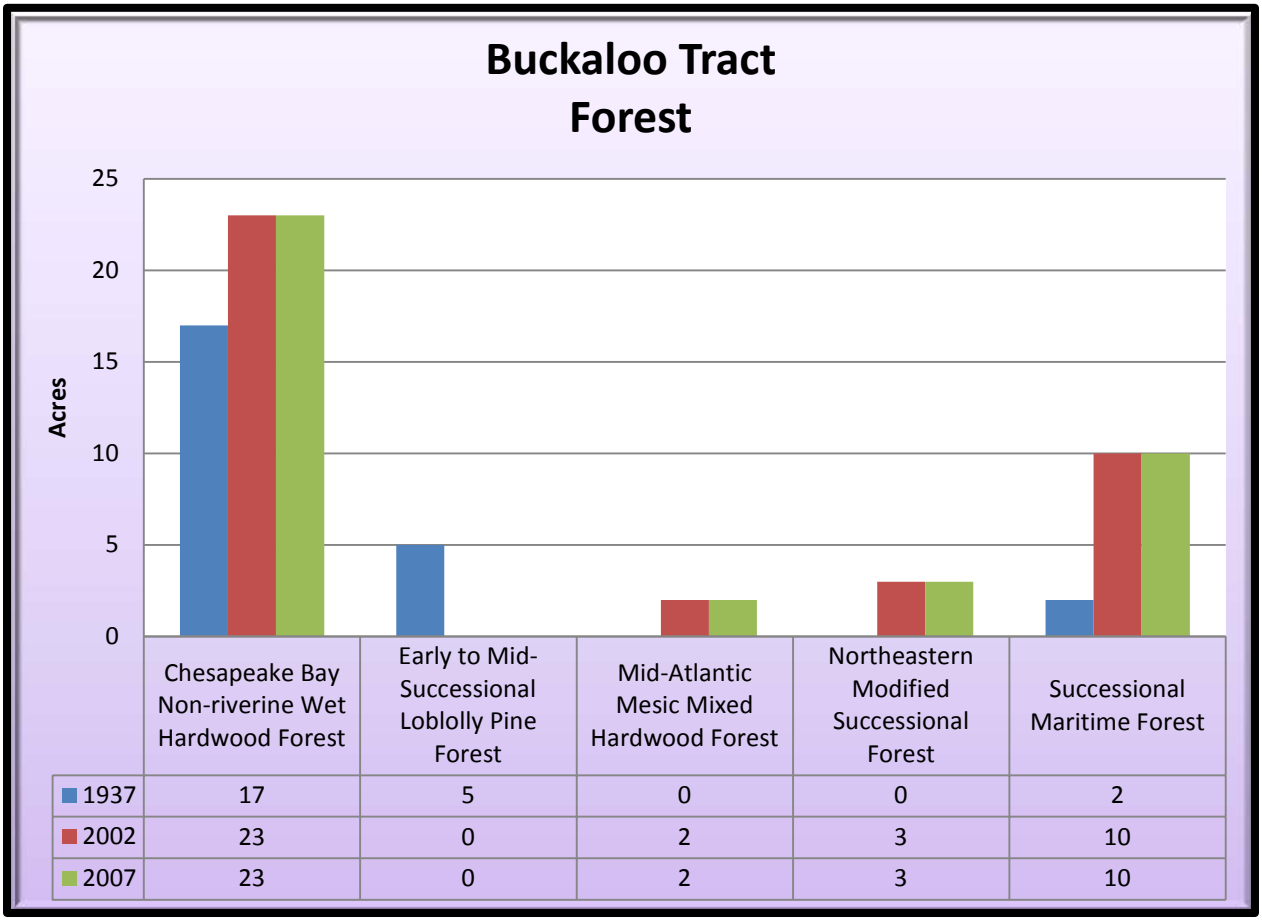


Figure 4-1.5. Buckaloo Tract Forest (1937, 2002, and 2007)

Buckaloo Tract Forest (Figure 4-1.5): The Buckaloo Tract has a small amount of forest area that is mostly composed of Red Maple-Sweetgum Swamp-Flatwoods Type. Since 1937, Successional Maritime Forest has increased to a little more than 10 acres. Early to Mid-Successional Loblolly Pine Forest which was present in 1937, has succeeded into another forest type, most likely Chesapeake Bay Non-riverine Wet Hardwood Forest.

DNREC Sea Level Rise Analysis (Table 4-1.3)

A small amount of the forested area in the Bucklaoo Tract will be inundated by 0.5 m of sea level rise. At 1 m of rise about 17 acres will be inundated and with 1.5 m of rise 27 acres will be inundated.

Table 4-1.3. Projected acres of Buckaloo Tract Forests Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	8 acres
1 m	17 acres
1.5 m	27 acres

Natural Capital (Table 4-1.4)

The natural capital of forests in the Buckaloo Tract has remained stable in the recent period (2002-2007), but has increased since 1937.

Table 4-1.4. Natural Capital of Buckaloo Tract Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$210,279/year
2002	$285,541/year
2007	$285,541/year

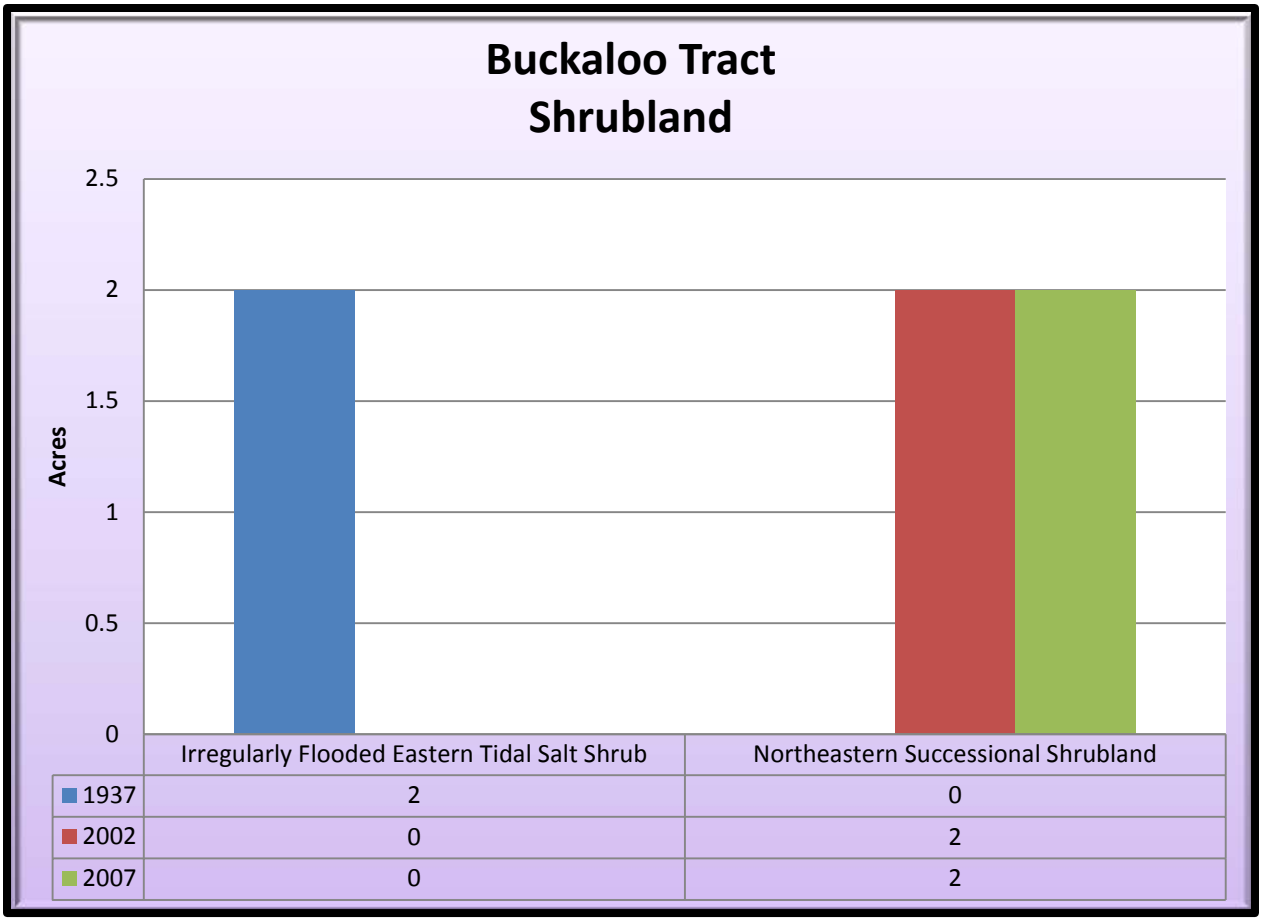


Figure 4-1.6. Buckaloo Tract Shrubland (1937, 2002, and 2007)

Buckaloo Tract Shrubland (Figure 4-1.6): Northeastern Successional Shrubland, which was not present in 1937, and Irregularly Flooded Eastern Tidal Salt, which was present in 1937, have been the only shrublands present on the Buckaloo Tract.

DNREC Sea Level Rise Analysis (Table 4-1.5)

A small amount of the shrubland present in the Buckaloo Tract will be inundated by 0.5 m of sea level rise. At 1m and 1.5 m of sea level rise about half of the shrubland will be inundated.

Table 4-1.5. Projected acres of Buckaloo Tract Shrubland Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	0.2 acres
1 m	1 acre
1.5 m	1 acre

Natural Capital (Table 4-1.6)

Capital of the Buckaloo Tract shrubland has decreased greatly with the loss of Irregularly Flooded Eastern Tidal Salt Shrub.

Table 4-1.6. Natural Capital of Buckaloo Tract Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1937	$12,543/year
2002	$291/year
2007	$291/year

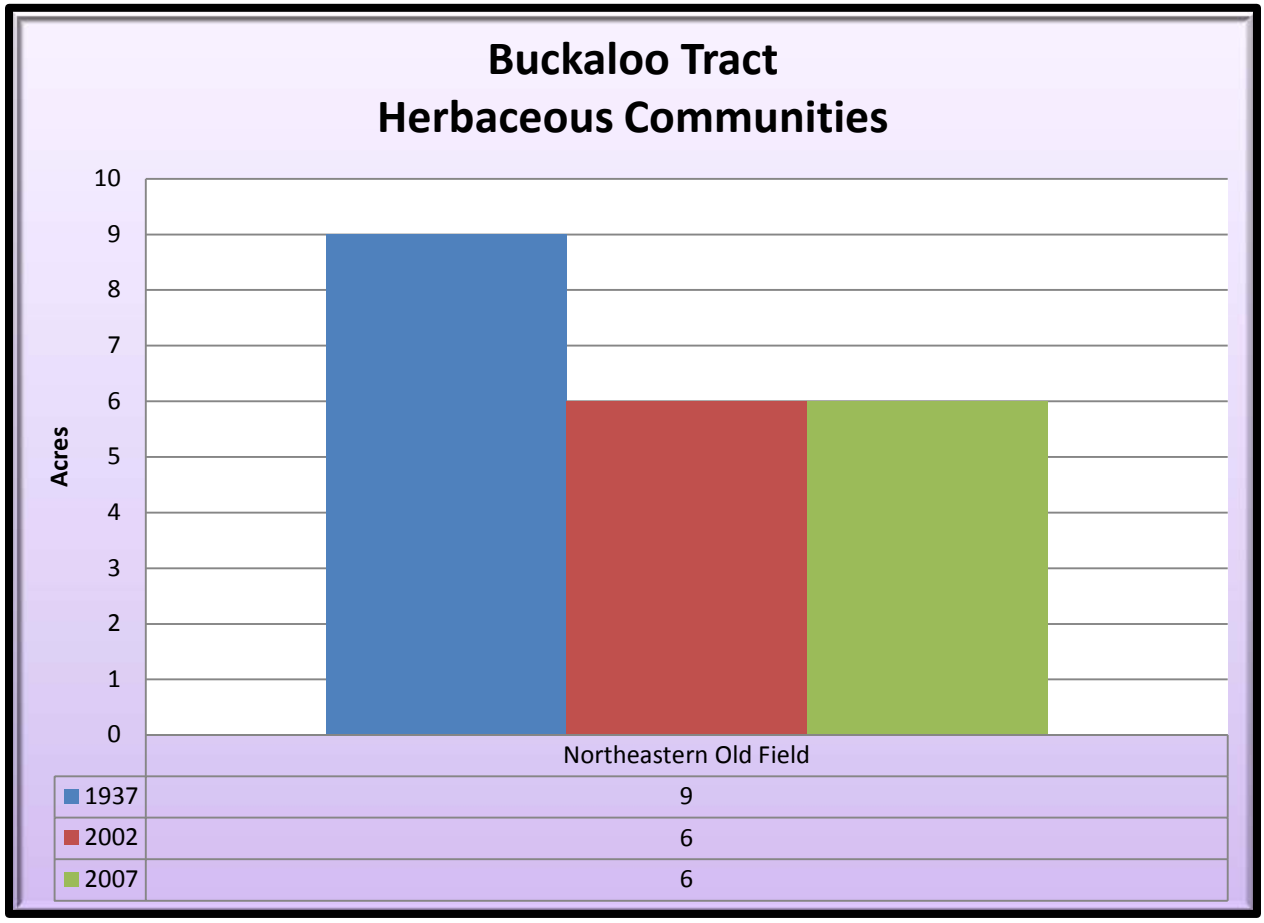


Figure 4-1.7. Buckaloo Tract Herbaceous Communities (1937, 2002, and 2007)

Buckaloo Tract Herbaceous Communities (Figure 4-1.7): Northeastern Old Field is the only herbaceous community present in the Buckaloo Tract. It has decreased overall since 1937, but has been stable in the recent period (2002-2007).

DNREC Sea Level Rise Analysis (Table 4-1.7)

Northeastern Old Field will only be affected, and just barely, with 1.5 m of sea level rise.

Table 4-1.7. Projected acres of Buckaloo Tract Herbaceous Communities Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	0 acres
1 m	0 acres
1.5 m	0.5 acres

Natural Capital (Table 4-1.8)

The natural capital of herbaceous communities has been going down as these communities mature.

Table 4-1.8. Natural Capital of Buckaloo Tract Herbaceous Communities	
Year	**Natural Capital (in 2012 dollars)**
1937	$1,311/year
2002	$874/year
2007	$874/year

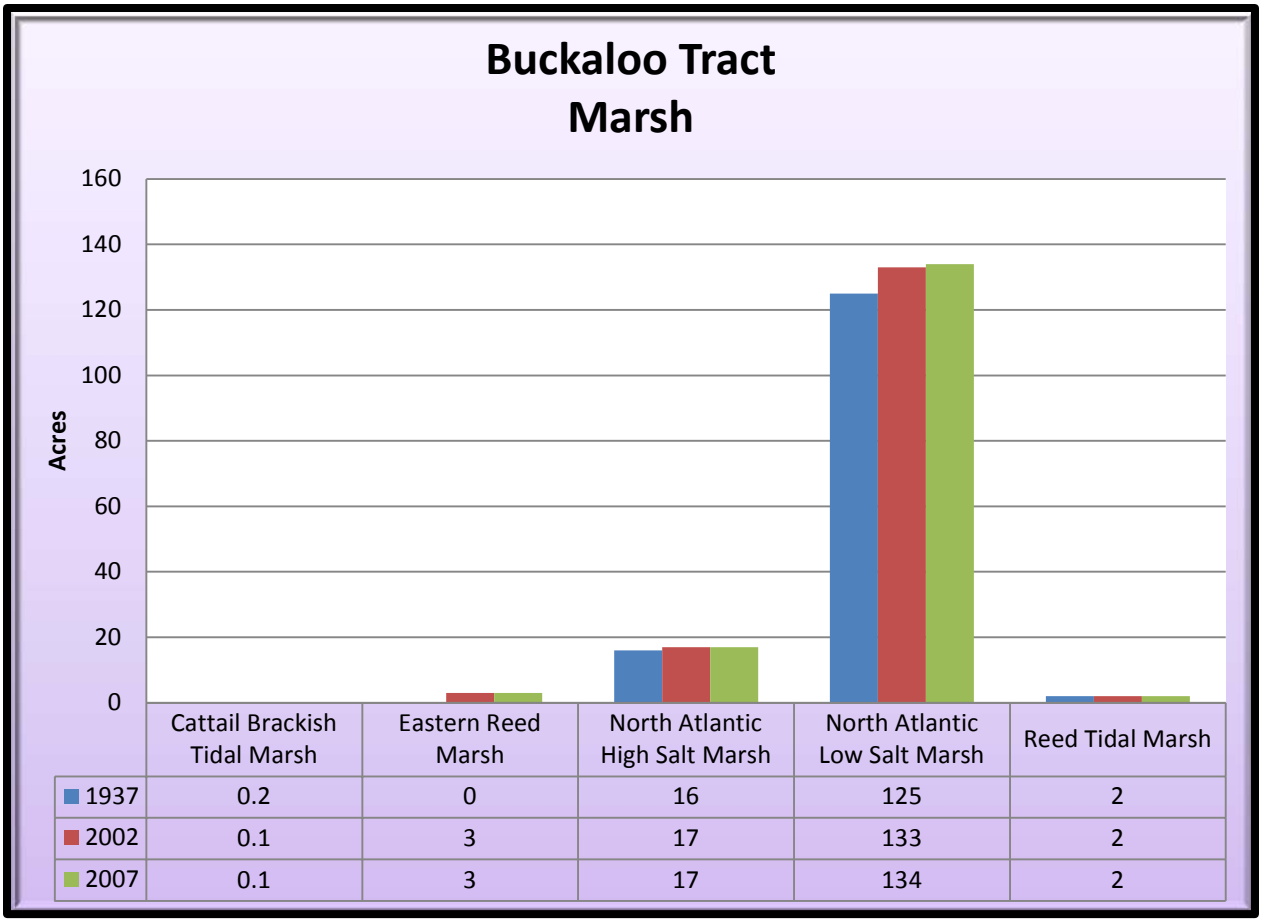


Figure 4-1.8. Buckaloo Tract Marsh (1937, 2002, and 2007)

Buckaloo Tract Marsh (Figure 4-1.8): North Atlantic Low Salt Marsh is and has been the most common marsh in the Buckaloo Tract and has increased slightly over time. North Atlantic High Salt Marsh constitutes a small amount of the marsh acreage in the Buckaloo Tract has increased very slightly, bucking a trend seen in other marsh areas.

DNREC Sea Level Rise Analysis (Table 4-1.9)

Most of the marshland in the Buckaloo Tract will be lost with 0.5 m of sea level rise and all will be lost with 1 m and above of rise in its current acreage.

Table 4-1.9. Projected acres of Buckaloo Tract Marsh Impacted by Sea Level Rise

Rise	Acres
0.5 m	152 acres
1 m	155 acres
1.5 m	155 acres

Natural Capital (Table 4-1.10)

Natural capital of marshland has increased and is propelled by an increase in North Atlantic Low Salt Marsh and a stable amount of North Atlantic High Salt Marsh. It is unknown why North Atlantic High Salt Marsh has been steady in this tract, but it could be due to *Phragmites* control efforts.

Table 4-1.10. Natural Capital of Buckaloo Tract Marsh	
Year	**Natural Capital (in 2012 dollars)**
1937	$909,339/year
2002	$981,709/year
2007	$987,980/year

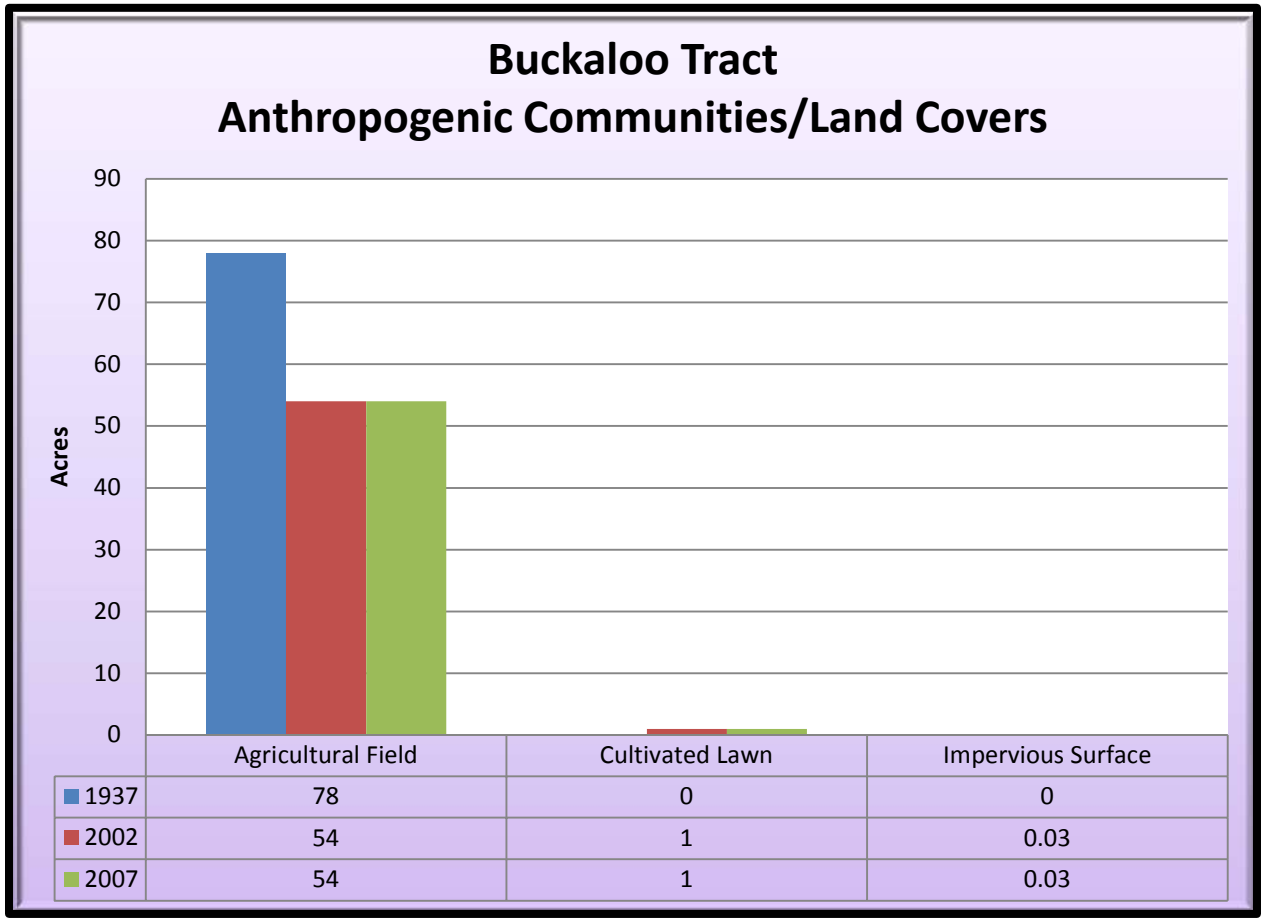


Figure 4-1.9. Buckaloo Tract Anthropogenic Communities/Land Covers (1937, 2002, and 2007)

Buckaloo Tract Anthropogenic Communities/Land Covers (Figure 4-1.9): Agricultural field is the most prominent anthropogenic community in the Buckaloo Tract and has declined over time as more and more fields are abandoned. Cultivated Lawn and Impervious Surface are generally inconsequential to the acreage here.

DNREC Sea Level Rise Analysis (Table 4-1.11)

Most of the anthropogenic communities present in the Buckaloo Tract are located in the higher parts of the tract and therefore are not subject to much inundation. At 0.5 m of rise only 2 acres will be affected. At 1 m of rise, 9 acres will be affected and at 1.5 m 21 acres will be inundated, or a little less than half of the acreage.

Table 4-1.11. Projected acres of Buckaloo Tract Herbaceous Communities Impacted by Sea Level Rise

Rise	Acres
0.5 m	2 acres
1 m	9 acres
1.5 m	21 acres

Natural Capital (Table 4-1.12)

The only community with any capital value is agricultural field and it has decreased with abandonment of agricultural activities.

Table 4-1.12. Natural Capital of Buckaloo Tract Anthropogenic Communities/Land Covers

Year	Natural Capital (in 2012 dollars)
1937	$4,473/year
2002	$3,097/year
2007	$3,097/year

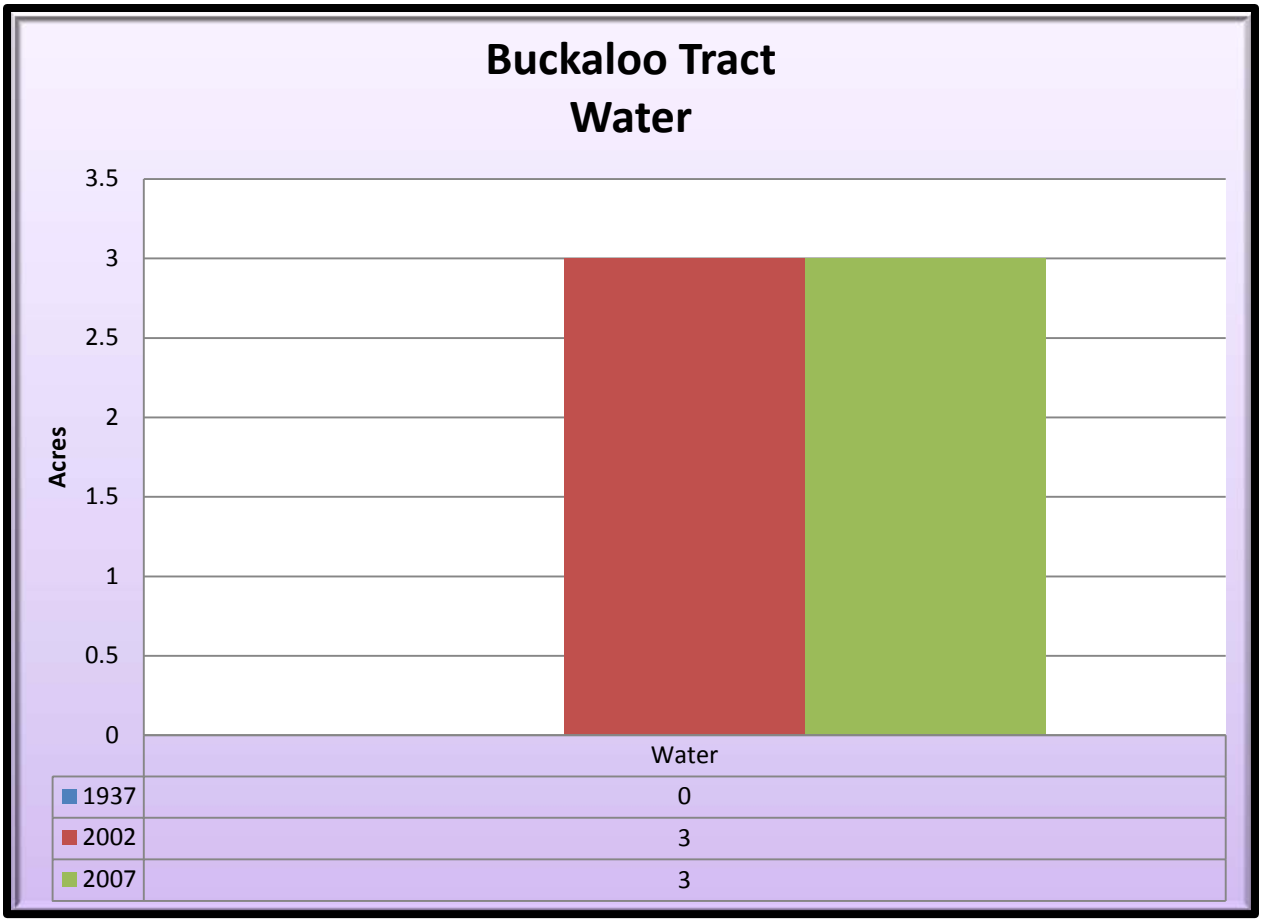


Figure 4-1.10. Buckaloo Tract Water coverage (1937, 2002, and 2007)

Buckaloo Tract Water Coverage (Figure 4-1.10): In 1937, there was no water coverage within the boundaries of the Buckaloo Tract. By 2002 this amount had increased to three acres and has stayed stable since.

Natural Capital (Table 4-1.13)

In 1937, there was no water coverage within the boundaries of the Buckaloo Tract. Since this time some water has inundated the marshland transferring its capitalization to water and has been stable in amount in the recent period (2002-2007).

Table 4-1.13. Natural Capital of Buckaloo Tract Water	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$42,999/year
2007	$42,999/year

2. Island Farm Tract

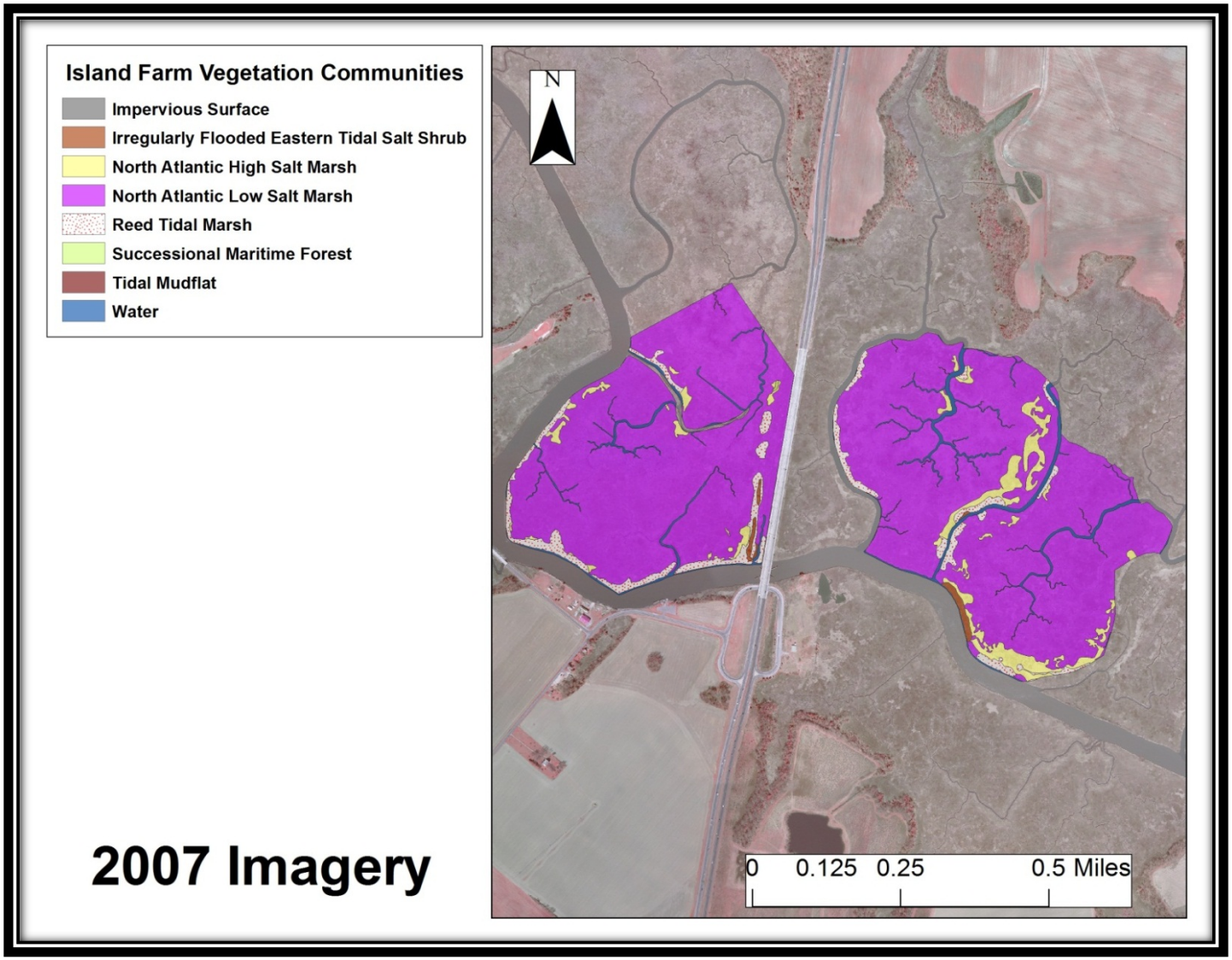


Figure 4-2.1. 2007 Vegetation Community Map of the Island Farm Tract

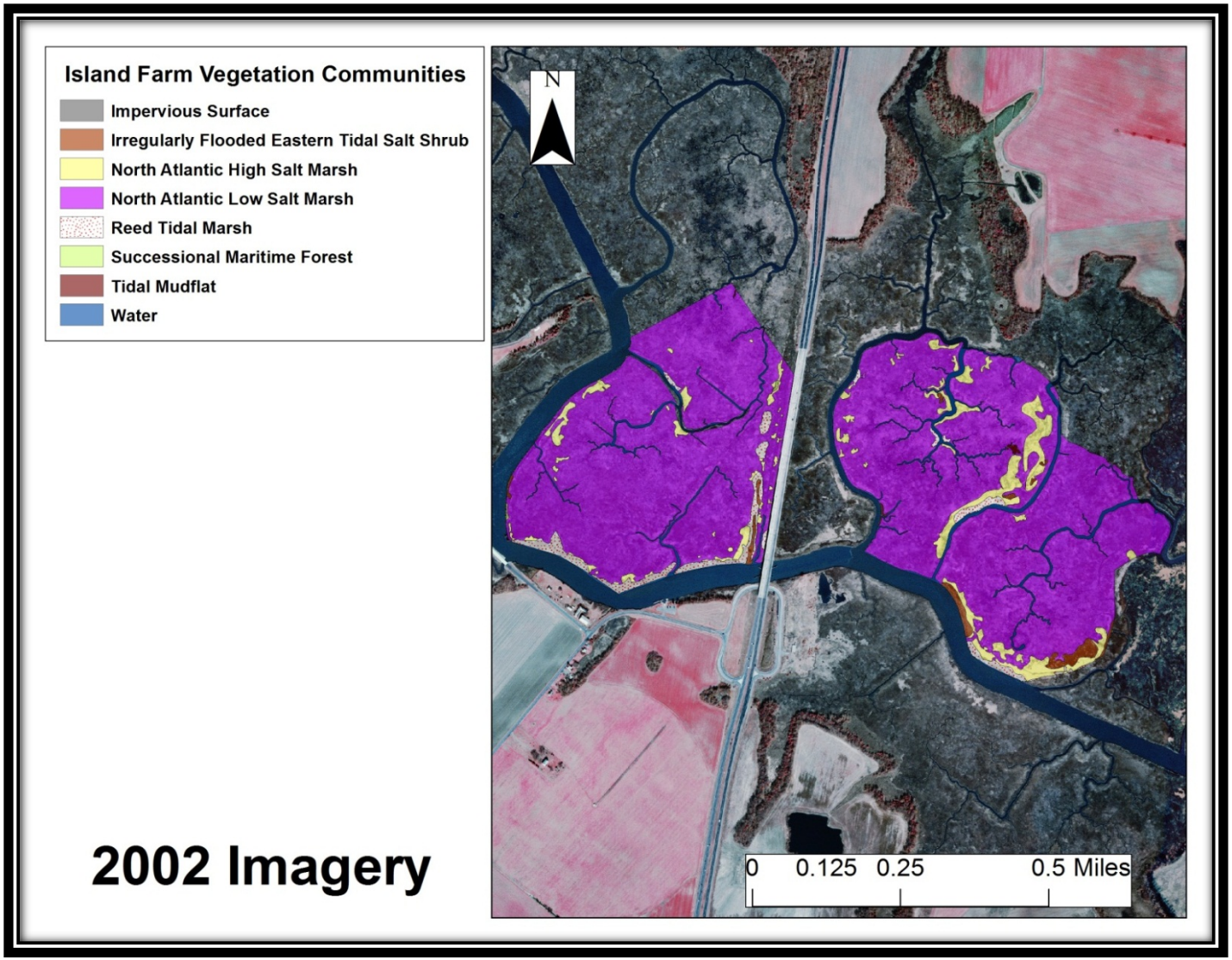


Figure 4-2.2. 2002 Vegetation Community Map of the Island Farm Tract

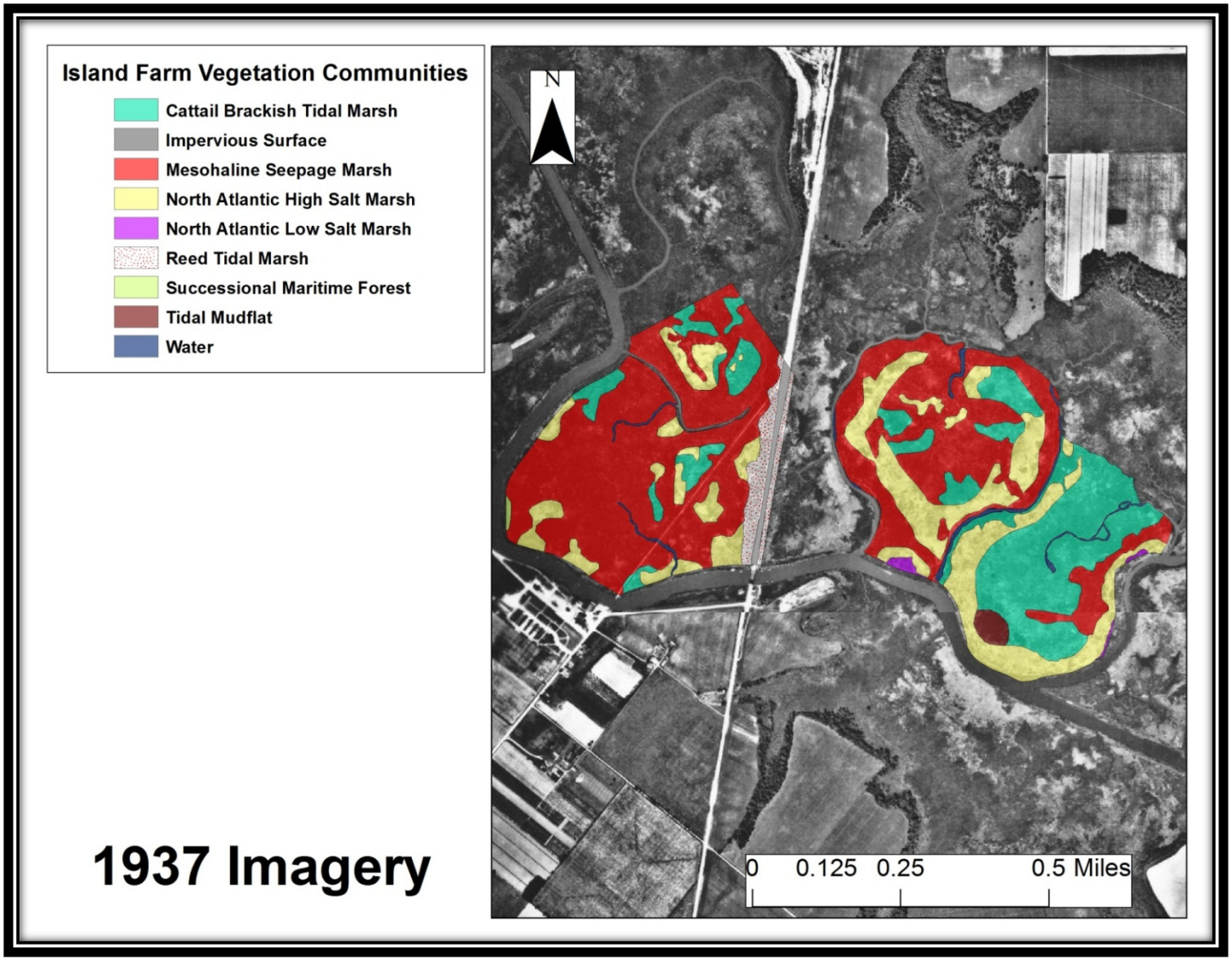
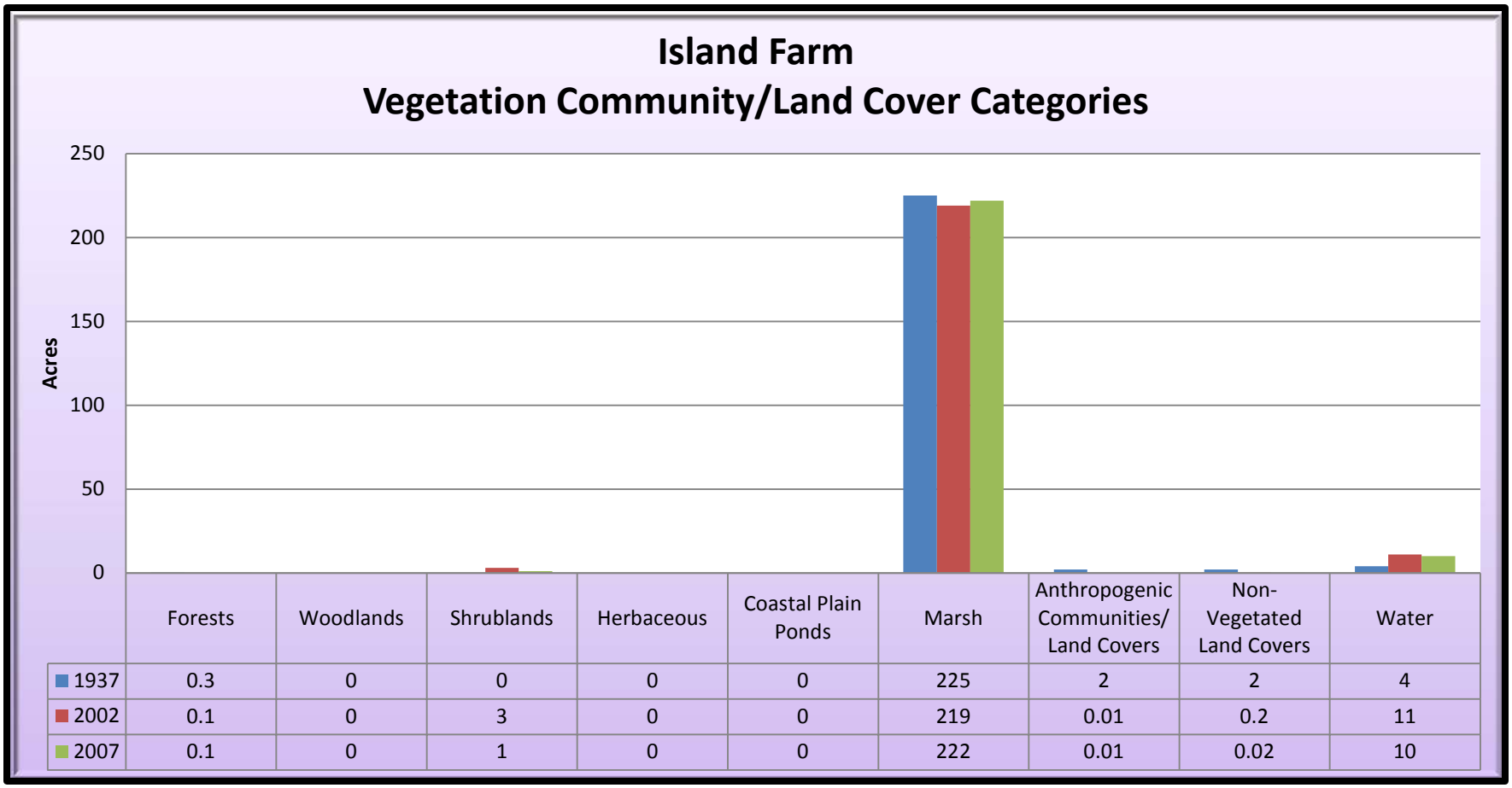


Figure 4-2.3. 1937 Vegetation Community Map of the Island Farm Tract



	Forests	Woodlands	Shrublands	Herbaceous	Coastal Plain Ponds	Marsh	Anthropogenic Communities/ Land Covers	Non-Vegetated Land Covers	Water
1937	0.3	0	0	0	0	225	2	2	4
2002	0.1	0	3	0	0	219	0.01	0.2	11
2007	0.1	0	1	0	0	222	0.01	0.02	10

Figure 4-2.4. Island Farm Tract Vegetation Community/Land Cover Categories (1937, 2002, and 2007)

Island Farm Tract Vegetation Community/Land Covers (Figure 4-2.4): Marshland is the most prominent vegetation community in the Island Farm Tract.

DNREC Sea Level Rise Analysis (Table 4-2.1)

All of the Island Farm Tract will be inundated with 0.5 m of sea level rise making it the most vulnerable tract in the wildlife area to sea level rise.

Table 4-2.1. Projected acres of the Island Farm Tract Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	233 acres
1 m	233 acres
1.5 m	233 acres

Natural Capital (Table 4-2.2)

The capitalization of the Island Farm tract rose up to 2002 and then has declined with a loss in water coverage. It is expected that it increase in the future as the capitalization of marsh is transferred to water.

Table 4-2.2. Natural Capital of the Island Farm Tract	
Year	**Natural Capital (in 2012 dollars)**
1937	$1,481,260/year
2002	$1,551,220/year
2007	$1,541,847/year

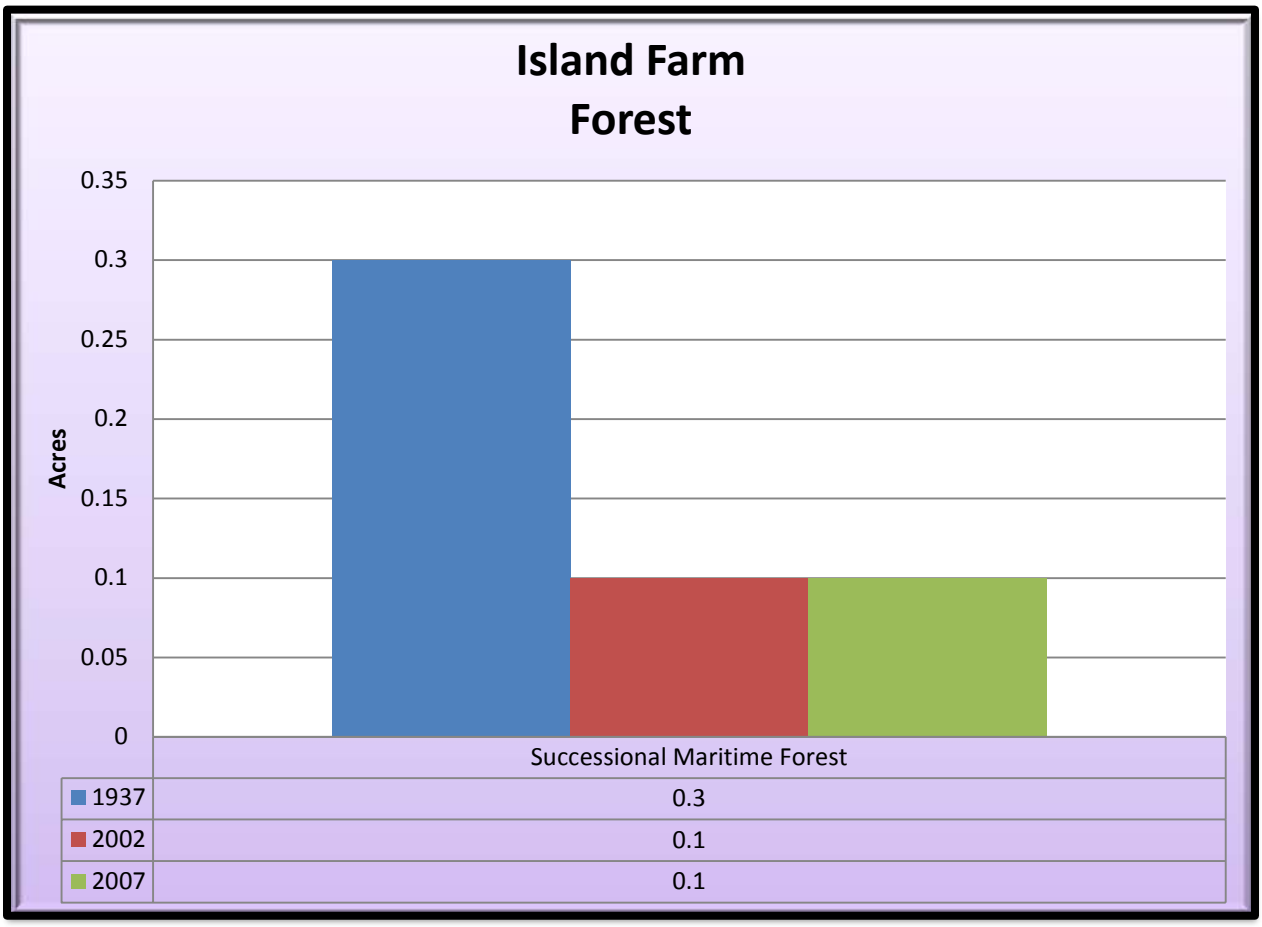


Figure 4-2.5. Island Farm Tract Forest (1937, 2002, and 2007)

Island Farm Tract Forest (Figure 4-2.5): Successional Maritime Forest was the only forest type present in the Island Farm Tract in 1937, and remains so in 2007, barely.

DNREC Sea Level Rise Analysis (Table 4-2.3)

All of the Island Farm Tract forests will be inundated with 0.5 m of sea level rise.

Table 4-2.3. Projected acres of Island Farm Tract Forest Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	0.1 acres
1 m	0.1 acres
1.5 m	0.1 acres

Natural Capital (Table 4-2.4)

There is not much forestland present in the Island Farm Tract and there is does not have much capitalization. The amount left is expected to be transferred to marsh soon with sea level rise.

Table 4-2.4. Natural Capital of Island Farm Tract Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$57/year
2002	$19/year
2007	$19/year

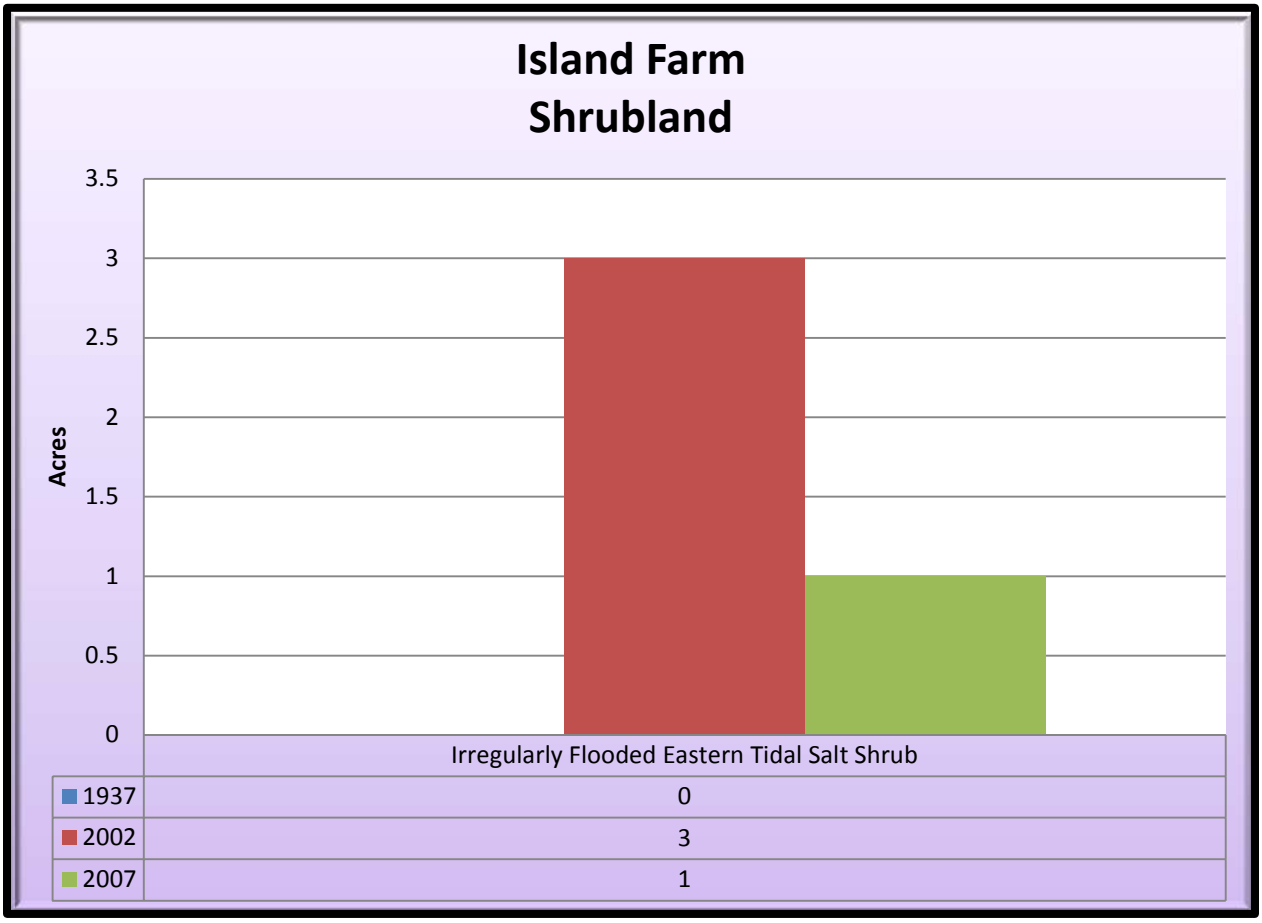


Figure 4-2.6. Island Farm Shrubland (1937, 2002, and 2007)

Island Farm Tract Shrubland (Figure 4-2.6): In 1937, the Island Farm Tract did not have any shrublands but it has since gained three acres of Irregularly Flooded Eastern Tidal Salt Shrub, which had decreased two acres by 2007.

DNREC Sea Level Rise Analysis (Table 4-2.5)

All of the Island Farm Tract shrubland will be inundated with 0.5 m of sea level rise.

Table 4-2.5. Projected acres of Island Farm Tract Shrubland Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	1 acre
1 m	1 acre
1.5 m	1 acre

Natural Capital (Table 4-2.6)

No shrubland was present in the Island Farm tract in 1937 and has since appeared in the tract, likely where Successional Maritime Forest and Impervious surface used to be. Since this time it has declined as the entire tract converts to marsh and then to water.

Table 4-2.6. Natural Capital of Island Farm Tract Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$18,814/year
2007	$6,271/year

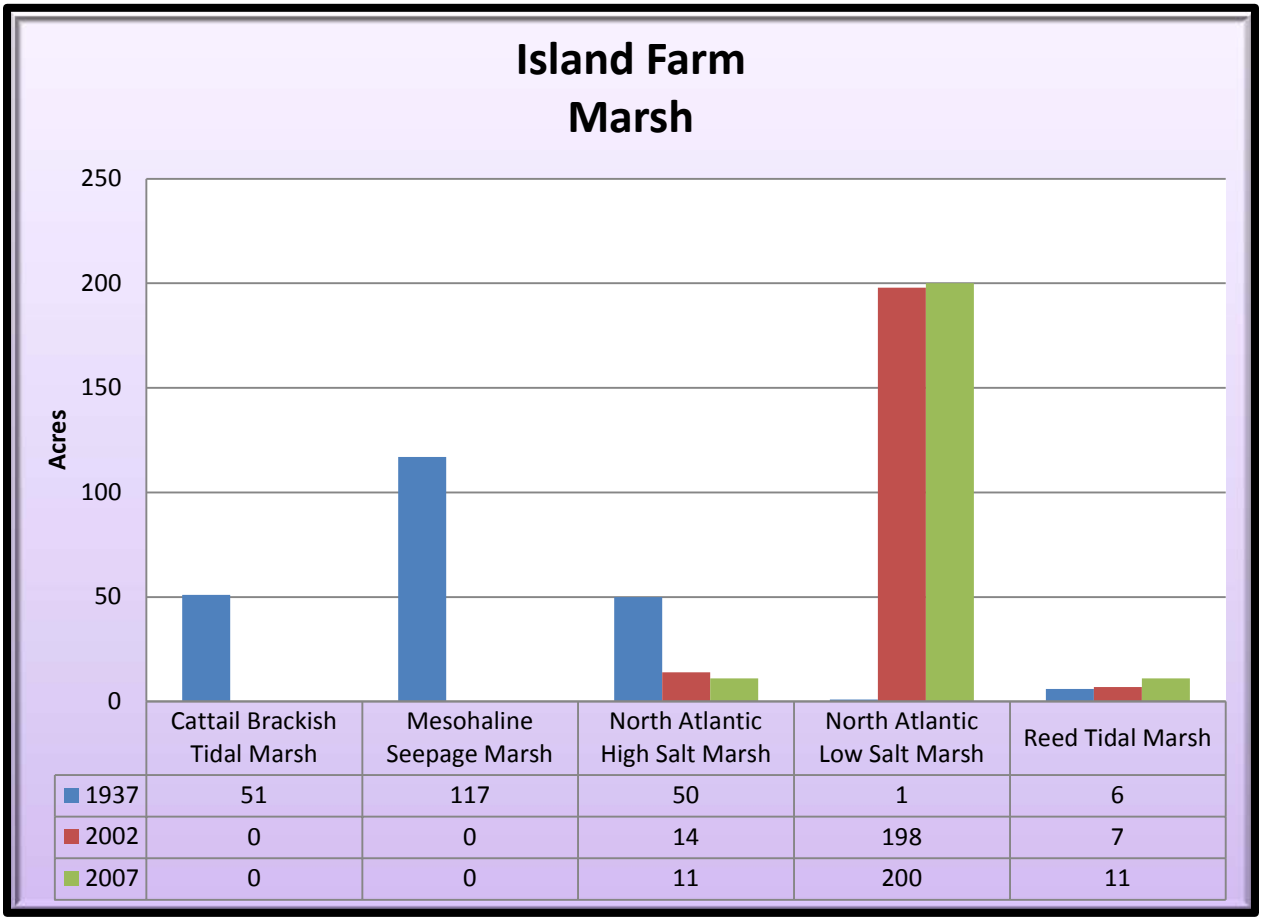


Figure 4-2.7. Island Farm Tract Marsh (1937, 2002, and 2007)

Island Farm Tract Marsh (Figure 4-2.7): In 1937, Mesohaline Seepage Marsh and Cattail Brackish Tidal Marsh were the most common marshes in the Island Farm Tract. Today with increased salinity in the area, these marshes have changed to North Atlantic Low Salt Marsh. Along with sea level rise, North Atlantic High Salt Marsh has declined over time, reflecting a trend seen in other places on the coast. These declines could be from an artificially high amount in 1937 due to salt hay farming or other factors such Reed Tidal Marsh taking over its area. Reed Tidal Marsh has consistently increased over time but remains in relatively small amount.

DNREC Sea Level Rise Analysis (Table 4-2.7)

All of the Island Farm Tract marsh will be inundated with 0.5 m of sea level rise.

Table 4-2.7. Projected acres of Island Farm Tract Marsh Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	222 acres
1 m	222 acres
1.5 m	222 acres

Natural Capital (Table 4-2.8)

Capitalization of marsh has gained with an increase in marshland through the conversion of upland communities. This figure will likely start to decline in time as water starts to inundate the tract.

Table 4-2.8. Natural Capital of Island Farm Tract Marsh	
Year	**Natural Capital (in 2012 dollars)**
1937	$1,411,043/year
2002	$1,373,415/year
2007	$1,392,229/year

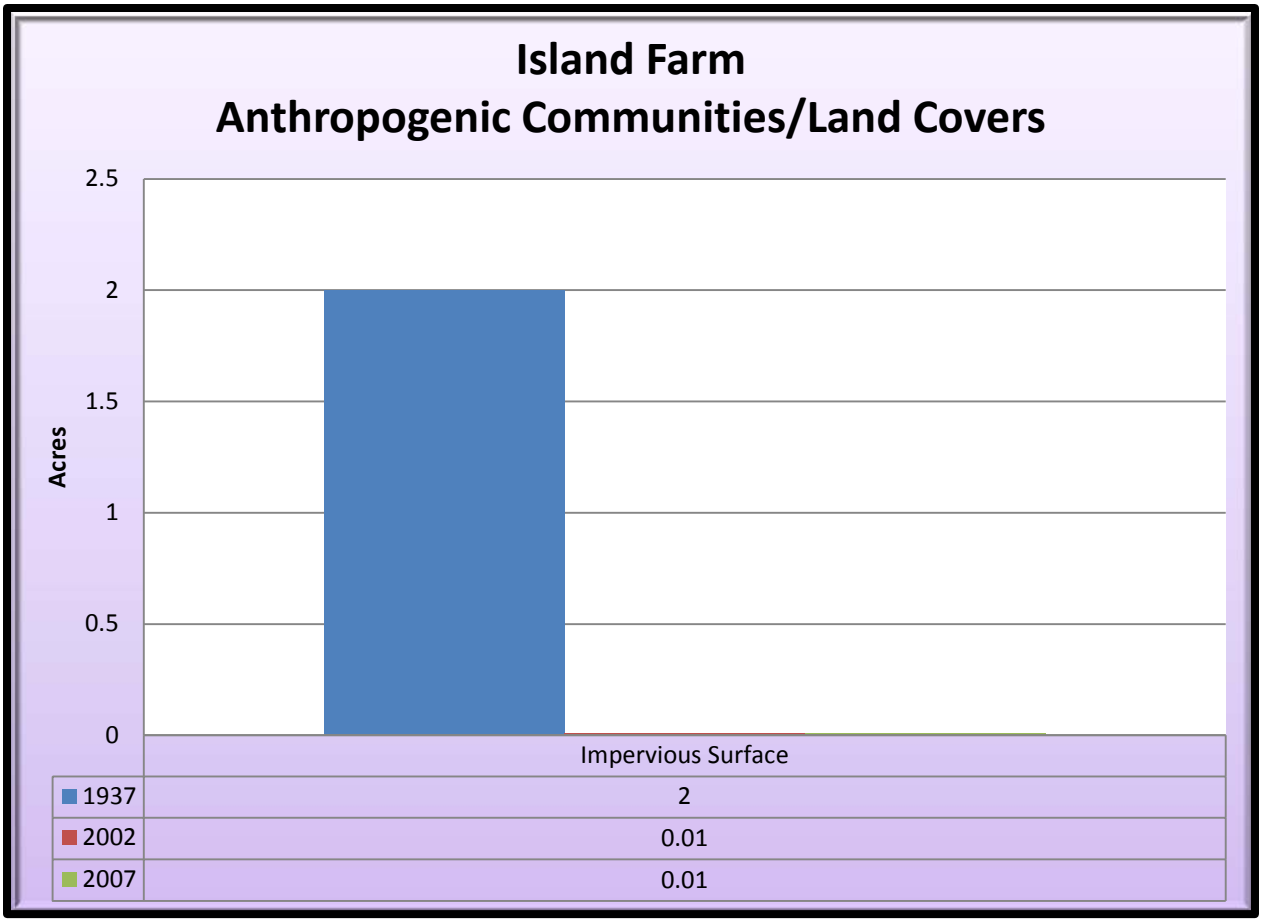


Figure 4-2.8. Island Farm Tract Anthropogenic Communities/Land Covers (1937, 2002, and 2007)

Island Farm Tract Anthropogenic Communities/Land Covers (Figure 4-2.8): Impervious Surface is the only anthropogenic community located on the Island Farm Tract and has nearly disappeared since 1937.

DNREC Sea Level Rise Analysis (Table 4-2.9)

All of the Island Farm Tract will be inundated with 0.5 m of sea level rise making it the most vulnerable tract in the wildlife area to sea level rise.

Table 4-2.9. Projected acres of Island Farm Tract Anthropogenic Communities/Land Covers Impacted by Sea Level Rise

Rise	Acres
0.5 m	233 acres
1 m	233 acres
1.5 m	233 acres

Natural Capital

None of the anthropogenic communities/land covers have any capital value.

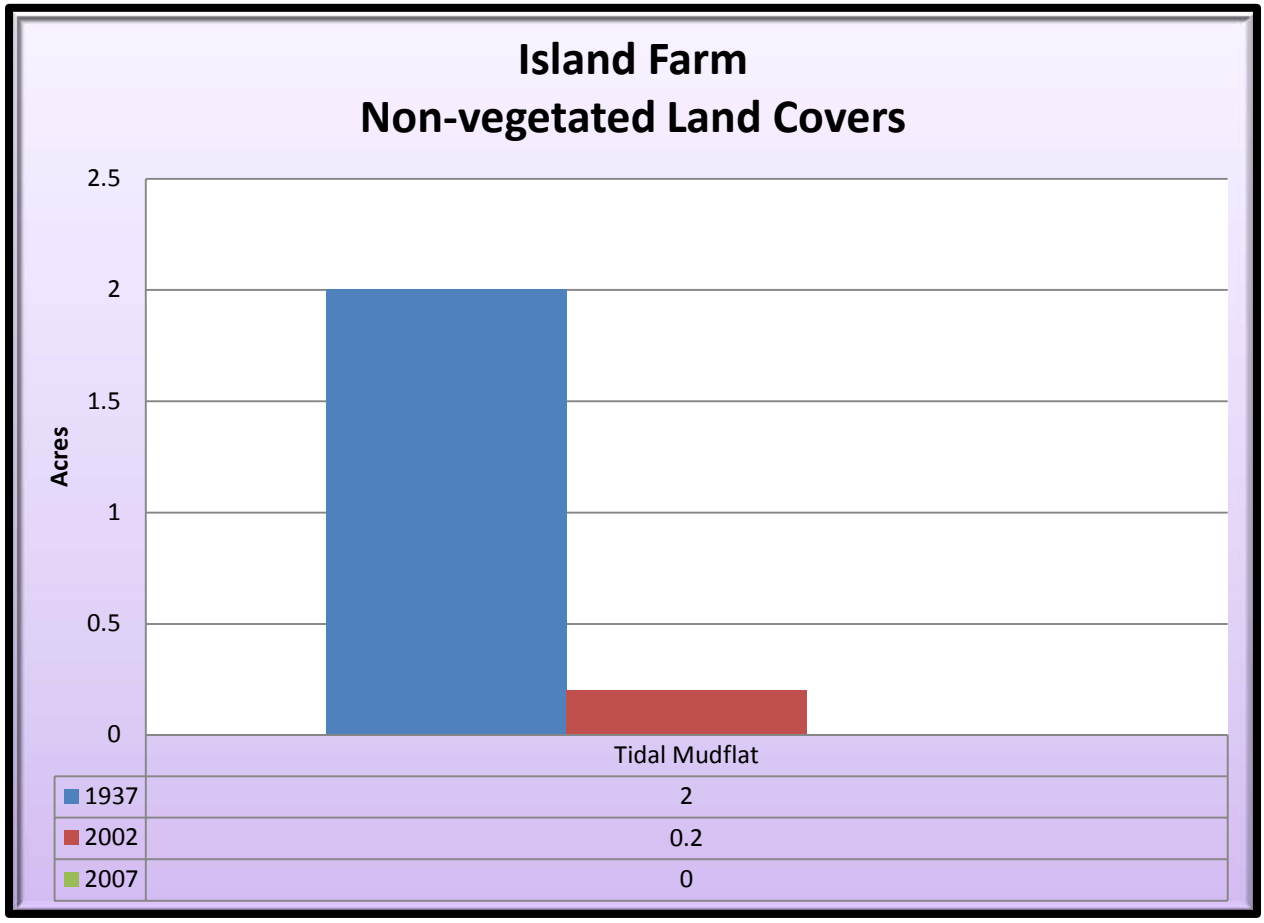


Figure 4-2.9. Island Farm Non-vegetated Land Covers (1937, 2002, and 2007)

Island Farm Non-vegetated Land Covers (Figure 4-2.9): Tidal Mudflat is the only non-vegetated land cover located on the Island Farm Tract and had disappeared by the time of the 2007 imagery.

DNREC Sea Level Rise Analysis

Non-vegetated land covers are longer present in the Island Farm tract.

Natural Capital (Table 4-2.10)

Capitalization of the one land cover has been transferred to water and is no longer present or has any value.

Table 4-2.10. Natural Capital of Island Farm Tract Non-vegetated Land Covers	
Year	**Natural Capital (in 2012 dollars)**
1937	$12,543/year
2002	$1,254/year
2007	$0/year (not present)

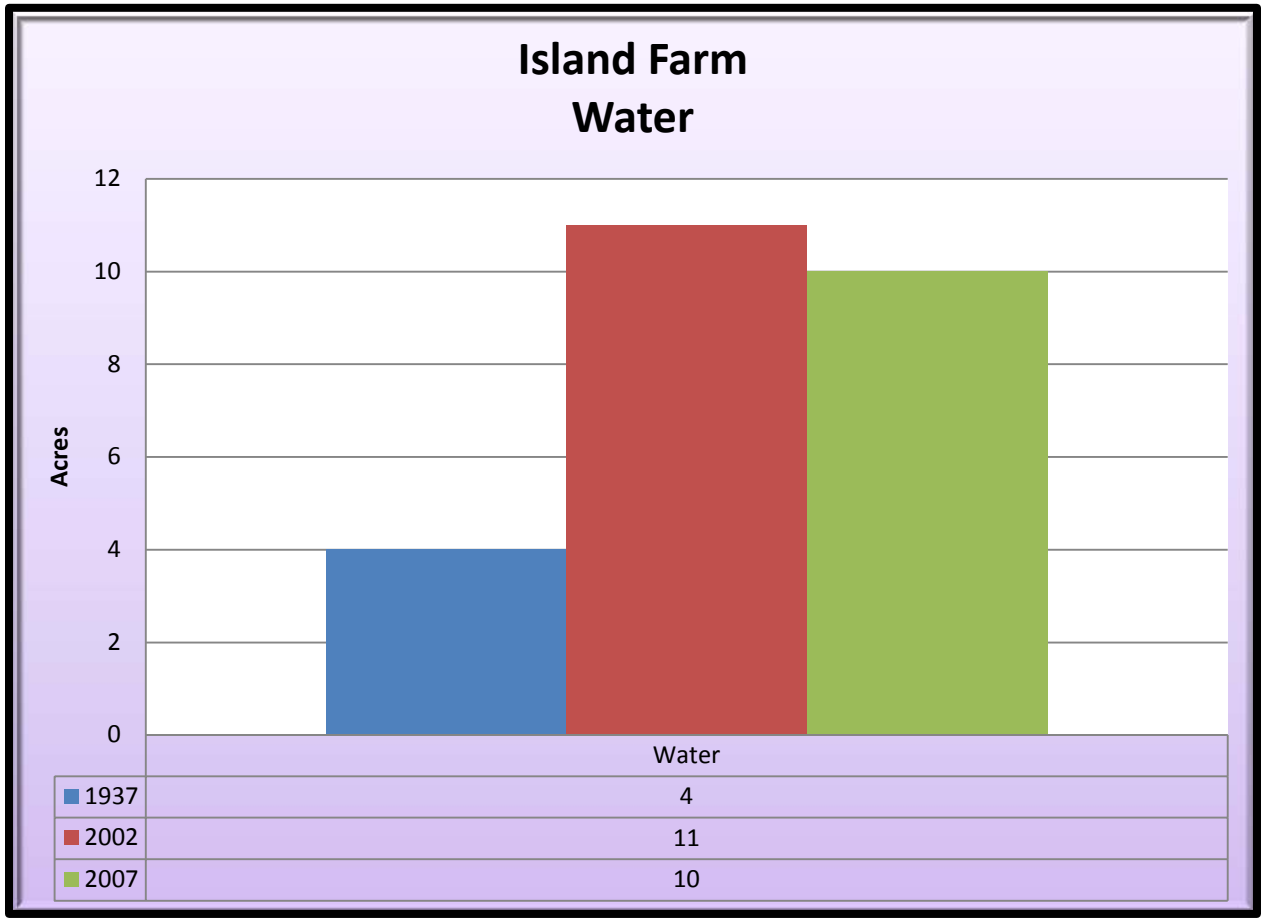


Figure 4-2.10. Island Farm Tract Water Coverage (1937, 2002, and 2007)

Island Farm Tract Water Coverage (Figure 4-2.10): Like a lot of areas on the coast, water has increased overall within the boundaries of the Island Farm Tract. Unlike other areas, though, water had decreased by one acre since 2002.

Natural Capital (Table 4-2.12)

Water has been largely increasing in capitalization with gains from 1937 to 2002, but has recently gone down, likely because of increased sedimentation on the upstream side of the DE 1 bridge.

Table 4-2.12. Natural Capital of Island Farm Tract Water	
Year	**Natural Capital (in 2012 dollars)**
1937	$57,331/year
2002	$157,661/year
2007	$143,329/year

3. Logan Lane Tract

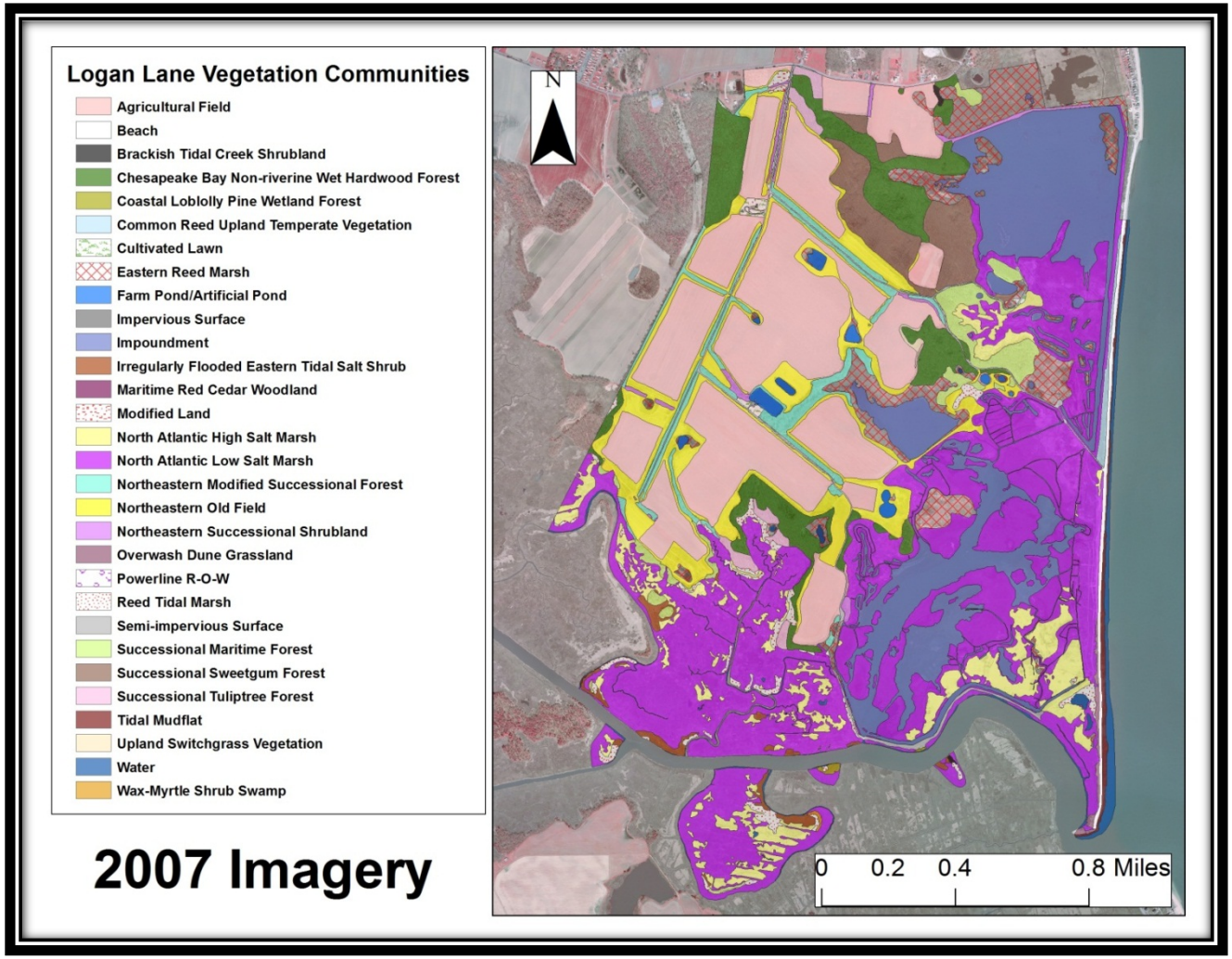


Figure 4-3.1. 2007 Vegetation Community Map of the Logan Lane Tract

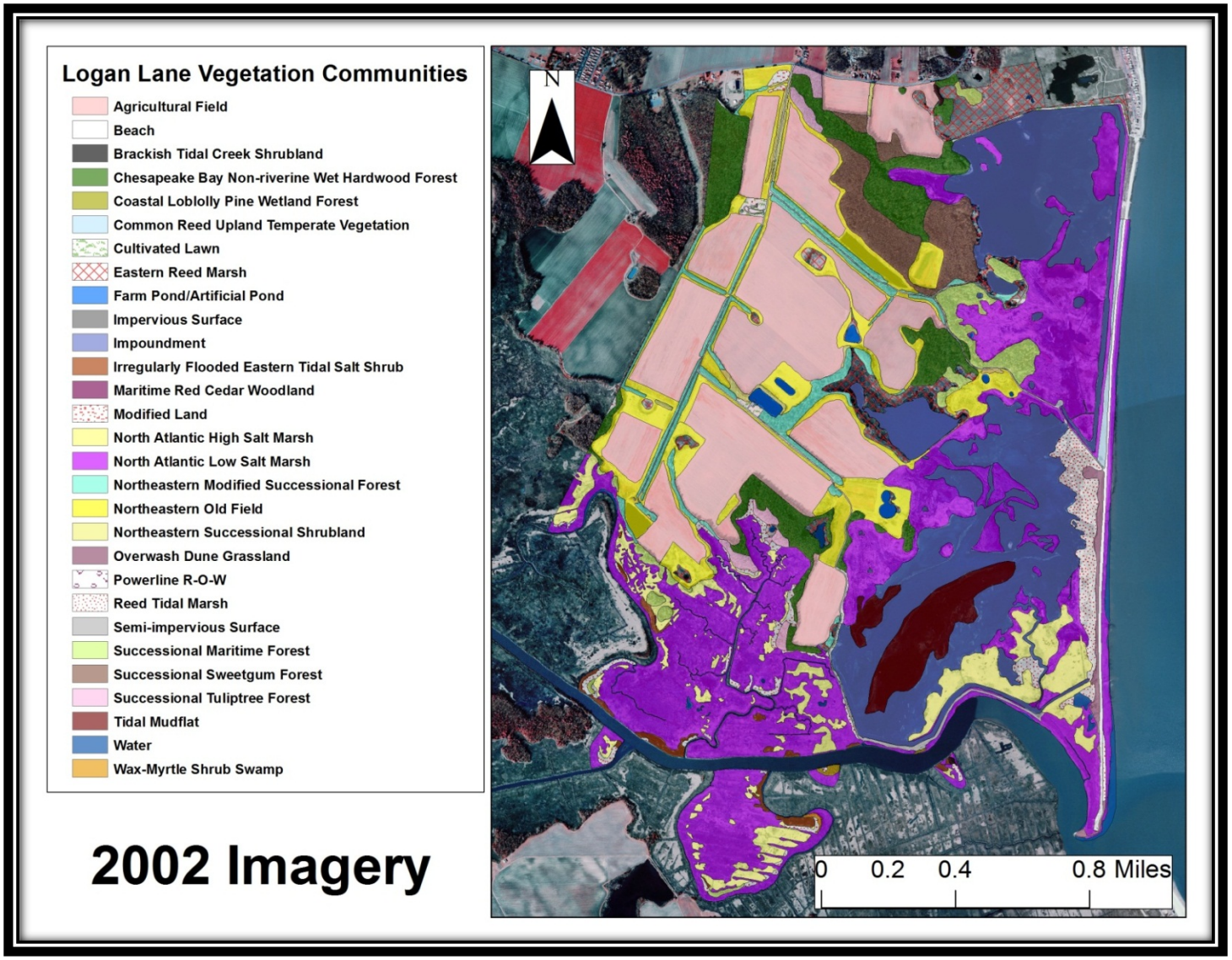


Figure 4-3.2. 2002 Vegetation Community Map of the Logan Lane Tract

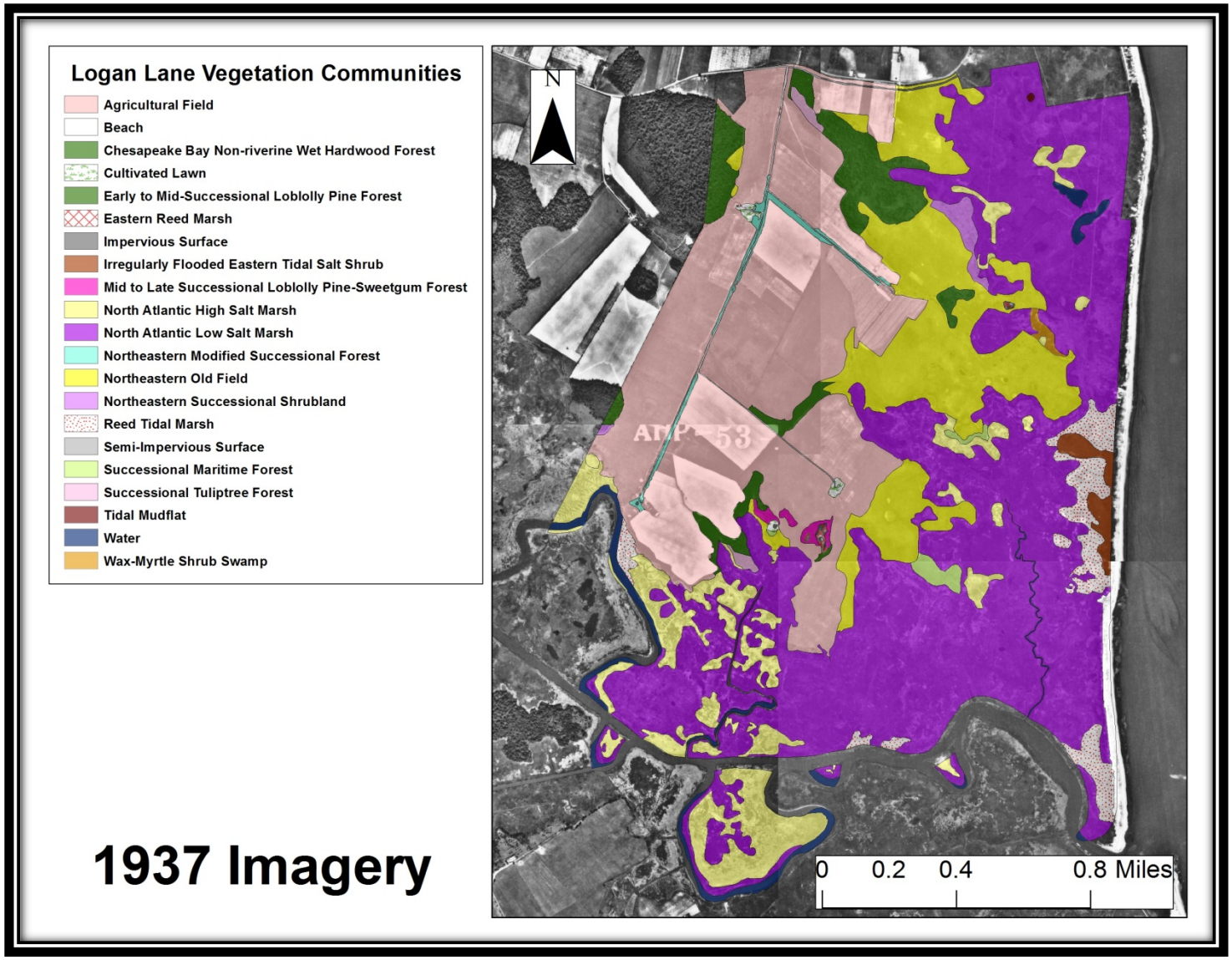


Figure 4-3.3. 1937 Vegetation Community Map of the Logan Lane Tract

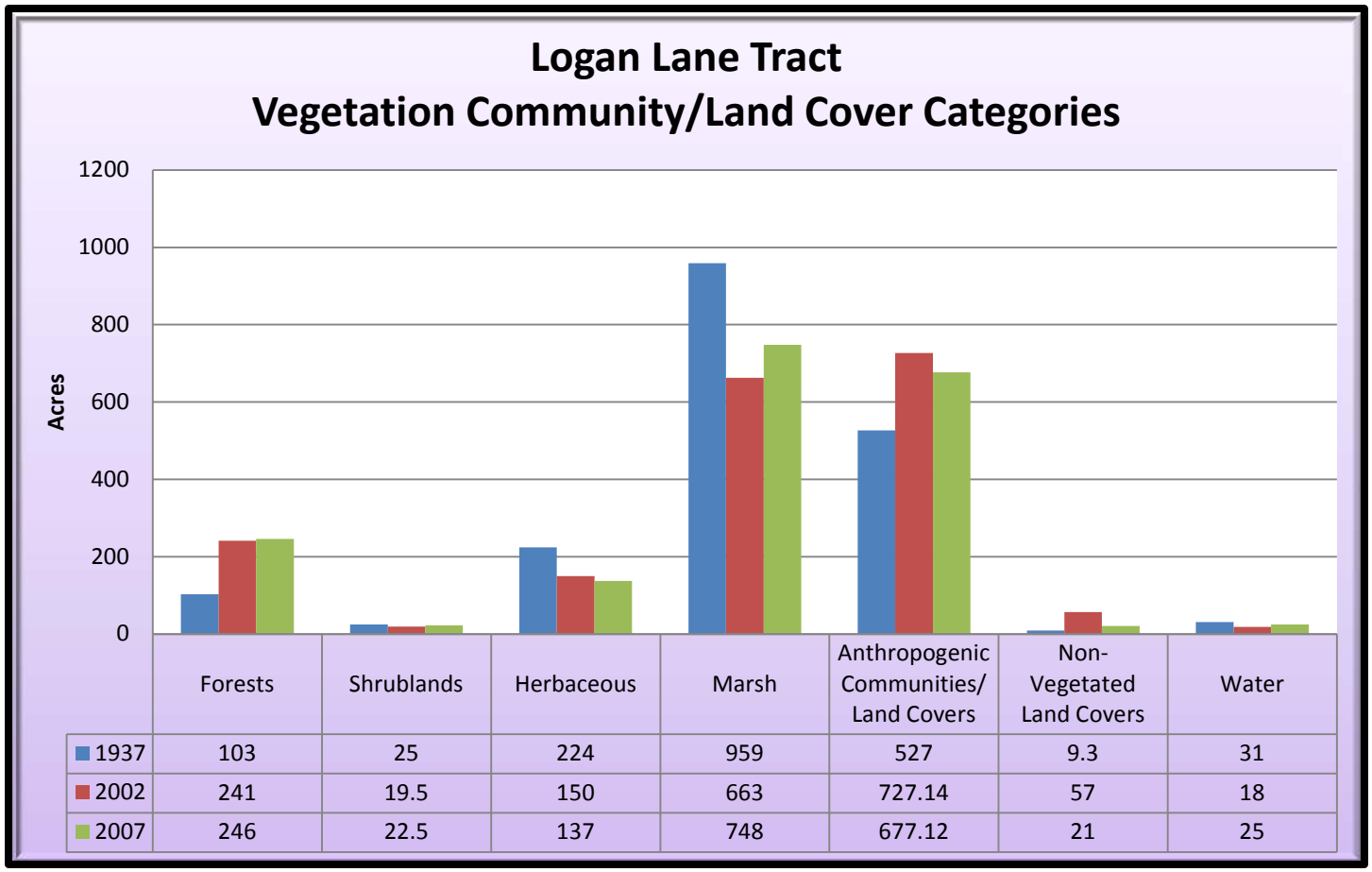


Figure 4-3.4. Logan Lane Tract Vegetation Community/Land Cover Categories (1937, 2002, and 2007)

Logan Lane Tract Vegetation Community/Land Covers (Figure 4-3.4): Marshland and Anthropogenic Communities are the most prominent vegetation community and land cover types on the Logan Lane Tract. Herbaceous communities (Northeastern Old Field), which were prominent in 1937, have decreased as they have succeeded to other community types.

DNREC Sea Level Rise Analysis (Table 4-3.1)

About half of the Logan Lane Tract will be inundated with 0.5 m of sea level rise. Another 432 acres will be flooded at 1 m of sea level rise and 1.5 m will flood a total of 1,441 acres or a little more than ¾ of the tract.

Table 4-3.1. Projected acres of the Logan Lane Tract Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	862 acres
1 m	1,294 acres
1.5 m	1,441 acres

Natural Capital (Table 4-3.2)

Capitalization of the Logan Lane Tract has been increasing, being driven by increases in marshland and water. This trend will likely continue in the short-term future.

Table 4-3.2. Natural Capital of the Logan Lane Tract	
Year	**Natural Capital (in 2012 dollars)**
1937	$7,046,061/year
2002	$8,049,796/year
2007	$8,276,987/year

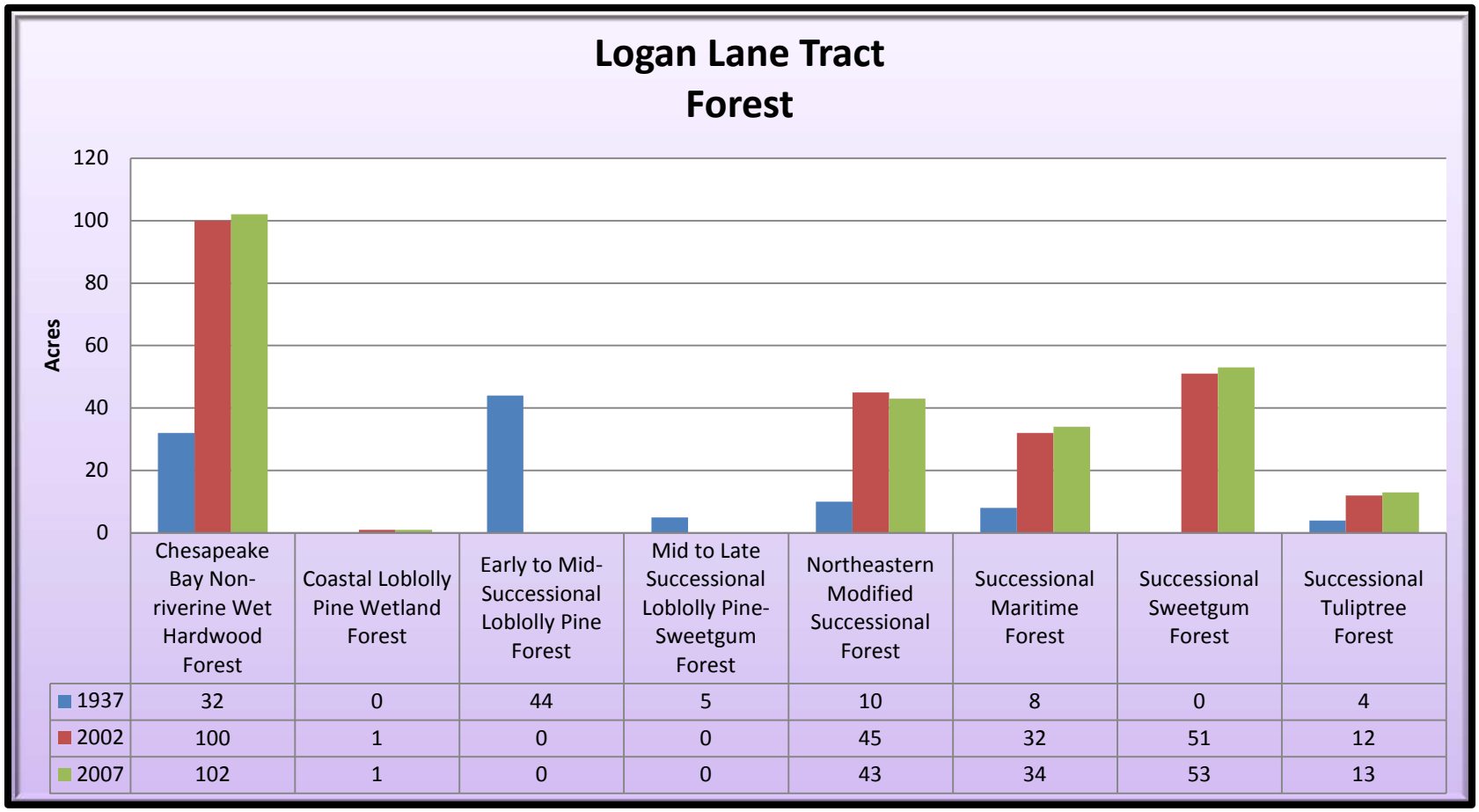


Figure 4-3.5. Logan Lane Tract Forest (1937, 2002, and 2007)

Logan Lane Tract Forest (Figure 4-3.5): In 1937, Early to Mid-Successional Loblolly Pine Forest was the most common forested community followed by Red Maple-Sweetgum Swamp-Alluvial Type. Since 1937 as the Early to Mid-Successional Loblolly Pine Forest has matured; Red Maple-Sweetgum Swamp-Alluvial Type has become the most prominent forested community in the Logan Lane Tract followed by Successional

Sweetgum Forest. Most forest communities have increased except for those which are successional (Early to Mid-Successional Loblolly Pine Forest and Mid to Late Successional Loblolly Pine-Sweetgum Forest).

DNREC Sea Level Rise Analysis (Table 4-3.3)

A lot of the forestland in the Logan Lane Tract is located in floodplains and is slightly affected by 0.5 m of rise with 31 acres flooded. At 1 m of rise, a little more than half of the forests will be inundated and about 2/3 will be inundated with 1.5 m of rise.

Table 4-3.3. Projected acres of Logan Lane Tract Forest Impacted by Sea Level Rise

Rise	Acres
0.5 m	31 acres
1 m	135 acres
1.5 m	182 acres

Natural Capital (Table 4-3.4)

Natural capital of forests has been increasing due to maturation of the forests. This trend will decrease slightly in the near term and then decrease faster past 0.5 m of rise.

Table 4-3.4. Natural Capital of Logan Lane Tract Forest

Year	Natural Capital (in 2012 dollars)
1937	$406,754/year
2002	$1,267,916/year
2007	$1,293,066/year

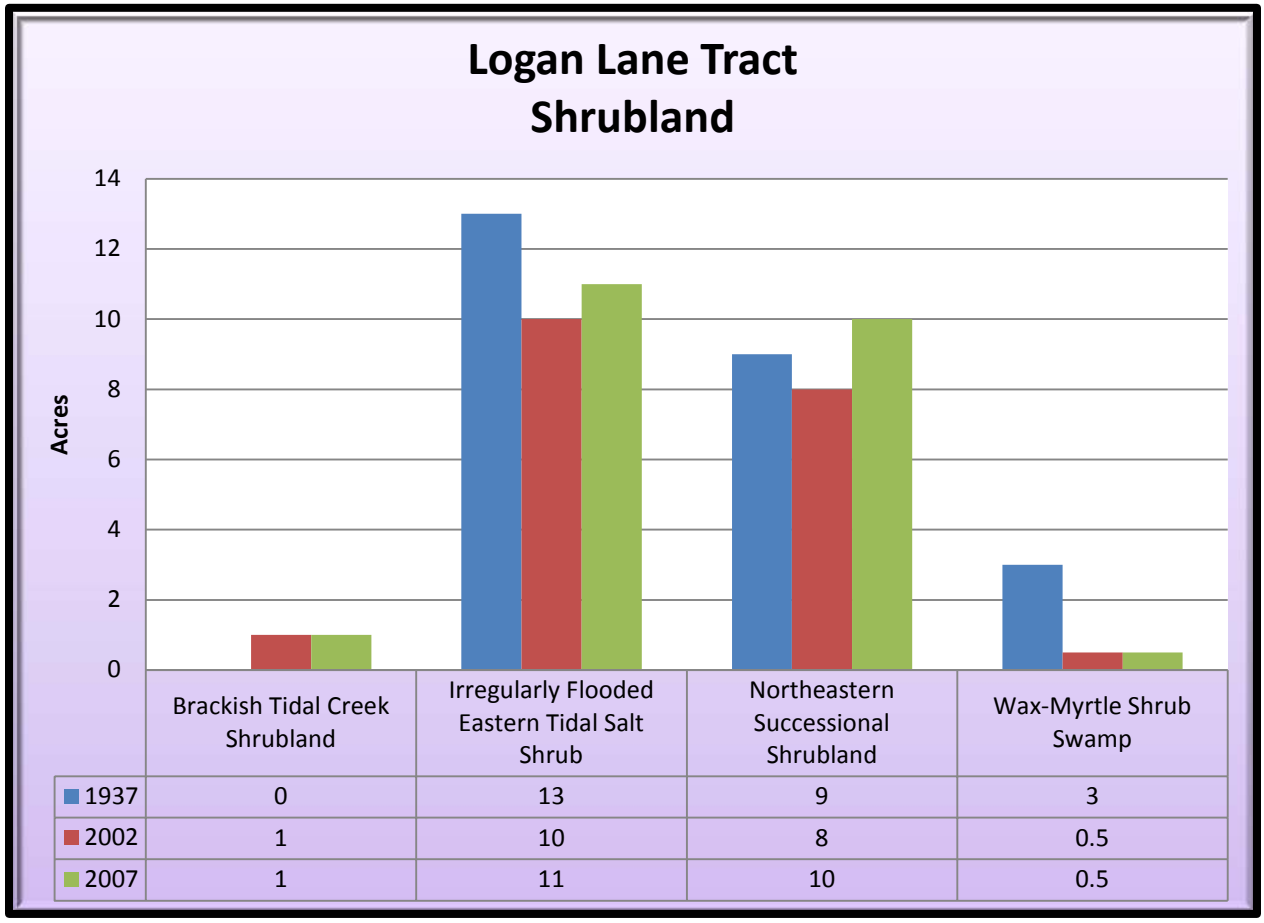


Figure 4-3.6. Logan Lane Tract Shrubland (1937, 2002, and 2007)

Logan Lane Tract Shrubland (Figure 4-3.6): Irregularly Flooded Eastern Tidal Salt Shrub and Northeastern Successional Shrubland are the most prominent shrublands in the Logan Lane Tract. Irregularly Flooded Eastern Tidal Salt Shrub has decreased by about 2 acres since 1937. Brackish Tidal Creek Shrubland and Wax-Myrtle Shrub Swamp are minor shrublands.

DNREC Sea Level Rise Analysis (Table 4-3.5)

More than half of the shrubland present in the Logan Lane Tract will be inundated by 0.5 m of sea level rise, with about ¾ inundated at 1 m of rise. Another 0.5 m of rise will add 2 acres to the flooded area.

Table 4-3.5. Projected acres of Logan Lane Tract Shrubland Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	13 acres
1 m	16 acres
1.5 m	18 acres

Natural Capital

A slight uptick in the amount of shrubland increased the capitalization, but the amount was at its highest in 1937.

Table 4-3.6. Natural Capital of Logan Lane Tract Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1937	$110,681/year
2002	$74,790/year
2007	$81,353/year

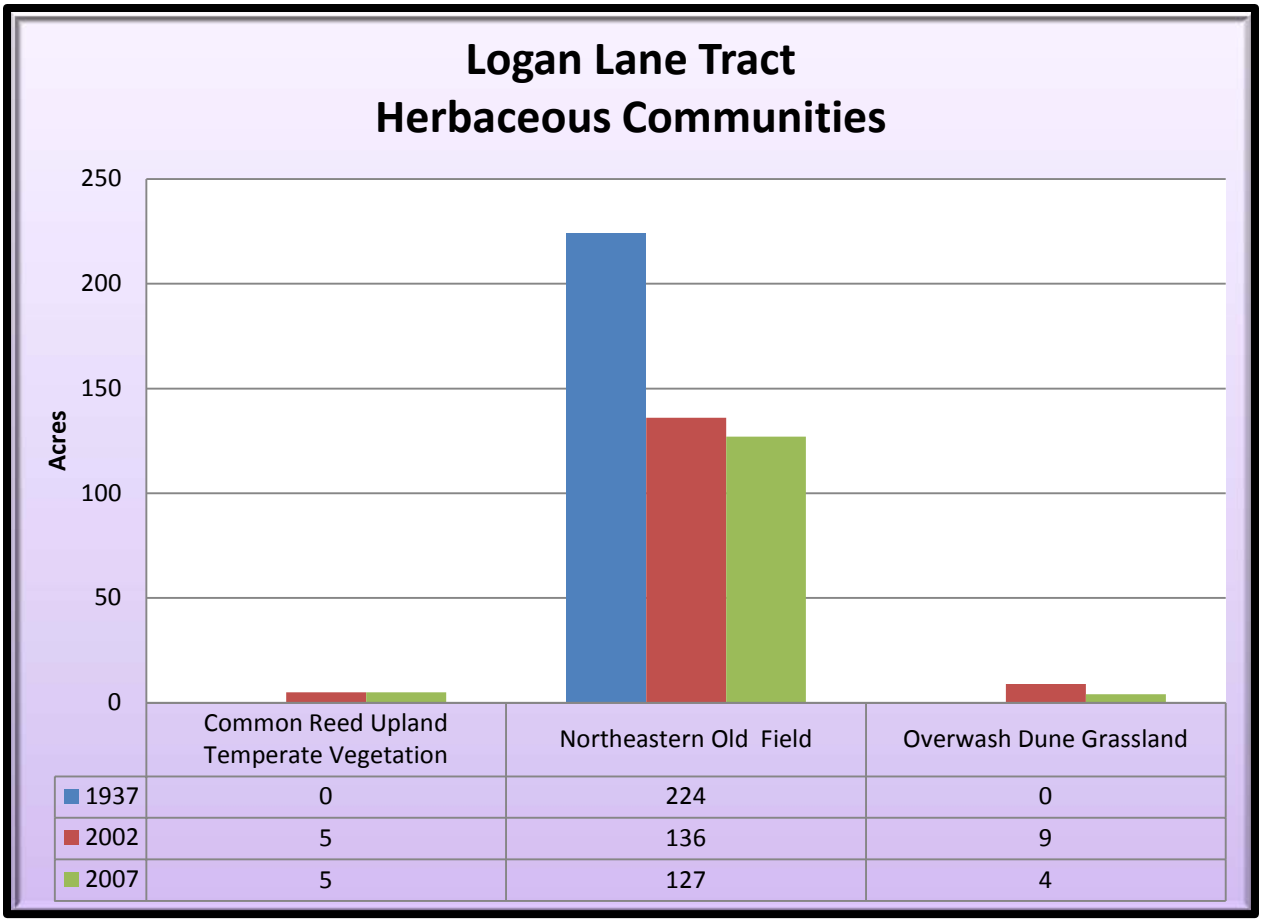


Figure 4-3.7. Logan Lane Tract Herbaceous Communities (1937, 2002, and 2007)

Logan Lane Tract Herbaceous Communities (Figure 4-3.7): Northeastern Old Field is the most prominent herbaceous community in the Logan Lane Tract, but has decreased as these fields have matured into forests or have been flooded to become marsh. Common Reed Upland Temperate Vegetation and Overwash Dune Grassland are minor herbaceous communities.

DNREC Sea Level Rise Analysis (Table 4-3.7)

Most of the herbaceous communities in the Logan Lane Tract are present as Northeastern Old Field and are located in higher elevation areas. About 0.5 m of sea level rise will flood 7 acres, and an additional 30 acres will be flooded at 1 m. At 1.5 m of rise a little less than half of these communities will be flooded.

Table 4-3.7. Projected acres of Logan Lane Tract Herbaceous Communities Impacted by Sea Level Rise

Rise	Acres
0.5 m	7 acres
1 m	37 acres
1.5 m	62 acres

Natural Capital

Capitalization of herbaceous communities has been going down as these communities mature into shrublands and forests.

Table 4-3.8. Natural Capital of Logan Lane Tract Herbaceous Communities

Year	Natural Capital (in 2012 dollars)
1937	$32,637/year
2002	$21,855/year
2007	$19,815/year

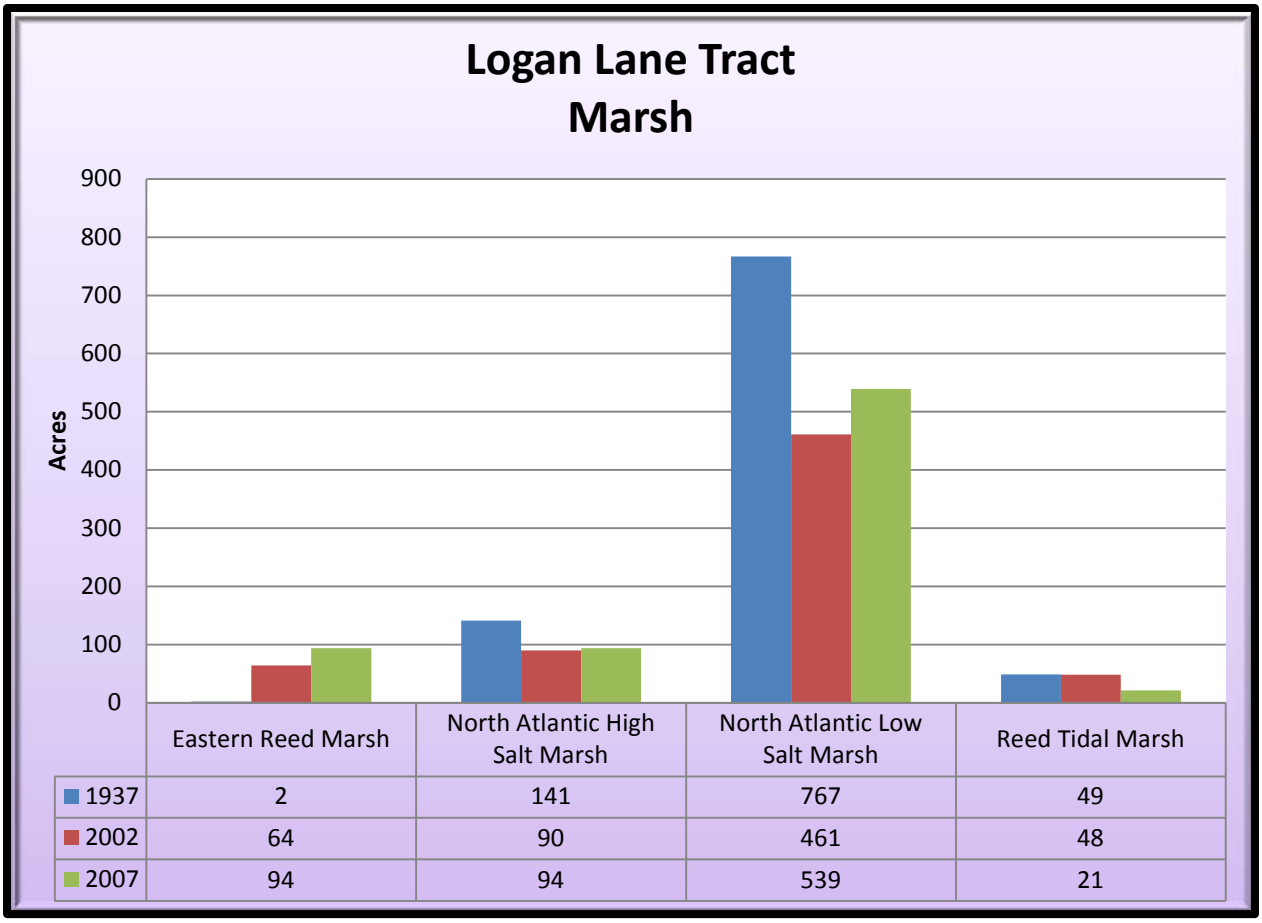


Figure 4-3.8. Logan Lane Tract Marsh (1937, 2002, and 2007)

Logan Lane Tract Marsh (Figure 4-3.8): North Atlantic Low Salt Marsh is the most prominent marsh in the Logan Lane Tract and has been declining over time, mostly due to the development of impoundments. North Atlantic High Salt Marsh which used to rank second has also been declining and has been superseded by Eastern Reed Marsh.

DNREC Sea Level Rise Analysis (Table 4-3.9)

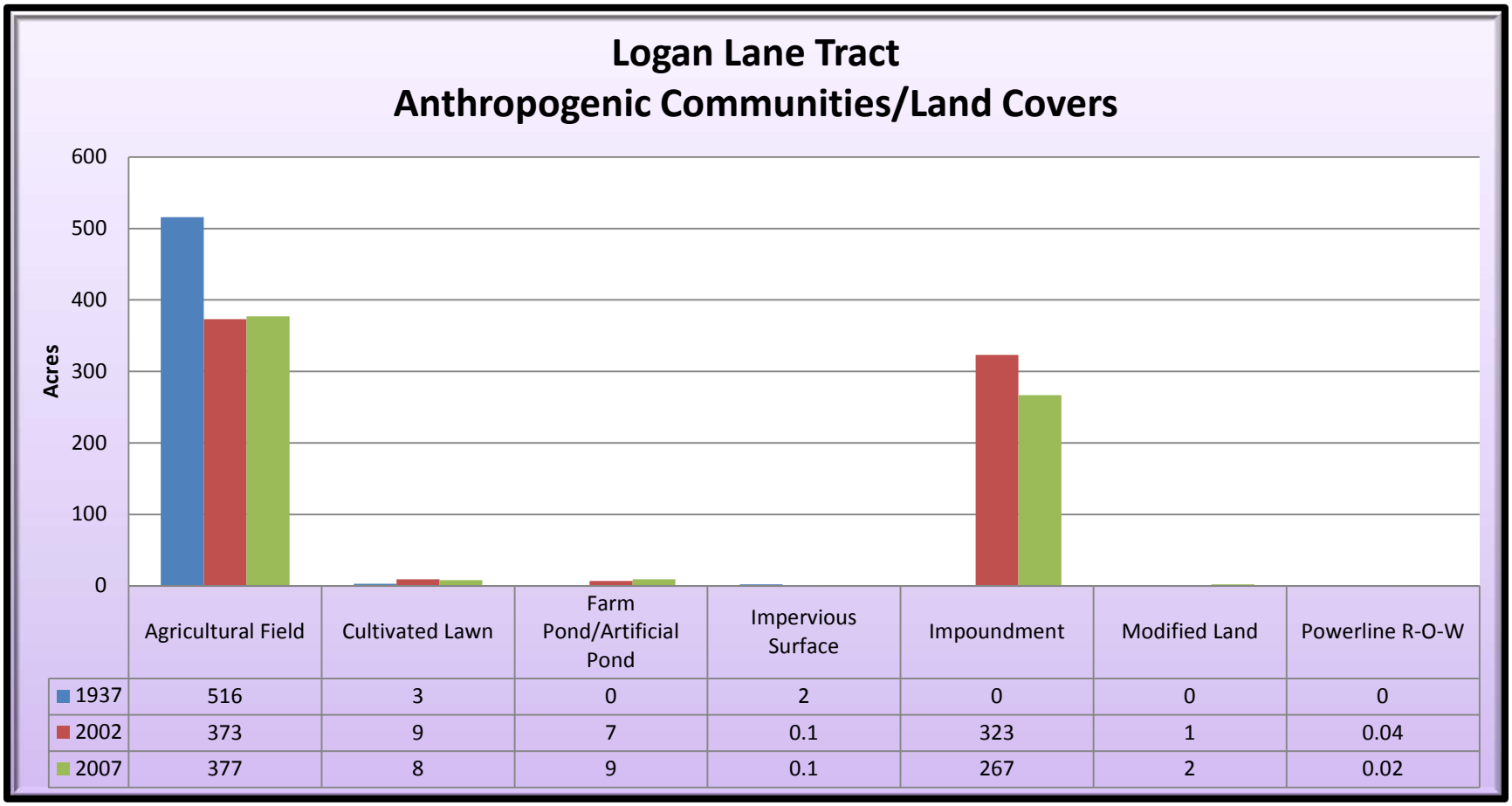
Most of the marshland present in the Logan Lane Tract is inundated with 0.5 m of sea level and by 1 m of rise it is virtually eliminated.

Table 4-3.9. Projected acres of Logan Lane Tract Marsh Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	623 acres
1 m	739 acres
1.5 m	743 acres

Natural Capital

Marshland capital has gone down from its 1937 level in 2002 and has since gained with an increase in North Atlantic Low Salt Marsh.

Table 4-3.10. Natural Capital of Logan Lane Tract Marsh	
Year	**Natural Capital (in 2012 dollars)**
1937	$6,020,197/year
2002	$4,350,518/year
2007	$4,973,882/year



	Agricultural Field	Cultivated Lawn	Farm Pond/Artificial Pond	Impervious Surface	Impoundment	Modified Land	Powerline R-O-W
1937	516	3	0	2	0	0	0
2002	373	9	7	0.1	323	1	0.04
2007	377	8	9	0.1	267	2	0.02

Figure 4-3.9. Logan Lane Tract Anthropogenic Communities/Land Covers (1937, 2002, and 2007)

Logan Lane Tract Anthropogenic Communities/Land Covers (Figure 4-3.9): Agricultural field has and remains the most prominent anthropogenic community in the Logan Lane Tract. Since 1937, Impoundments have been developed in this tract, which have reduced the acreage of North Atlantic Low Salt Marsh.

DNREC Sea Level Rise Analysis (Table 4-3.12)

Most of the flooding of anthropogenic communities will be in agricultural field. At 0.5 m of rise 148 acres will be flooded of these communities, and an additional 0.5 m of rise will flood an additional 169 acres. At 1.5 m of rise 384 acres will be inundated or about half of the total.

Table 4-3.12. Projected acres of Logan Lane Tract Anthropogenic Communities/Land Covers Impacted by Sea Level Rise

Rise	Acres
0.5 m	148 acres
1 m	317 acres
1.5 m	384 acres

Natural Capital (Table 4-3.13)

Capitalization of these communities has been decreasing with abandonment of agricultural fields. Most of this tract was in agricultural field in 1937, which does carry as much capital value as impoundments.

Table 4-3.13. Natural Capital of Logan Lane Tract Anthropogenic Communities/Land Covers

Year	Natural Capital (in 2012 dollars)
1937	$29,593/year
2002	$1,718,975/year
2007	$1,494,109/year

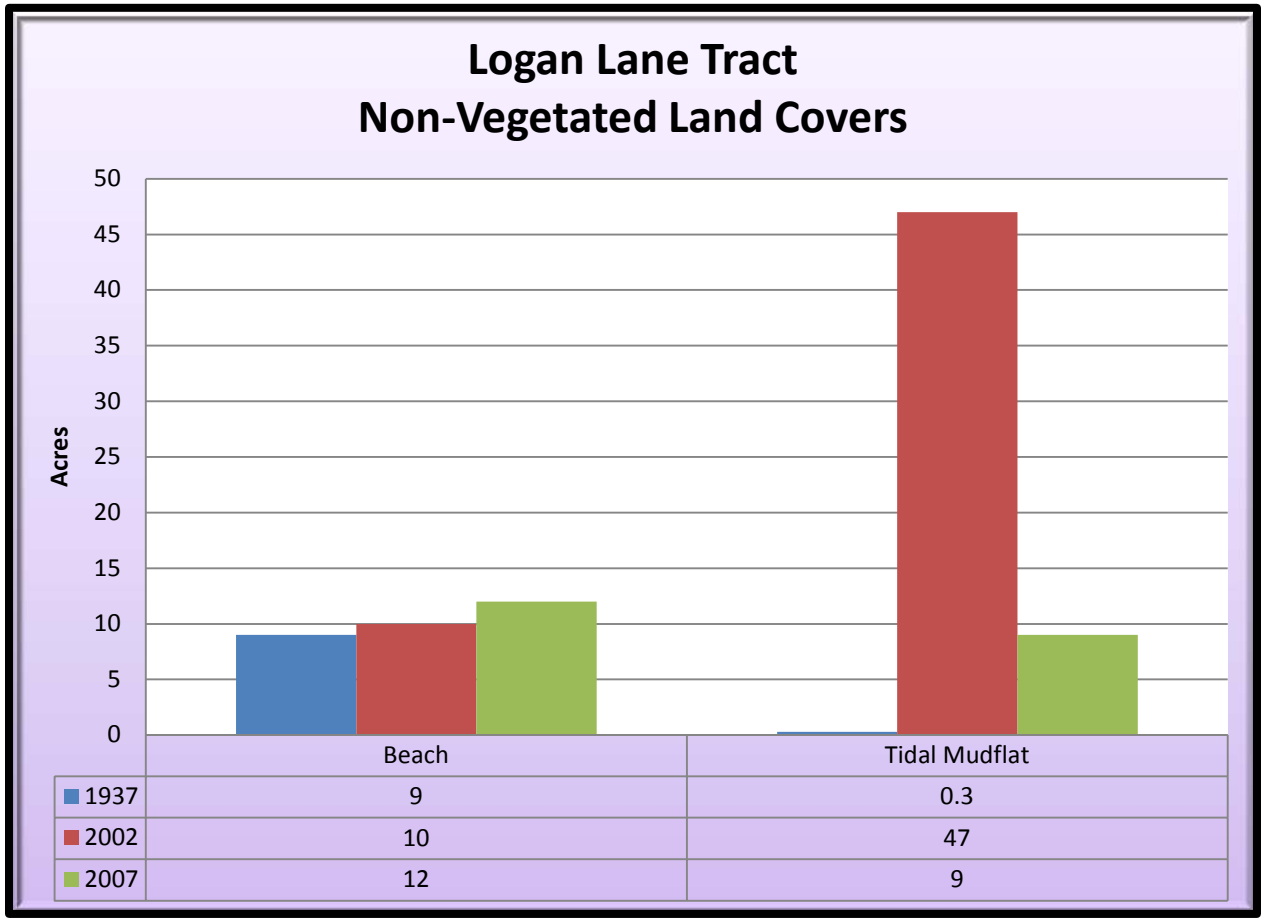


Figure 4-3.10. Logan Lane Tract Non-vegetated Covers (1937, 2002, and 2007)

Logan Lane Tract Non-vegetated Land Covers (Figure 4-3.10): Beach and tidal mudflat are the only non-vegetated land covers present on the Logan Lane Tract.

DNREC Sea Level Rise Analysis (Table 4-3.14)

Most of the Non-vegetated land covers will be inundated with 0.5 m of sea level rise and will be totally inundated with 1 m of rise.

Table 4-3.14. Projected acres of Logan Lane Tract Non-vegetated Land Covers Impacted by Sea Level Rise

Rise	Acres
0.5 m	16 acres
1 m	21 acres
1.5 m	21 acres

Natural Capital

Capitalization of these communities has decreased with losses in tidal mudflat.

Table 4-3.15. Natural Capital of Logan Lane Tract Non-vegetated Communities	
Year	**Natural Capital (in 2012 dollars)**
1937	$1,881/year
2002	$294,751/year
2007	$56,442/year

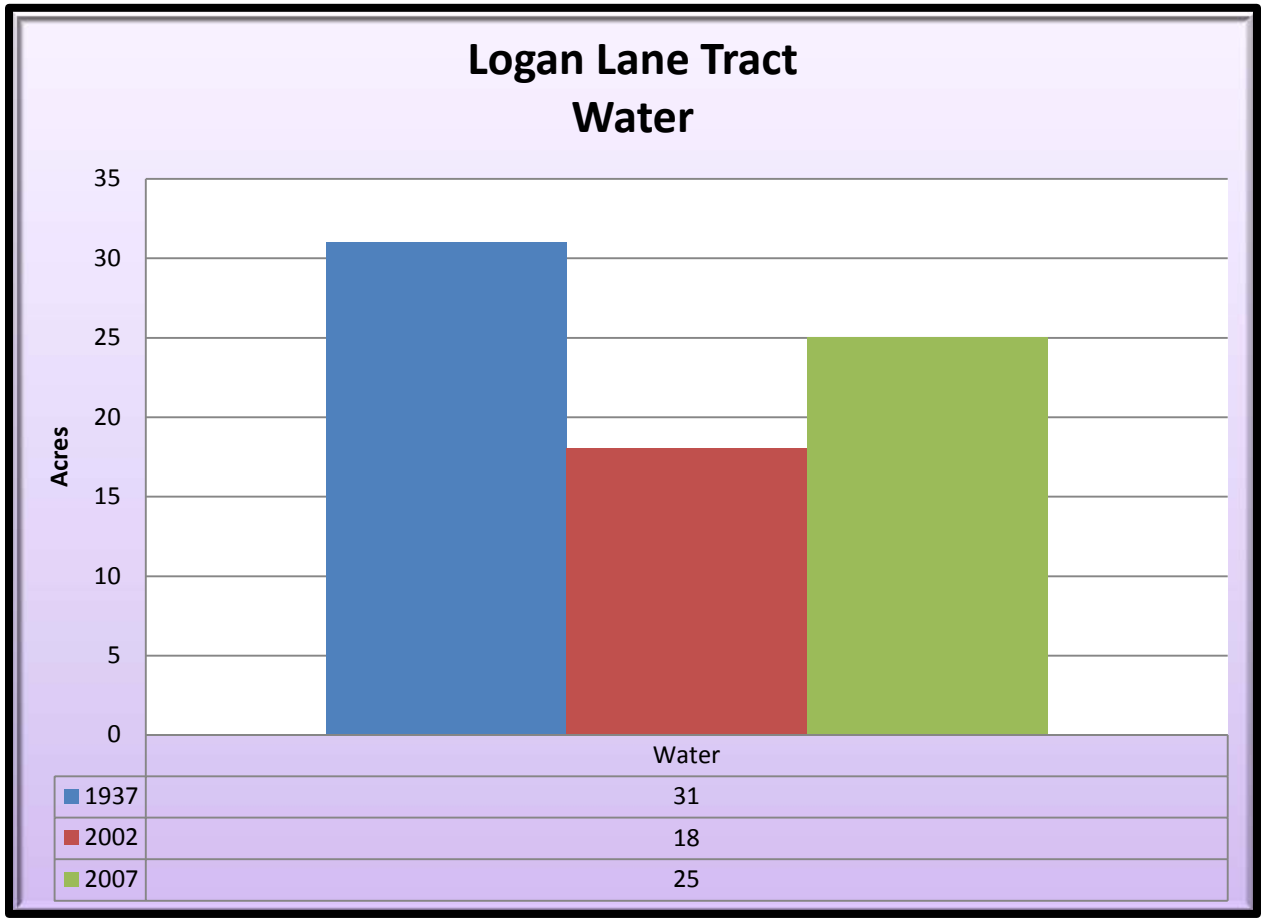


Figure 4-3.11. Logan Lane Tract Water Coverage (1937, 2002, and 2007)

Logan Lane Tract Water Coverage (Figure 4-3.11): Water coverage has varied in the Logan Lane Tract and has been affected by human driven changes in the marshes.

Natural Capital (Table 4-3.17)

Capitalization of water has been increasing with the increasing amount of water in the short-term. However, it is not up to its 1937 yet.

Table 4-3.16. Natural Capital of Logan Lane Tract Water	
Year	**Natural Capital (in 2012 dollars)**
1937	$444,318/year
2002	$257,991/year
2007	$358,321/year

4. Roberts Tract

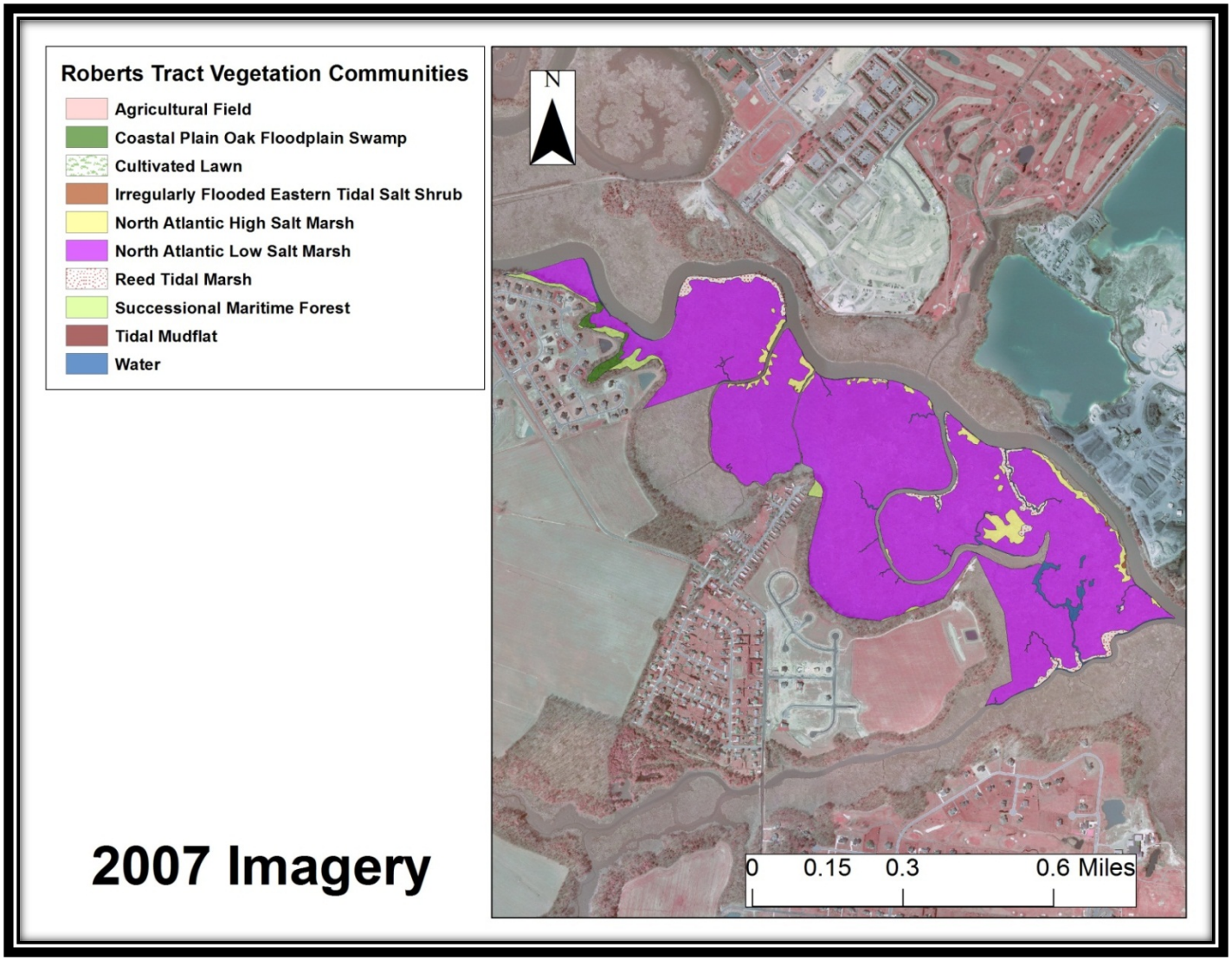


Figure 3-4.1. 2007 Vegetation Community Map of the Roberts Tract

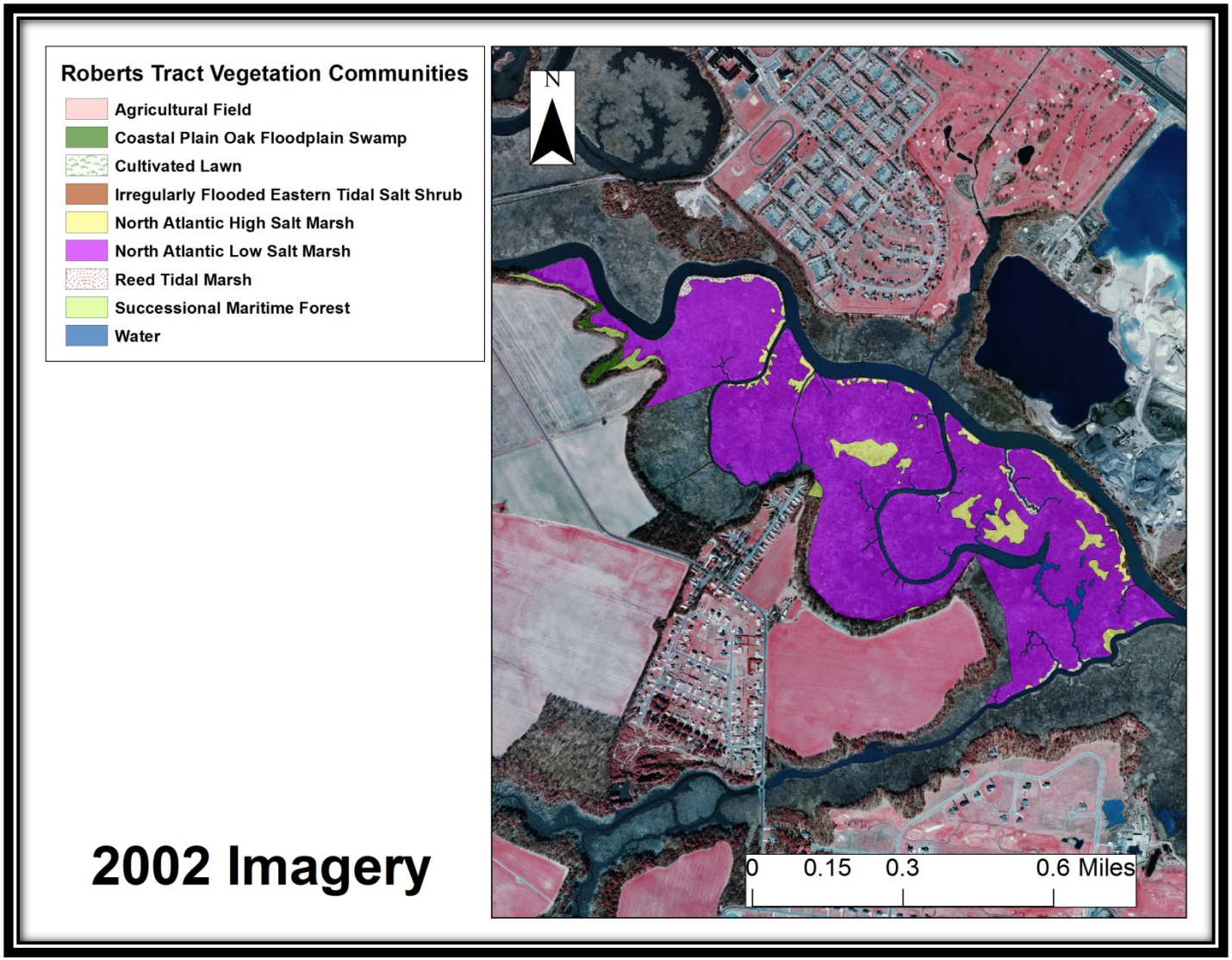


Figure 3-4.2. 2002 Vegetation Community Map of the Roberts Tract

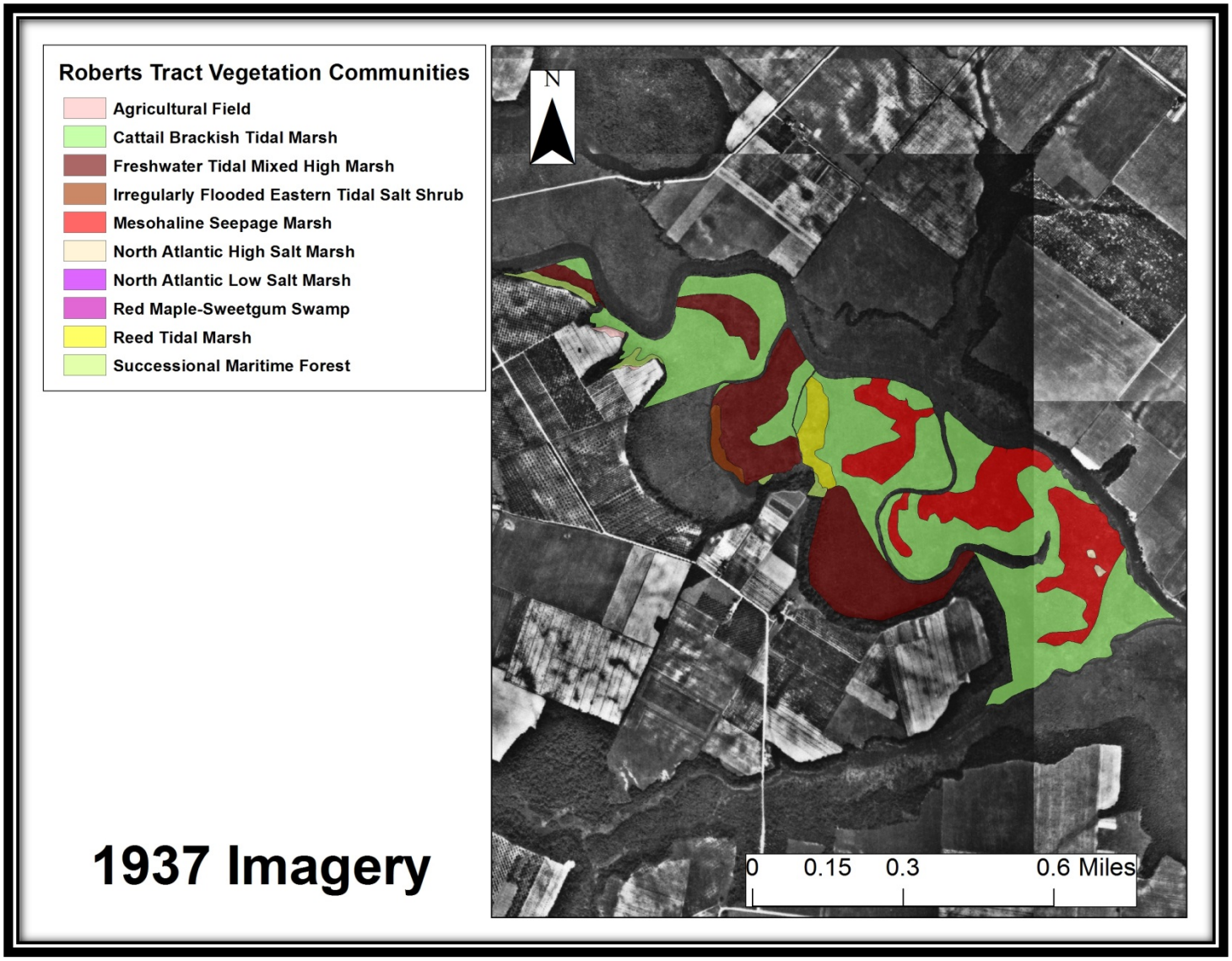
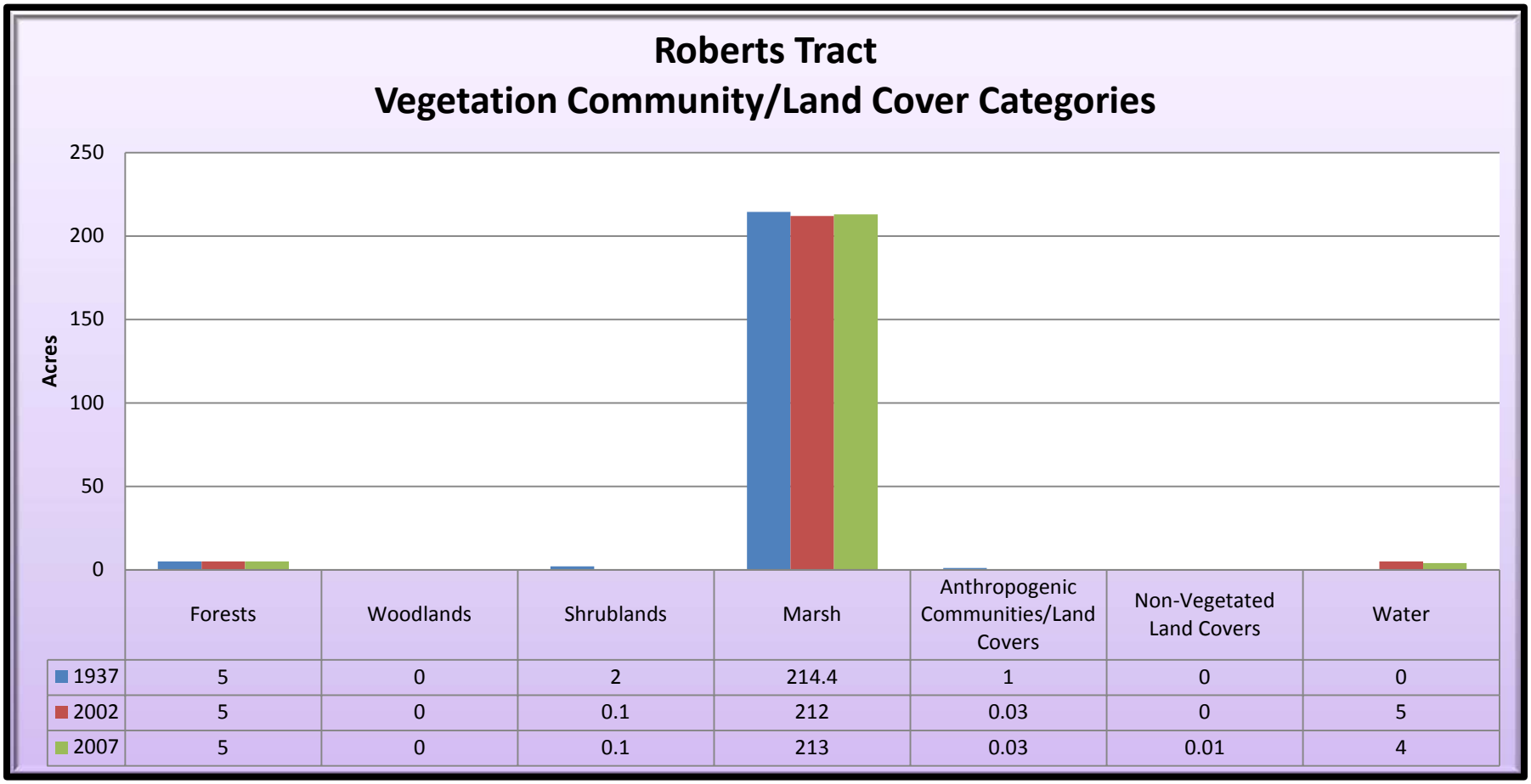


Figure 3-4.3. 1937 Vegetation Community Map of the Roberts Tract



	Forests	Woodlands	Shrublands	Marsh	Anthropogenic Communities/Land Covers	Non-Vegetated Land Covers	Water
1937	5	0	2	214.4	1	0	0
2002	5	0	0.1	212	0.03	0	5
2007	5	0	0.1	213	0.03	0.01	4

Figure 4-4.4. Roberts Tract Vegetation Community/Land Cover Categories (1937, 2002, and 2007)

Roberts Tract Vegetation Community/Land Covers (Figure 4-4.4): Marshland is the most prominent vegetation category in the Roberts Tract, with all other vegetation categories being minor to marsh.

DNREC Sea Level Rise Analysis (Table 4-4.1)

All of the Roberts Tract will be inundated with sea level rise of 0.5 m or higher.

Table 4-4.1. Projected acres of the Roberts Tract Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	221 acres
1 m	221 acres
1.5 m	221 acres

Natural Capital (Table 4-4.2)

Capital of the Roberts Tract has been gradually going higher with increases in marsh.

Table 4-4.2. Natural Capital of the Roberts Tract	
Year	**Natural Capital (in 2012 dollars)**
1937	$1,382,317/year
2002	$1,426,958/year
2007	$1,418,960/year

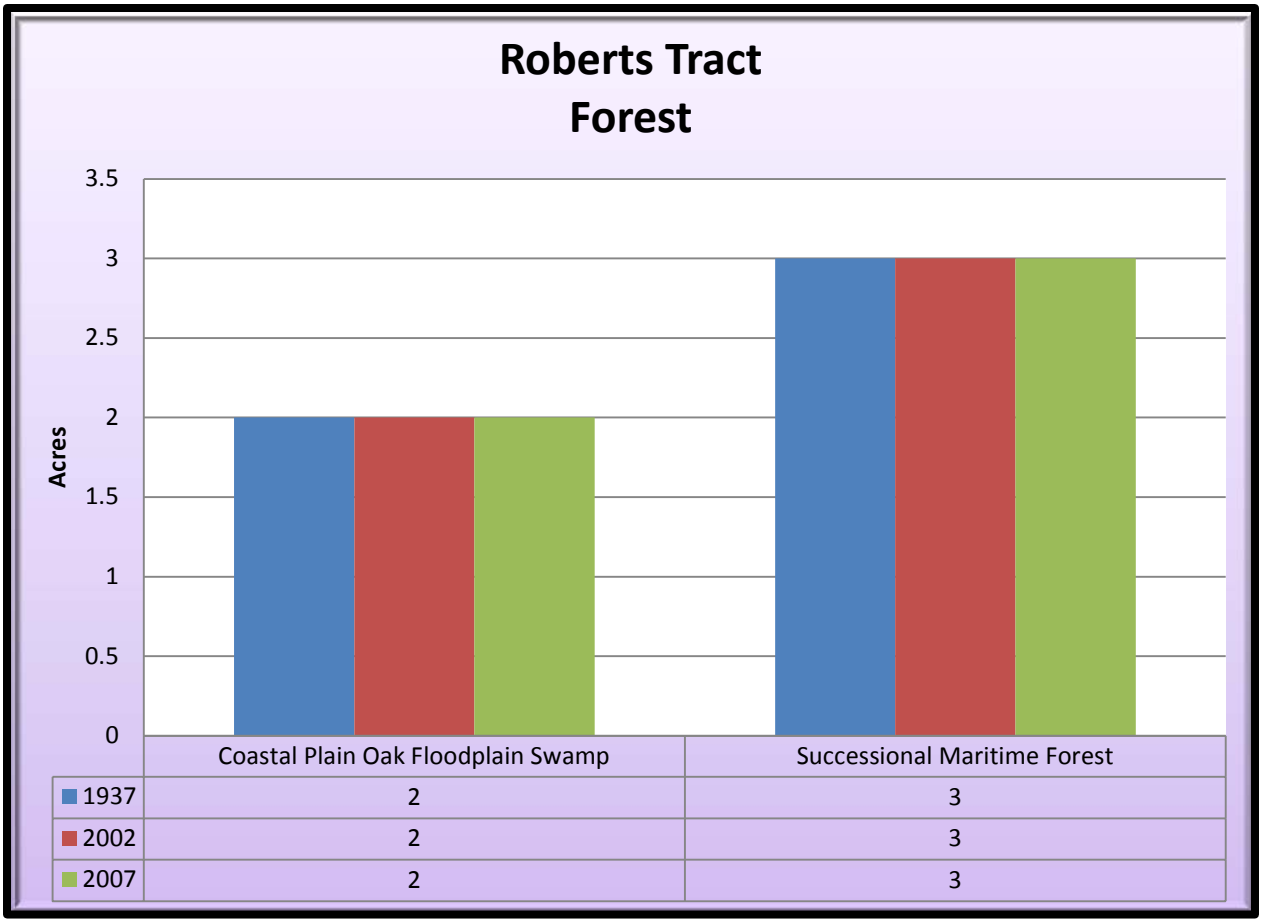


Figure 4-4.5. Roberts Tract Forest (1937, 2002, and 2007)

Roberts Tract Forest (Figure 4-4.5): Coastal Plain Oak Floodplain Swamp and Successional Maritime Forest are the only forests present in the Roberts Tract which have remained at the same acreage during the study period.

DNREC Sea Level Rise Analysis (Table 4-4.3)

All of the forestland present in the Roberts Tract will be inundated with 0.5 m of sea level rise. Note: the totals do not match because of rounding.

Table 4-4.3. Projected acres of Roberts Tract Forest Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	3 acres
1 m	3 acres
1.5 m	3 acres

Natural Capital (Table 4-4.4)

Capitalization of forest in the Roberts Tract has been stable over the study period.

Table 4-4.4. Natural Capital of Roberts Tract Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$25,150/year
2002	$25,150/year
2007	$25,150/year

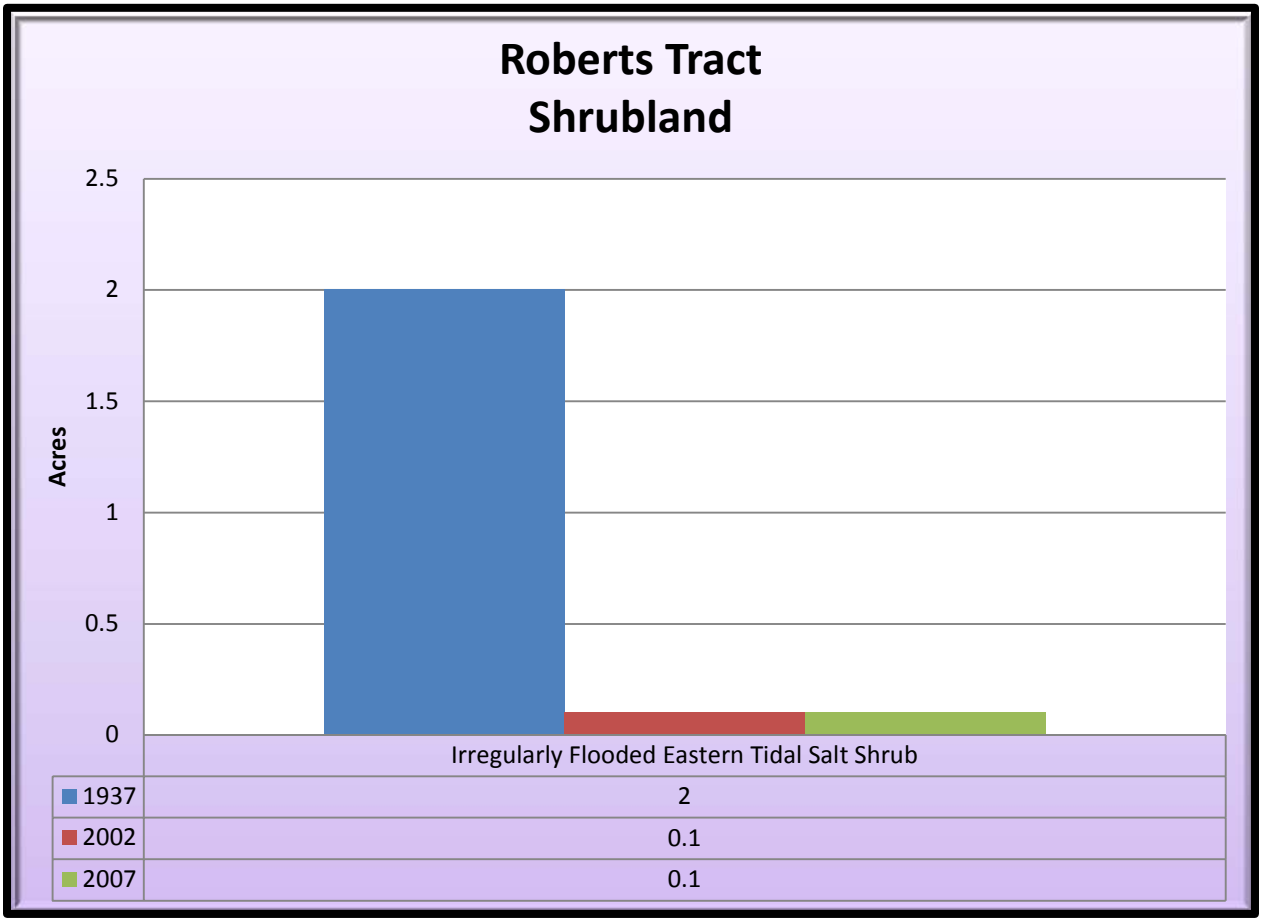


Figure 4-4.6. Roberts Tract Shrubland (1937, 2002, and 2007)

Roberts Tract Shrubland (Figure 4-4.6): Irregularly Flooded Eastern Tidal Salt Shrub is the only shrubland present in the Roberts Tract has decreased nearly to elimination since 1937.

DNREC Sea Level Rise Analysis (Table 4-4.5)

All of the Roberts Tract shrubland will be inundated with sea level rise of 0.5 m or higher.

Table 4-4.5. Projected acres of Roberts Tract Shrubland Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	0.1 acres
1 m	0.1 acres
1.5 m	0.1 acres

Natural Capital (Table 4-4.6)

The capitalization of shrubland has been largely transferred to marsh and only a little bit remains.

Table 4-4.6. Natural Capital of Roberts Tract Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1937	$12,543/year
2002	$627/year
2007	$627/year

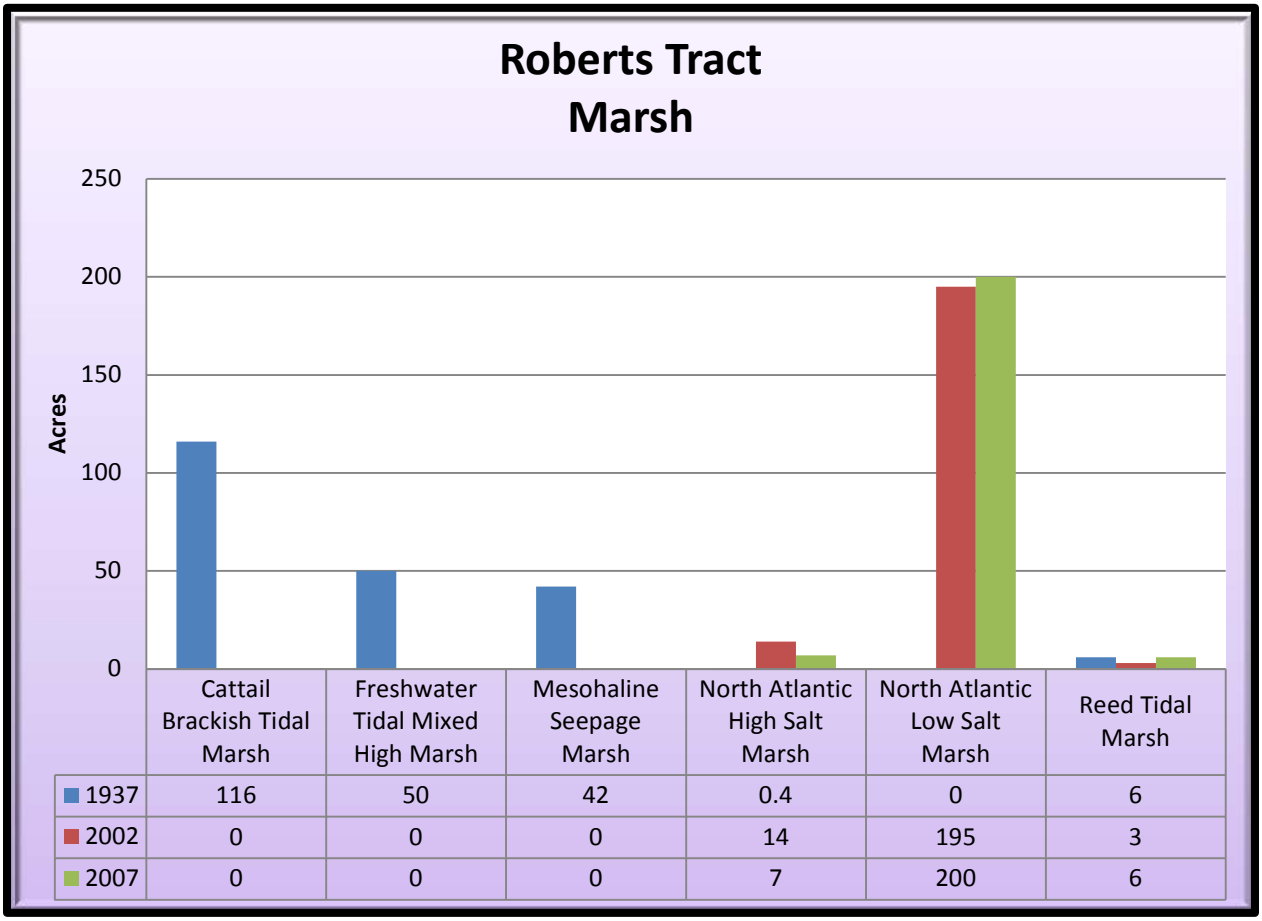


Figure 4-4.7. Roberts Tract Marsh (1937, 2002, and 2007)

Roberts Tract Marsh (Figure 4-4.7): In 1937, brackish and fresh marshes; Cattail Brackish Tidal Marsh and Mesohaline Seepage Marsh, and Freshwater Tidal Mixed High Marsh were the most common marshes in the Roberts Tract. Increasing salinities in the tract have changed these marshes to North Atlantic Low Salt Marsh which is now the most common marsh present in the Roberts Tract. North Atlantic High Salt Marsh and Reed Tidal Marsh are minor vegetation communities showing increases recently. For North Atlantic High Salt Marsh, this bucks a trend of decreases seen in other areas.

DNREC Sea Level Rise Analysis (Table 4-4.7)

All of the Roberts Tract marshland will be inundated with sea level rise of 0.5 m or higher.

Table 4-4.7. Projected acres of Roberts Tract Marsh Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	213 acres
1 m	213 acres
1.5 m	213 acres

Natural Capital (Table 4-4.8)

Natural capital of marshland has been going up in the recent period with conversion of other communities to marsh. This trend will likely continue in the near term and then markedly decline due to sea level rise transferring the capital to water.

Table 4-4.8. Natural Capital of Roberts Tract Marsh	
Year	**Natural Capital (in 2012 dollars)**
1937	$1,344,567/year
2002	$1,329,516/year
2007	$1,335,787/year

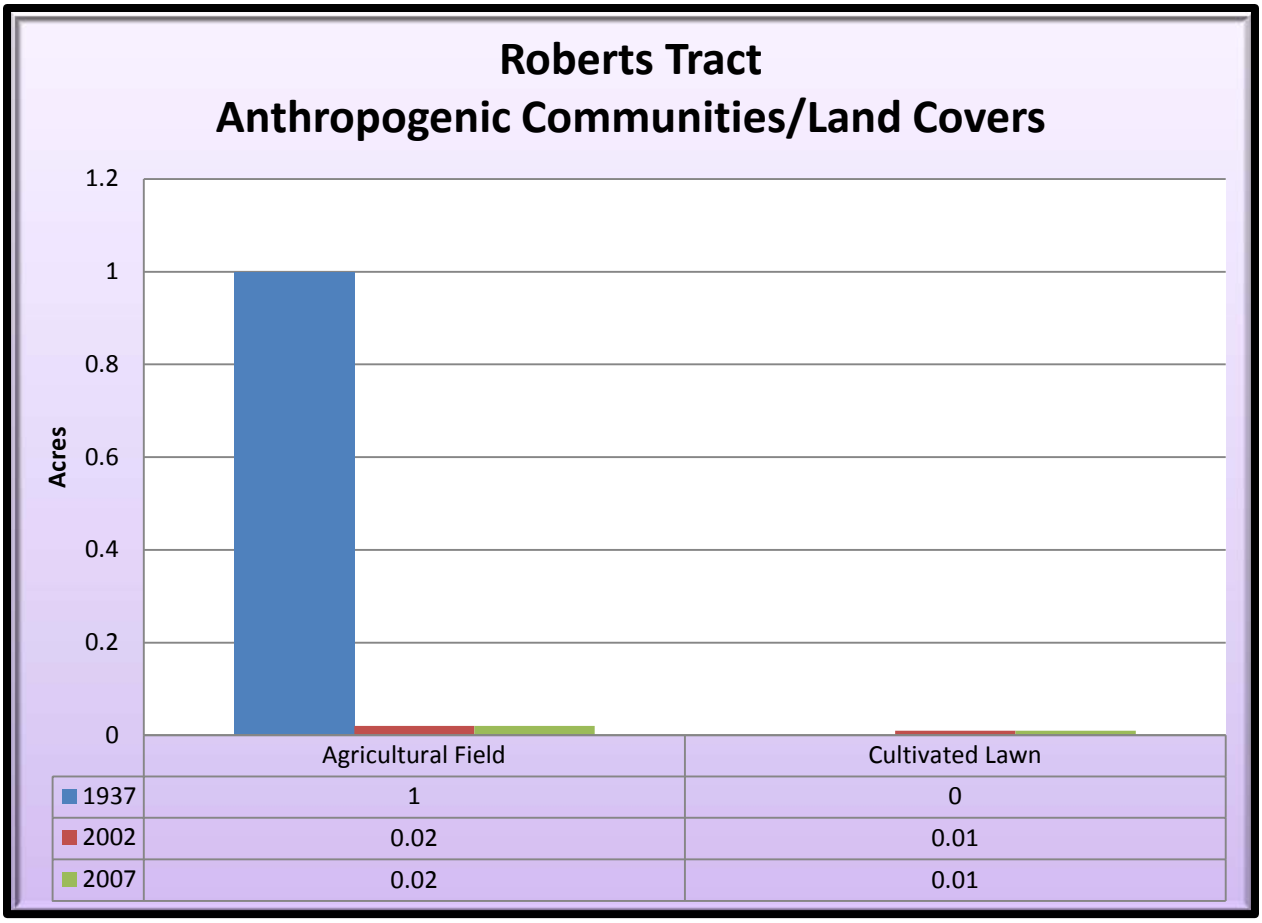


Figure 4-4.8. Roberts Tract Anthropogenic Communities/Land Covers (1937, 2002, and 2007)

Roberts Tract Anthropogenic Communities/Land Covers (Figure 4-4.8): This category has never amounted to much in the Roberts Tract and is decreasing.

DNREC Sea Level Rise Analysis (Table 4-4.10)

All of the Roberts Tract Anthropogenic Communities/Land Covers will be inundated with sea level rise of 0.5 m or higher.

Table 4-4.10. Projected acres of Roberts Tract Anthropogenic Communities/Land Covers Impacted by Sea Level Rise

Rise	Acres
0.5 m	0.03 acres
1 m	0.03 acres
1.5 m	0.03 acres

Natural Capital (Table 4-4.11)

The amount of Anthropogenic Communities/Land Covers is the value of a dollar in the recent period. This very small amount will be transferred to marsh at some point in the near future.

Table 4-4.11. Natural Capital of Roberts Tract Anthropogenic Communities/Land Covers	
Year	**Natural Capital (in 2012 dollars)**
1937	$57/year
2002	$1/year
2007	$1/year

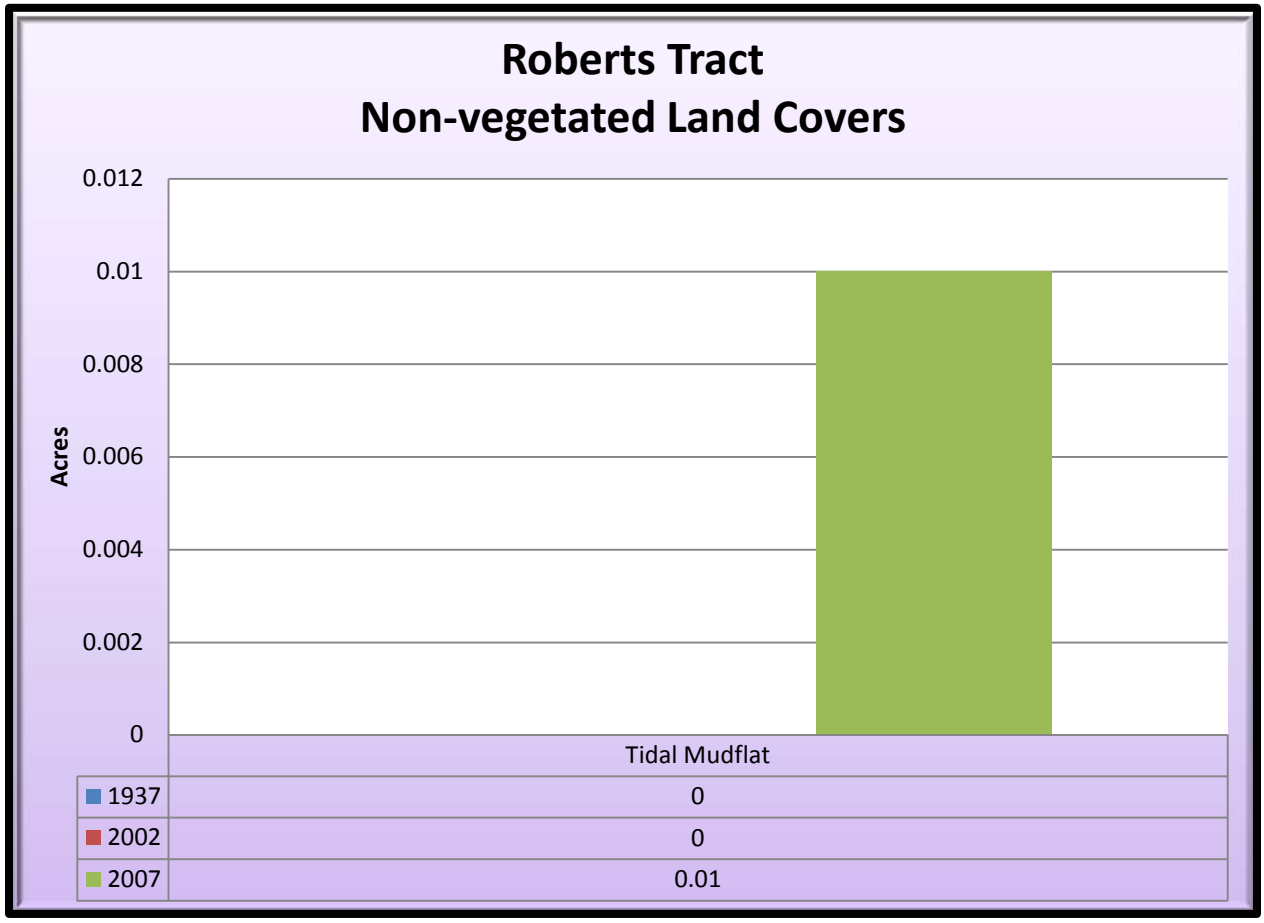


Figure 4-4.9. Roberts Tract Non-vegetated Land Covers (1937, 2002, and 2007)

Roberts Tract Non-vegetated Land Covers (Figure 4-4.9): Tidal Mudflat is the only non-vegetated land cover in the Roberts Tract and has only come about recently.

DNREC Sea Level Rise Analysis (Table 4-4.12)

All of the Roberts Tract will be inundated with sea level rise of 0.5 m or higher.

Table 4-4.12. Projected acres of Roberts Tract Non-vegetated Land Covers Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	0.01 acres
1 m	0.01 acres
1.5 m	0.01 acres

Natural Capital (Table 4-4.13)

Tidal mudflat has only recently come into the Roberts Tract and only very slightly. Currently this area is valued at $67.00.

Table 4-4.13. Natural Capital of Roberts Tract Non-vegetated Land Covers	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$0/year (not present)
2007	$63/year (not present)

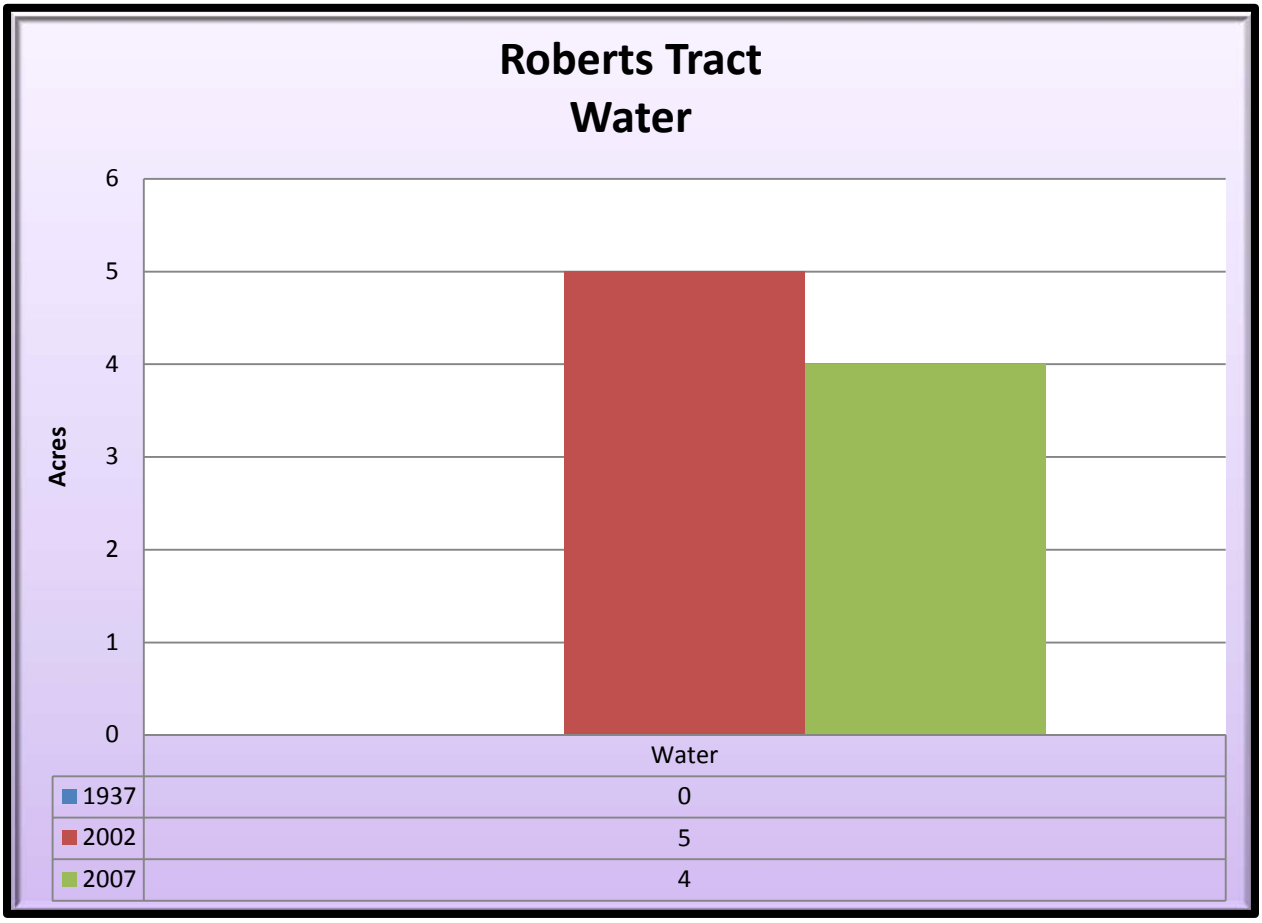


Figure 4-4.10. Roberts Tract Water Coverage (1937, 2002, and 2007)

Roberts Tract Water Coverage (Figure 4-4.10): Water has increased overall in the Roberts Tract since 1937 but has recently decreased reflecting fluctuations seen in other tracts.

Natural Capital (Table 4-4.14)

The amount of water in the Roberts Tract has been fluctuating and could be the result of sedimentation in the upper reaches of the St. Jones River.

Table 4-4.14. Natural Capital of Roberts Tract Water	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$71,664/year
2007	$57,331/year

CHAPTER 5: DESCRIPTIONS OF THE VEGETATION COMMUNITIES

Twenty-two vegetation communities were noted in the survey (Figures 4-1.1-1.3, 4-2.1-2.3, and 4-3.1-3.3, 4-4.1-4.3). Below are the descriptions of the vegetation communities. The National Vegetation Classification (NVC) Association number is given with the vegetation community and their approximate acreage in the project area. Names of communities correspond with the common names as given in the NVC and the Guide to Delaware Vegetation Communities.

Current Vegetation Communities (2007):

1. Brackish Tidal Creek Shrubland (CEGL006846)—1 acre
2. Cattail Brackish Tidal Marsh (CEGL004201)—0.1 acres
3. Chesapeake Bay Non-riverine Wet Hardwood Forest (CEGL004644)—125 acres
4. Coastal Loblolly Pine Wetland Forest (CEGL006137)—1 acre
5. Coastal Plain Oak Floodplain Forest (CEGL006605)—2 acres
6. Common Reed Upland Temperate Vegetation (CEGL004019)—5 acres
7. Cultivated Lawn (CEGL008462)—9 acres
8. Eastern Reed Marsh (CEGL004141)—97 acres
9. Irregularly Flooded Eastern Tidal Salt Shrub (CEGL003921)—12 acres
10. Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075)—2 acres
11. North Atlantic High Salt Marsh (CEGL006006)—129 acres
12. North Atlantic Low Salt Marsh (CEGL004192)—1,073 acres
13. Northeastern Modified Successional Forest (CEGL006599)—46 acres
14. Northeastern Old Field (CEGL006107)—133 acres
15. Northeastern Successional Shrubland (CEGL006451)—12 acres
16. Overwash Dune Grassland (CEGL004097)—4 acres
17. Reed Tidal Marsh (CEGL004187)—40 acres
18. Successional Maritime Forest (CEGL006145)—47 acres
19. Successional Sweetgum Forest (CEGL007216)—53 acres
20. Successional Tuliptree Forest (CEGL007220)—13 acres
21. Upland Switchgrass Vegetation (CEGL006616)—1 acre
22. Wax-Myrtle Shrub Swamp (CEGL003840)—0.5 acres

Historical Vegetation Communities (1937 or 2002):

1. Early to Mid-Successional Loblolly Pine Forest (CEGL006011)—49 acres
2. Mid to Late Successional Loblolly Pine-Sweetgum Forest (CEGL008462)—5 acres
3. Freshwater Tidal Mixed High Marsh (CEGL006325)—50 acres
4. Mesohaline Seepage Marsh (CEGL006418)—159 acres

Brackish Tidal Creek Shrubland **[1 acre (Figure 5.1 and Tables 5.1-5.3] GNR S3**

DEWAP: Tidal High Marsh
NHC: Northern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh

Description

This shrubland community is found in one location on the wildlife area between an agricultural field and a North Atlantic Low Salt Marsh. From all appearances this shrubland came about through the gradually flooding of a forest area as the salt marsh encroached on the agricultural field.

Analysis of Condition at Ted Harvey Wildlife Area

This shrubland community has formed since 1937 and during the 2002 to 2007 period it has been stable. It formed from 1 acre of Northeastern Old Field and 0.2 acres of North Atlantic Low Salt Marsh (Table 5.1). The prognosis for this community in the wildlife area can be considered to be fair to good depending on the rate of sea level rise and changes to the agricultural fields behind it.

Table 5.1. Brackish Tidal Creek Shrubland has migrated into X or remained since 1937	
X	**Acreage**
Northeastern Old Field	1 acre
North Atlantic Low Salt Marsh	0.2 acres

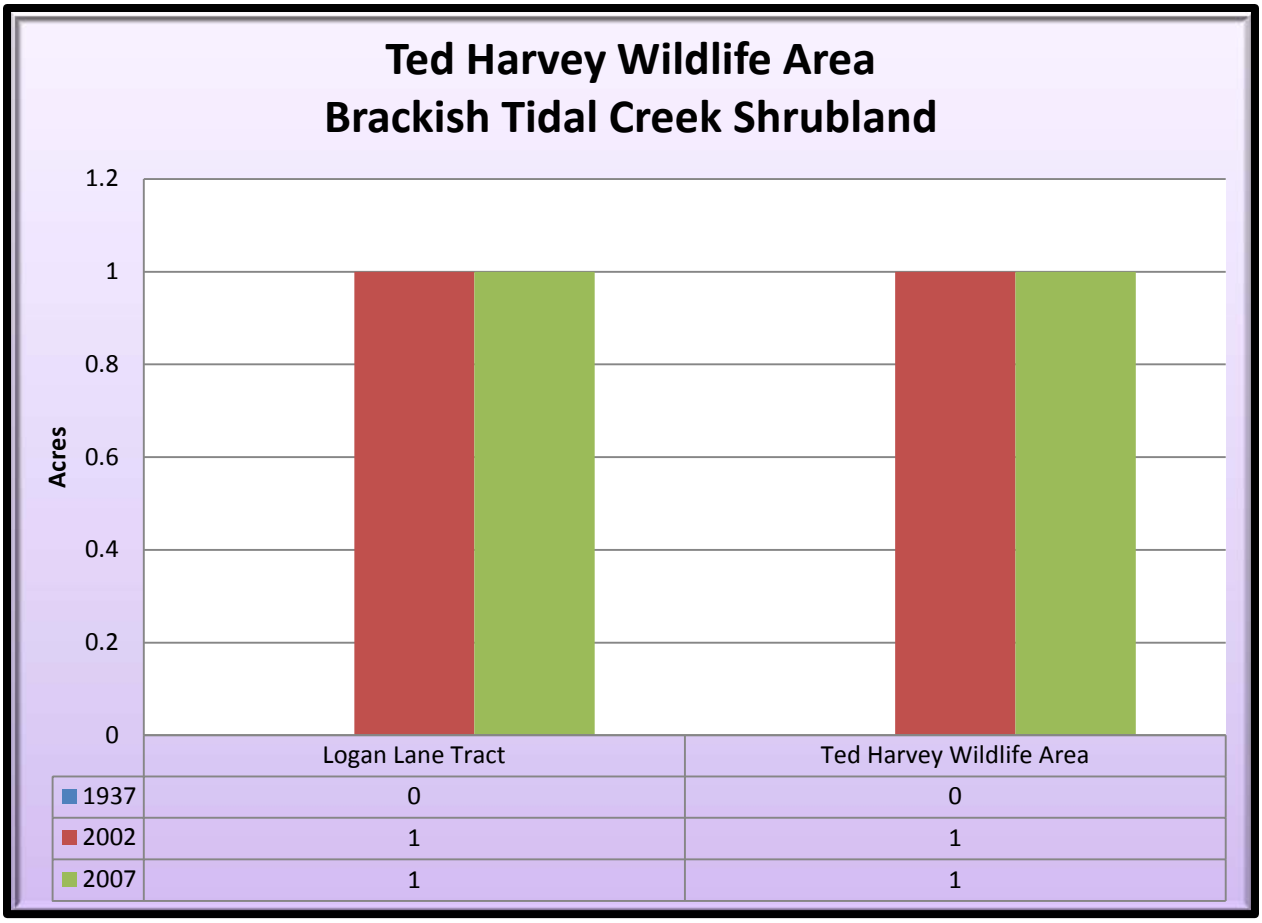


Figure 5.1. Brackish Tidal Shrubland at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Analysis (Table 5.2)

All of the current acreage of Brackish Tidal Creek Shrubland would be inundated with 0.5 m of sea level rise. This community may not move inland fast enough to keep with the rise.

Table 5.2. Projected acres of Brackish Tidal Creek Shrubland Impacted by Sea Level Rise

Rise	Acres
0.5 m	1 acre
1 m	1 acre
1.5 m	1 acre

Natural Capital (Table 5.3)

Brackish Tidal Creek Shrubland first appeared in 2002 and has remained at the same capital value in the 2002-2007 period.

Table 5.3. Natural Capital of Brackish Tidal Creek Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year
2002	$6,271/year
2007	$6,271/year

Cattail Brackish Tidal Marsh **[0.1 acres (Figures 5.2-5.4, and Tables 5.4-5.7)] G4G5 S3**

DEWAP: Tidal Low Marsh
NHC: Northern Atlantic Coastal Plain Tidal Low Marsh

Description

Figure 5.2. Cattail Brackish Tidal Marsh (Buckaloo Tract)

This marsh community is currently found in a very small area on the Buckaloo Tract. It is composed of narrow-leaf cattail (*Typha angustifolia*) and wide-leaved cattail (*Typha latifolia*) in a tidal marsh. This community ranges from oligohaline to mesohaline.

Analysis of Condition at Ted Harvey Wildlife Area

This community used to occur in large amount across three tracts in the wildlife area. As the salinities have risen with sea level rise it has declined and changed over to North Atlantic Low Salt Marsh. The highest rate of decline is the historical rate (1937-2002) at 2.6 acres of loss per year (Figure 4.4). Since this time, the rate has decreased, a trend that could be due to decreasing amounts overall. The current rate (2002-2007) of loss is 0, a rate that may be a result of so little of this community being left.

Based on proximity to Delaware Bay, this area may in time become too brackish for cattail and the remainder may transition to North Atlantic Low Salt Marsh.

None of the 1937 acreage of this community still existed in 2007. Most of the former acreage has become North Atlantic Low Salt Marsh (153 acres), with smaller amounts becoming Reed Tidal Marsh (5 acres), North Atlantic High Salt Marsh (5 acres), Water (4 acres), and Irregularly Flooded Eastern Tidal Salt Shrub (0.1 acres) (Table 5.4). Cattail Brackish Tidal Marsh has barely migrated going on 0.1 acres of Agricultural field (Table 5.5), which accounts for the current acreage.

Table 5.4. What was once Cattail Brackish Tidal Marsh in 1937 has become X or remained in 2007	
X	**Acreage**
North Atlantic Low Salt Marsh	153 acres
Reed Tidal Marsh	5 acres
North Atlantic High Salt Marsh	5 acres
Water	4 acres
Irregularly Flooded Eastern Tidal Salt Shrub	0.1 acres

Table 5.5. Cattail Brackish Tidal Marsh has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	0.1 acres

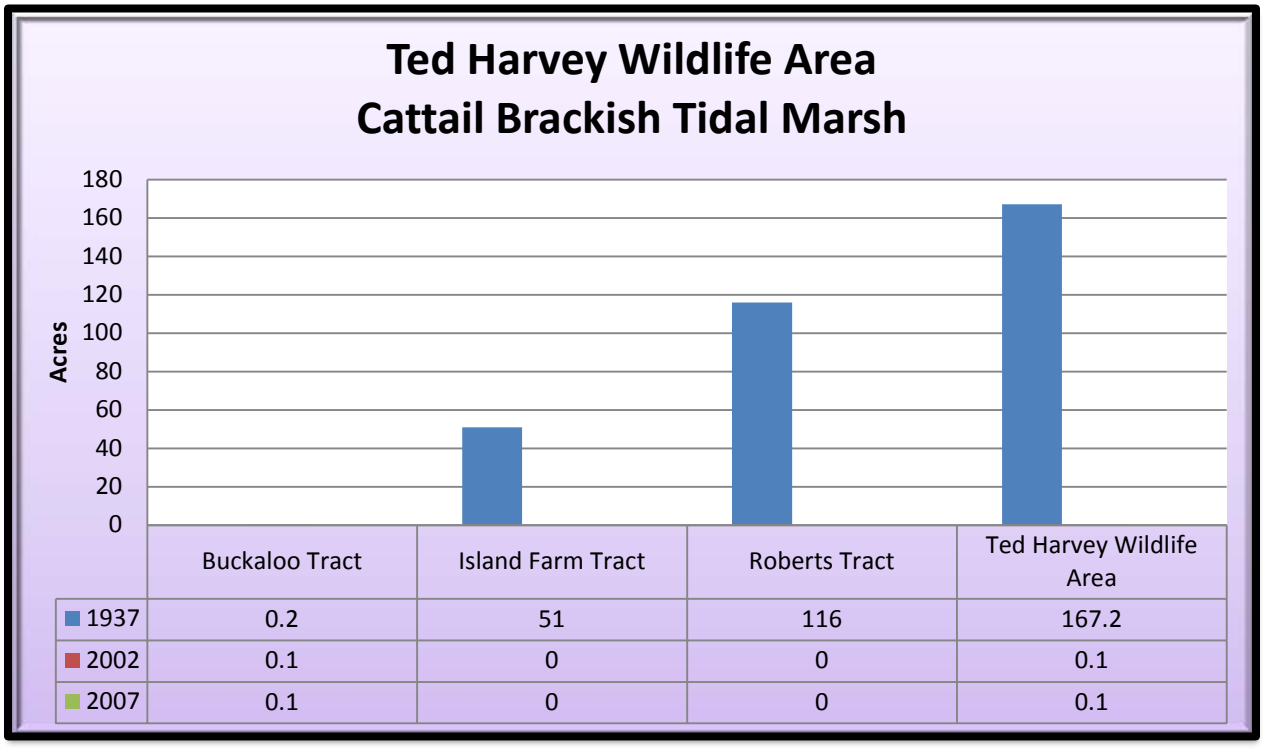


Figure 5.3. Cattail Brackish Tidal Marsh at Ted Harvey Wildlife Area (1937, 2002, and 2007)

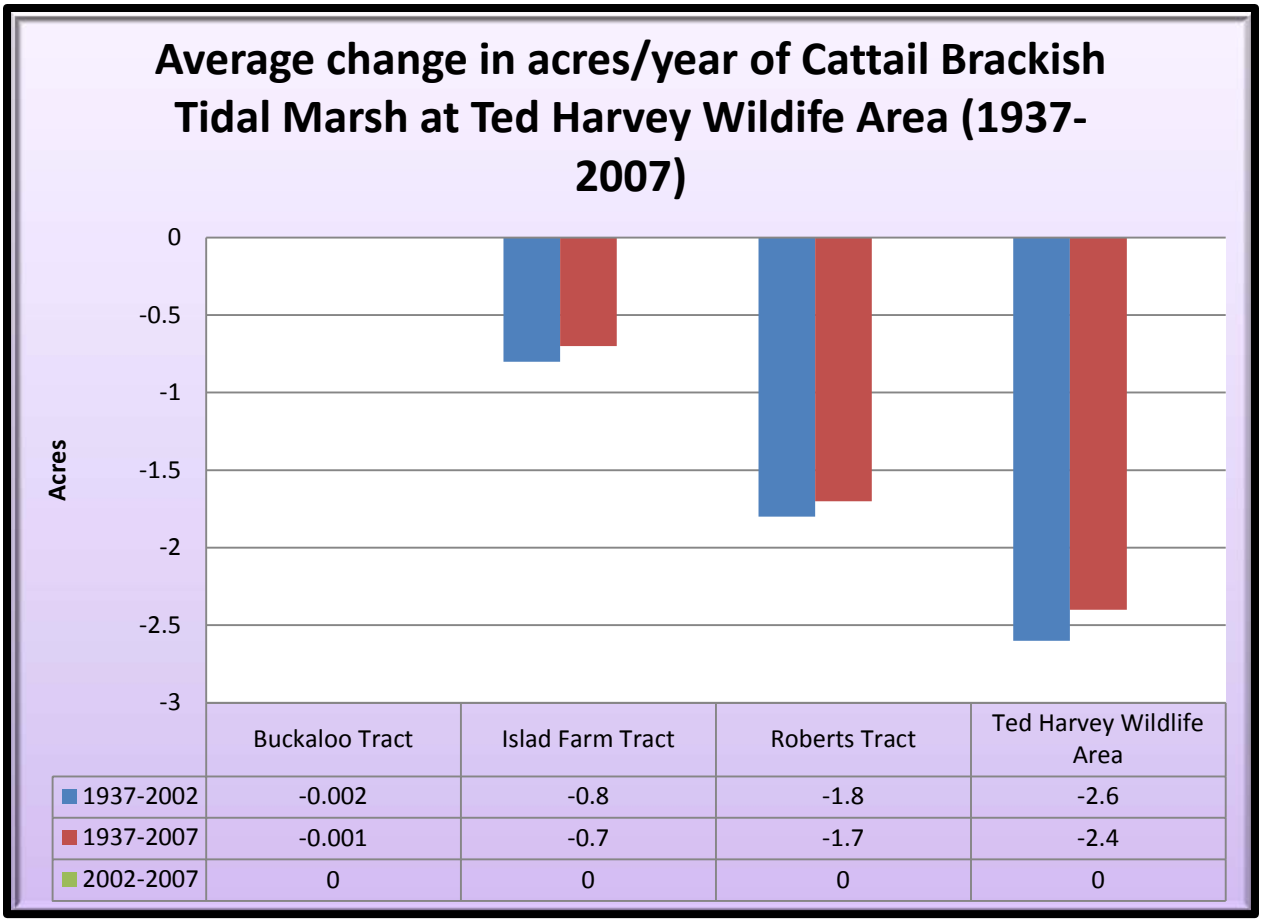


Figure 5.4. Average change in acres/year of Cattail Brackish Tidal Marsh at Ted Harvey Wildlife Area (1937-2007)

DNREC Sea Level Rise Analysis (Table 5.6)

All of the current acreage of Cattail Brackish Tidal Marsh would be inundated with 0.5 m of sea level rise. Because of the more saline conditions and the fact that this community has migrated only slightly (0.1 acres of agricultural field) it is unlikely that this community will survive.

Table 5.6. Projected acres of Cattail Brackish Tidal Marsh Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	0.1 acres
1 m	0.1 acres
1.5 m	0.1 acres

Natural Capital (Table 5.7)

The highest capitalization of Cattail Brackish Tidal Marsh during the study period was achieved in 1937 and has since greatly declined. Most of the value of this marsh has been transferred to North Atlantic Low Salt Marsh.

Table 5.7. Natural Capital of Cattail Brackish Tidal Marsh	
Year	**Natural Capital (in 2012 dollars)**
1937	$1,048,561/year
2002	$627/year
2007	$627/year

Chesapeake Bay Non-riverine Wet Hardwood Forest **[125 acres (Figures 5.5-5.6, Tables 5.8-5.11)]**
G4G5 S5

DEWAP: Isolated Forested Wetlands
NHC: Northern Atlantic Coastal Plain Basin Swamp and Wet Hardwood Forest

Description

This forested community is co-dominated by red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*). It is currently a subtype of Red Maple-Sweetgum Swamp but will likely become its own community type in the future once all of the locations can be analyzed. Other canopy species include willow oak (*Quercus phellos*), pin oak (*Quercus palustris*), and white oak (*Quercus alba*). Understory associates include smaller members of the canopy plus Hercules club (*Aralia spinosa*), blackgum (*Nyssa sylvatica*), American holly (*Ilex opaca*), sassafras (*Sassafras albidum*), and wild black cherry (*Prunus serotina*). Shrubs and vines include Japanese honeysuckle (*Lonicera japonica*), arrowwood (*Viburnum dentatum*), common greenbrier (*Smilax rotundifolia*), highbush blueberry (*Vaccinium corymbosum*), and sweet pepperbush (*Clethra alnifolia*). Herbs include Virginia creeper (*Parthenocissus quinquefolia*), royal fern (*Osmunda regalis*), Atlantic sedge (*Carex atlantica*), partridgeberry (*Mitchella repens*), cinnamon fern (*Osmunda cinnamomea*), black snakeroot (*Sanicula marilandica*), and asymmetrical fringed sedge (*Carex crinita*).

Figure 5.5. Chesapeake Bay Non-riverine Wet Hardwood Forest (Logan Lane Tract)

Most of the examples of this community in Ted Harvey Wildlife Area are mature with fairly large canopy trees and good layering. Some examples do have incursions of exotic invasive plant species.

Analysis of Condition at Ted Harvey Wildlife Area

This community has more than doubled its acreage since 1937 in the wildlife area but not uniformly, with the Logan Lane Tract accounting for most of the increase and the Buckaloo and Roberts Tracts staying stable. Most of the new acreage is coming from the maturing of Early to Mid-Successional Loblolly Pine Forest.

Table 5.8. What was once Chesapeake Bay Non-riverine Wet Hardwood Forest in 1937 has become X or remained in 2007	
X	**Acreage**
Chesapeake Bay Non-riverine Wet Hardwood Forest	33 acres
Northeastern Modified Successional Forest	8 acres
Reed Tidal Marsh	2 acres
Northeastern Old Field	1 acre
Mid-Atlantic Mesic Mixed Hardwood Forest	1 acre
Other communities/land covers	4 acres

Table 5.9. Chesapeake Bay Non-riverine Wet Hardwood Forest has migrated into X or remained since 1937	
X	**Acreage**
Chesapeake Bay Non-riverine Wet Hardwood Forest	33 acres
Northeastern Old Field	32 acres
Early to Mid-Successional Loblolly Pine Forest	31 acres
Agricultural Field	25 acres
Mid to Late Successional Loblolly Pine-Sweetgum Forest	2 acres
Other communities/land covers	2 acres

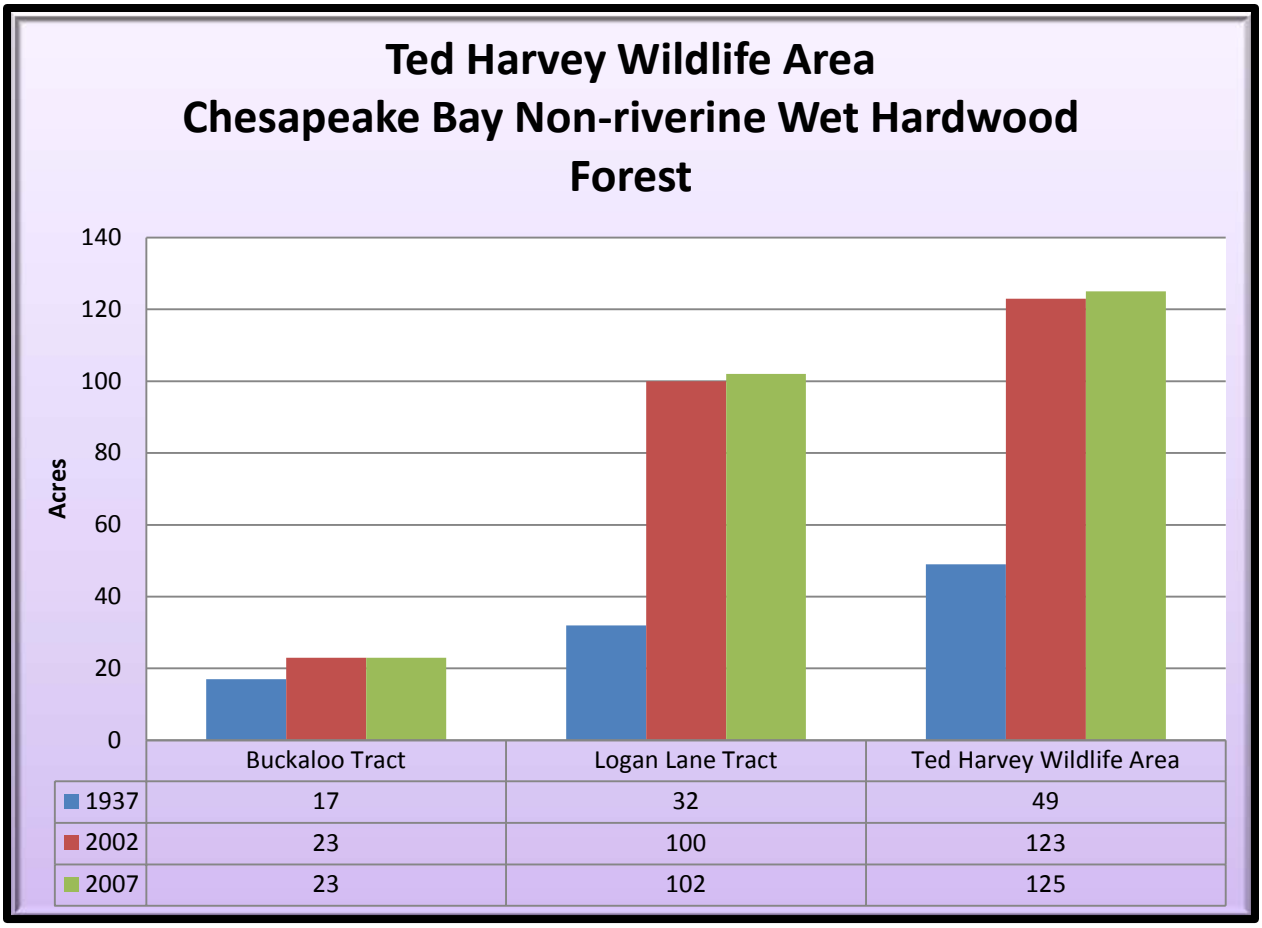


Figure 5.6. Chesapeake Bay Non-riverine Wet Hardwood Forest at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Scenarios (Table 5.10)

Chesapeake Bay Non-riverine Wet Hardwood Forest will be little affected by 0.5 m of sea level rise; however, at 1 m of rise about half of the existing acreage will be inundated. Another 0.5 m of rise, to 1.5 m in total, takes another ¼ of the acreage.

Table 5.10. Projected acres of Chesapeake Bay Non-riverine Wet Hardwood Forest Impacted by Sea Level Rise

Rise	Acres
0.5 m	14 acres
1 m	69 acres
1.5 m	91 acres

Natural Capital (Table 5.11)

The capital of this community has been rising as the acreage increases. Swamp communities are valuable communities for their buffering and filtering capacity and command a high value.

Table 5.11. Natural Capital of Chesapeake Bay Non-riverine Wet Hardwood Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$602,284/year
2002	$1,511,855/year
2007	$1,536,438/year

Coastal Loblolly Pine Wetland Forest **[1 acre (Figure 5.7, Tables 5.12-5.14)] G3 S3**

DEWAP: Isolated Forested Wetlands
NHC: Northern Atlantic Coastal Plain Maritime Forest

Description

This forested community is often a large component of the near coastal areas of Delaware. At Ted Harvey Wildlife Area it composes a very small area on the southern edge of the St. Jones River. Because of the location and lack of accessibility of the two occurrences, they were not visited. In these communities, Loblolly pine (*Pinus taeda*) is the dominant species in the canopy and is associated by red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*). The understory is generally composed of common greenbrier (*Smilax rotundifolia*), with poison ivy (*Toxicodendron radicans*) and Virginia creeper (*Parthenocissus quinquefolia*). A shrub layer of southern bayberry (*Morella cerifera*) is sometimes present. The herbaceous layer is sparse and can be composed of netted chain fern (*Woodwardia areolata*), royal fern (*Osmunda regalis* var. *spectabilis*), cinnamon fern (*Osmunda cinnamomea*) and Pennsylvania smartweed (*Polygonum pensylvanicum*).

This community was not present in the 1937 imagery, so it can be assumed that it is probably in a mid-successional to late successional stage.

Analysis of Condition at Ted Harvey Wildlife Area

The two occurrences of this community are surrounded by marshland. As the level of the water rises or erosion from the St. Jones River eats into the area of high elevation where this community is located they will gradually transition to marsh or water. In the short-term (2002-2007) this community appears to be stable in amount.

Coastal Loblolly Pine Wetland Forest was not present in 1937 and has since come into an acre of North Atlantic Low Salt Marsh and 0.1 acres of North Atlantic High Salt Marsh. This area edges an impoundment and therefore the hydrology was changed.

Table 5.12. Coastal Loblolly Pine Wetland Forest has migrated into X or remained since 1937	
X	**Acreage**
North Atlantic Low Salt Marsh	1 acre
North Atlantic High Salt Marsh	0.1 acres

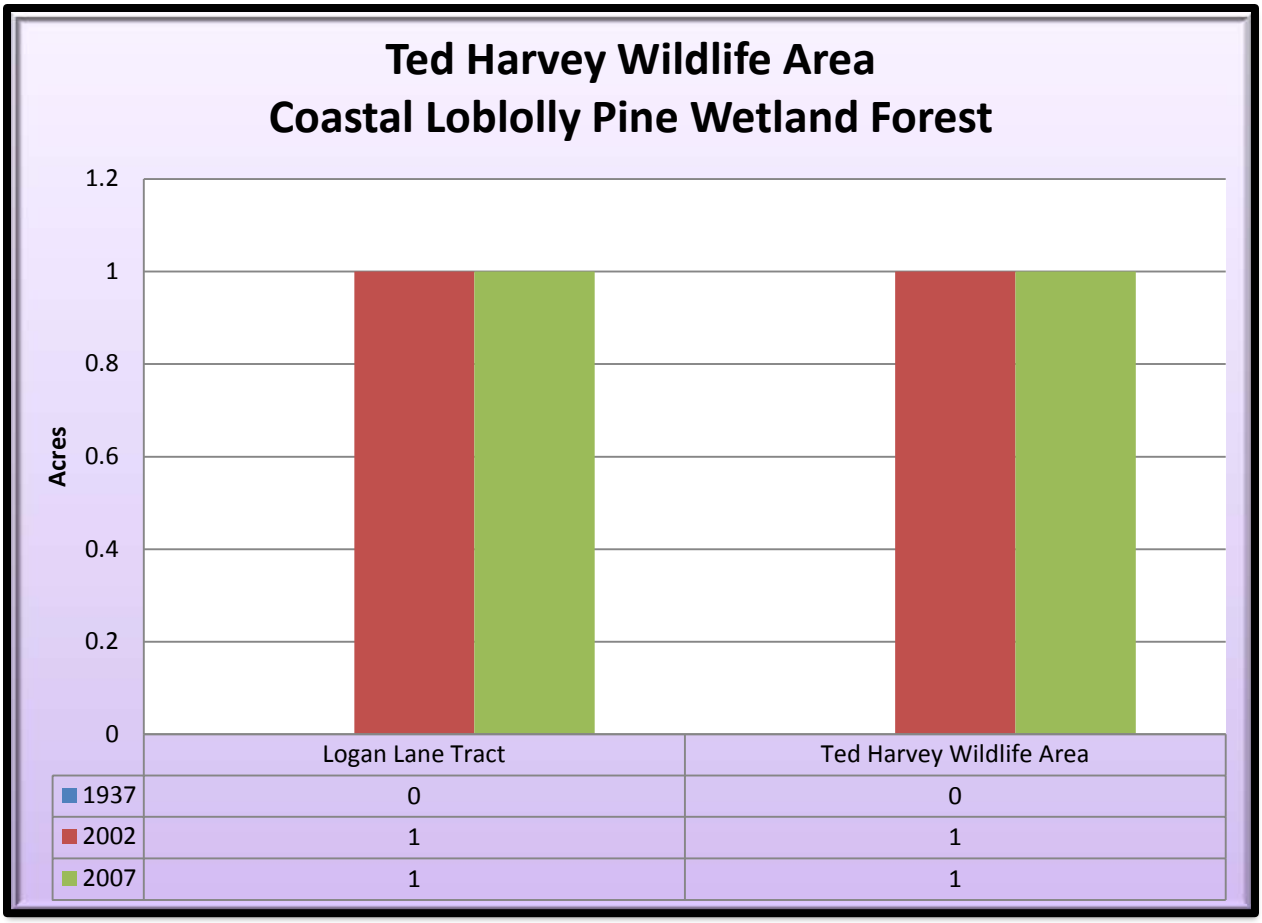


Figure 5.7. Coastal Loblolly Pine Wetland Forest at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Scenarios (Table 5.13)

All of the current acreage of Coastal Loblolly Pine Wetland Forest would be inundated with 0.5 m of sea level rise. This community was new to the wildlife area in 2002, appearing at some point between 1937 and 2002. It has grown into areas that were formerly North Atlantic Low Salt Marsh and North Atlantic High Salt Marsh.

Table 5.13. Projected acres of Coastal Loblolly Pine Wetland Forest Impacted by Sea Level Rise

Rise	Acres
0.5 m	1 acre
1 m	1 acre
1.5 m	1 acre

Natural Capital (Table 5.14)

Coastal Loblolly Pine Wetland Forest does not have much capitalization and has obtained it from North Atlantic Low Salt Marsh and North Atlantic High Salt Marsh, resulting in an overall decrease in value for the wildlife area.

Table 5.14. Natural Capital of Coastal Loblolly Pine Wetland Forest

Year	Natural Capital (in 2012 dollars)
1937	$0/year
2002	$189/year
2007	$189/year

Coastal Plain Oak Floodplain Swamp **[2 acres (Figure 5.8, Tables 5.15-5.18)] G4G5 S5**

DEWAP: Forested Floodplains and Riparian Swamps
NHC: Northern Atlantic Coastal Plain Stream and River

Description

This forested community is very similar to the Chesapeake Bay Non-riverine Wet Hardwood Forest with the exception that is occurs in a floodplain. Like the comparable community it is co-dominated by red maple (*Acer rubrum*) and sweetgum (*Liquidambar styraciflua*). Other canopy species include willow oak (*Quercus phellos*), pin oak (*Quercus palustris*), and white oak (*Quercus alba*). Understory associates include smaller members of the canopy plus Hercules club (*Aralia spinosa*), blackgum (*Nyssa sylvatica*), American holly (*Ilex opaca*), sassafras (*Sassafras albidum*), and wild black cherry (*Prunus serotina*). Shrubs and vines include Japanese honeysuckle (*Lonicera japonica*), arrowwood (*Viburnum dentatum*), common greenbrier (*Smilax rotundifolia*), highbush blueberry (*Vaccinium corymbosum*), and sweet pepperbush (*Clethra alnifolia*). Herbs include Virginia creeper (*Parthenocissus quinquefolia*), royal fern (*Osmunda regalis*), Atlantic sedge (*Carex atlantica*), partridgeberry (*Mitchella repens*), cinnamon fern (*Osmunda cinnamomea*), black snakeroot (*Sanicula marilandica*), and asymmetrical fringed sedge (*Carex crinita*).

The one example of this community is in a late successional state with fairly good layering, but somewhat small size canopy trees.

Analysis of Condition at Ted Harvey Wildlife Area

This community has more than doubled its acreage since 1937 in the wildlife area but not uniformly, with the Logan Lane Tract accounting for most of the increase and the Buckaloo and Roberts Tracts staying stable. Most of the new acreage is coming from the maturing of Early to Mid-Successional Loblolly Pine Forest. This community has stayed the same since 1937 with all of the original acreage surviving in 2007 from 1937 and it did not migrate (Tables 5.15-5.16).

Table 5.15. What was once Coastal Plain Oak Floodplain Swamp in 1937 has become X or remained in 2007	
X	**Acreage**
Coastal Plain Oak Floodplain Swamp	2 acres

Table 5.16. Coastal Plain Oak Floodplain Swamp has migrated into X or remained since 1937	
X	**Acreage**
Coastal Plain Oak Floodplain Swamp	2 acres

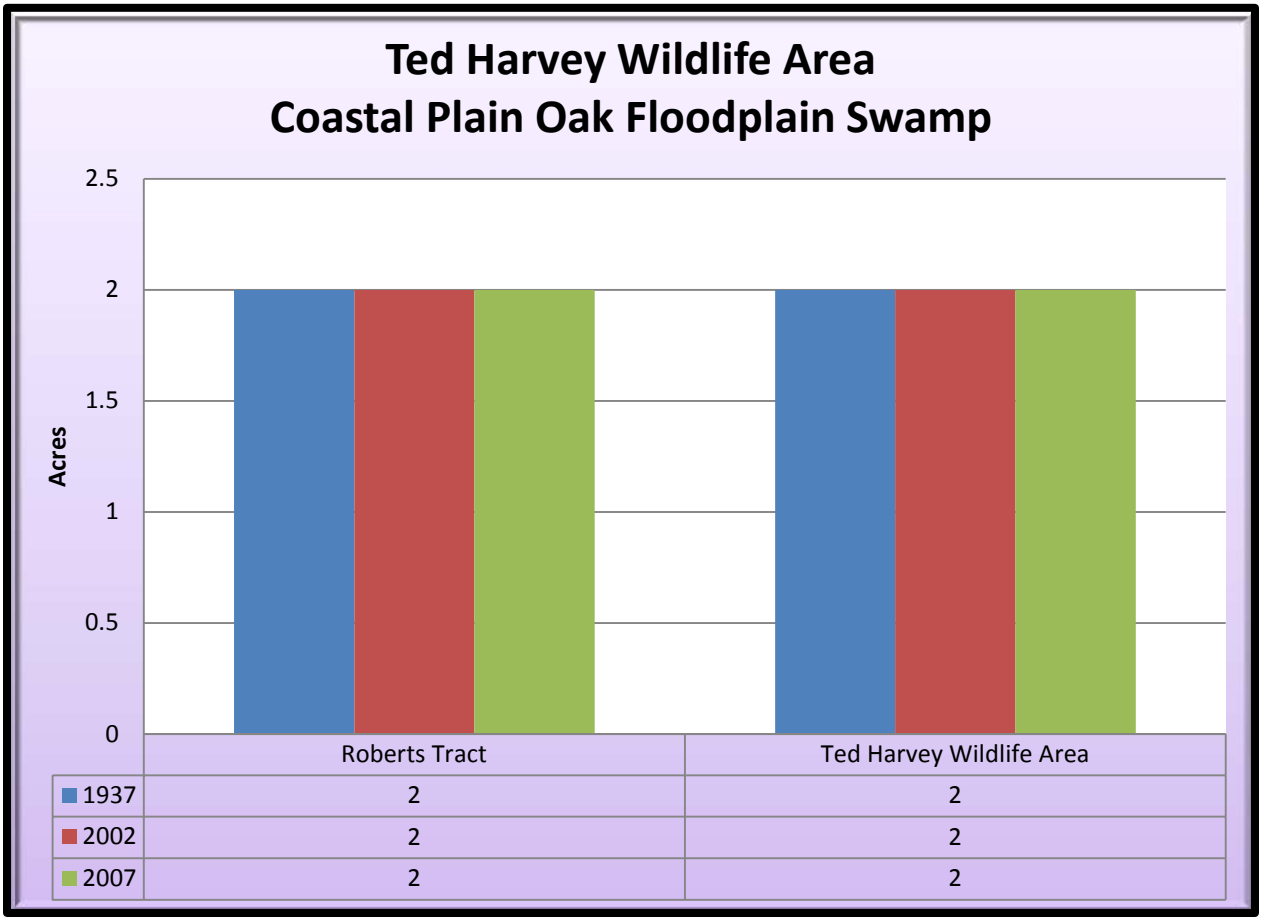


Figure 5.8. Coastal Plain Oak Floodplain Swamp at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Scenarios (Table 5.17)

Coastal Plain Oak Floodplain Swamp will have half of its acreage inundated with 0.5 m and 1 m of sea level rise. The rest will be consumed with 1.5 m of rise.

Table 5.17. Projected acres of Coastal Plain Oak Floodplain Swamp Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	1 acre
1 m	1 acre
1.5 m	2 acres

Natural Capital (Table 5.18)

The capital of this community has not changed as the acreage has not changed.

Table 5.18. Natural Capital of Coastal Plain Oak Floodplain Swamp	
Year	**Natural Capital (in 2012 dollars)**
1937	$24,583/year
2002	$24,583/year
2007	$24,583/year

Common Reed Upland Temperate Vegetation **[5 acres (Figures 5.9-5.10, Tables 5.19-5.21)] GNA SNA**

DEWAP: No Equivalent Community
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

Figure 5.9. Common Reed Upland Temperate Vegetation (Logan Lane Tract)

This herbaceous community is similar in habit and composition to the Eastern Reed Marsh but is located in an upland situation and without tidal influence. It is composed entirely of common reed (*Phragmites australis*).

Analysis of Condition at Ted Harvey Wildlife Area

This community is composed of an exotic invasive plant species. It is hoped that this community will be eradicated in the wildlife area at some point. This community has converted 3 acres of North Atlantic Low Salt Marsh and 2 acres of Reed Tidal Marsh since 1937 (Table 5.19).

Table 5.19. Common Reed Temperate Upland Vegetation has migrated into X or remained since 1937

X	**Acreage**
North Atlantic Low Salt Marsh	3 acres
Reed Tidal Marsh	2 acres
Irregularly Flooded Eastern Tidal Salt Shrub	0.4 acres

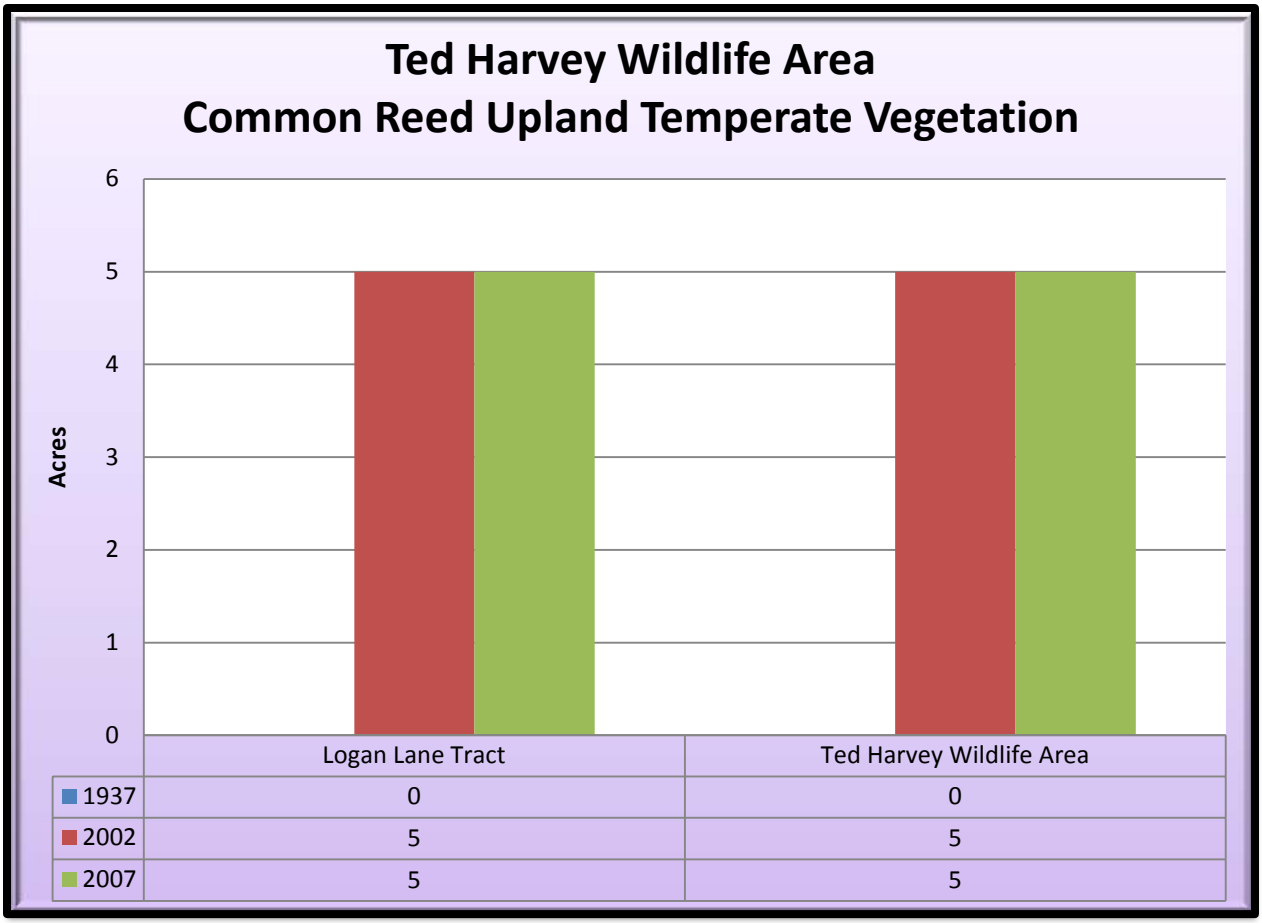


Figure 5.10. Common Reed Upland Temperate Vegetation at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Scenarios (Table 5.20)

Because of its location in an upland this community will not see effects of sea level rise until 1 m of rise at which point it will be inundated.

Table 5.20. Projected acres of Common Reed Temperate Upland Vegetation Impacted by Sea Level Rise

Rise	Acres
0.5 m	0 acres
1 m	4 acres
1.5 m	5 acres

Natural Capital (Table 5.21)

Common Reed Temperate Vegetation was not present in 1937 and has since grown to a capitalization of $729.00, which has remained stable in the short-term.

Table 5.21. Natural Capital of Common Reed Temperate Upland Vegetation	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year
2002	$729/year
2007	$729/year

Cultivated Lawn **[9 acres (Figure 5.11, Tables 5.22-5.24)]** **GNA SNA**

DEWAP: No Equivalent Community
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

This community is located adjacent to some of the historic houses and roadsides in the wildlife area. It is dominated by tall fescue (*Festuca arundinacea*) with other ornamental grasses and plants. It is mowed more than once a year.

Analysis of Condition at Ted Harvey Wildlife Area

This community is artificially created and maintained and is not judged by condition. It has, increased over time but other parts have converted over to other communities since 1937. One acre of the original three acres from 1937 is still present in 2007. The rest of the acreage has become 1 acre of Northeastern Modified Successional Forest, 0.3 acres of agricultural field, and 0.2 acres each of Northeastern Old Field and Semi-impervious Surface (Table 5.22).

This community has been developed on 4 acres of agricultural field, 2 acres of Northeastern Old Field, and 1 acre each of Northeastern Modified Successional Forest and Chesapeake Bay Non-riverine Wet Hardwood Forest (Table 5.23).

Table 5.22. What was once Cultivated Lawn in 1937 has become X or remained in 2007

X	Acreage
Northeastern Modified Successional Forest	1 acre
Cultivated Lawn	1 acre
Agricultural Field	0.3 acres
Northeastern Old Field	0.2 acres
Semi-impervious Surface	0.2 acres
Other communities/land covers	1 acre

Table 5.23. Cultivated Lawn has migrated into X or remained since 1937

X	Acreage
Agricultural Field	4 acres
Northeastern Old Field	2 acres
Northeastern Modified Successional Forest	1 acre
Cultivated Lawn	1 acre
Chesapeake Bay Non-riverine Wet Hardwood Forest	1 acre
Other communities/land covers	1 acre

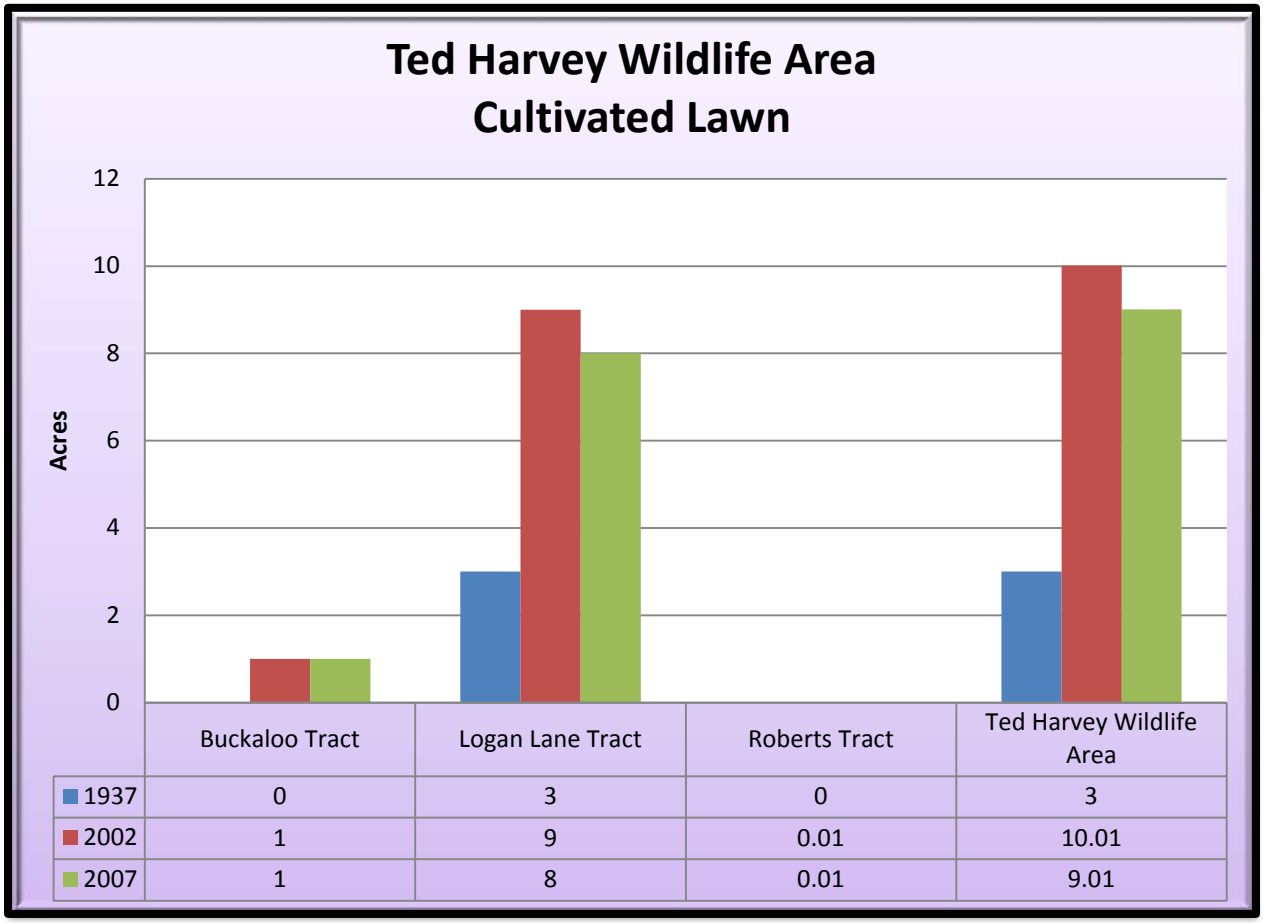


Figure 5.11. Cultivated Lawn at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Scenarios (Table 5.24)

Most of the cultivated lawn in the wildlife area is located on the edges of roads in the higher elevation areas. As such this community is not impacted as much as other communities. At 0.5 m of sea level rise this community will lose 0.2 acres to flooding. At 1 m of rise 2 acres will be affected and another acre at 1.5 m of rise.

Table 5.24. Projected acres of Cultivated Lawn Impacted by Sea Level Rise

Rise	Acres
0.5 m	0.4 acres
1 m	2 acres
1.5 m	3 acres

Natural Capital

This community does not carry any natural capital.

Early to Mid-Successional Loblolly Pine Forest **[0 acres (Figure 5.12, Tables 5.25-5.26)] GNA SNA**

DEWAP: Early Successional Upland Habitats
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

This successional forest community is historical to the wildlife area and has succeeded to more forest types such as Red Maple-Sweetgum Swamp or Northeastern Modified Successional Forest. Loblolly Pine (*Pinus taeda*) is the only species in the canopy overtopping red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), and other hardwood species. Some scattered vines of common greenbrier (*Smilax rotundifolia*) may be present. The herbaceous layer in these communities is usually non-existent due to the shading of the canopy.

Analysis of Condition at Ted Harvey Wildlife Area

This community is longer present in the wildlife area and has succeeded into more mature forest types including Chesapeake Bay Non-riverine Wet Hardwood Forest (31 acres), Successional Sweetgum Forest (13 acres), Successional Maritime Forest (4 acres), and Successional Tuliptree Forest (1 acre) (Table 5.25). One acre was cut to form an agricultural field.

Table 5.25. What was once Early to Mid-Successional Loblolly Pine Forest in 1937 has become X or remained in 2007

X	**Acreage**
Chesapeake Bay Non-riverine Wet Hardwood Forest	31 acres
Successional Sweetgum Forest	13 acres
Successional Maritime Forest	4 acres
Successional Tuliptree Forest	1 acre
Agricultural Field	1 acre
Other vegetation communities/land covers	0.5 acres

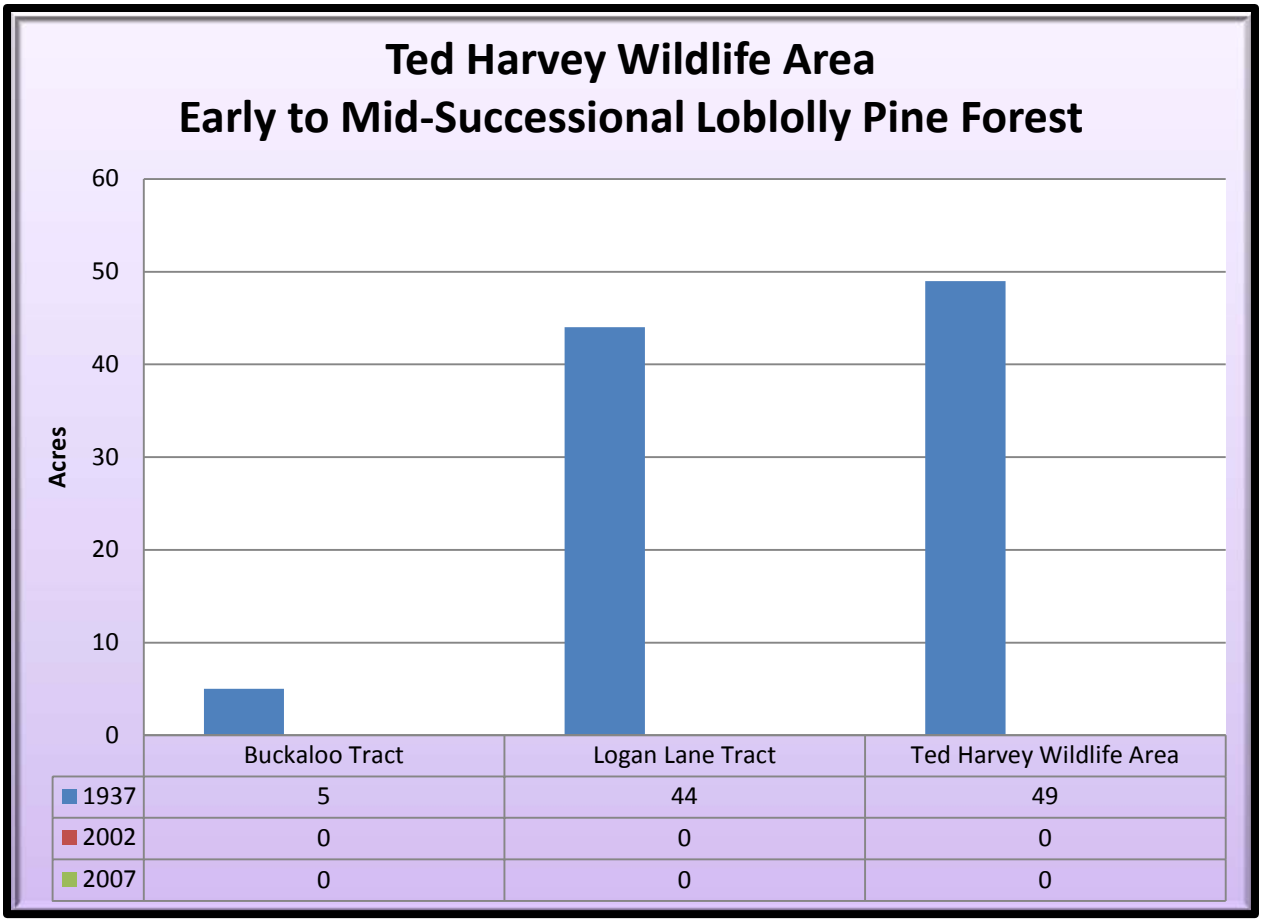


Figure 5.12. Early to Mid-Successional Loblolly Pine Forest at Ted Harvey Wildlife Area (1937, 2002, and 2007)

Natural Capital (Table 5.26)

Common Reed Temperate Vegetation was not present in 1937 and has since grown to a capitalization of $729.00, which has remained stable in the short-term.

Table 5.26. Natural Capital of Early to Mid-Successional Loblolly Pine Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$9,266/year
2002	$0/year (not present)
2007	$0/year (not present)

Eastern Reed Marsh **[97 acres (Figures 5.13-5.14, Tables 5.27-5.30)]** **GNA SNA**

DEWAP: Non-Forested Wetlands
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

Figure 5.13. Eastern Reed Marsh (Logan Lane Tract)

This community is dominated to totality by eastern reed (*Phragmites australis*) in non-tidal wetland situations.

Analysis of Condition at Ted Harvey Wildlife Area

This community has made significant gains since 1937 and it is hoped that this community will be eradicated in the near future in the wildlife area.

About half of the marsh acreage from 1937 still exists in 2007. The rest has been taken by water (1 acre) and Chesapeake Bay Non-riverine Wet Hardwood Forest (0.4 acres) (Table 5.27).

Since 1937, this community has converted 54 acres of North Atlantic Low Salt Marsh through the development of an impoundment, 32 acres of Northeastern Old Field, 7 acres of agricultural field, and one acre each of Mid to Late Successional Loblolly Pine-Sweetgum Forest and North Atlantic High Salt Marsh (Table 5.28).

Table 5.27. What was once Eastern Reed Marsh in 1937 has become X or remained in 2007	
X	**Acreage**
Eastern Reed Marsh	1 acre
Water	1 acre
Chesapeake Bay Non-riverine Wet Hardwood Forest	0.4 acres
Semi-impervious Surface	0.1 acres

Table 5.28. Eastern Reed Marsh has migrated into X or remained since 1937	
X	**Acreage**
North Atlantic Low Salt Marsh	54 acres
Northeastern Old Field	32 acres
Agricultural Field	7 acres
Mid to Late Successional Loblolly Pine-Sweetgum Forest	1 acre
North Atlantic High Salt Marsh	1 acre
Other communities/land covers	2 acres

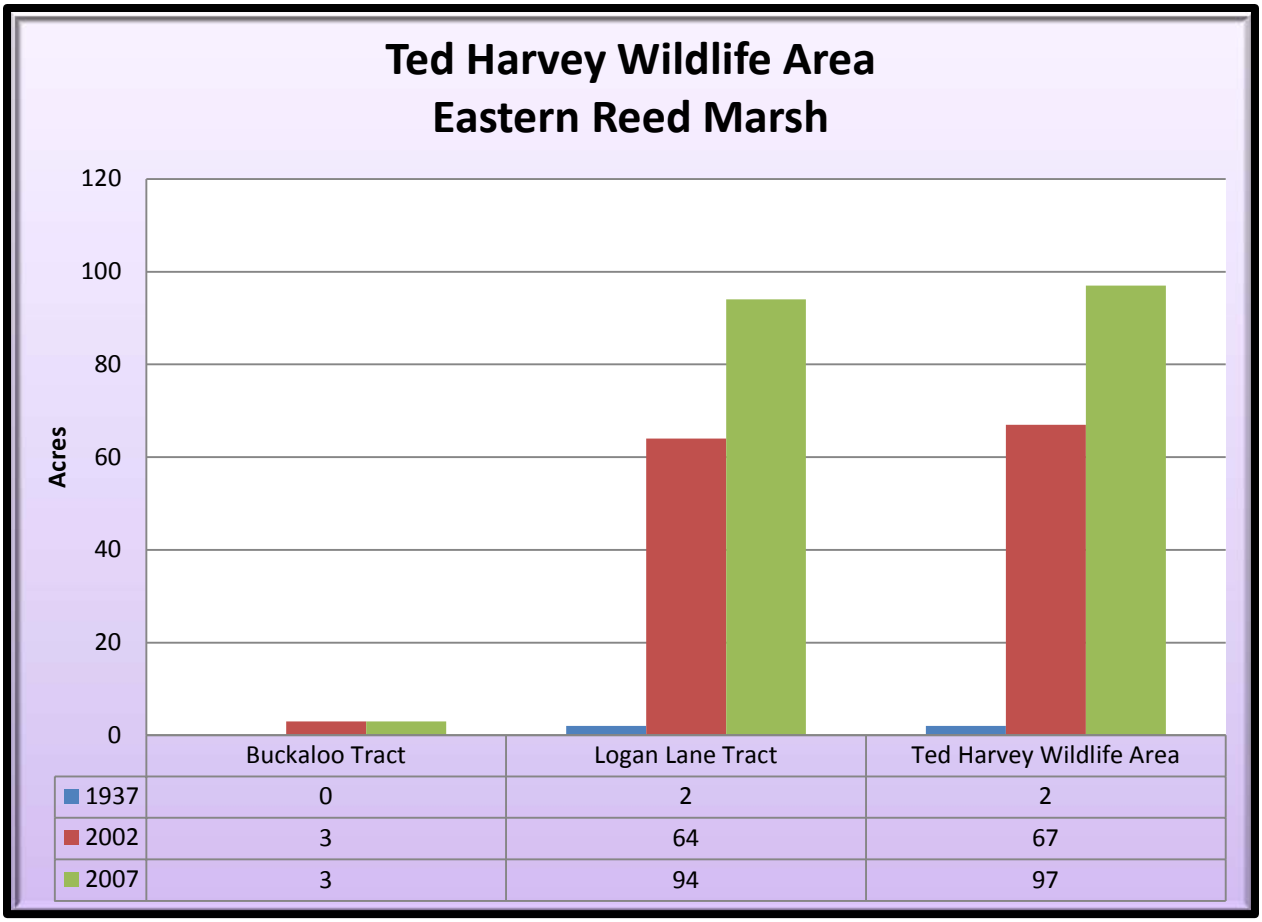


Figure 5.14. Eastern Reed Marsh at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Scenarios (Table 5.29)

At 0.5 m of sea level rise a little more than half of the current acreage will be flooded. At 1 m and greater sea level rise, it will essentially be eliminated from the wildlife area.

Table 5.29. Projected acres of Eastern Reed Marsh Impacted by Sea Level Rise

Rise	Acres
0.5 m	58 acres
1 m	94 acres
1.5 m	95 acres

Natural Capital (Table 5.30)

Even though Eastern Reed Marsh is dominated by a non-native species it is still a wetland that provides nutrient cycling. As this community has spread it has gained in natural capital. In spite of this, it would be beneficial to be able to transfer the capital to a native community.

Table 5.30. Natural Capital of Eastern Reed Marsh

Year	Natural Capital (in 2012 dollars)
1937	$18,563/year
2002	$621,854/year
2007	$900,296/year

Freshwater Tidal Mixed High Marsh **[0 acres (Figures 5.15-5.16, Table 5.31)] GNR S1**

DEWAP: Freshwater Tidal Marshes
NHC: Northern Atlantic Coastal Plain Fresh and Oligohaline Tidal Marsh

Description

This freshwater tidal marsh community is historic in the wildlife area and has changed into a more brackish marsh due to rising salinity from sea level rise. The community is dominated or co-dominated by arrow-arum (*Peltandra virginica*), orange-spotted jewelweed (*Impatiens capensis*), broad-leaf arrow-head (*Sagittaria latifolia*), and/or narrow-leaf cattail (*Typha angustifolia*). Other associates may include pickerelweed (*Pontederia cordata*), halbeard-leaf tearthumb (*Polygonum arifolium*), arrow-leaf tearthumb (*Polygonum sagittatum*), and other freshwater marsh plants.

Analysis of Condition at Ted Harvey Wildlife Area

This community is historical to the wildlife area and is not currently present. What was this community has become 49 acres of North Atlantic Low Salt Marsh, 1 acre of North Atlantic High Salt Marsh, 0.2 acres of water, and 0.2 acres of Successional Maritime Forest (Table 5.31).

Table 5.31. What was once Freshwater Tidal Mixed High Marsh in 1937 has become X or remained in 2007

X	**Acreage**
North Atlantic Low Salt Marsh	49 acres
North Atlantic High Salt Marsh	1 acre
Water	0.2 acres
Successional Maritime Forest	0.2 acres

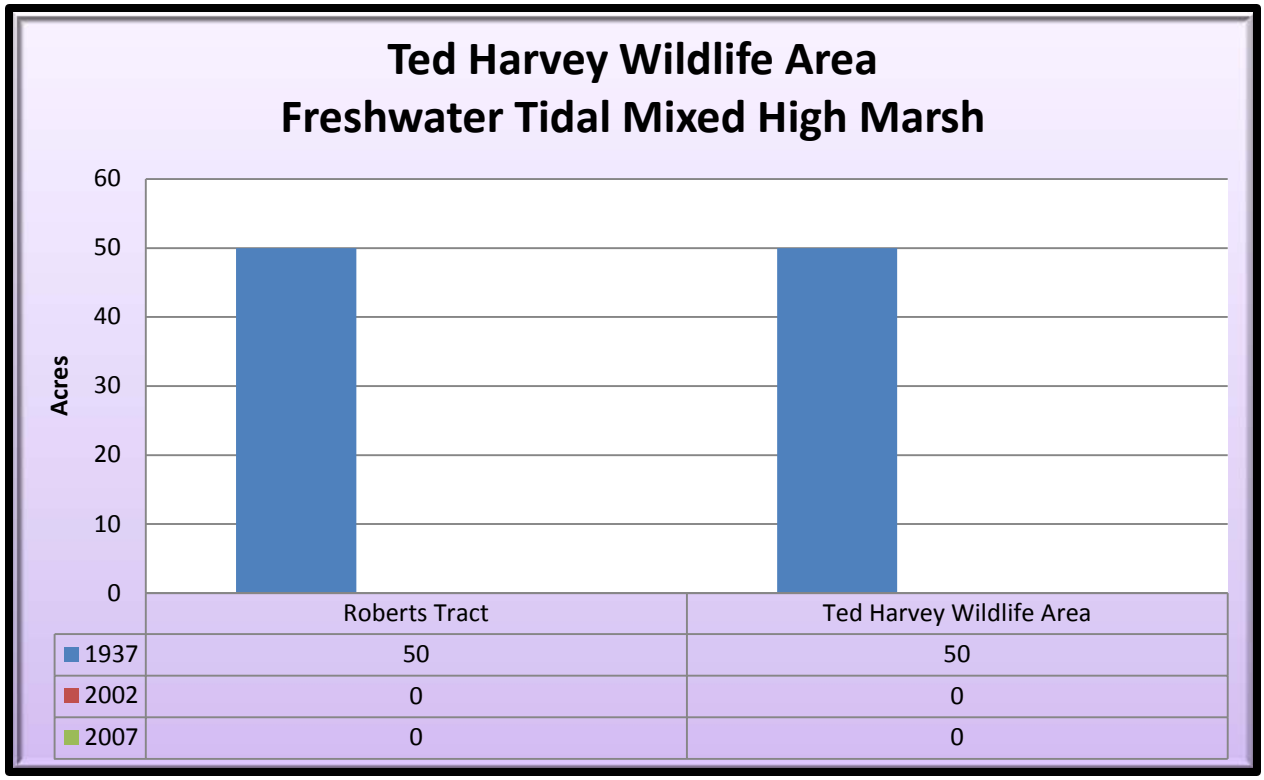


Figure 5.15. Freshwater Tidal Mixed High Marsh at Ted Harvey Wildlife Area (1937, 2002, and 2007)

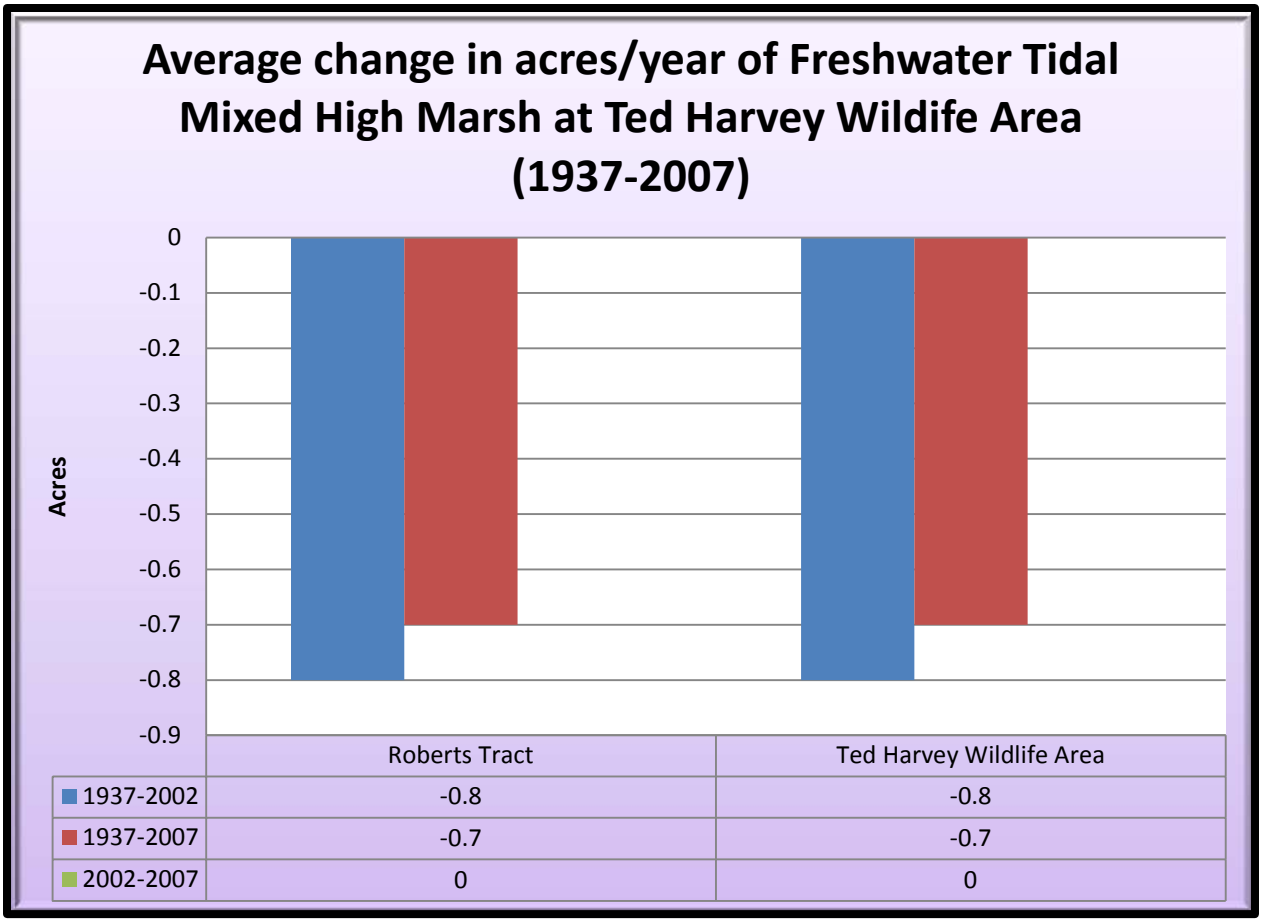


Figure 5.16. Average change in acres/year of Freshwater Tidal Mixed High Marsh at Ted Harvey Wildlife Area (1937-2007)

Natural Capital (Table 5.32)

Even though Eastern Reed Marsh is dominated by a non-native species it is still a wetland that provides nutrient cycling. As this community has spread it has gained in natural capital. In spite of this, it would be beneficial to be able to transfer the capital to a native community.

Table 5.32. Natural Capital of Freshwater Tidal Mixed High Marsh	
Year	**Natural Capital (in 2012 dollars)**
1937	$313,565/year
2002	$0/year (not present)
2007	$0/year (not present)

Irregularly Flooded Eastern Tidal Salt Shrub **[12 acres (Figures 5.17-5.18, Tables 5.33-5.36)] G5 S5**

DEWAP: Tidal High Marshes
NHC: Northern Atlantic Coastal Plain Tidal Salt Marsh

Description

This brackish shrub community is found just above the elevation of the North Atlantic High Salt Marsh and just below other forested communities such as the Successional Maritime Forest. At Ted Harvey Wildlife Area it is composed primarily of salt shrub (*Baccharis halimifolia*) with a small amount of elderbush (*Iva frutuscens*). Some salt meadow hay (*Spartina alterniflora*) may be mixed in underneath the shrubs.

Analysis of Condition at Ted Harvey Wildlife Area

It has been noted in other areas around the coast of Delaware that there has been a decline in the amount of Irregularly Flooded Eastern Tidal Salt Shrub since 1937. Up to 2002 this trend was true for Ted Harvey Wildlife Area. Between 2002 and 2007 there has been an upward trend of this community. It is unknown if this trend will continue or if this is just a bump in the road downward.

The changeable nature of this community is shown in the historical analysis, as none of the 1937 acreage is present in 2007. What was once Irregularly Flooded Eastern Tidal Salt Shrub has become North Atlantic Low Salt Marsh (9 acres), water (2 acres), beach (2 acres), tidal mudflat (1 acre), and impoundment (0.5 acres) (Table 5.33). This community has moved into 9 acres of North Atlantic High Salt Marsh, 2 acres of North Atlantic Low Salt Marsh, and one acre each of water and Reed Tidal Marsh since 1937 (Table 5.34).

Table 5.33. What was once Irregularly Flooded Eastern Tidal Salt Shrub in 1937 has become X or remained in 2007	
X	**Acreage**
North Atlantic Low Salt Marsh	9 acres
Water	2 acres
Beach	2 acres
Tidal Mudflat	1 acre
Impoundment	0.5 acres
Other communities/land covers	1 acre

Table 5.34. Irregularly Flooded Eastern Tidal Salt Shrub has migrated into X or remained since 1937	
X	**Acreage**
North Atlantic High Salt Marsh	9 acres
North Atlantic Low Salt Marsh	2 acres
Water	1 acre
Reed Tidal Marsh	1 acre
Cattail Brackish Tidal Marsh	0.1 acres
Other communities/land covers	0.1 acres

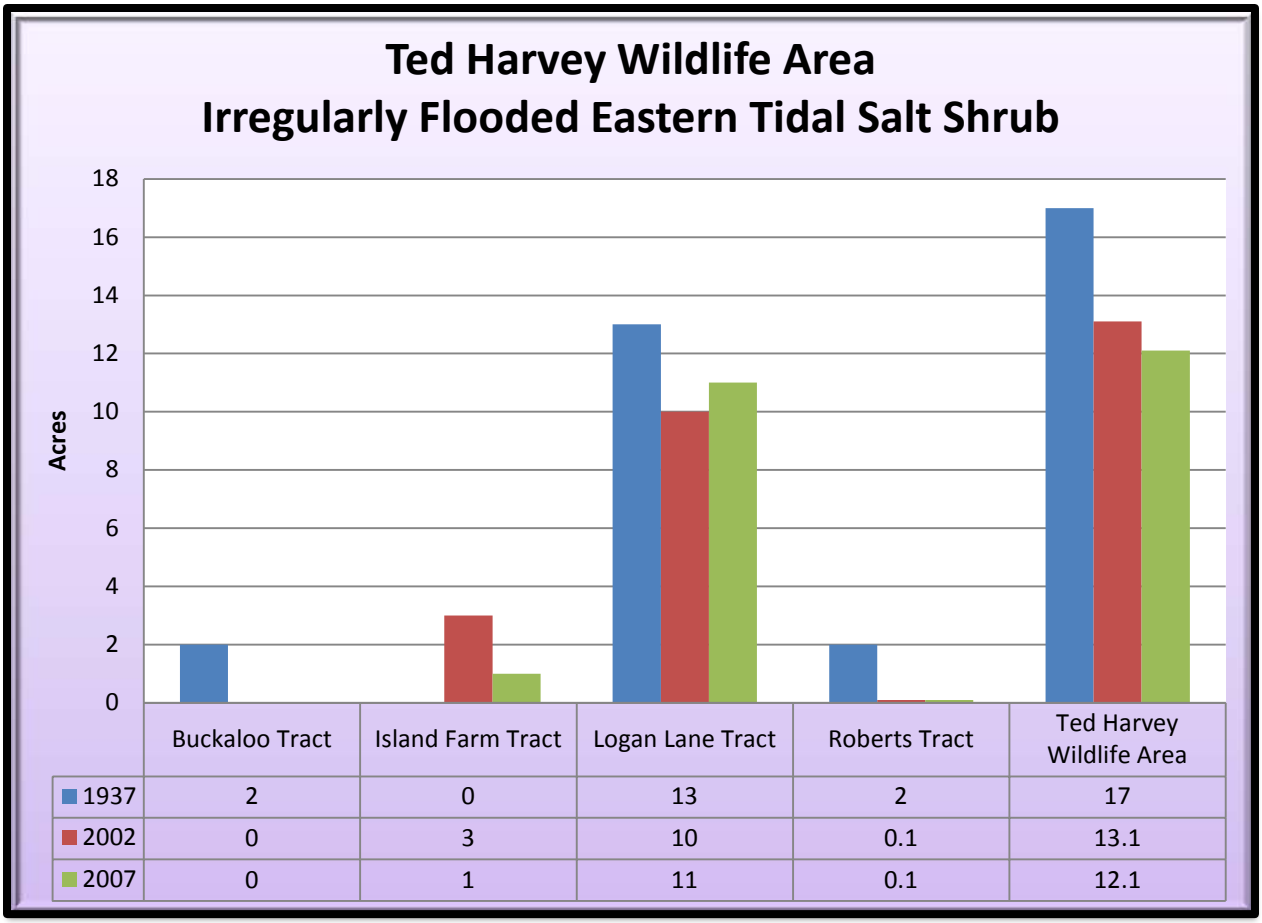


Figure 5.17. Irregularly Flooded Eastern Tidal Salt Shrub at Ted Harvey Wildlife Area (1937, 2002, and 2007)

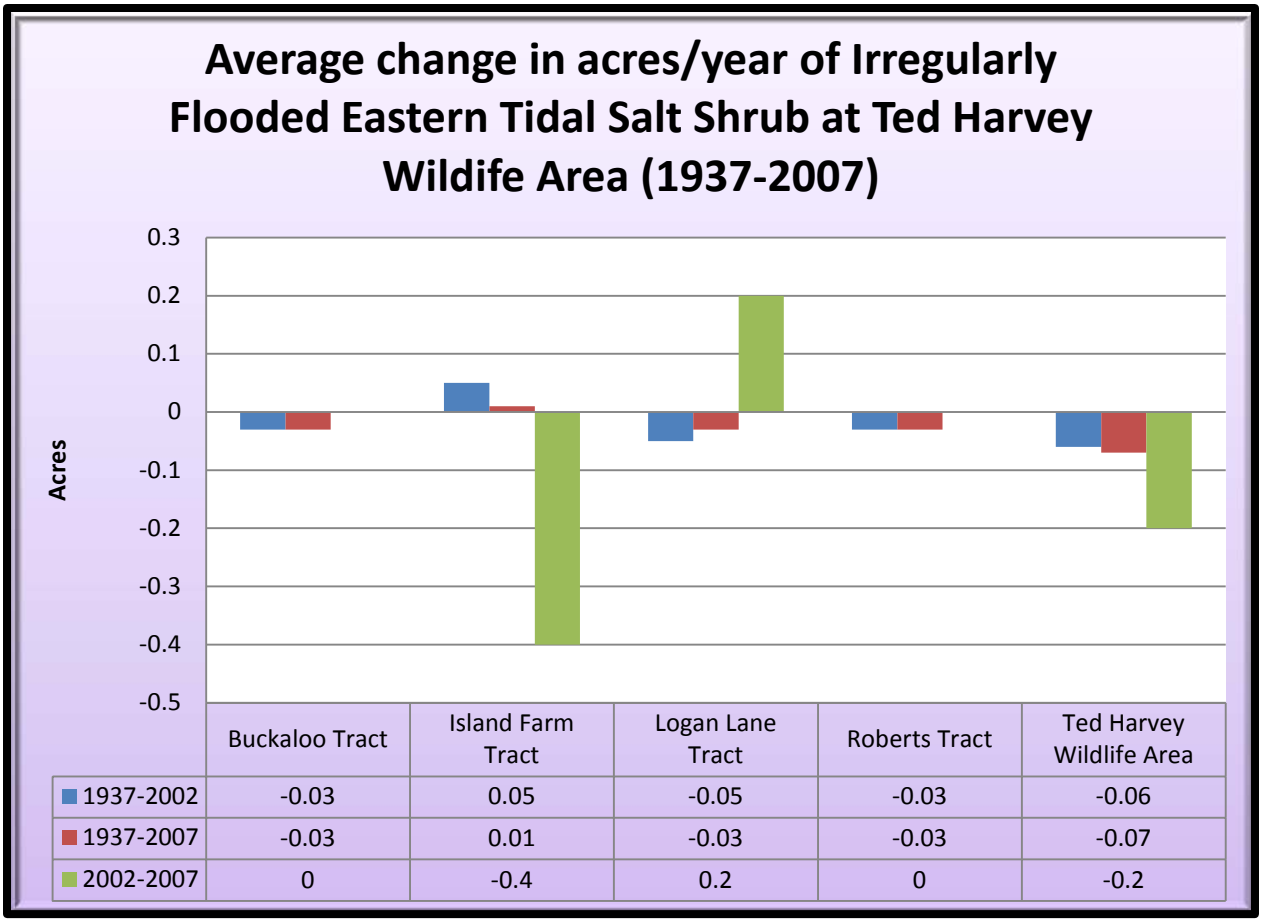


Figure 5.18. Average change in acres/year of Irregularly Flooded Eastern Tidal Salt Shrub at Ted Harvey Wildlife Area (1937-2007)

DNREC Sea Level Rise Analysis (Table 5.35)

All of the current acreage of Irregularly Flooded Eastern Tidal Salt Shrub will be flooded at 0.5 m and above of sea level rise.

Table 5.35. Projected acres of Irregularly Flooded Eastern Tidal Salt Shrub Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	12 acres
1 m	12 acres
1.5 m	12 acres

Natural Capital (Table 5.36)

Even though Eastern Reed Marsh is dominated by a non-native species it is still a wetland that provides nutrient cycling. As this community has spread it has gained in natural capital. In spite of this, it would be beneficial to be able to transfer the capital to a native community.

Table 5.36. Natural Capital of Irregularly Flooded Eastern Tidal Salt Shrub	
Year	**Natural Capital (in 2012 dollars)**
1937	$106,612/year
2002	$81,527/year
2007	$75,256/year

Mesohaline Seepage Marsh **[0 acres (Figures 5.19-5.20 and Tables 5.37-5.38)] GNR S4**

DEWAP: Tidal High Marshes
NHC: Northern Atlantic Coastal Plain Brackish Tidal Marsh

Description

This brackish marsh community was located on the Island Farm and Roberts Tracts in 1937. Rising salinities have caused this marsh to become North Atlantic Low Salt Marsh. Mesohaline Seepage Marshes are co-dominated by salt marsh fleabane (*Pluchea odorata*), northern tickseed sunflower (*Bidens coronata*), and Virginia sea-shore mallow (*Kostelezkya virginica*). Associates can include small spikerush (*Eleocharis parvula*), slender flatsedge (*Cyperus filicinus*), swamp rosemallow (*Hibiscus moscheutos*), and waterhemp (*Amaranthus cannabinus*).

Analysis of Condition at Ted Harvey Wildlife Area

This community is historical to the wildlife area and is not currently present. What used to be Mesohaline Seepage Marsh is now North Atlantic Low Salt Marsh (142 acres), water (7 acres), Reed Tidal Marsh (5 acres), and North Atlantic High Salt Marsh (4 acres) (Table 5.37).

Table 5.37. What was once Mesohaline Seepage Marsh in 1937 has become X or remained in 2007	
X	**Acreage**
North Atlantic Low Salt Marsh	142 acres
Water	7 acres
Reed Tidal Marsh	5 acres
North Atlantic High Salt Marsh	4 acres

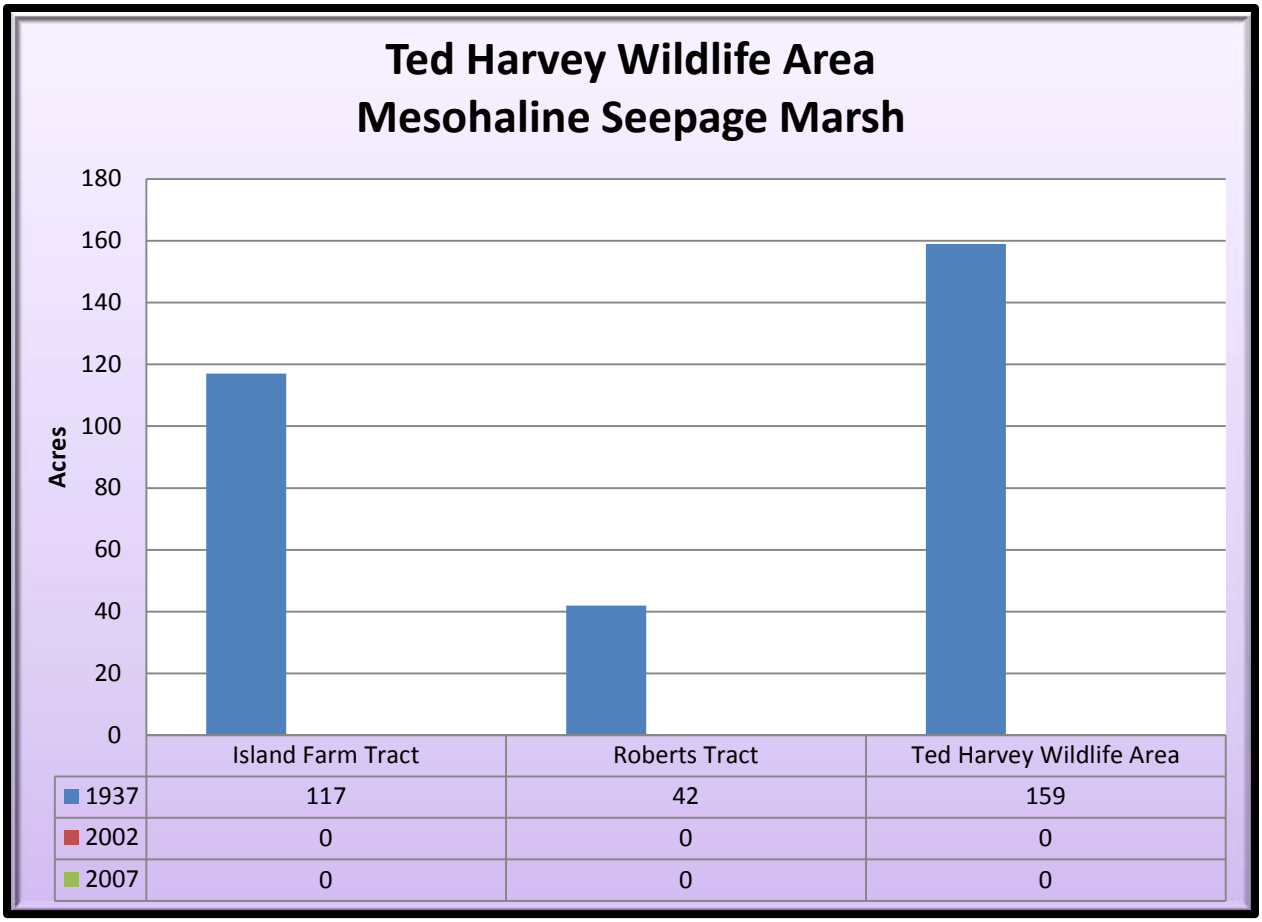


Figure 5.19. Mesohaline Seepage Marsh at Ted Harvey Wildlife Area (1937, 2002, and 2007)

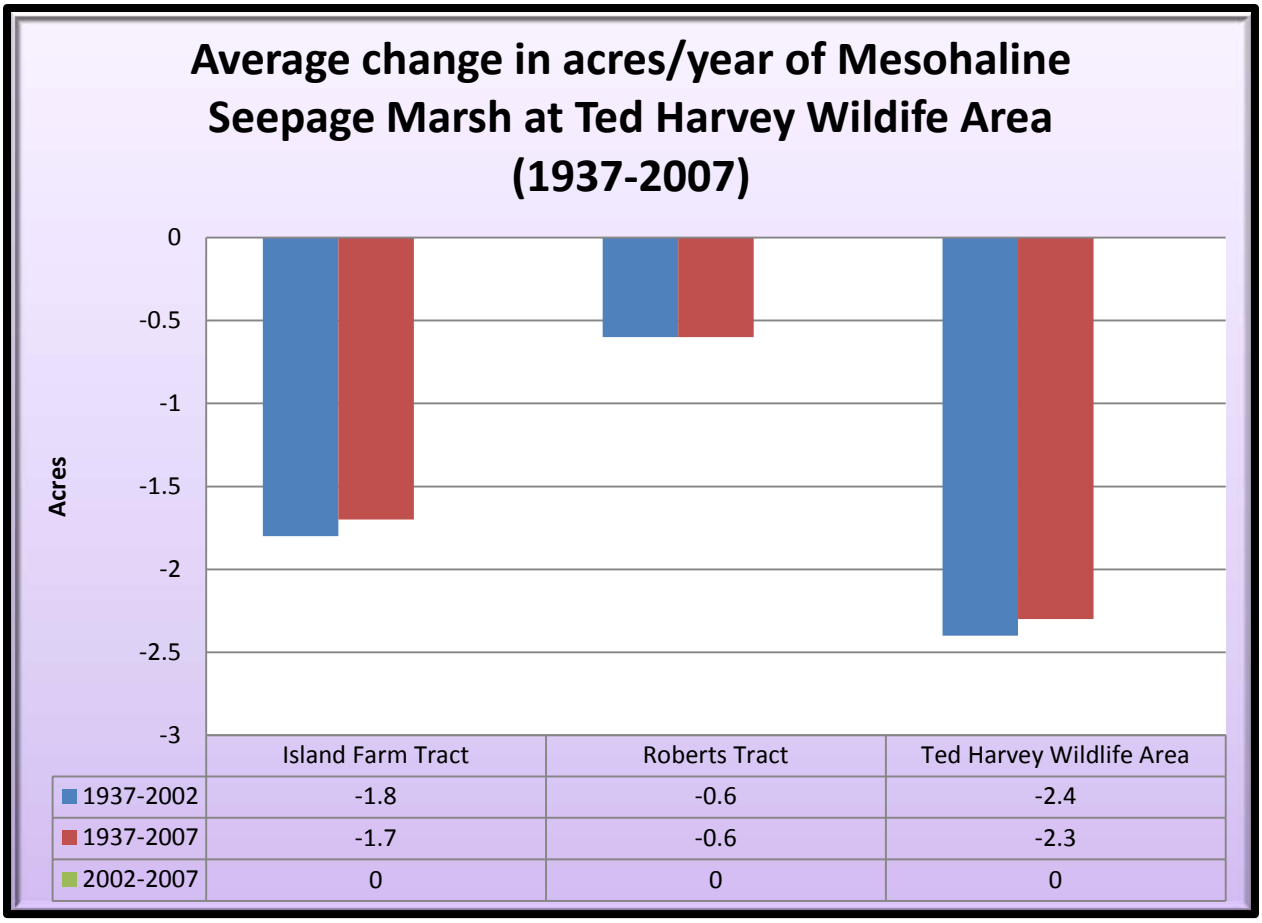


Figure 5.20. Average change in acres/year of Mesohaline Seepage Marsh at Ted Harvey Wildlife Area (1937-2007)

Natural Capital (Table 5.38)

Even though Eastern Reed Marsh is dominated by a non-native species it is still a wetland that provides nutrient cycling. As this community has spread it has gained in natural capital. In spite of this, it would be beneficial to be able to transfer the capital to a native community.

Table 5.38. Natural Capital of Mesohaline Seepage Marsh	
Year	**Natural Capital (in 2012 dollars)**
1937	$997,137/year
2002	$0/year (not present)
2007	$0/year (not present)

Mid to Late Successional Loblolly Pine-Sweetgum Forest **[0 acres (Figure 5.21, Tables 5.39-5.40)]**
GNA SNA

DEWAP: Coastal Plain Upland Forests
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

This successional forested community was present in the wildlife area in 1937, but has since matured into a Red Maple-Sweetgum Swamp. Loblolly pine (*Pinus taeda*) general dominates the canopy and is joined by red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), white oak (*Quercus alba*), and southern red oak (*Quercus falcata*). Understory associates include smaller members of the canopy plus flowering dogwood (*Cornus florida*), wild black cherry (*Prunus serotina*), and blackgum (*Nyssa sylvatica*). Common shrubs and vines include highbush blueberry (*Vaccinium corymbosum*), sweet pepperbush (*Clethra alnifolia*), common greenbrier (*Smilax rotundifolia*), and white-leaf greenbrier (*Smilax glauca*). The herbaceous layer, generally sparse due to the acidity of the needles, can include spotted wintergreen (*Chimaphila maculata*) and fireweed (*Erechtites hieracifolia*).

Analysis of Condition at Ted Harvey Wildlife Area

This community is historical in the wildlife area and has succeeded into Chesapeake Bay Non-riverine Wet Hardwood Forest (2 acres) and Successional Tuliptree Forest (1 acre). Another acre has become Eastern Reed Marsh (Table 5.39).

Table 5.39. What was once Mid to Late Successional Loblolly Pine-Sweetgum Forest in 1937 has become X or remained in 2007

X	**Acreage**
Chesapeake Bay Non-riverine Wet Hardwood Forest	2 acres
Successional Tuliptree Forest	1 acre
Eastern Reed Marsh	1 acre

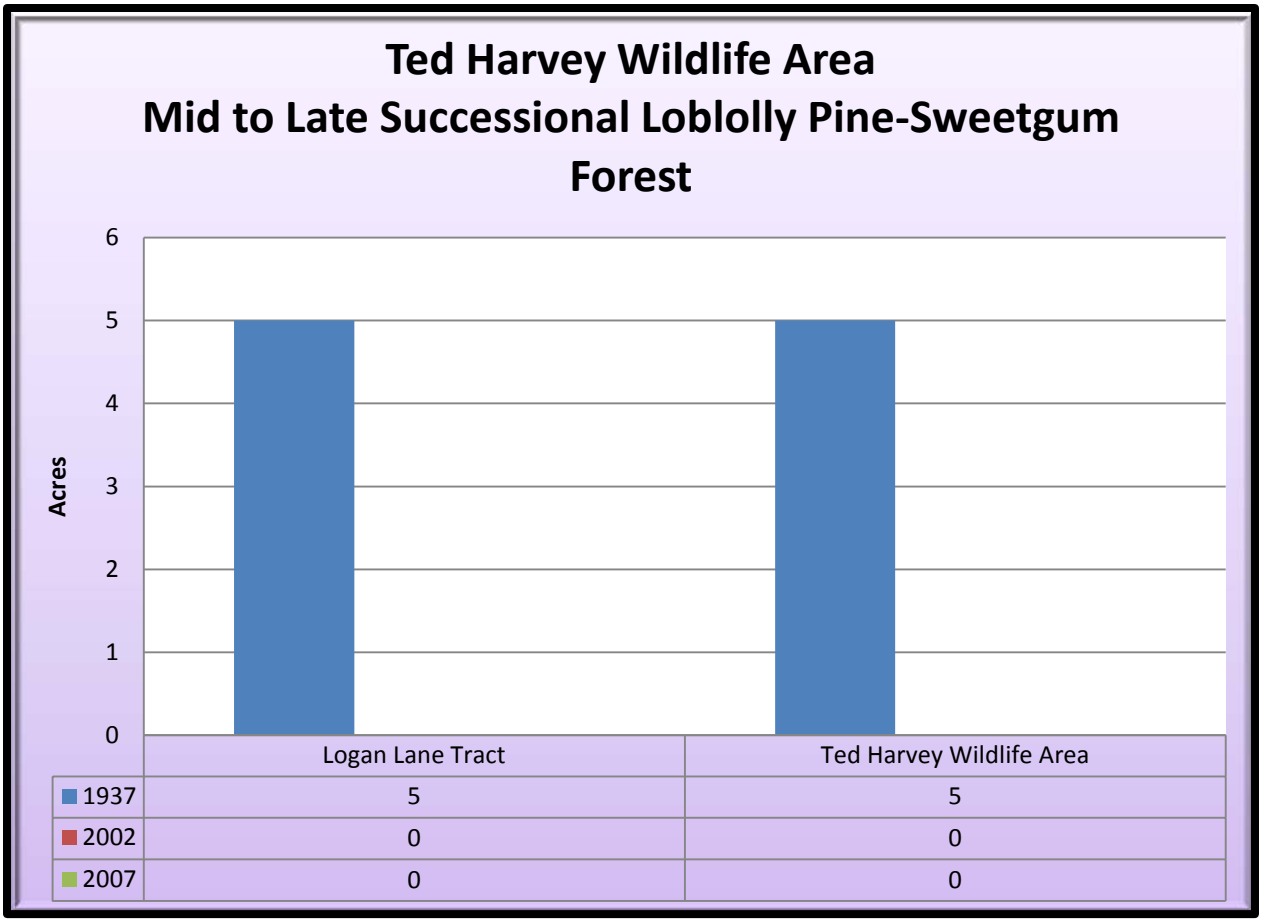


Figure 5.21. Mid to Late Successional Loblolly Pine-Sweetgum Forest at Ted Harvey Wildlife Area (1937, 2002, and 2007)

Natural Capital (Table 5.40)

Even though Eastern Reed Marsh is dominated by a non-native species it is still a wetland that provides nutrient cycling. As this community has spread it has gained in natural capital. In spite of this, it would be beneficial to be able to transfer the capital to a native community.

Table 5.40. Natural Capital of Mid to Late Successional Loblolly Pine-Sweetgum Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$946/year
2002	$0/year (not present)
2007	$0/year (not present)

Mid-Atlantic Mesic Mixed Hardwood Forest **[2 acres (Figure 5.22, Tables 5.41-5.43)] G5 S5**

DEWAP: Coastal Plain Upland Forests
NHC: Northern Atlantic Coastal Plain Hardwood Forest

Description

This mature forested community, found only on the Buckaloo Tract in the wildlife area, is composed of red maple (*Acer rubrum*), white oak (*Quercus alba*), tuliptree (*Liriodendron tulipifera*), sweetgum (*Liquidambar styraciflua*), and willow oak (*Quercus phellos*) in the canopy. Understory associates include smaller members of the canopy plus blackgum (*Nyssa sylvatica*), American holly (*Ilex opaca*), and sweetbay (*Magnolia virginiana*). The shrub and vine layer is composed of common greenbrier (*Smilax rotundifolia*), highbush blueberry (*Vaccinium corymbosum*), Japanese honeysuckle (*Lonicera japonica*), arrowwood (*Viburnum dentatum*), sweet pepperbush (*Clethra alnifolia*), and winterberry (*Ilex verticillata*). The herbaceous layer in the occurrence was dominated by mayapple (*Podophyllum peltatum*), and associated by Virginia creeper (*Parthenocissus quinquefolia*), false solomon's seal (*Maianthemum racemosum*), New York fern (*Thelypteris novaboracensis*), cinnamon fern (*Osmunda cinnamomea*), and weak stellate sedge (*Carex seorsa*).

Analysis of Condition at Ted Harvey Wildlife Area

This mature forest community has one small occurrence on the Buckaloo Tract and has arisen from a Chesapeake Bay Non-riverine Wet Hardwood Forest (1 acre) and agricultural field (1 acre) (Table 5.41). It is located away from any water or marshland and appears to be stable in amount. Japanese honeysuckle that is present in the understory could become a problem at some point in the future.

Table 5.41. Mid-Atlantic Mesic Mixed Hardwood Forest has migrated into X or remained since 1937

X	**Acreage**
Chesapeake Bay Non-riverine Wet Hardwood Forest	1 acre
Agricultural Field	1 acre

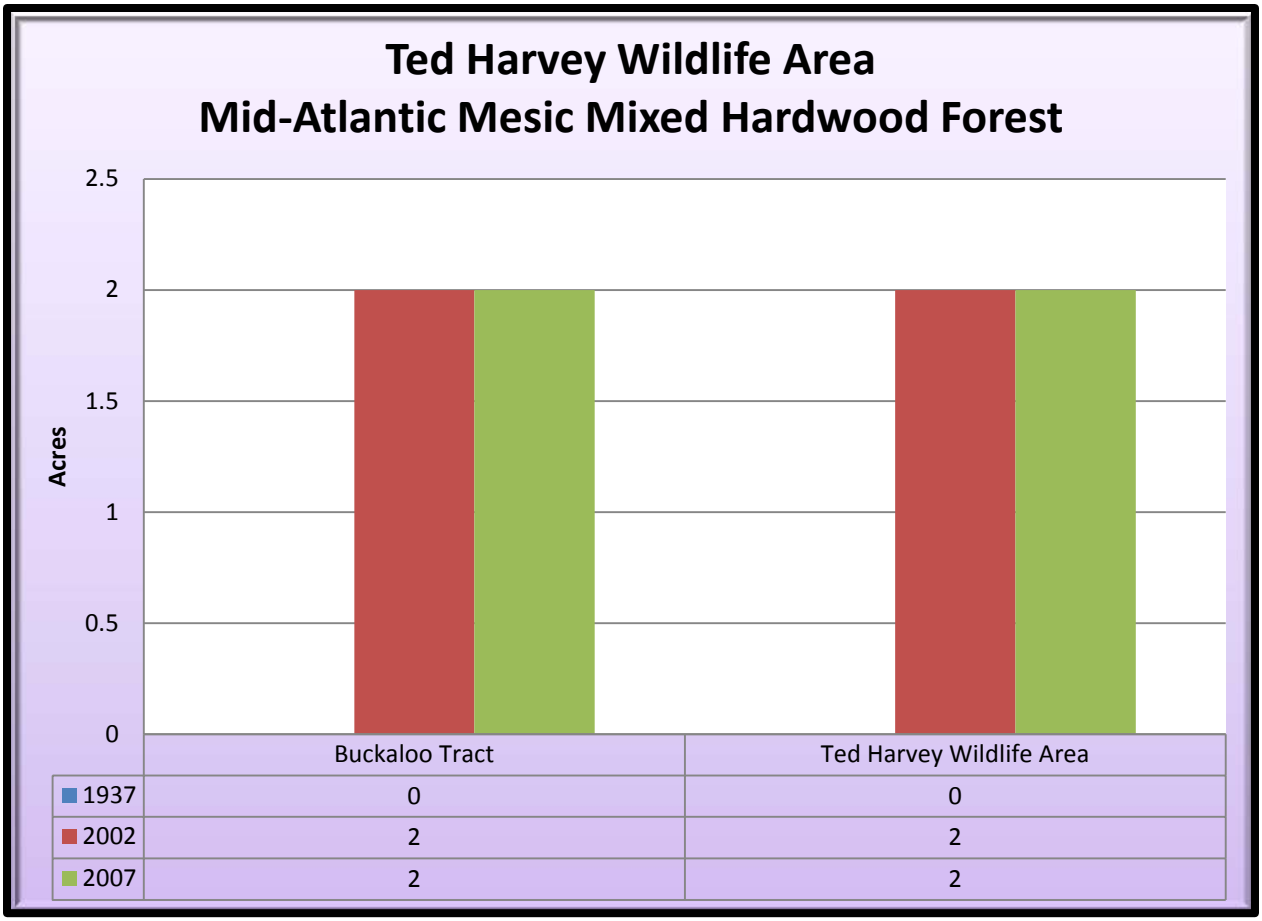


Figure 5.22. Mid-Atlantic Mesic Mixed Hardwood Forest at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Analysis (Table 5.42)

Most of the small amount of Mid-Atlantic Mesic Mixed Hardwood Forest is located in an area of high elevation. Only about half of the acreage will be affected with 1.5 m of sea level rise.

Table 5.42. Projected acres of Mid-Atlantic Mesic Mixed Hardwood Forest Impacted by Sea Level Rise

Rise	Acres
0.5 m	0 acres
1 m	0.01 acres
1.5 m	1 acre

Natural Capital (Table 5.43)

Even though Eastern Reed Marsh is dominated by a non-native species it is still a wetland that provides nutrient cycling. As this community has spread it has gained in natural capital. In spite of this, it would be beneficial to be able to transfer the capital to a native community.

Table 5.43. Natural Capital of Mid-Atlantic Mesic Mixed Hardwood Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year
2002	$378/year
2007	$378/year

North Atlantic High Salt Marsh **[129 acres (Figures 5.23-5.24, Tables 5.44-5.47)] G5 S4**

DEWAP: Tidal High Marshes
NHC: Northern Atlantic Coastal Plain Tidal Salt Marsh

Description

This marsh community occurs at a slightly higher elevation than the North Atlantic Low Salt Marsh and is dominated by salt meadow cordgrass (*Spartina patens*). Other associates include salt grass (*Distichlis spicata*), sea lavender (*Limonium carolinianum*), and salt marsh fleabane (*Pluchea odorata*).

Analysis of Condition at Ted Harvey Wildlife Area

This marsh community is located throughout the wildlife area and has been in decline as sea level rises. North Atlantic High Salt Marsh is one of the most imperiled communities in the wildlife area and perhaps in Delaware due to sea level rise. The table below shows that most of this community has converted to North Atlantic Low Salt Marsh. Development of the impoundments took an additional 15 acres and 9 acres each has converted to Irregularly Flooded Eastern Tidal Salt Shrub and Reed Tidal Marsh (Table 5.44).

Since 1937, North Atlantic High Salt Marsh has managed to migrate into 66 acres of North Atlantic Low Salt Marsh, 7 acres of Northeastern Old Field, 5 acres of Cattail Brackish Tidal Marsh, and 4 acres of Mesohaline Seepage Marsh (Table 5.45).

Table 5.44. What was once North Atlantic High Salt Marsh in 1937 has become X or remained in 2007

X	**Acreage**
North Atlantic Low Salt Marsh	127 acres
North Atlantic High Salt Marsh	41 acres
Impoundment	15 acres
Irregularly Flooded Eastern Tidal Salt Shrub	9 acres
Reed Tidal Marsh	9 acres
Other communities/land covers	6 acres

Table 5.45. North Atlantic High Salt Marsh has migrated into X or remained since 1937	
X	**Acreage**
North Atlantic Low Salt Marsh	66 acres
North Atlantic High Salt Marsh	41 acres
Northeastern Old Field	7 acres
Cattail Brackish Tidal Marsh	5 acres
Mesohaline Seepage Marsh	4 acres
Other communities/land covers	6 acres

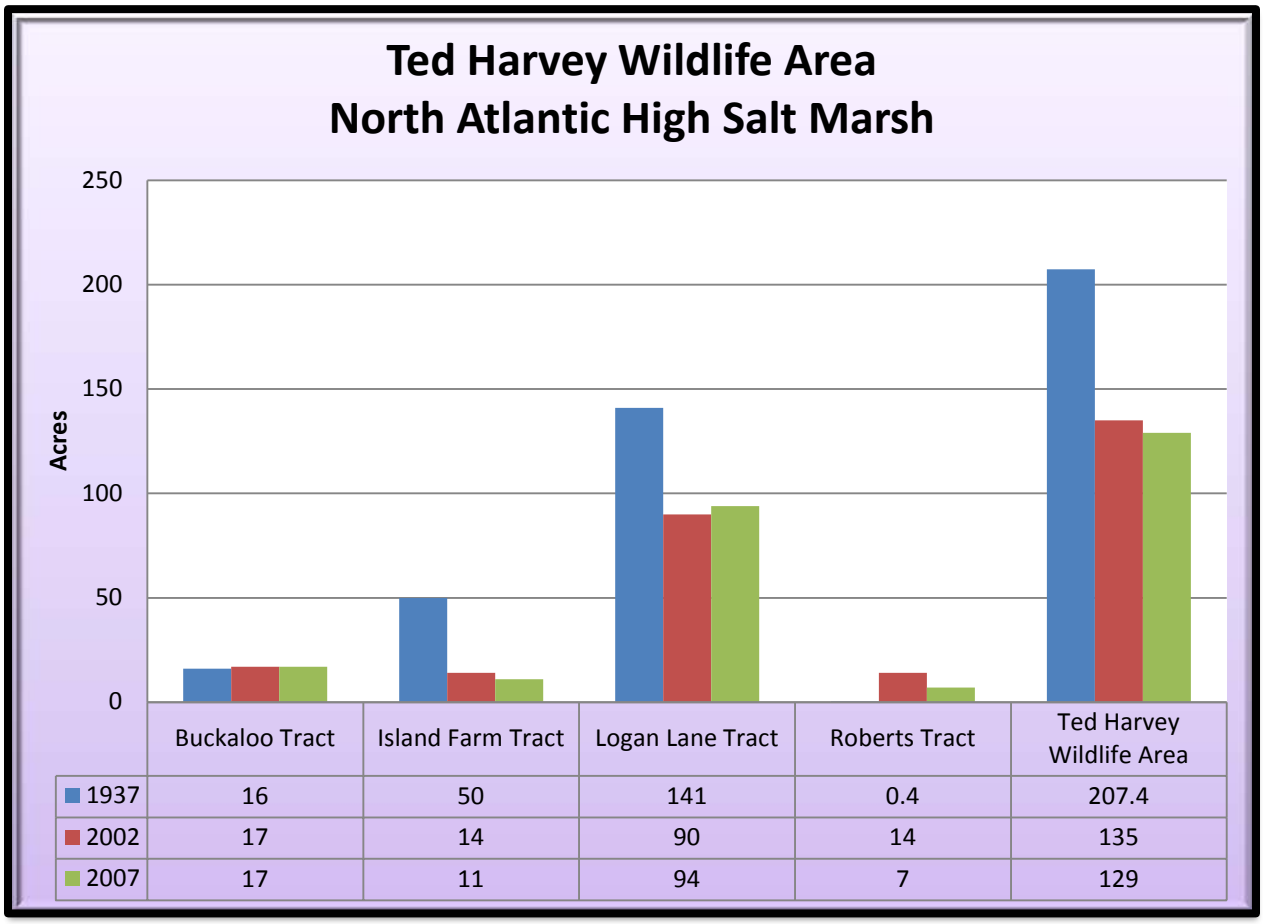


Figure 5.23. North Atlantic High Salt Marsh at Ted Harvey Wildlife Area (1937, 2002, and 2007)

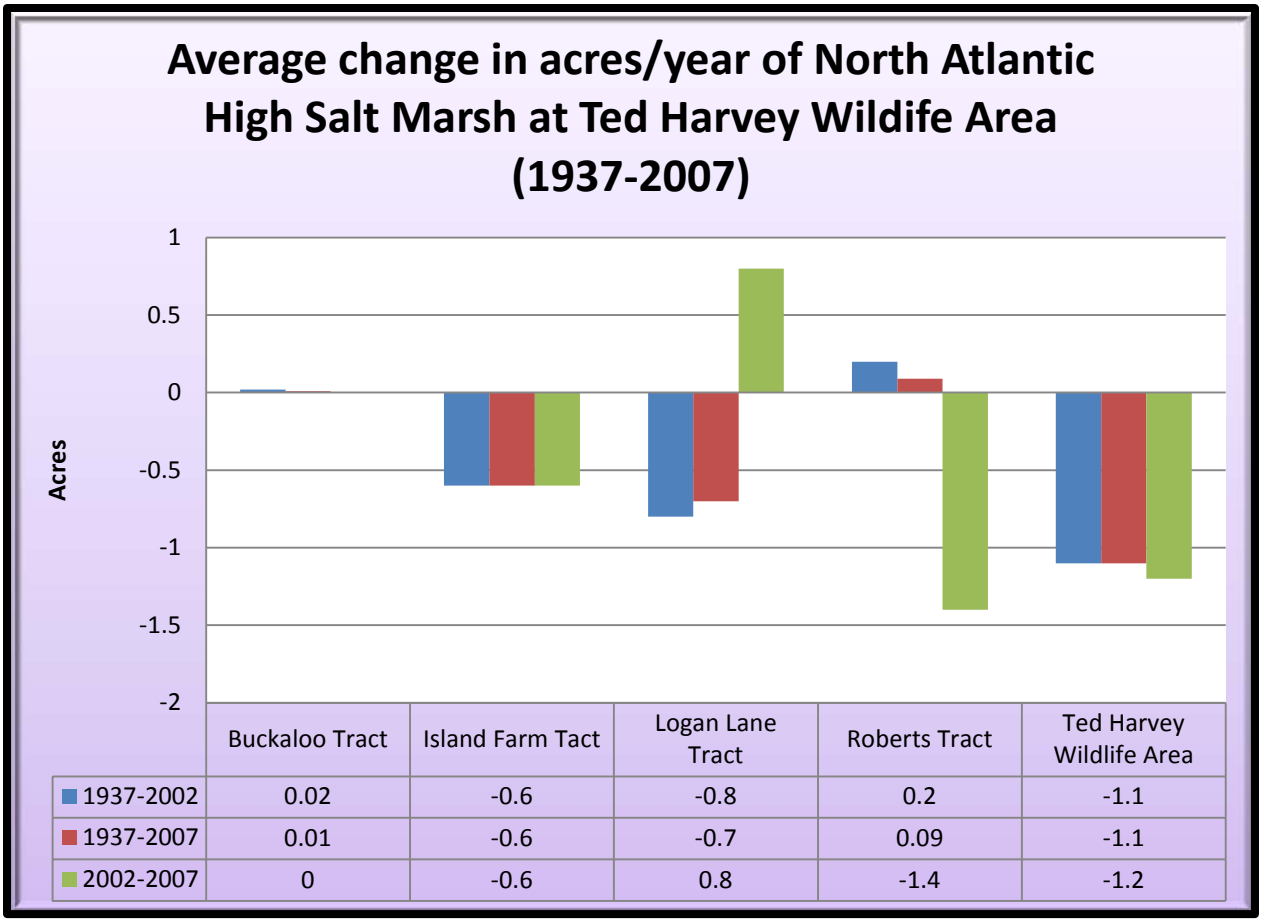


Figure 5.24. Average change in acres/year of North Atlantic High Salt Marsh at Ted Harvey Wildlife Area (1937-2007)

DNREC Sea Level Rise Analysis (Table 5.46)

Most of the North Atlantic High Salt Marsh present in the wildlife area will be inundated with 0.5 m of sea level rise or it may be sooner before the water as the above shows. The rest will succumb with 1 m of rise or greater.

Table 5.46. Projected acres of North Atlantic High Salt Marsh Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	118 acres
1 m	128 acres
1.5 m	128 acres

Natural Capital (Table 5.47)

The natural capital of North Atlantic High Salt Marsh has been declining and is mostly being transferred to North Atlantic Low Salt Marsh and then on to water.

Table 5.47. Natural Capital of North Atlantic High Salt Marsh	
Year	**Natural Capital (in 2012 dollars)**
1937	$1,300,668/year
2002	$846,626/year
2007	$808,998/year

North Atlantic Low Salt Marsh **[1,073 acres (Figures 5.25-5.27, Tables 5.48-5.51)] G5 S5**

DEWAP: Tidal Low Marshes
NHC: Northern Atlantic Coastal Plain Tidal Salt Marsh

Description

Figure 5.25. North Atlantic Low Salt Marsh (Logan Lane Tract)

North Atlantic Low Salt Marsh is the most common marsh community in the wildlife area. It receives diurnal tides and is dominated nearly entirely by salt marsh cordgrass (*Spartina alterniflora*).

Analysis of Condition at Ted Harvey Wildlife Area

With one exception in the Buckaloo Tract, this community has been declining in Ted Harvey Wildlife Area. It may in time "eat" the high marsh present and then start to decline even faster at the current rates of water inundation.

A little more than half of this community from 1937 still existed in 2007. The rest was changed in development of impoundments (232 acres), North Atlantic High Salt Marsh (65 acres), Eastern Reed Marsh (54 acres), which is impoundment related, and water (12 acres) (Table 5.48).

Since 1937 this community has converted the last of the middle haline marsh, Cattail Brackish Tidal Marsh (153 acres) and Mesohaline Seepage Marsh (142 acres), and Freshwater Marsh, Freshwater Tidal Mixed High Marsh (42 acres), in the wildlife area (Table 5.49). It has also consumed 127 acres of North Atlantic High Salt Marsh.

Table 5.48. What was once North Atlantic Low Salt Marsh in 1937 has become X or remained in 2007	
X	**Acreage**
North Atlantic Low Salt Marsh	486 acres
Impoundment	232 acres
North Atlantic High Salt Marsh	65 acres
Eastern Reed Marsh	54 acres
Water	12 acres
Other communities/land covers	43 acres

Table 5.49. North Atlantic Low Salt Marsh has migrated into X or remained since 1937	
X	**Acreage**
North Atlantic Low Salt Marsh	486 acres
Cattail Brackish Tidal Marsh	153 acres
Mesohaline Seepage Marsh	142 acres
North Atlantic High Salt Marsh	127 acres
Freshwater Tidal Mixed High Marsh	49 acres
Other communities/land covers	114 acres

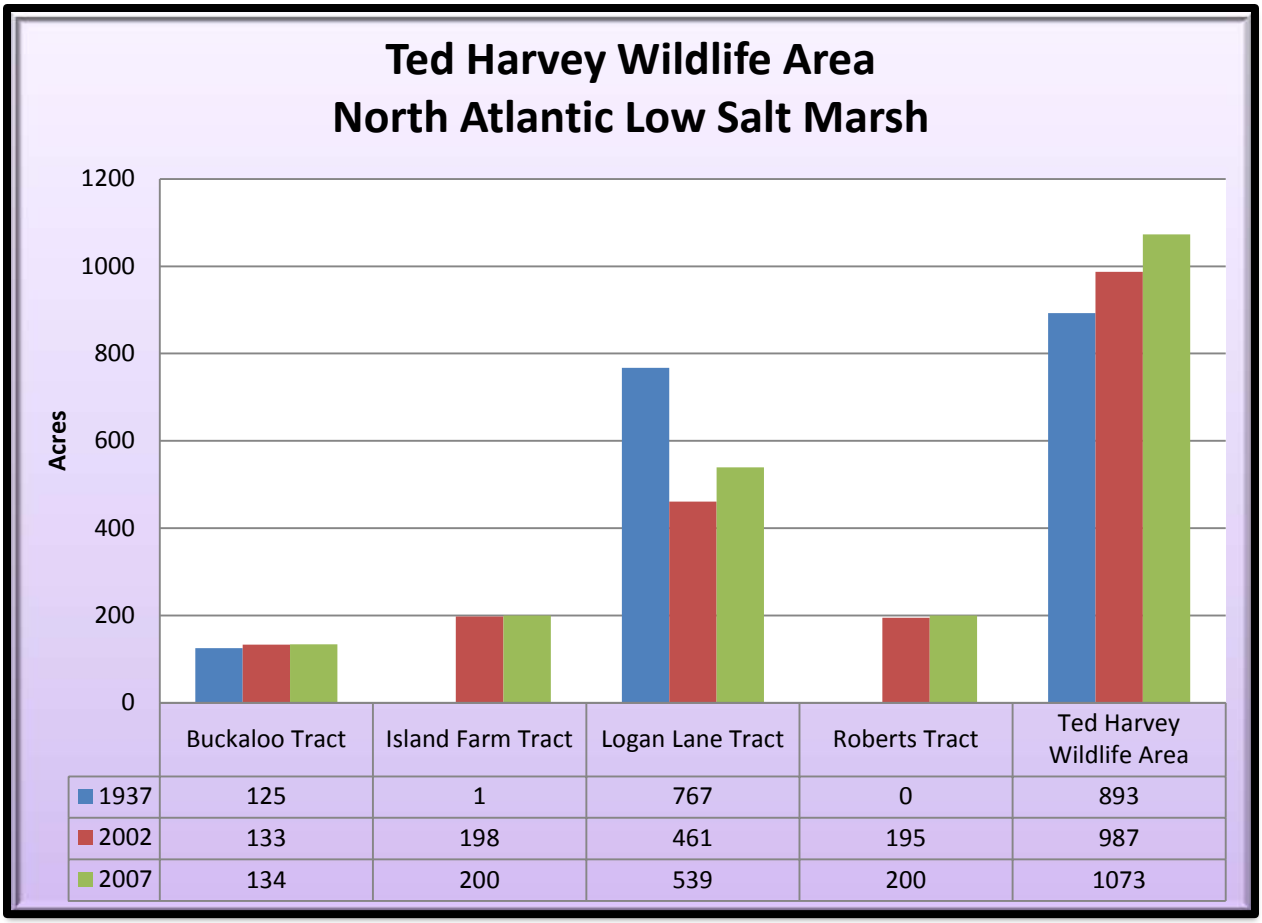


Figure 5.26. North Atlantic Low Salt Marsh at Ted Harvey Wildlife Area (1937, 2002, and 2007)

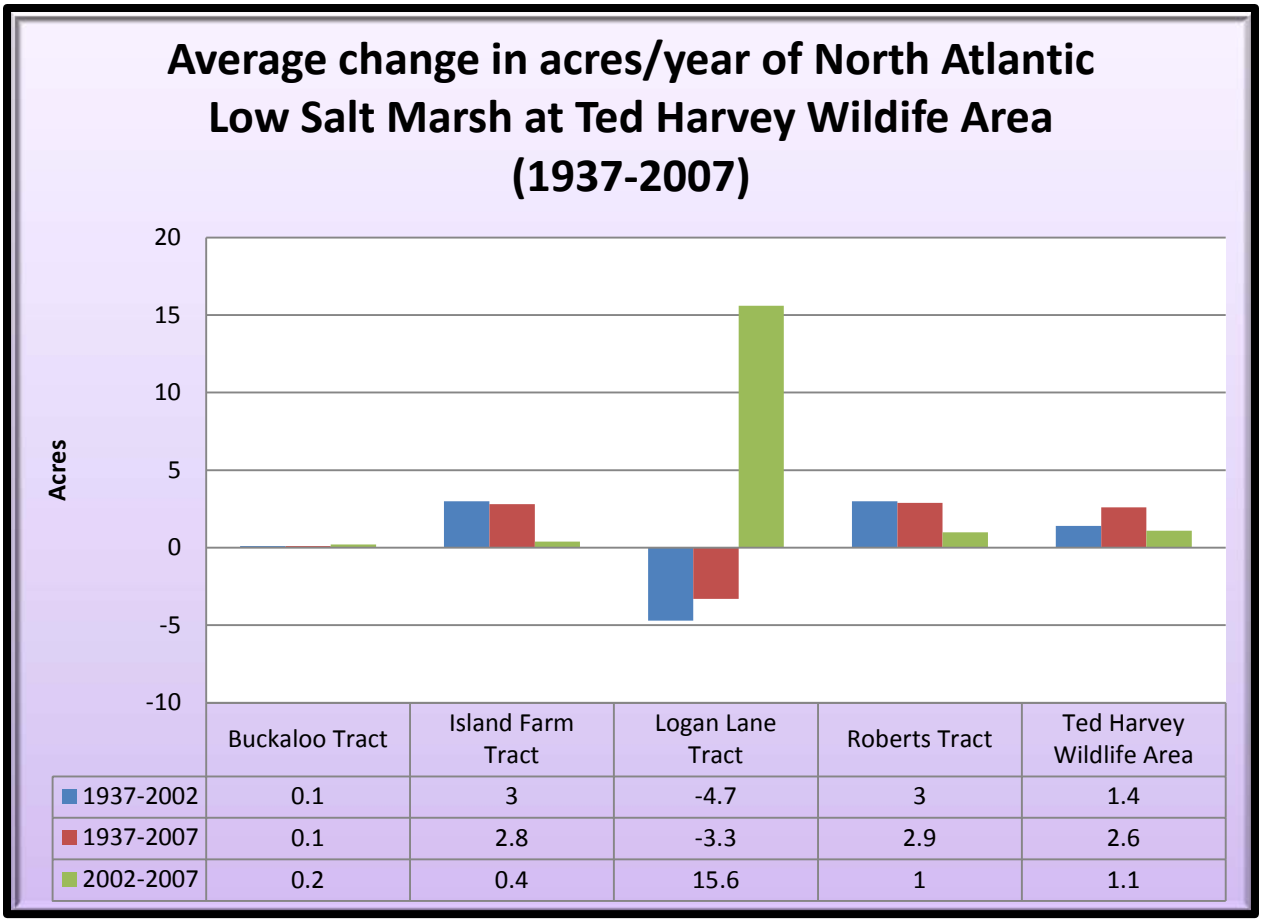


Figure 5.27. Average change in acres/year of North Atlantic High Salt Marsh at Ted Harvey Wildlife Area (1937-2007)

DNREC Sea Level Rise Analysis (Table 5.50)

Most of the North Atlantic Low Salt Marsh in the wildlife area will be flooded with 0.5 m of sea level rise. Some of the marsh that is in the impoundment will survive to 1 m and 1.5 m of rise at which point the community will eliminated in its current extent.

Table 5.50. Projected acres of North Atlantic Low Salt Marsh Impacted by Sea Level Rise

Rise	Acres
0.5 m	995 acres
1 m	1,066 acres
1.5 m	1,069 acres

Natural Capital (Table 5.51)

The natural capital of North Atlantic Low Salt Marsh has been increasing mostly from transfers of other marsh types.

Table 5.51. Natural Capital of North Atlantic Low Salt Marsh	
Year	**Natural Capital (in 2012 dollars)**
1937	$5,600,271/year
2002	$6,189,773/year
2007	$6,729,105/year

Northeastern Modified Successional Forest **[46 acres (Figure 5.28-5.29, Tables 5.52-5.55)]** **GNA SNA**

DEWAP: Coastal Plain Upland Forest
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

This successional forest community, more successional due to exotics, is composed of tuliptree (*Liriodendron tulipifera*), silver maple (*Acer saccharinum*), red maple (*Acer rubrum*), osage-orange (*Maclura pomifera*), and wild black cherry (*Prunus serotina*) in the canopy. The understory composed of smaller members of the canopy overtops a dense shrub and vine layer of multiflora rose (*Rosa multiflora*), autumn olive (*Elaeagnus umbellata*), Japanese honeysuckle (*Lonicera japonica*), poison ivy (*Toxicodendron radicans*), summer grape (*Vitis aestivalis*), common greenbrier (*Smilax rotundifolia*), and blackberry (*Rubus* sp.). Virginia creeper (*Parthenocissus quinquefolia*) was the only herb observed.

Figure 5.28. Northeastern Modified Successional Forest (Logan Lane Tract)

Analysis of Condition at Ted Harvey Wildlife Area

This community has steadily increased over time in the Logan Lane Tract as more disturbance and exotic invasive plant species enter the wildlife area and those that are present become more common. It was not present in the Buckaloo Tract in 1937 but was present in 2002 and remains at the same amount in 2007. It has greatly expanded in the Logan Lane Tract.

Once established, this forest community tends to remain unless removed by some artificial means and the occurrences at Ted Harvey Wildlife area no exception. Five acres of the original 1937 acreage remained in 2007. The rest has become 2 acres of Northeastern Old Field, and one each of agricultural field, Semi-impervious surface, and Cultivated Lawn (Table 5.52). All of these communities and land cover types are artificial in nature or are man induced.

Since 1937, this community has expanded to cover about 4.5 times the acreage it covered historically. Communities it has converted or matured into include agricultural field (26 acres), Chesapeake Bay Non-riverine Wet Hardwood Forest (8 acres), Northeastern Old Field (5 acres), and Semi-impervious surface (1 acre) (Table 5.53). Most of the communities it has come into are disturbance communities or land covers which it thrives on.

Table 5.52. What was once Northeastern Modified Successional Forest in 1937 has become X or remained in 2007	
X	**Acreage**
Northeastern Modified Successional Forest	5 acres
Northeastern Old Field	2 acres
Agricultural Field	1 acre
Semi-impervious Surface	1 acre
Cultivated Lawn	1 acre
Other communities/land covers	0.1 acres

Table 5.53. Northeastern Modified Successional Forest has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	26 acres
Chesapeake Bay Non-riverine Wet Hardwood Forest	8 acres
Northeastern Modified Successional Forest	5 acres
Northeastern Old Field	5 acres
Semi-impervious Surface	1 acre
Other communities/land covers	1 acre

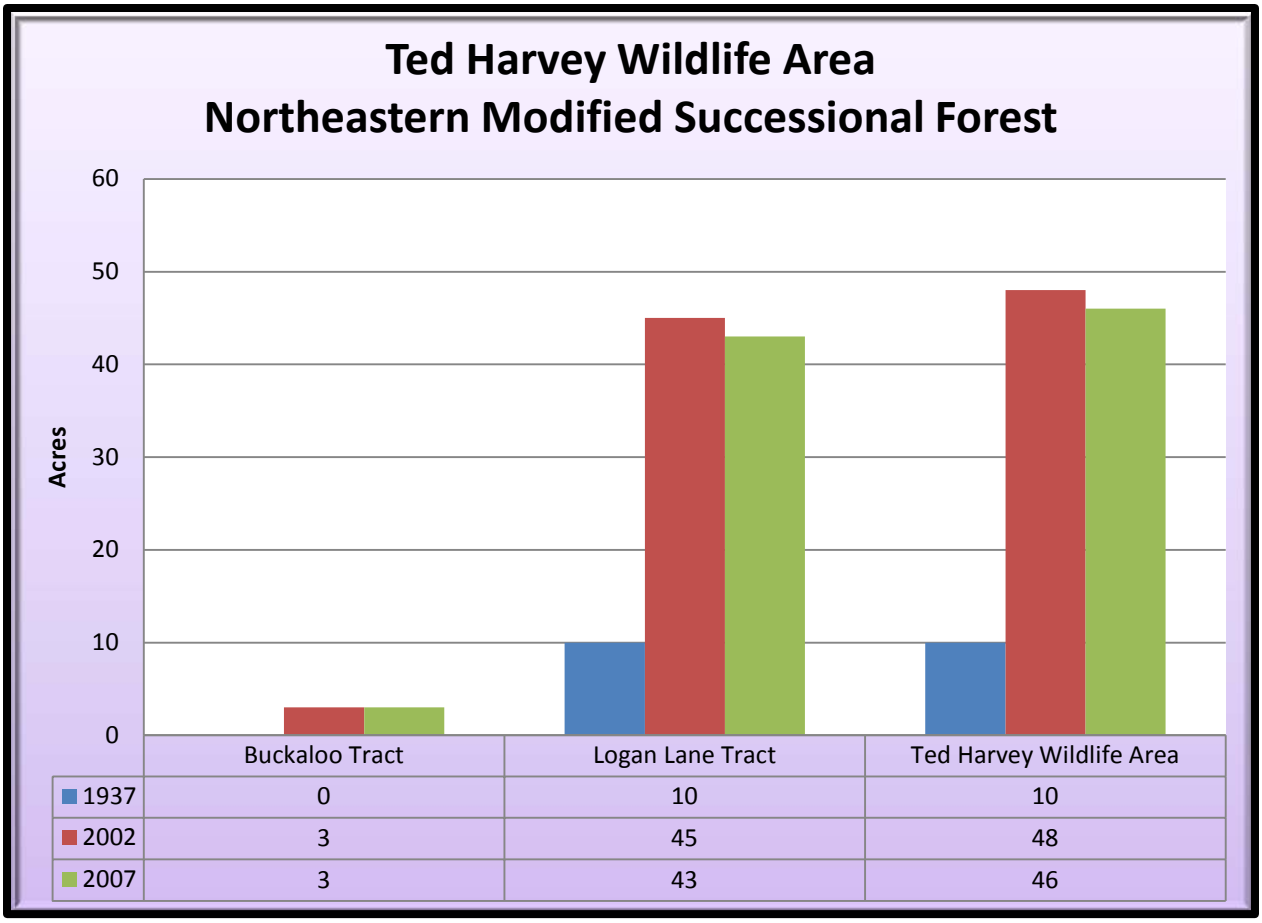


Figure 5.29. Northeastern Modified Successional Forest at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Analysis (Table 5.54)

Most of the occurrences of Northeastern Modified Successional Forest are located in places of higher elevation near anthropogenic communities or land covers and hence it is not as affected by sea level rise. A rise of 0.5 m will inundate 5 acres and a rise of 1 m will inundate an additional 4 acres for a 9 acre total. At 1.5 m of rise, 15 acres will be inundated or about a third of the current acreage.

Table 5.54. Projected acres of Northeastern Modified Successional Forest Impacted by Sea Level Rise

Rise	Acres
0.5 m	5 acres
1 m	9 acres
1.5 m	15 acres

Natural Capital (Table 5.55)

This community reached its highest capitalization in 2002 and declined somewhat between 2002 and 2007. Because of the aggressive characteristics of the species in this community and the elevation, this community will likely keep most of its capital and may increase some.

Table 5.55. Natural Capital of Northeastern Modified Successional Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$1,891/year
2002	$9,077/year
2007	$8,699/year

Northeastern Old Field **[133 acres (Figures 5.30-5.31, Tables 5.56-5.58)]GNR S5**

DEWAP: Early Successional Upland Habitats
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

Figure 5.30. Northeastern Old Field (Logan Lane Tract)

This herbaceous community is composed of tall fescue (*Festuca rubra*), orchard grass (*Dactylis glomerata*), white clover (*Trifolium arvense*), red clover (*Trifolium pratense*), blackberry (*Rubus* sp.), salt shrub (*Baccharis halimifolia*), and milkweed (*Asclepias* sp.).

Analysis of Condition at Ted Harvey Wildlife Area

This community often arises from agricultural fields that have gone fallow or other lands that are in the process of successional from clearing. It is often changeable as it matures quickly to shrubland or forest and reappears with the abandonment of agriculture as shown that only 19 acres of the original 1937 acreage 233 acres still remained in 2007. The rest of the acreage became agricultural field (34 acres), Chesapeake Bay Non-riverine Wet Hardwood Forest (32 acres), Eastern Reed Marsh (32 acres), Successional Sweetgum Forest (31 acres), and North Atlantic Low Salt Marsh (29 acres) (Table 5.55). Some of the agricultural field may have been fallow fields in 1937, as it is hard to tell the difference in the 1937 aerial imagery.

Since 1937, this community has developed in 108 acres of agricultural field (likely abandoned), 2 acres of North Atlantic Low Salt Marsh, 2 acres of Northeastern Modified Successional Forest, and 1 acre of Chesapeake Bay Non-riverine Wet Hardwood Forest (Table 5.56).

Table 5.55. What was once Northeastern Old Field in 1937 has become X or remained in 2007	
X	**Acreage**
Agricultural Field	34 acres
Chesapeake Bay Non-riverine Wet Hardwood Forest	32 acres
Eastern Reed Marsh	32 acres
Successional Sweetgum Forest	31 acres
North Atlantic Low Salt Marsh	29 acres
Other communities/land covers	74 acres

Table 5.56. Northeastern Old Field has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	108 acres
Northeastern Old Field	19 acres
North Atlantic Low Salt Marsh	2 acres
Northeastern Modified Successional Forest	2 acres
Chesapeake Bay Non-riverine Wet Hardwood Forest	1 acre
Other communities/land covers	2 acres

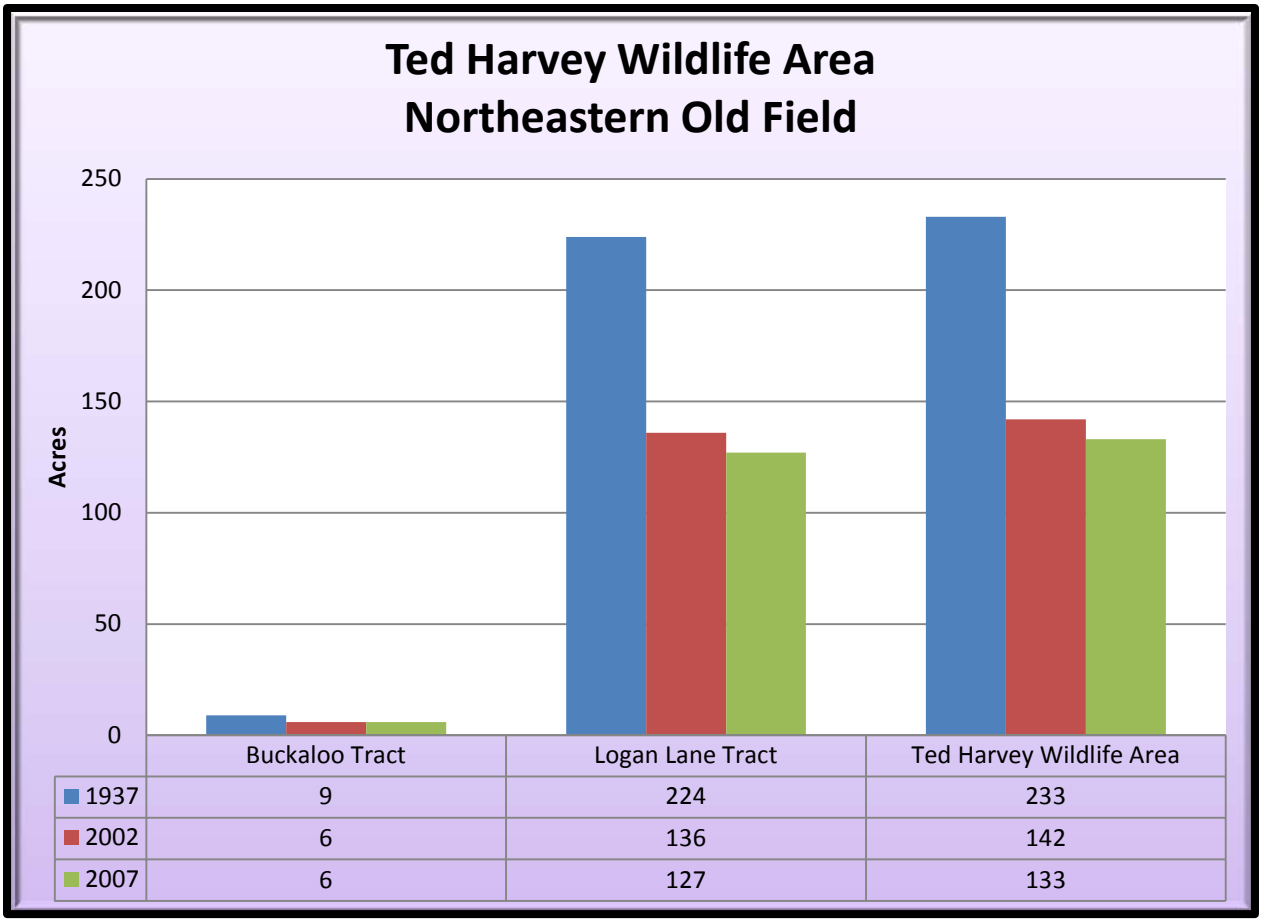


Figure 5.31. Northeastern Old Field at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Scenarios (Table 5.57)

Most of the occurrences of Northeastern Old Field are located in places of higher elevation in the wildlife area and this community will not be impacted as much as others. At 0.5 m of sea level rise, about 7 acres will be inundated. At 1 m of rise, 31 acres will be flooded and at 1.5 m, 54 acres will be inundated.

Table 5.57. Projected acres of Northeastern Old Field Impacted by Sea Level Rise

Rise	Acres
0.5 m	7 acres
1 m	31 acres
1.5 m	54 acres

Natural Capital (Table 5.58)

Northeastern Old Field was at its highest capitalization in 1937, when a lot of the wildlife area was open and agricultural area was dominant. Since this time the capitalization has fallen with the acreage and has been transferred the wooded area and marshland.

Table 5.58. Natural Capital of Northeastern Old Field

Year	Natural Capital (in 2012 dollars)
1937	$33,948/year
2002	$20,689/year
2007	$19,378/year

Northeastern Successional Shrubland **[12 acres (Figures 5.32-5.33, Tables 5.59-5.61)]**

DEWAP: Early Successional Upland Habitats
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

Figure 5.32. Northeastern Successional Shrubland (Logan Lane Tract)

This shrubland community is often located on the edges of roads and agricultural fields. Most expressions of it are composed of multiflora rose (*Rosa multiflora*), autumn olive (*Elaeagnus umbellata*), wild black cherry (*Prunus serotina*), Japanese honeysuckle (*Lonicera japonica*), tuliptree (*Liriodendron tulipifera*), timothy (*Phleum pratense*), and poison ivy (*Toxicodendron radicans*).

Analysis of Condition at Ted Harvey Wildlife Area

This shrubland community is intermediate between the Northeastern Old Field and a forested community. In some cases it can contain a lot of exotic plants species but with aggressive management it can be composed of native shrubs and progress to a more natural forested community such as Red Maple-Sweetgum Swamp or Mid-Atlantic Mesic Mixed Hardwood Forest. It has gained about 3 acres during the study period.

Showing the changeable nature of this community, none of the acreage from 1937 was still present in 2007. The former 1937 acreage has become 8 acres of Successional Sweetgum Forest, and one acre each of North Atlantic Low Salt Marsh and Chesapeake Bay Non-riverine Wet Hardwood Forest (Table 5.59). Since 1937 this community has migrated into 6 acres of agricultural field, 3 acres of North Atlantic Low Salt Marsh, 2 acres of Northeastern Old Field, 0.5 acres of Semi-impervious Surface, and 0.4 acres of Chesapeake Bay Non-riverine Wet Hardwood Forest (Table 5.60).

Table 5.59. What was once Northeastern Successional Shrubland in 1937 has become X or remained in 2007	
X	**Acreage**
Successional Sweetgum Forest	8 acres
North Atlantic Low Salt Marsh	1 acre
Chesapeake Bay Non-riverine Wet Hardwood Forest	1 acre

Table 5.60. Northeastern Successional Shrubland has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	6 acres
North Atlantic Low Salt Marsh	3 acres
Northeastern Old Field	2 acres
Semi-impervious Surface	0.5 acres
Chesapeake Bay Non-riverine Wet Hardwood Forest	0.4 acres
Other communities/land covers	0.1 acres

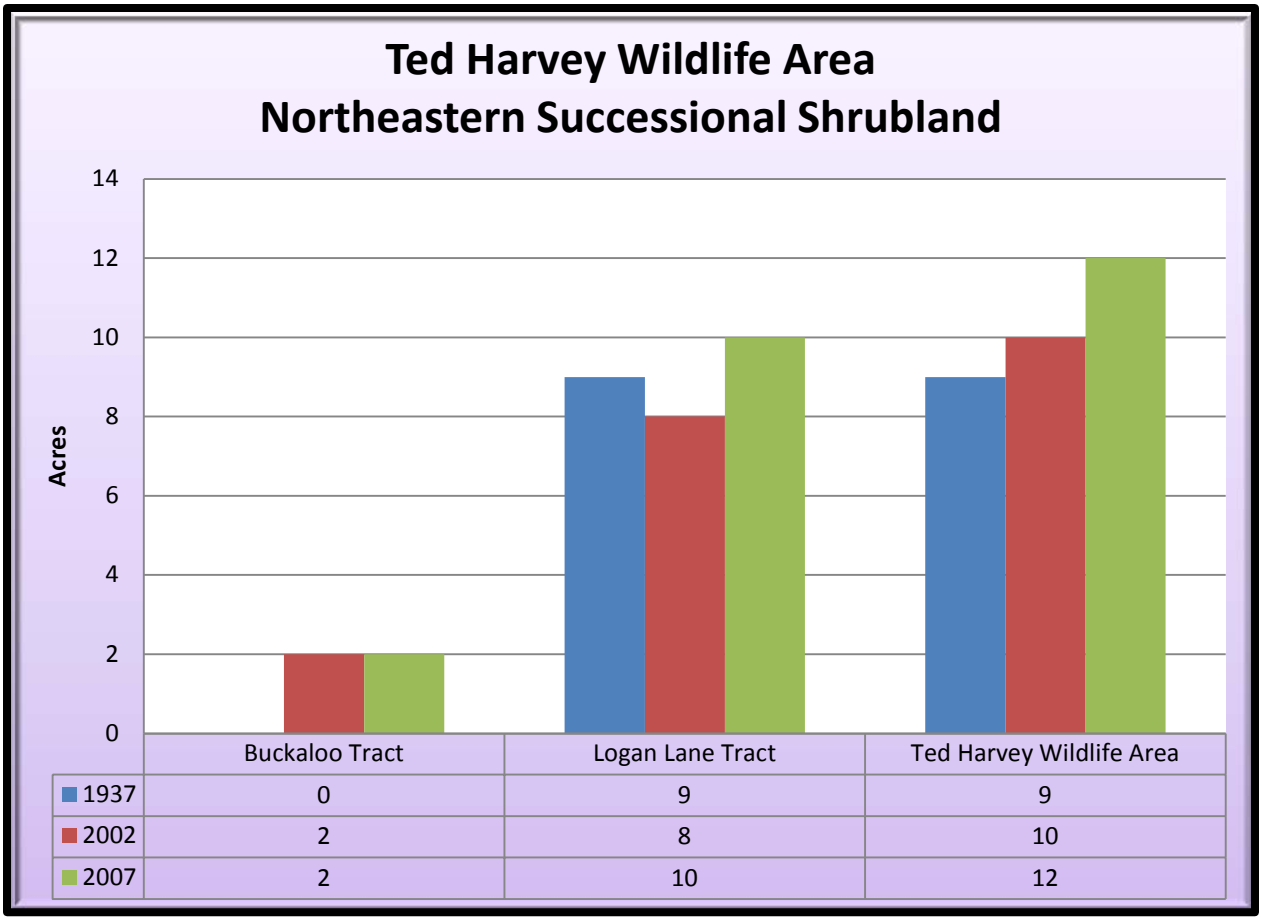


Figure 5.33. Northeastern Successional Shrubland at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Scenarios (Table 5.61)

This community was progressively inundated by water in the sea level rise scenarios. At the most it will be half inundated in its current acreage.

Table 5.61. Projected acres of Northeastern Successional Shrubland Impacted by Sea Level Rise

Rise	Acres
0.5 m	1 acre
1 m	4 acres
1.5 m	6 acres

Natural Capital (Table 5.62)

The acreage of this community has been gradually increasing leading to an increase in capital.

Table 5.62. Natural Capital of Northeastern Successional Shrubland	
Year	**Natural Capital (in 2012 dollars)**
1937	$1,311/year
2002	$1,457/year
2007	$1,748/year

Overwash Dune Grassland **[4 acres (Figure 5.34, Tables 5.63-5.65)] G2G3 S2S3?**

DEWAP: Beach and Dune Habitats
NHC: Northern Atlantic Coastal Plain Dune and Swale

Description

This grassland community is located just behind the beach and dune areas on the Delaware Bay at the eastern end of the Logan Lane Tract. It is formed when sand is pushed over the beach during storms forming a fan configuration behind the beach. Some of the newer overwashes are un-vegetated but others can contain salt meadow hay (*Spartina patens*), olney's three square bulrush (*Schoenoplectus pungens*), seaside goldenrod (*Solidago sempervirens*), dune sandbur (*Cenchrus tribuloides*), and seashore saltgrass (*Distichlis spicata*).

Analysis of Condition at Ted Harvey Wildlife Area

This is an ephemeral community at Ted Harvey Wildlife Area and comes and goes depending on storm activity. In recent times (2002-2007) Overwash Dune Grassland has declined to about three acres.

Since 1937 Overwash Dune Grassland has covered 3 acres of North Atlantic Low Salt Marsh, 1 acre of Reed Tidal Marsh, and 0.1 acres of water (Table 5.63).

Table 5.63. Overwash Dune Grassland has migrated into X or remained since 1937

X	**Acreage**
North Atlantic Low Salt Marsh	3 acres
Reed Tidal Marsh	1 acre
Water	0.1 acres

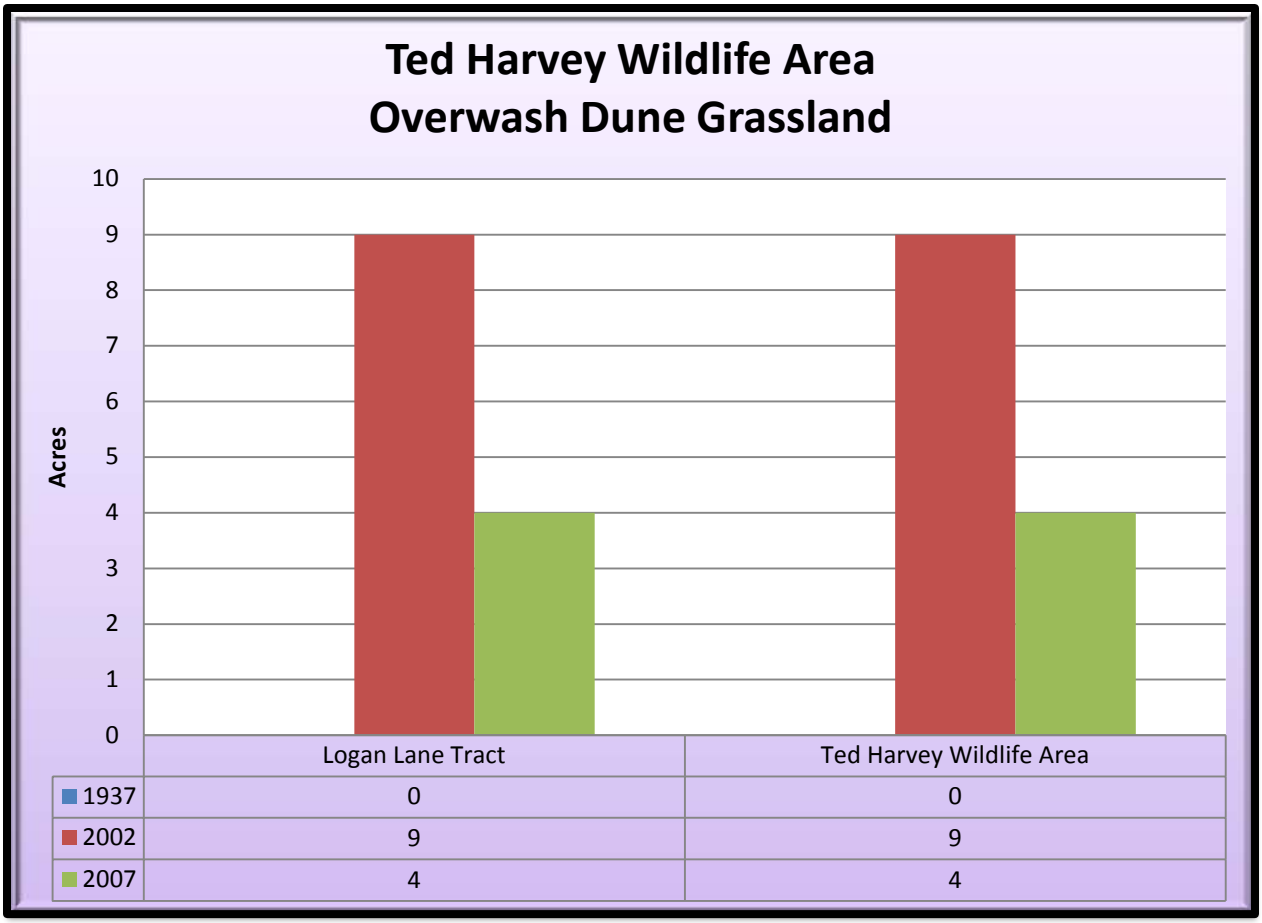


Figure 5.34. Overwash Dune Grassland at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Analysis (Table 5.64)

About ¼ of the current acreage of this community will be inundated with 0.5 m of sea level rise. An additional 0.5 m of rise will inundate 2 more acres and 1.5 m of rise will flood the entire community.

Table 5.64. Projected acres of Overwash Dune Grassland Impacted by Sea Level Rise

Rise	Acres
0.5 m	1 acre
1 m	3 acres
1.5 m	4 acres

Natural Capital (Table 5.65)

The capital of this community has decreased in the recent period (2002-2007) and was not present in 1937.

Table 5.65. Natural Capital of Overwash Dune Grassland	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$1,311/year
2007	$583/year

Reed Tidal Marsh **[40 acres (Figures 5.35-5.36, Tables 5.65-5.68)] GNA SNA**

DEWAP: Tidal High Marshes
NHC: Northern Atlantic Coastal Plain Tidal Salt Marsh

Description

Figure 5.35. Reed Tidal Marsh (Logan Lane Tract)

Reed Tidal Marsh is dominated completely by eastern reed grass (*Phragmites australis*) and is influenced by tide as compared to the Eastern Reed Marsh is which is not tidal.

Analysis of Condition at Ted Harvey Wildlife Area

This community has been stable to declining in the wildlife area. It is hoped that eradication efforts will continue to eliminate this community from the wildlife area.

Reed Tidal Marsh has changed in location quite a bit since 1937. Only 2 acres of the 1937 marsh was still present in 2007. The rest had become 41 acres of North Atlantic Low Salt Marsh, 4 acres of North Atlantic High Salt Marsh, 4 acres of water, and 3 acres each of Impoundment and Beach (Table 5.65). Since 1937, Reed Tidal Marsh has infested 11 acres of North Atlantic Low Salt Marsh, 9 acres of North Atlantic High Salt Marsh, 5 acres each of Cattail Brackish Tidal Marsh and Mesohaline Seepage Marsh, and 3 acres of Northeastern Old Field (Table 5.66).

Table 5.65. What was once Reed Tidal Marsh in 1937 has become X or remained in 2007	
X	**Acreage**
North Atlantic Low Salt Marsh	41 acres
North Atlantic High Salt Marsh	4 acres
Water	4 acres
Impoundment	3 acres
Beach	3 acres
Other vegetation communities/land covers	9 acres

Table 5.66. Reed Tidal Marsh has migrated into X or remained since 1937	
X	**Acreage**
North Atlantic Low Salt Marsh	11 acres
North Atlantic High Salt Marsh	9 acres
Mesohaline Seepage Marsh	5 acres
Cattail Brackish Tidal Marsh	5 acres
Northeastern Old Field	3 acres
Other communities/land covers	7 acres

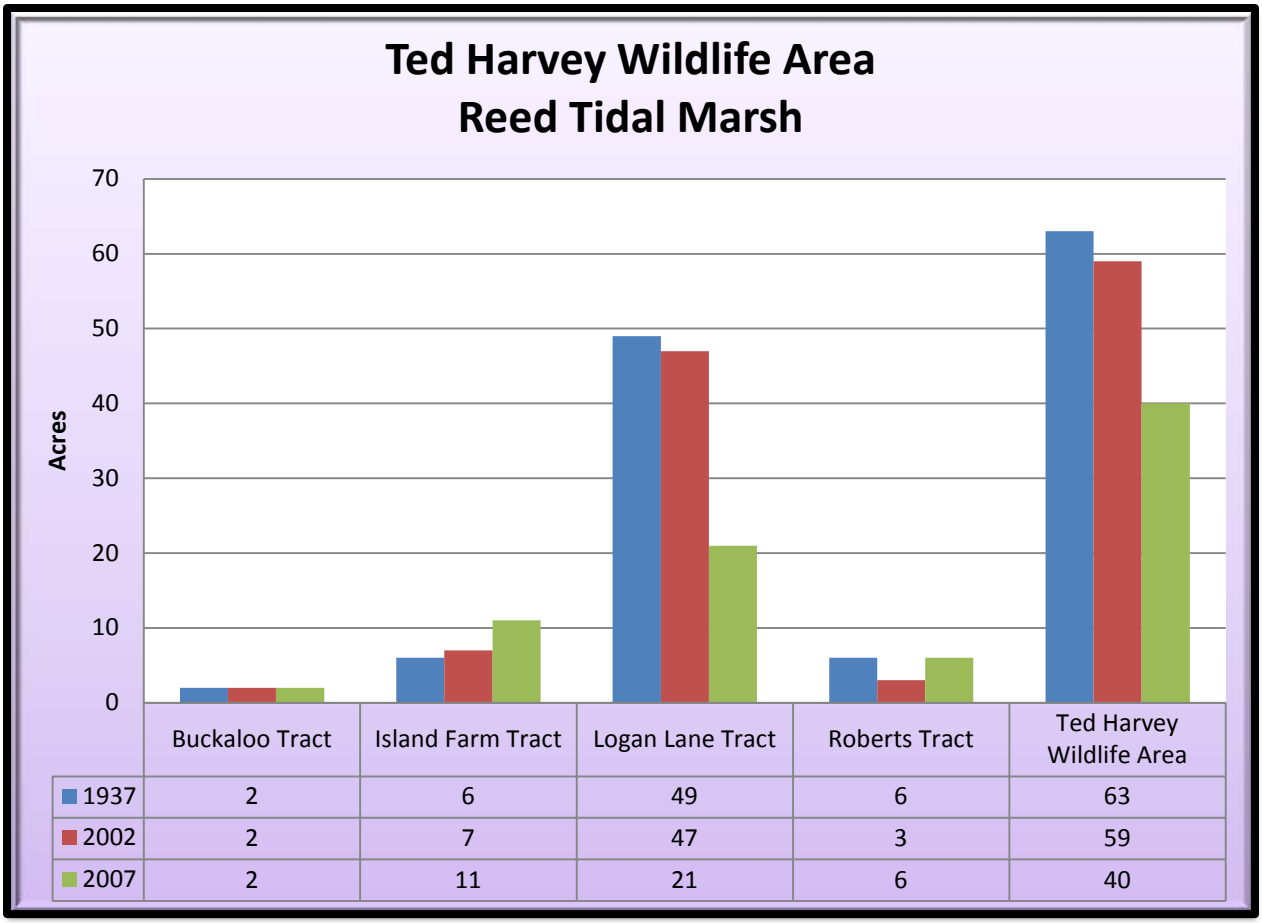


Figure 5.36. Reed Tidal Marsh at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Scenarios (Table 5.67)

The current acreage of Reed Tidal Marsh will be inundated with 0.5 m of sea level rise.

Table 5.67. Projected acres of Reed Tidal Marsh Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	40 acres
1 m	40 acres
1.5 m	40 acres

Natural Capital (Table 5.68)

Capital in Reed Tidal Marsh has been decreasing with decreases in acreage.

Table 5.68. Natural Capital of Reed Tidal Marsh	
Year	**Natural Capital (in 2012 dollars)**
1937	$395,392/year
2002	$370,007/year
2007	$250,852/year

Successional Maritime Forest **[47.1 acres (Figures 5.37-5.38, Tables 5.69-5.71)] G2G3 S3**

DEWAP: Beach and Dune Habitats
NHC: Northern Atlantic Coastal Plain Maritime Forest

Description

Figure 5.37. Successional Maritime Forest (Buckaloo Tract)

This forested community is located near the edges of the marshes and has a stunted canopy composed of sweetgum (*Liquidambar styraciflua*), wild black cherry (*Prunus serotina*), persimmon (*Diospyros virginiana*), and eastern red cedar (*Juniperus virginiana*). The understory is composed of smaller members of the canopy plus southern bayberry (*Morella cerifera*). No shrubs or vines were observed and the only herbaceous species is common reed (*Phragmites australis*). Note: this description is from one occurrence in the Buckaloo Tract. A lot of the occurrences are located in places are away from land and are unable to be accessed on foot.

Analysis of Condition at Ted Harvey Wildlife Area

This community has shown increases in all of the tracts except for the Island Farm Tract where sea level rise have converted all but a sliver of the previous forest. About 4 acres of the original 13 acres from 1937 still existed in 2007. A lot of the rest of the forest was eliminated in the development of the impoundments (6 acres), and other parts became North Atlantic Low Salt Marsh (3 acres) showing some movement landward of the marsh. Smaller areas became North Atlantic High Salt Marsh (0.3 acres) and Eastern Reed Marsh (0.3 acres) (Table 5.68).

Since 1937, Successional Maritime Forest has grown in acreage as it has matured in Northeastern Old Field (25 acres) and agricultural field (9 acres). About 4 acres of Early to Mid-Successional Loblolly Pine Forest matured into the type and one acre of North Atlantic Low Salt Marsh has become Successional Maritime Forest (Table 5.69)

Table 5.68. What was once Successional Maritime Forest in 1937 has become X or remained in 2007	
X	**Acreage**
Impoundment	6 acres
Successional Maritime Forest	4 acres
North Atlantic Low Salt Marsh	3 acres
North Atlantic High Salt Marsh	0.3 acres
Eastern Reed Marsh	0.3 acres
Other vegetation communities/land covers	0.5 acres

Table 5.69. Successional Maritime Forest has migrated into X or remained since 1937	
X	**Acreage**
Northeastern Old Field	25 acres
Agricultural Field	9 acres
Successional Maritime Forest	4 acres
Early to Mid-Successional Loblolly Pine Forest	4 acres
North Atlantic Low Salt Marsh	1 acre
Other communities/land covers	2 acres

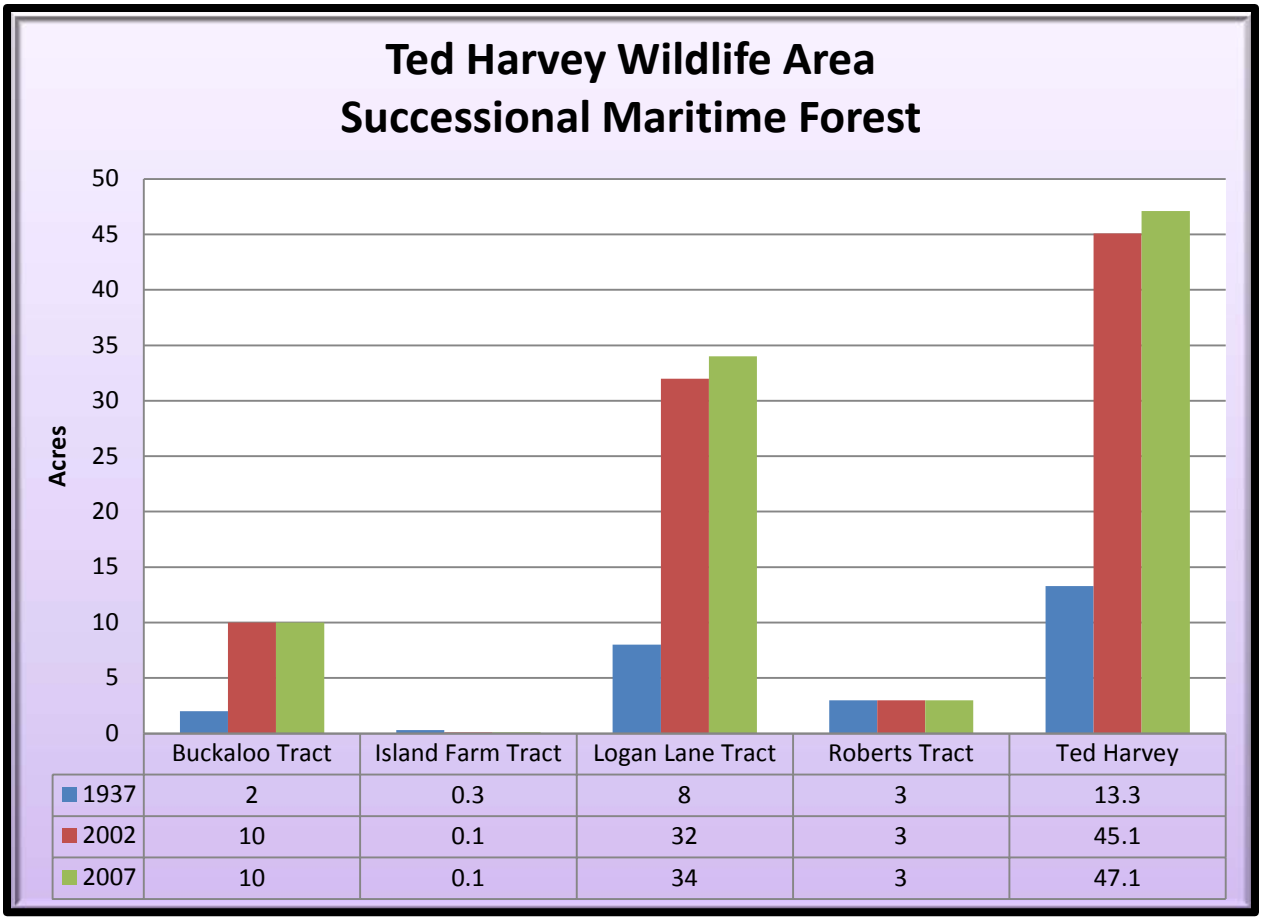


Figure 5.38. Successional Maritime Forest at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Analysis (Table 5.70)

About 18 acres of Successional Maritime Forest will be inundated with 0.5 m of sea level rise, while most of the rest will be inundated with 1 m of rise or greater.

Table 5.70. Projected acres of Successional Maritime Forest Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	18 acres
1 m	44 acres
1.5 m	46 acres

Natural Capital (Table 5.71)

Capitalization of Successional Maritime Forest has been going up as the acreage increases adding to the overall capitalization for the wildlife area.

Table 5.71. Natural Capital of Successional Maritime Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$2,515/year
2002	$8,510/year
2007	$8,888/year

Successional Sweetgum Forest **[53 acres (Figures 5.39-5.40, Tables 5.72-5.74)] GNA SNA**

DEWAP: No Equivalent Classification
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

This community is one of the larger forested communities on the Logan Lane Tract. The expressions present comprise a wide variety of ages from young age to almost mature. Sweetgum (*Liquidambar styraciflua*) dominates the canopy with an understory of wild black cherry (*Prunus serotina*), willow oak (*Quercus phellos*), and blackgum (*Nyssa sylvatica*). Shrubs and vines include Japanese honeysuckle (*Lonicera japonica*), multiflora rose (*Rosa multiflora*), blackberry (*Rubus* sp.), common greenbrier (*Smilax rotundifolia*), poison ivy (*Toxicodendron radicans*), highbush blueberry (*Vaccinium corymbosum*), and arrowwood (*Viburnum dentatum*). Herbs include Virginia creeper (*Parthenocissus quinquefolia*), Japanese stiltgrass (*Microstegium vimineum*), lyre-leaf sage (*Salvia lyrata*), royal fern (*Osmunda regalis*), sensitive fern (*Onoclea sensibilis*), Jack-in-the-pulpit (*Arisaema triphyllum*), and milkweed (*Asclepias* sp.).

Figure 5.39. Successional Sweetgum Forest (Logan Lane Tract)

Analysis of Condition at Ted Harvey Wildlife Area

This is a successional community that grows from old agricultural fields and other abandoned areas. Fifty acres have grown up since 1937 and have converted 31 acres of Northeastern Old Field, 13 acres of Early to Mid-Successional Loblolly Pine Forest, 8 acres of Northeastern Successional Shrubland, and 1 acre of agricultural field (Table 5.72).

Table 5.72. Successional Sweetgum Forest has migrated into X or remained since 1937	
X	**Acreage**
Northeastern Old Field	31 acres
Early to Mid-Successional Loblolly Pine Forest	13 acres
Northeastern Successional Shrubland	8 acres
Agricultural Field	1 acre

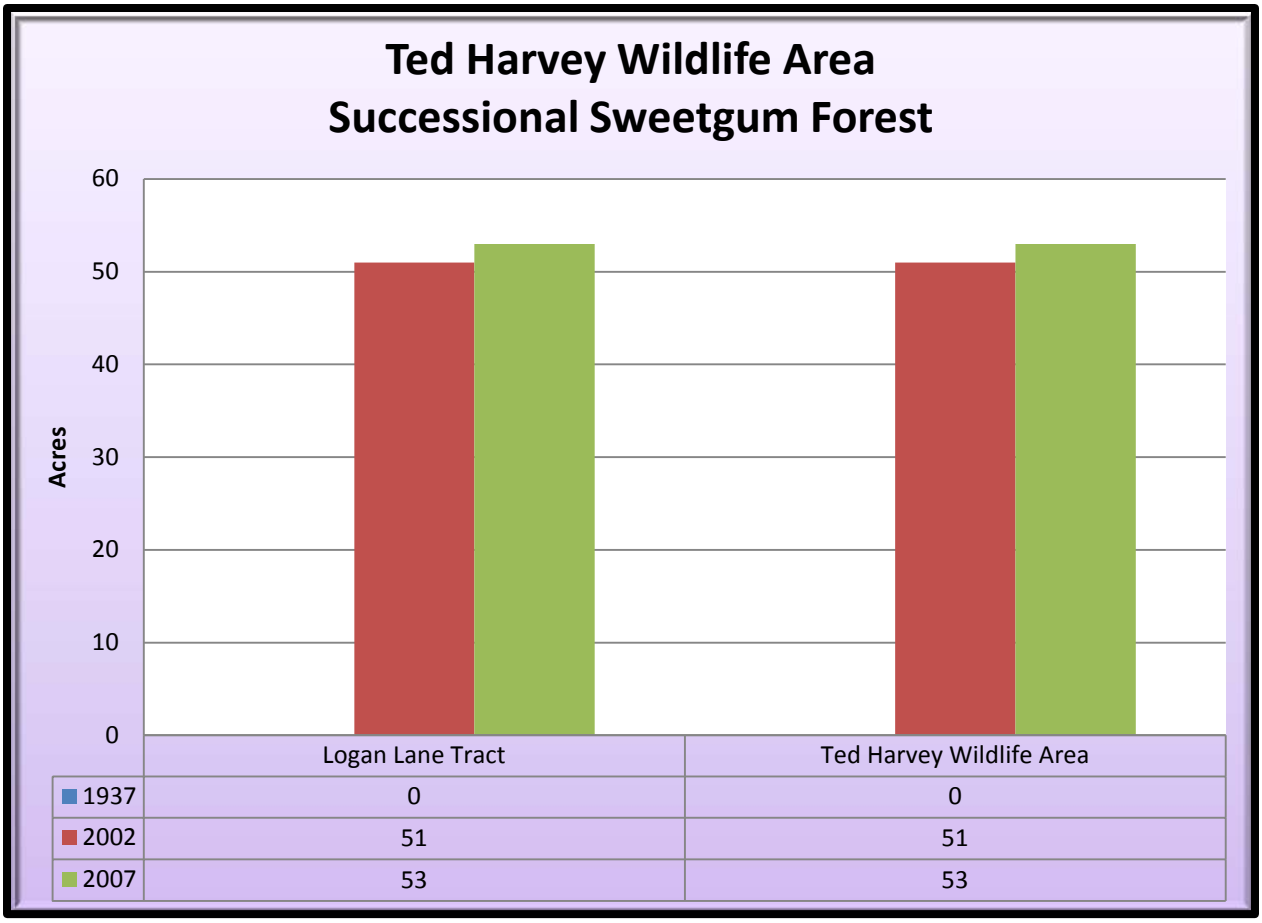


Figure 5.40. Successional Sweetgum Forest at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Scenarios (Table 5.73)

None of the current acreage of Successional Sweetgum Forest will be affected by 0.5 m of sea level rise. A rise of 1 m will inundate 25 acres and 1.5 m will flood 47 acres.

Table 5.73. Projected acres of Successional Sweetgum Forest Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	0 acres
1 m	25 acres
1.5 m	47 acres

Natural Capital (Table 5.74)

Capitalization of Successional Sweetgum Forest has gone up with its acreage with transfers from Northeastern Old Field and increasing the overall capitalization of the wildlife area.

Table 5.74. Natural Capital of Successional Sweetgum Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$9,644/year
2007	$10,022/year

Successional Tuliptree Forest **[13 acres (Figure 5.41, Tables 5.75-5.78)] GNA SNA**

DEWAP: Coastal Plain Upland Forest
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

This successional community is characterized by a canopy that is dominated nearly in whole by tuliptree (*Liriodendron tulipifera*). At Ted Harvey Wildlife Area, the canopy also contains sweetgum (*Liquidambar styraciflua*), and a few southern red oak (*Quercus falcata*) and white oak (*Quercus alba*). The understory is composed of red maple (*Acer rubrum*), hawthorn (*Crataegus* sp.), American holly (*Ilex opaca*), northern red oak (*Quercus rubra*), and wild black cherry (*Prunus serotina*). The shrub and vine layer is dense with multiflora rose (*Rosa multiflora*), Japanese honeysuckle (*Lonicera japonica*), common greenbrier (*Smilax rotundifolia*), poison ivy (*Toxicodendron radicans*), arrowwood (*Viburnum dentatum*), summer grape (*Vitis aestivalis*), and highbush blueberry (*Vaccinium corymbosum*). Herbs include Virginia creeper (*Parthenocissus quinquefolia*), Jack-in-the-pulpit (*Arisaema triphyllum*), mayapple (*Podophyllum peltatum*), New York fern (*Thelypteris novaboracensis*), royal fern (*Osmunda regalis*), enchanter's nightshade (*Circaea lutetiana*), horse balm (*Collinsonia canadensis*), herbaceous greenbrier (*Smilax herbacea*), and false solomon's seal (*Maianthemum racemosum*).

Analysis of Condition at Ted Harvey Wildlife Area

This community was present in small amount in 1937 and has increased up to 2002. It has remained stable in amount since 2002. All of the 1937 acreage was still present in 2007 (Table 5.75) and additions were from converted agricultural field (2 acres), North Atlantic Low Salt Marsh (1 acre), Mid to Late Successional Loblolly Pine-Sweetgum Forest (1 acre), and Northeastern Old Field (1 acre) (Table 5.76).

Table 5.75. What was once Successional Tuliptree Forest in 1937 has become X or remained in 2007

X	Acreage
Successional Tuliptree Forest	4 acres

Table 5.76. Successional Tuliptree Forest has migrated into X or remained since 1937

X	Acreage
Successional Tuliptree Forest	4 acres
Agricultural Field	2 acres
North Atlantic Low Salt Marsh	1 acre
Mid to Late Successional Loblolly Pine-Sweetgum Forest	1 acre
Northeastern Old Field	1 acre

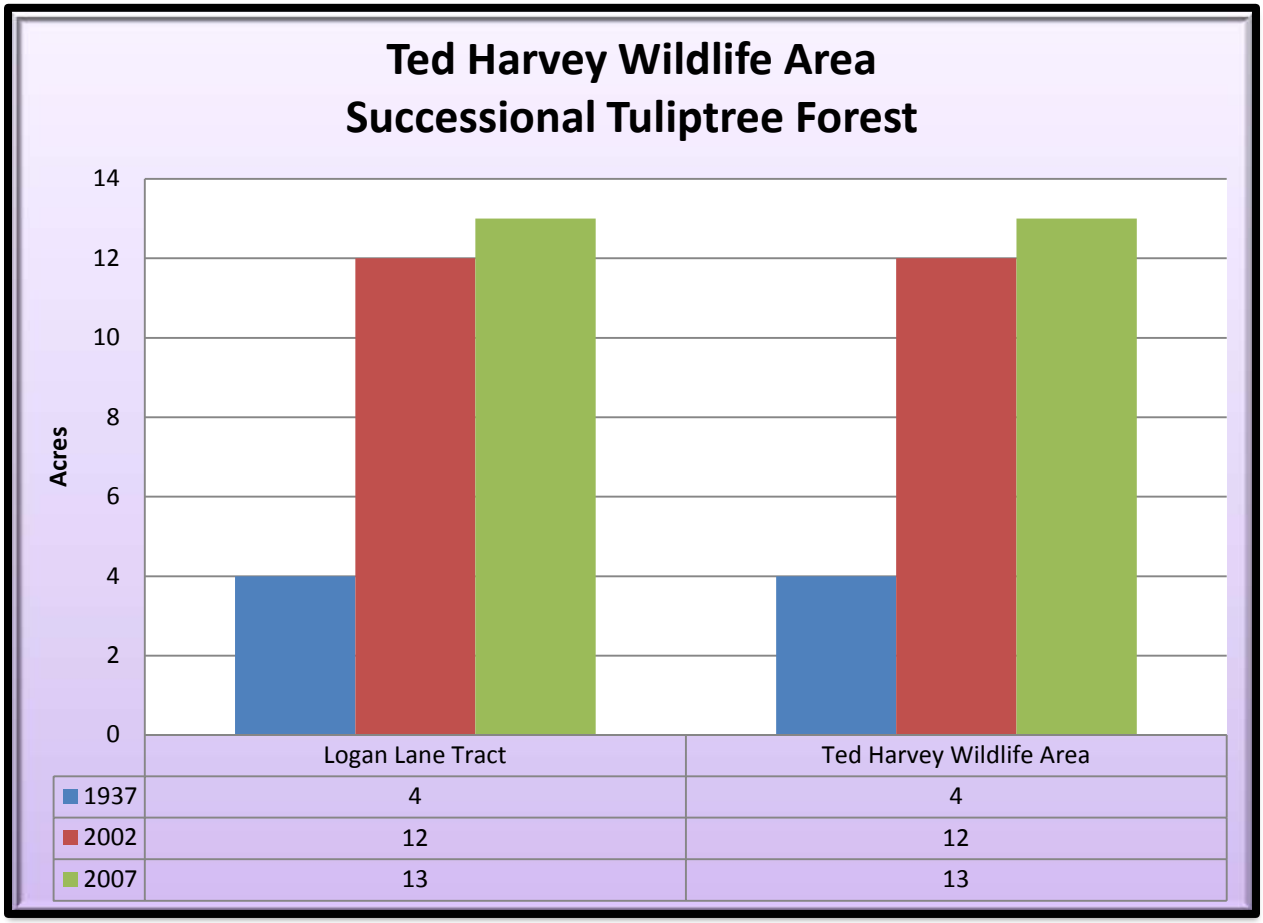


Figure 5.41. Successional Tuliptree Forest at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Scenarios (Table 5.77)

A little bit (3 acres) of Successional Tuliptree Forest will be inundated with 0.5 m of sea level rise and double this amount with 1 m of rise. At 1.5 m of rise, 11 acres will be flooded.

Table 5.77. Projected acres of Successional Tuliptree Forest Impacted by Sea Level Rise

Rise	Acres
0.5 m	3 acres
1 m	6 acres
1.5 m	11 acres

Natural Capital (Table 5.78)

Capitalization of Successional Tuliptree Forest has been going up as the acreage increases adding to the overall capitalization for the wildlife area.

Table 5.78. Natural Capital of Successional Tuliptree Forest	
Year	**Natural Capital (in 2012 dollars)**
1937	$756/year
2002	$2,269/year
2007	$2,458/year

Upland Switchgrass Vegetation **[1 acre (Figure 5.42, Tables 5.79-5.80)] GNA SNA**

DEWAP: Early Successional Upland Habitats
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

This community is artificial and is planted as a vegetated buffer around agricultural fields in the wildlife area. It is composed nearly entirely of switchgrass (*Panicum virgatum*). Some areas that mapped as Northeastern Old Field may also be this community, since not all fields were checked for this community.

Analysis of Condition at Ted Harvey Wildlife Area

This community is planted and is not subject to natural changes in the landscape. If left alone or abandoned it may succeed to a Northeastern Successional Shrubland. All of the current Upland Switchgrass Vegetation has come into an acre of Northeastern Old Field since 2002.

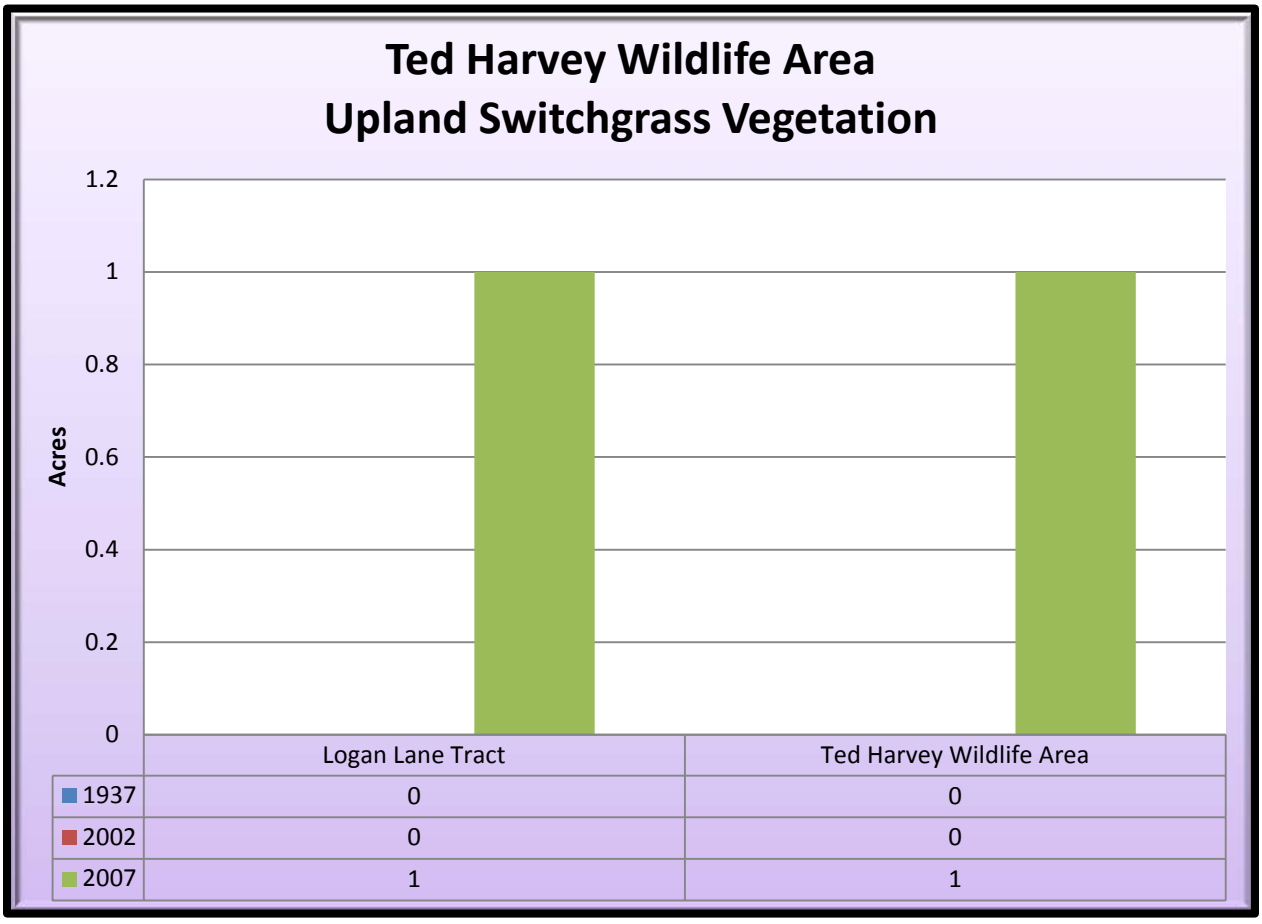


Figure 5.42. Upland Switchgrass Vegetation at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Analysis (Table 5.79)

None of this community will be flooded with 0.5 m of sea level rise. At 1 m of sea level rise, the community in its current extent will be inundated.

Table 5.79. Projected acres of Upland Switchgrass Vegetation Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	0 acres
1 m	1 acre
1.5 m	1 acre

Natural Capital (Table 5.80)

Capitalization of Upland Switchgrass Vegetation has come about since 2002 but has resulted in no net gain or loss for the wildlife area.

Table 5.80. Natural Capital of Upland Switchgrass Vegetation	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year
2002	$0/year
2007	$146/year

Wax-Myrtle Shrub Swamp **[0.5 acres (Figure 5.43, Tables 5.81-5.84)] G2G3 S2**

DEWAP: Beach and Dune Habitats
NHC: Northern Atlantic Coastal Plain Dune and Swale

Description

This community was aerially interpreted because of its location in a salt marsh. It is characterized by a shrubland that is dominated by southern bayberry (*Morella cerifera*). Other associates include salt shrub (*Baccharis halimifolia*) and red maple (*Acer rubrum*). The components of the herbaceous layer cannot be determined from the aerial imagery. Some typical herbs include netted chainfern (*Woodwardia areolata*), royal fern (*Osmunda regalis* var. *spectabilis*), Pennsylvania smartweed (*Polygonum pensylvanica*), and false nettle (*Boehmeria cylindrica*).

Analysis of Condition at Ted Harvey Wildlife Area

This community appears to have declined some since 1937, but has been stable in amount in the short-term (2002-2007). None of the occurrences from 1937 were still present in 2007. What was Wax Myrtle Shrub Swamp has become 2 acres of North Atlantic Low Salt Marsh, 1 acre of Impoundment, and 0.2 acres of Eastern Reed Marsh (Table 5.81). Since 1937, Wax Myrtle Shrub Swamp has migrated into 0.4 acres of North Atlantic High Salt Marsh (Table 5.82).

Table 5.81. What was once Wax-Myrtle Shrub Swamp in 1937 has become X or remained in 2007	
X	**Acreage**
North Atlantic Low Salt Marsh	2 acres
Impoundment	1 acre
Eastern Reed Marsh	0.2 acres

Table 5.82. Wax-Myrtle Shrub Swamp has migrated into X or remained since 1937	
X	**Acreage**
North Atlantic High Salt Marsh	0.4 acres

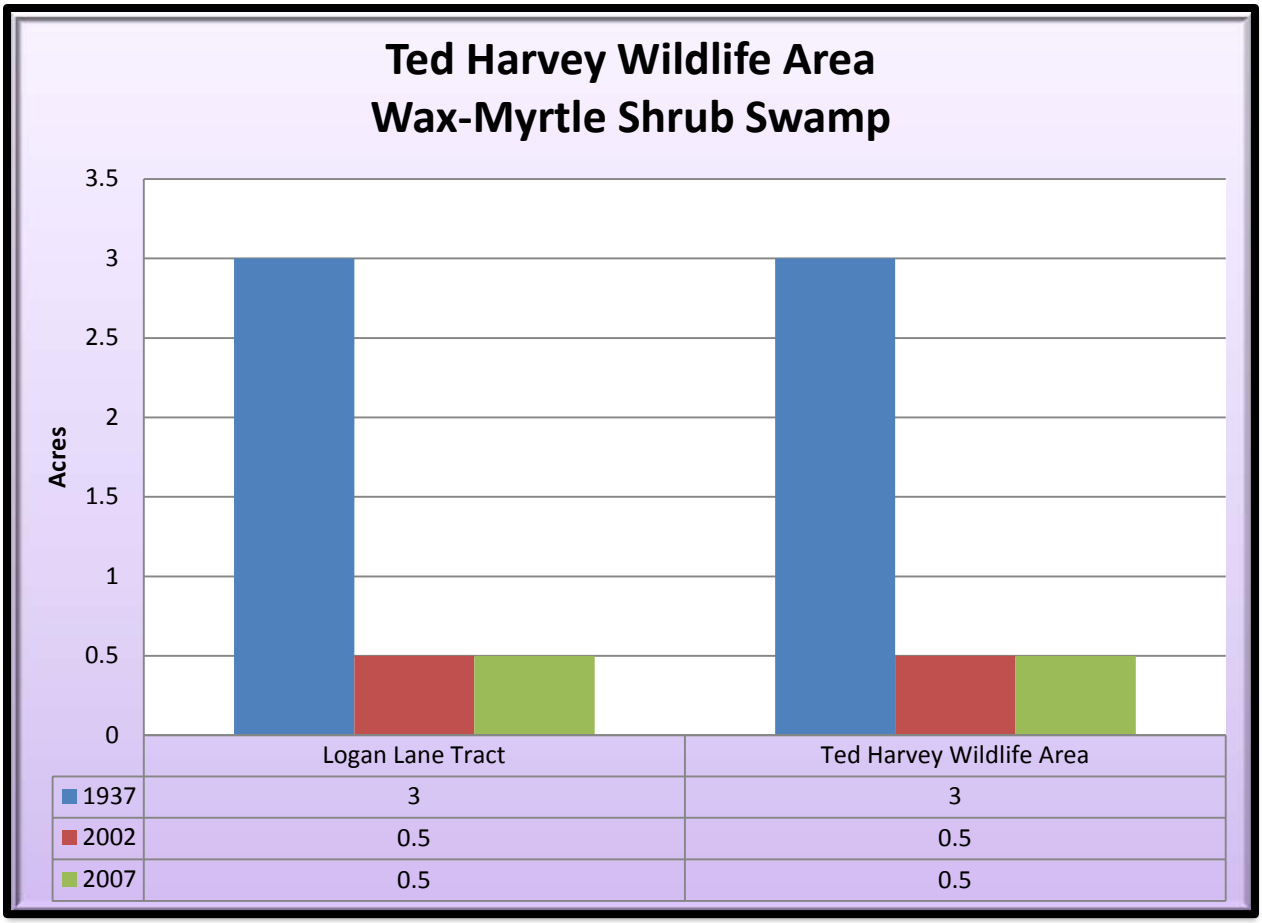


Figure 5.43. Wax-Myrtle Shrub Swamp at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Analysis (Table 5.83)

At 0.5 m of sea level 0.3 acres of Wax Myrtle Shrub Swamp will inundated and at 1 m of rise the entire extent of the current community will be inundated.

Table 5.83. Projected acres of Wax Myrtle Shrub Swamp Impacted by Sea Level Rise

Rise	Acres
0.5 m	0.3 acres
1 m	0.5 acres
1.5 m	0.5 acres

Natural Capital (Table 5.84)

Capitalization of Wax Myrtle Shrub Swamp has declined overall from its 1937 highs, with most of the transfers going to marshland which is neutral in capital for the wildlife area.

Table 5.84. Natural Capital of Wax Myrtle Shrub Swamp	
Year	**Natural Capital (in 2012 dollars)**
1937	$18,814/year
2002	$1,881/year
2007	$3,136/year

CHAPTER 6: DESCRIPTIONS AND ANALYSIS OF THE LAND COVERS

Land covers are those areas that are not vegetation communities but still cover ground surface. In terms of sea-level rise, water is most important but it effects can also be seen in the impoundments.

The land covers include:

1. Agricultural Field—431 acres
2. Beach—12 acres
3. Farm Pond/Artificial Pond—9 acres
4. Impervious Surface—0.1 acres
5. Impoundment—267 acres
6. Modified Land—2 acres
7. Powerline R-O-W—0.02 acres
8. Semi-impervious Surface—14 acres
9. Tidal Mudflat—9 acres
10. Water—45 acres

Agricultural Field **[431 acres (Figure 6.1, Tables 6.1-6.4)]**

DEWAP: No Equivalent Classification
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

Description

In 1937, 595 acres were planted in crops. Since this time the number of acres has been reduced to 431 acres.

Analysis of Condition at Ted Harvey Wildlife Area

Three of the tracts at Ted Harvey Wildlife contain agricultural fields. All of these tracts have seen reductions in the amount of land farmed and this amount is expected to decrease as more land is restored to original condition.

In 2007, 392 acres from the 595 acres in 1937 were still present as agricultural field. The rest had become 108 acres of Northeastern Old Field, which generally the first community formed when an agricultural field abandoned. Older abandoned agricultural fields have matured into 26 acres of Northeastern Modified Successional Forest, 25 acres of Chesapeake Bay Non-riverine Wet Hardwood Forest, and 9 acres of Successional Maritime Forest (Table 6.1).

A small amount of agricultural fields have been developed since 1937. Communities that have been converted to agricultural field include 34 acres of Northeastern Old Field, and 1 acre each of impervious surface, Northeastern Modified Successional Forest, and Chesapeake Bay Non-riverine Wet Hardwood Forest (Table 6.2).

Table 6.1. What was once Agricultural Field in 1937 has become X or remained in 2007

X	Acreage
Agricultural Field	392 acres
Northeastern Old Field	108 acres
Northeastern Modified Successional Forest	26 acres
Chesapeake Bay Non-riverine Wet Hardwood Forest	25 acres
Successional Maritime Forest	9 acres
Other vegetation communities/land covers	34 acres

Table 6.2. Agricultural Field has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	392 acres
Northeastern Old Field	34 acres
Impervious Surface	1 acre
Northeastern Modified Successional Forest	1 acre
Chesapeake Bay Non-riverine Wet Hardwood Forest	1 acre
Other communities/land covers	1 acre

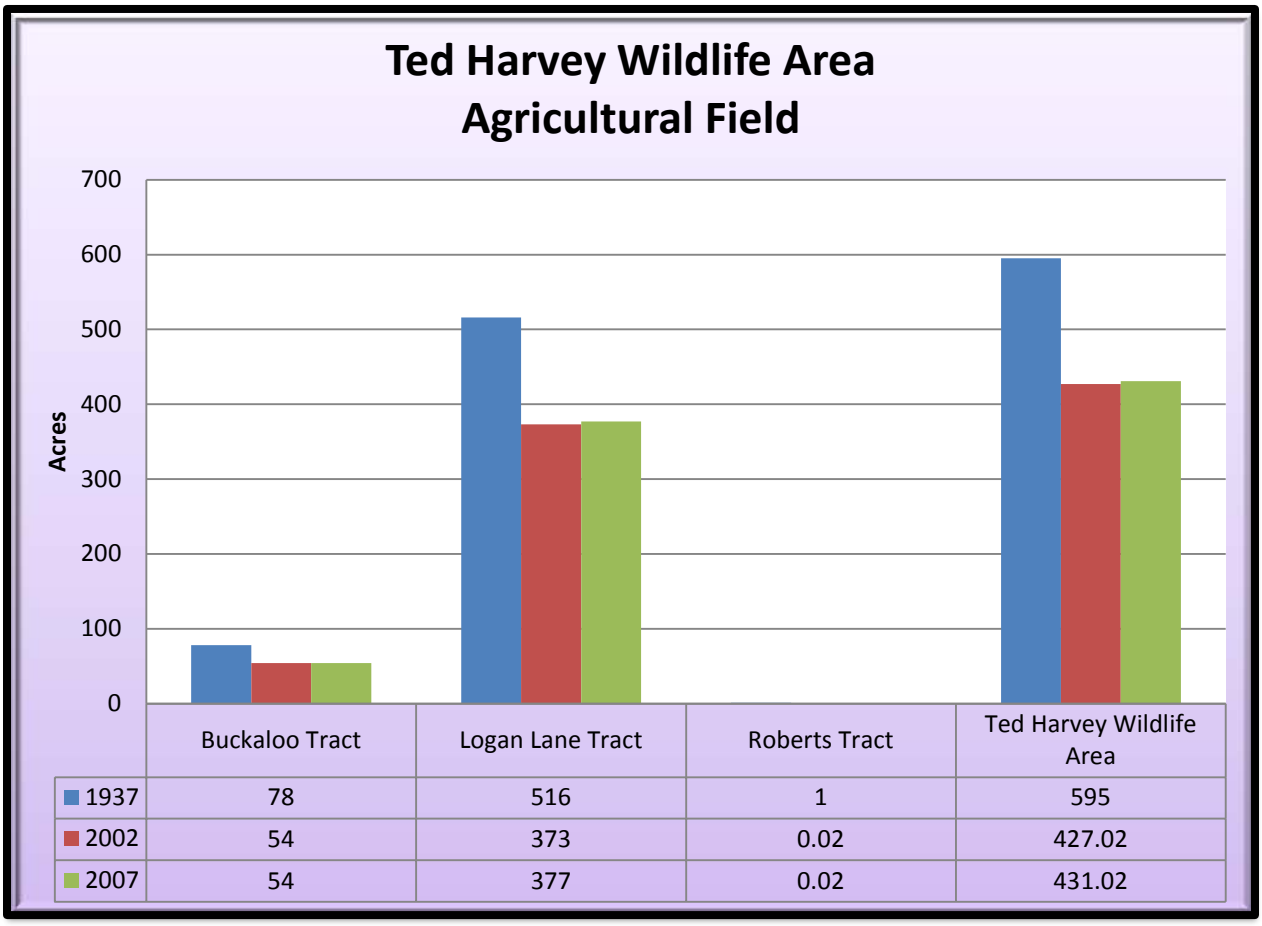


Figure 6.1. Agricultural Fields at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Scenarios (Table 6.3)

Not much of the current agricultural field will be impacted by sea level rise until about 1.5 m of rise occurs. Most of the agricultural fields are located in places of higher elevation.

Table 6.3. Projected acres of Agricultural Field Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	8 acres
1 m	50 acres
1.5 m	127 acres

Natural Capital (Table 6.4)

Capitalization of Agricultural Field has gone since 1937 and has gone to more valuable communities adding to the overall capitalization of the wildlife area. In the recent period it has gone up slightly with the addition of acreage.

Table 6.4. Natural Capital of Agricultural Field	
Year	**Natural Capital (in 2012 dollars)**
1937	$34,123/year
2002	$24,488/year
2007	$24,718/year

***Beach* [12 acres (Figure 6.2, Tables 6.5-6.7)]**

DEWAP: Beach and Dune Habitats
NHC: Northern Atlantic Coastal Plain Dune and Swale

Description

This land cover is located on edges of Delaware Bay and the St. Jones River. It is characterized by an un-vegetated stretch of sand.

Analysis of Condition at Ted Harvey Wildlife Area

This land cover tends to be ephemeral and comes and goes with storms and overwash areas on Delaware Bay. Showing this ephemeral nature, only 0.1 acres of the original 9 acres in 1937 were present in 2007. The rest of the beach areas have been inundated in 6 acres of water and 3 acres of tidal mudflat (Table 6.5).

Beaches have developed through storm action and sedimentation and have covered 7 acres of North Atlantic Low Salt Marsh, 3 acres of Reed Tidal Marsh, and 2 acres of Irregularly Flooded Eastern Tidal Salt Shrub (Table 6.6).

Table 6.5. What was once Beach in 1937 has become X or remained in 2007	
X	**Acreage**
Water	6 acres
Tidal Mudflat	3 acres
Beach	0.1 acres

Table 6.6. Beach has migrated into X or remained since 1937	
X	**Acreage**
North Atlantic Low Salt Marsh	7 acres
Reed Tidal Marsh	3 acres
Irregularly Flooded Eastern Tidal Salt Shrub	2 acres
Beach	0.1 acres

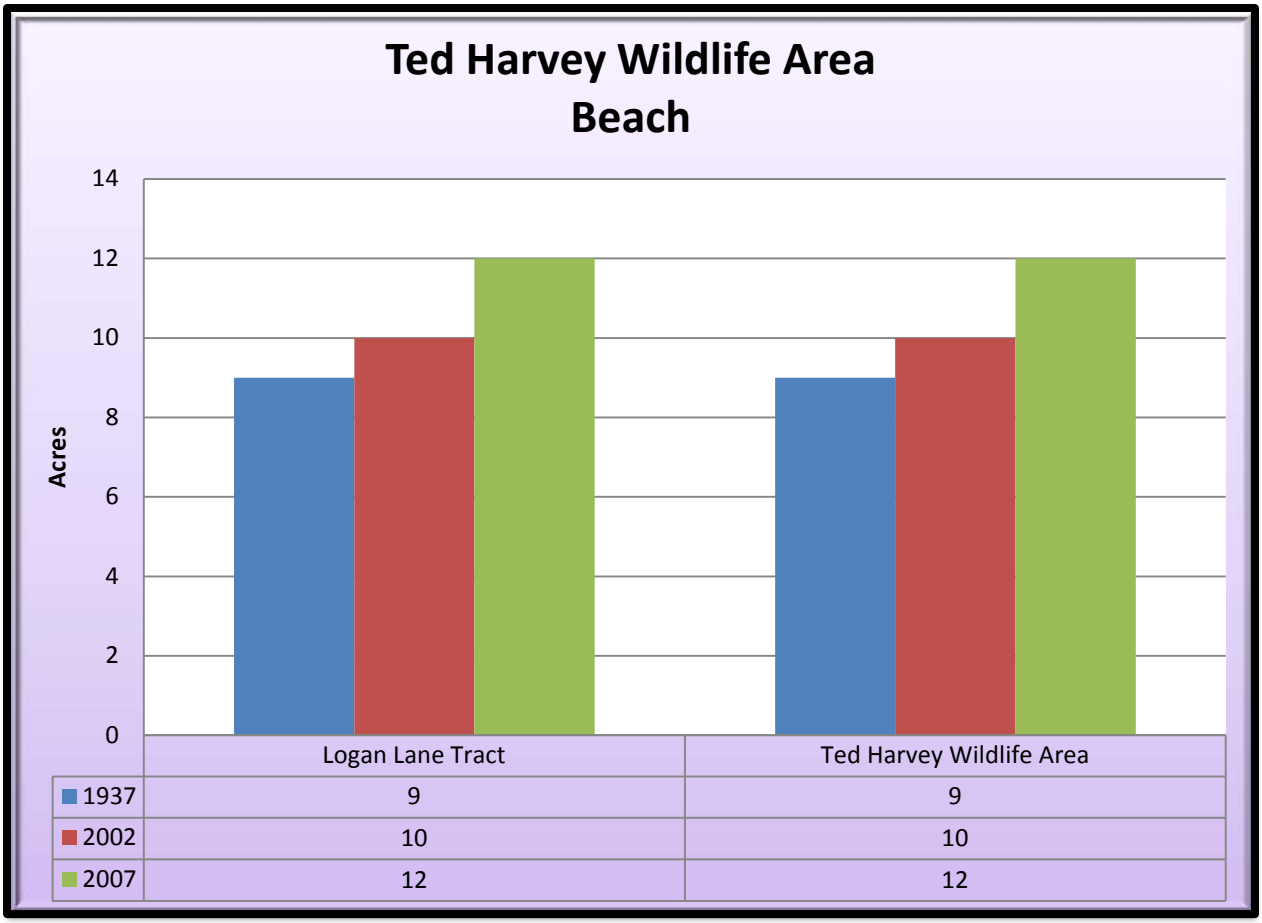


Figure 6.2. Beaches at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Scenarios (Table 6.7)

About of the beach area in the wildlife area will be inundated with 0.5 m of sea level rise and all of it will be inundated with 1 m or higher of sea level rise.

Table 6.7. Projected acres of Beach Impacted by Sea Level Rise

Rise	Acres
0.5 m	6 acres
1 m	11 acres
1.5 m	11 acres

Natural Capital

Beach does not have any capitalization value.

Farm Pond/Artificial Pond **[9 acres, (Figure 6.3, Tables 6.8-6.11)]**

DEWAP: Impoundments
NHC: No Equivalent Classification

Description

This land cover refers to bodies of water that are artificially created and less than five acres in size.

Analysis of Condition at Ted Harvey Wildlife Area

These water bodies are artificial in nature and not subject to natural changes. There were no ponds present in 1937, but since this time they have developed in 6 acres of agricultural field and 3 acres of Northeastern Old Field (Table 6.8).

Table 6.8. Farm Pond/Artificial Pond has migrated into X or remained since 1937

X	Acreage
Agricultural Field	6 acres
Northeastern Old Field	3 acres

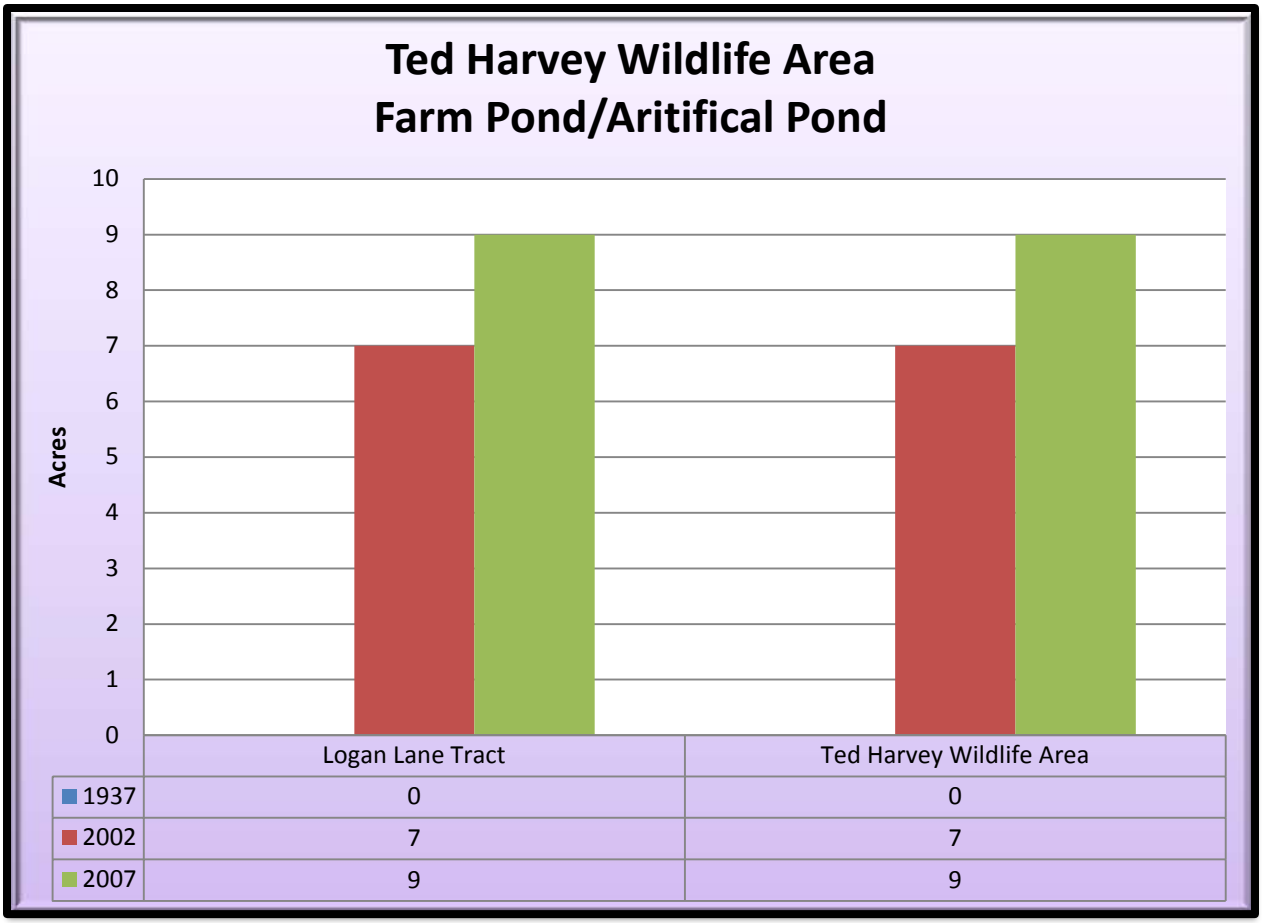


Figure 6.3. Farm Pond/Artificial Pond at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Scenarios (Table 6.9)

Most of the ponds in the wildlife area have been located in former agricultural fields and Northeastern Old Fields, which are located in places of higher elevation. Because of this farm ponds will not be affected much by sea level at least under the current scenarios. At 0.5 m of rise, 0.1 acres will be captured by water. At 1 m of rise 3 acres will be captured and at 1.5 m, 4 acres will be captured.

Table 6.9. Projected acres of Farm Pond/Artificial Pond Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	0.1 acres
1 m	3 acres
1.5 m	4 acres

Natural Capital (Table 6.10)

Capitalization of Farm Pond/Artificial Pond has gone up with its acreage resulting in an overall increase in the wildlife area capitalization.

Table 6.10. Natural Capital of Farm Pond/Artificial Pond	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$37,346/year
2007	$48,016/year

Impervious Surface **[0.1 acres, (Figure 6.4, Table 6.11)]**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

From the chart below it appears that a lot of impervious surface, which is associated with Kitts Hummock Road has been reduced since 1937. Most of the impervious surface is likely due a geo-referencing error that is hard to correct. It is likely the amount of impervious surface has stayed the same since 1937. For this reason and because of the possibility to alter results a historical analysis was not conducted.

DNREC Sea Level Rise Analysis (Table 6.11)

Impervious Surface will be barely affected under the current sea level rise scenarios.

Table 6.11. Projected acres of Impervious Surface Impacted by Sea Level Rise

Rise	Acres
0.5 m	0 acres
1 m	0 acres
1.5 m	0.02 acres

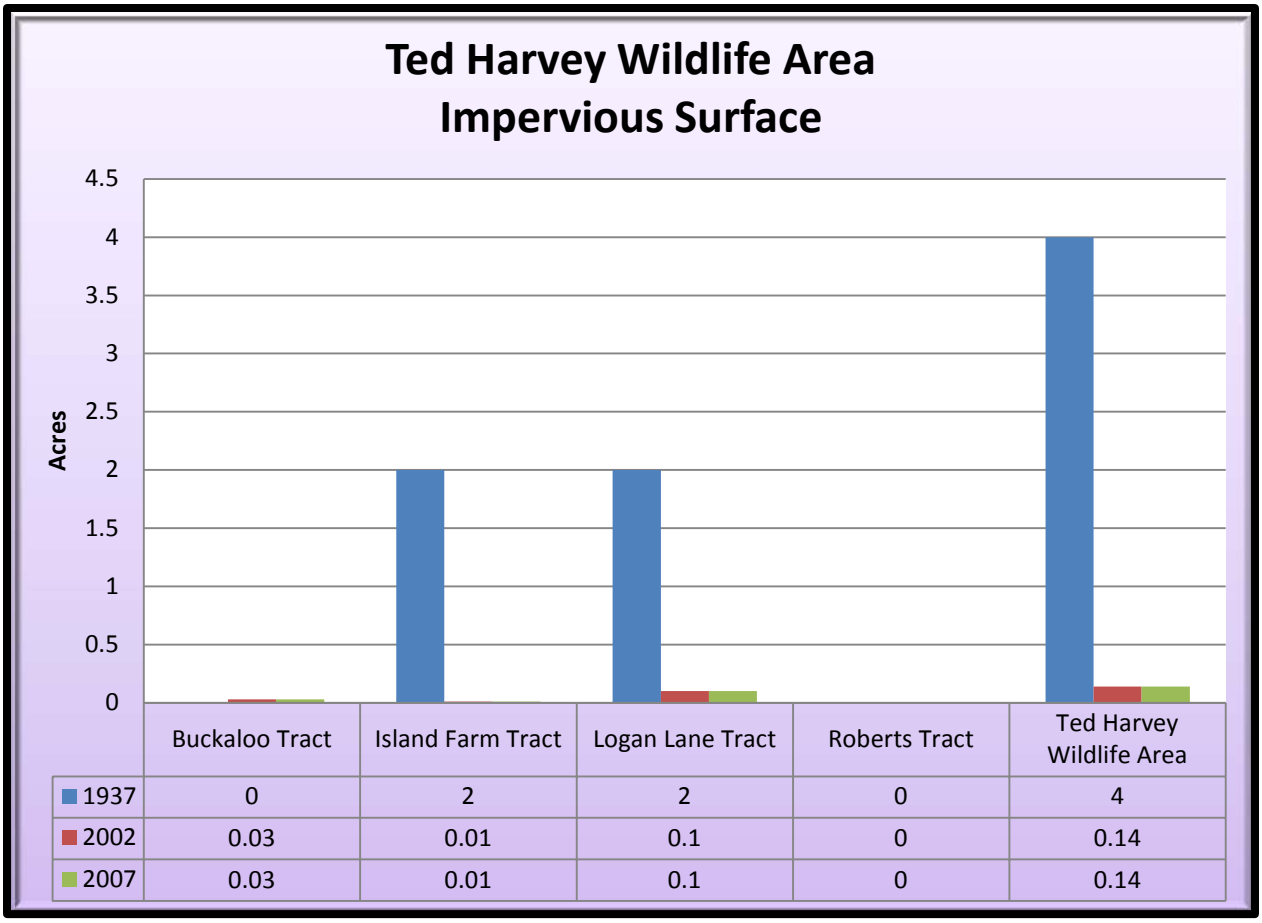


Figure 6.4. Impervious surface at Ted Harvey Wildlife Area (1937, 2002, and 2007)

Natural Capital

Impervious Surface does not have any capital value.

Impoundment **[267 acres (Figure 6.5, Tables 6.12-6.14)]**

DEWAP: Impoundment
NHC: No Equivalent Classification

No impoundments existed at Ted Harvey Wildlife Area in 1937, but were developed in the 1950s and 1960s to the detriment of North Atlantic Low Salt Marsh (232 acres) and to a lesser extent North Atlantic High Salt Marsh (15 acres). Other communities that were inundated in the impoundments include Successional Maritime Forest (6 acres) and Reed Tidal Marsh (3 acres) (Table 6.12). At the time of the 2002 imagery, 323 acres of the wildlife area were impounded. In 2007, 267 acres were impounded. Due to the fluctuating nature of the impoundments and the artificial control of the water levels, no conclusions can be made.

Table 6.12. Impoundment has migrated into X or remained since 1937

X	**Acreage**
North Atlantic Low Salt Marsh	232 acres
North Atlantic High Salt Marsh	15 acres
Successional Maritime Forest	6 acres
Water	5 acres
Reed Tidal Marsh	3 acres
Other communities/land covers	5 acres

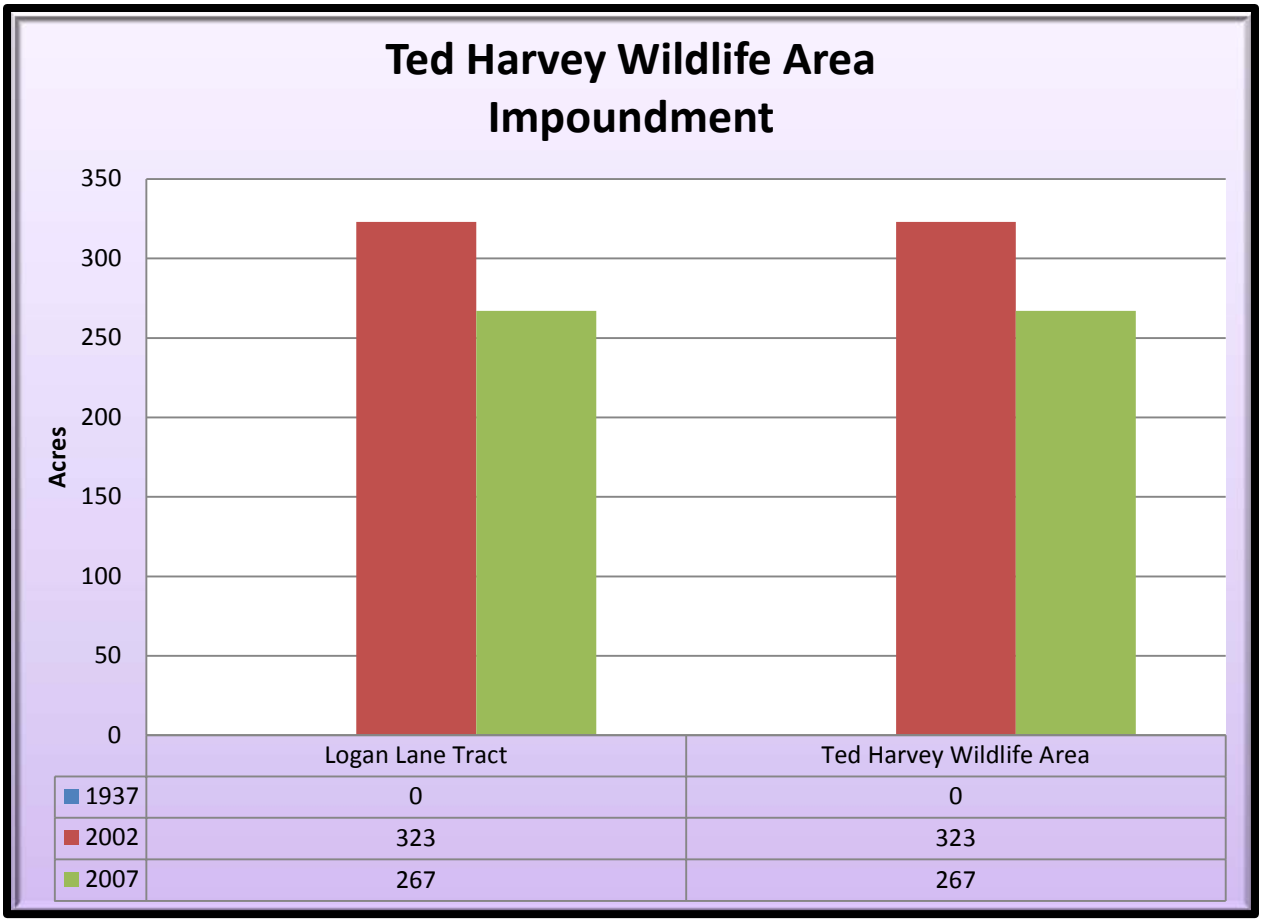


Figure 6.5. Impoundments at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Analysis (Table 6.13)

A little more than half of the impoundment area will be captured with 0.5 m of sea level rise and all will be captured with 1 m of more of rise.

Table 6.13. Projected acres of Impoundment Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	138 acres
1 m	267 acres
1.5 m	267 acres

Natural Capital (Table 6.14)

Capitalization of the impoundment has gone down in the recent period (2002-2007) and impoundments were not present in 1937.

Table 6.14. Natural Capital of Impoundment	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$1,723,237/year
2007	$1,424,472/year

Modified Land **[2 acres (Figure 6.6, Tables 6.15-6.16)]**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

This land cover includes those areas where the land has been disturbed and there is not plant cover. They are often present as bare dirt and have been developed in 1 acre of agricultural field and 0.2 acres of Semi-impervious surface (Table 6.15).

Table 6.15. Impoundment has migrated into X or remained since 1937	
X	**Acreage**
Agricultural Field	1 acre
Semi-impervious Surface	0.2 acres

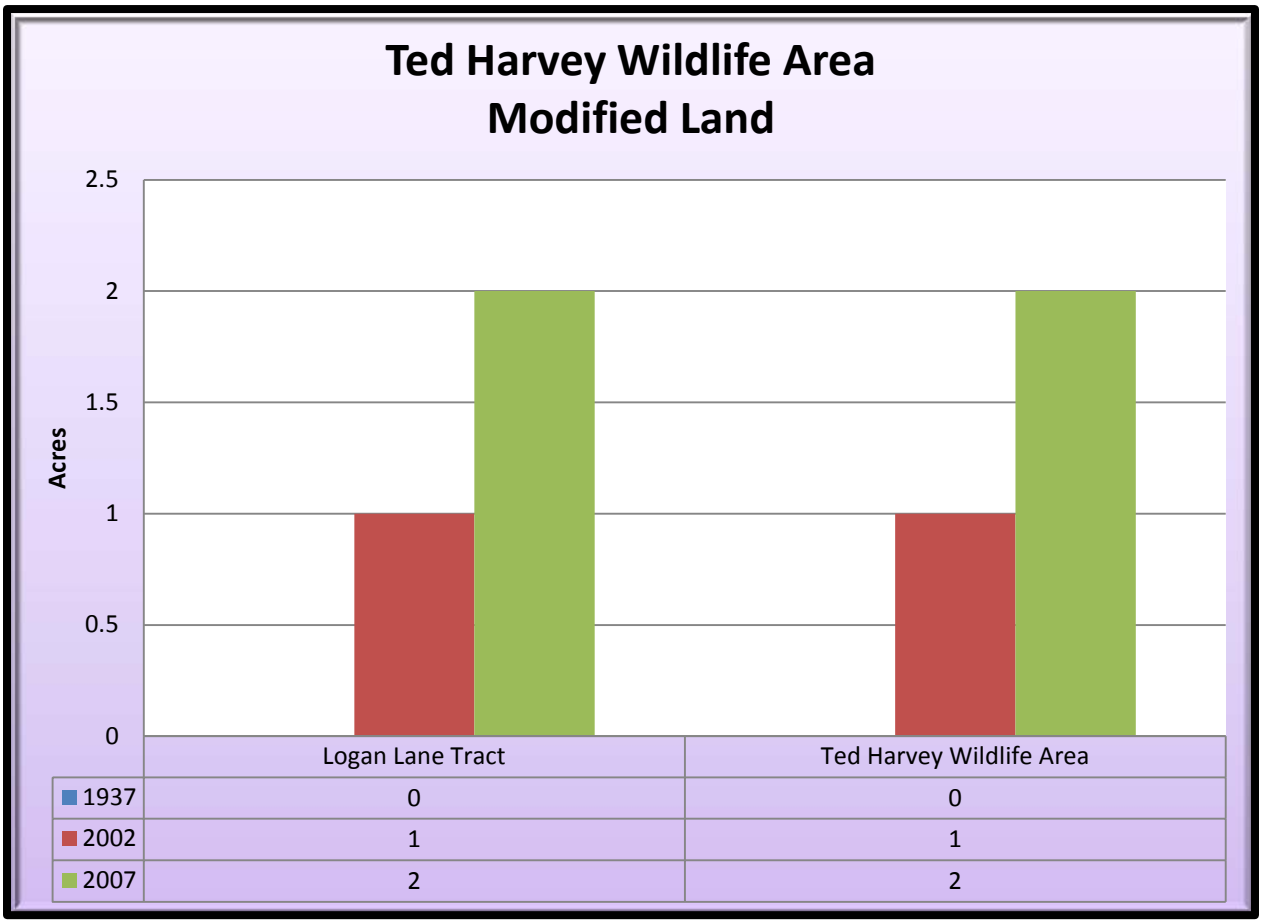


Figure 6.6. Modified Land at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Scenarios (Table 6.16)

Modified land and Powerline R-O-W are the only land covers that will not be affected by sea level rise under any of the current scenarios.

Table 6.16. Projected acres of Modified Land Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	0 acres
1 m	0 acres
1.5 m	0 acres

Natural Capital

Modified land does not have any natural capital associated with it.

Powerline R-O-W **[0.02 acres (Figure 6.7, Tables 6.17-6.18)]**

DEWAP: No Equivalent Classification
NHC: Semi-natural/Altered Vegetation and Conifer Plantations

This land cover is located underneath powerline R-O-Ws. These areas are often similar to Northeastern Old Fields and Northeastern Successional Shrublands but are intensively managed to keep vegetation low. The acreage of Powerline R-O-W is so few that no historical vegetation analysis was conducted for it.

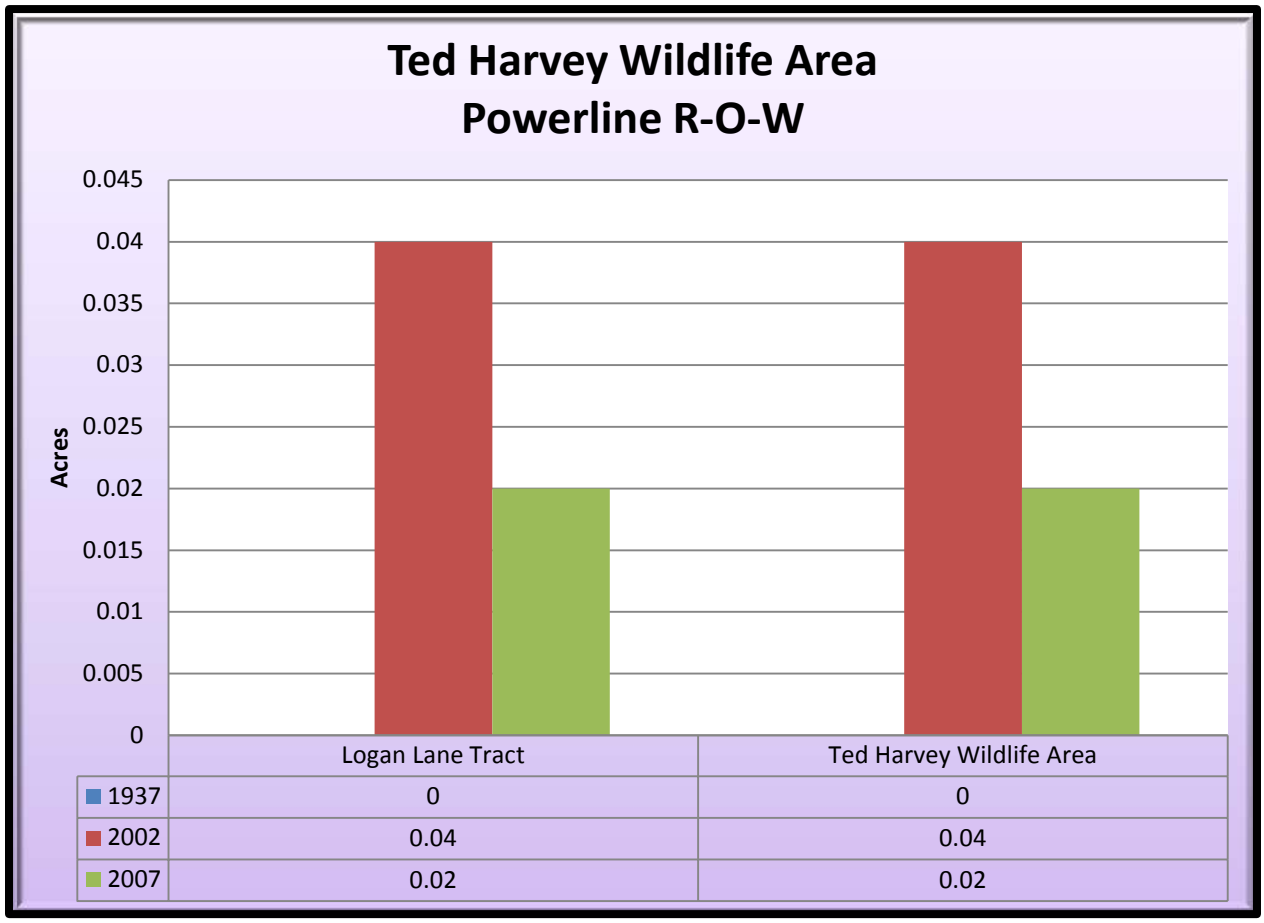


Figure 6.7. Powerline R-O-W at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Scenarios (Table 6.17)

Powerline R-O-W and Modified land are the only land covers that will not be affected by sea level rise under any of the current scenarios.

Table 6.17. Projected acres of Powerline R-O-W Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	0 acres
1 m	0 acres
1.5 m	0 acres

Natural Capital (Table 6.18)

Powerline R-O-W is similar to Northeastern Old Field in its species composition and was therefore included in this type for natural capital computation. The capitalization of Powerline R-O-W is miniscule and has been going down.

Table 6.18. Natural Capital of Powerline R-O-W	
Year	**Natural Capital (in 2012 dollars)**
1937	$0/year (not present)
2002	$6/year
2007	$3/year

Semi-impervious Surface **[14 acres (Figure 6.8, Tables 6.19-6.21)]**

DEWAP: No Equivalent Classification
NHC: No Equivalent Classification

This land cover includes the numerous dirt roads that go through the wildlife area. All of the roads are underlain by the sandy substrate that is common in the wildlife area. Most of the additional roads in the wildlife area have been dirt roads resulting in an increase in the acreage of this cover type.

About 3 acres of the semi-impervious surface area from 1937 still existed in 2007 with the rest becoming 1 acre of Northeastern Modified Successional Forest, 1 acre of Northeastern Old Field, 0.5 acres of Cultivated Lawn, and 0.5 acres of Northeastern Successional Shrubland (Table 6.19). Semi-impervious surfaces have been developed in 4 acres of North Atlantic Low Salt Marsh, 3 acres of Northeastern Old Field, 2 acres of agricultural field, and 1 acre of Northeastern Modified Successional Forest (Table 6.20).

Table 6.19. What was once Semi-impervious Surface in 1937 has become X or remained in 2007

X	Acreage
Semi-impervious Surface	3 acres
Northeastern Modified Successional Forest	1 acre
Northeastern Old Field	1 acre
Cultivated Lawn	0.5 acres
Northeastern Successional Shrubland	0.5 acres
Other vegetation communities/land covers	0.3 acres

Table 6.20. Semi-impervious Surface has migrated into X or remained since 1937

X	Acreage
North Atlantic Low Salt Marsh	4 acres
Northeastern Old Field	3 acres
Semi-impervious Surface	3 acres
Agricultural Field	2 acres
Northeastern Modified Successional Forest	1 acre
Other communities/land covers	1 acre

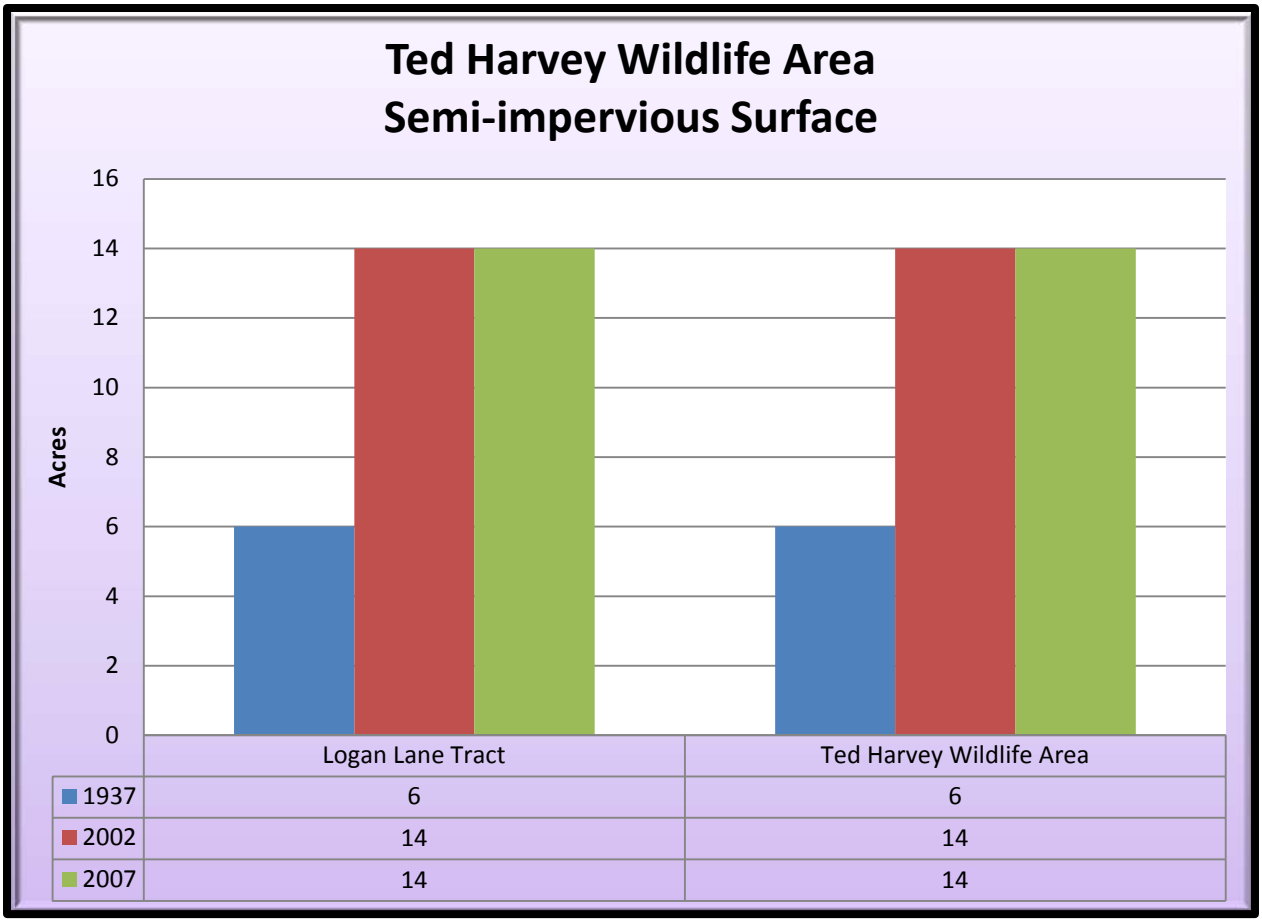


Figure 6.8. Semi-impervious Surface at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Analysis (Table 6.21)

A number of the roads in the wildlife area are near the impoundments and as such would be affected by sea level rise. At 0.5 m of rise, 3 acres would be inundated, and 1 m would inundate 7 acres. Another 0.5 m of rise would flood an additional acre. External costs would be involved if these roads were raised or rebuilt.

Table 6.21. Projected acres of Semi-impervious Surface Impacted by Sea Level Rise

Rise	Acres
0.5 m	3 acres
1 m	7 acres
1.5 m	8 acres

Natural Capital

Semi-impervious surface does not have any natural capital value.

Tidal Mudflat **[9 acres (Figure 6.9, Tables 6.22-6.25)]**

DEWAP: Tidal Low Marshes
NHC: Northern Atlantic Coastal Plain Tidal Salt Marsh

This land covers includes non-vegetated areas in marshlands that are subjected to tidal influence. They are often ephemeral and re-vegetate or convert to open water. None of the original tidal mudflats from 1937 existed in 2007. All of the former acreage has become 2 acres of North Atlantic Low Salt Marsh, 0.2 acres of Impoundment, 0.1 acres of North Atlantic High Salt Marsh, and 0.1 acres of Eastern Reed Marsh (Table 6.22). Since 1937, tidal mudflat has converted 3 acres each of North Atlantic Low Salt Marsh and beach, 2 acres of Reed Tidal Marsh, and 0.2 acres of water (Table 6.23).

Table 6.22. What was once Tidal Mudflat in 1937 has become X or remained in 2007	
X	**Acreage**
North Atlantic Low Salt Marsh	2 acres
Impoundment	0.2 acres
North Atlantic High Salt Marsh	0.1 acres
Eastern Reed Marsh	0.1 acres

Table 6.23. Tidal Mudflat has migrated into X or remained since 1937	
X	**Acreage**
North Atlantic Low Salt Marsh	3 acres
Beach	3 acres
Reed Tidal Marsh	2 acres
Water	0.2 acres

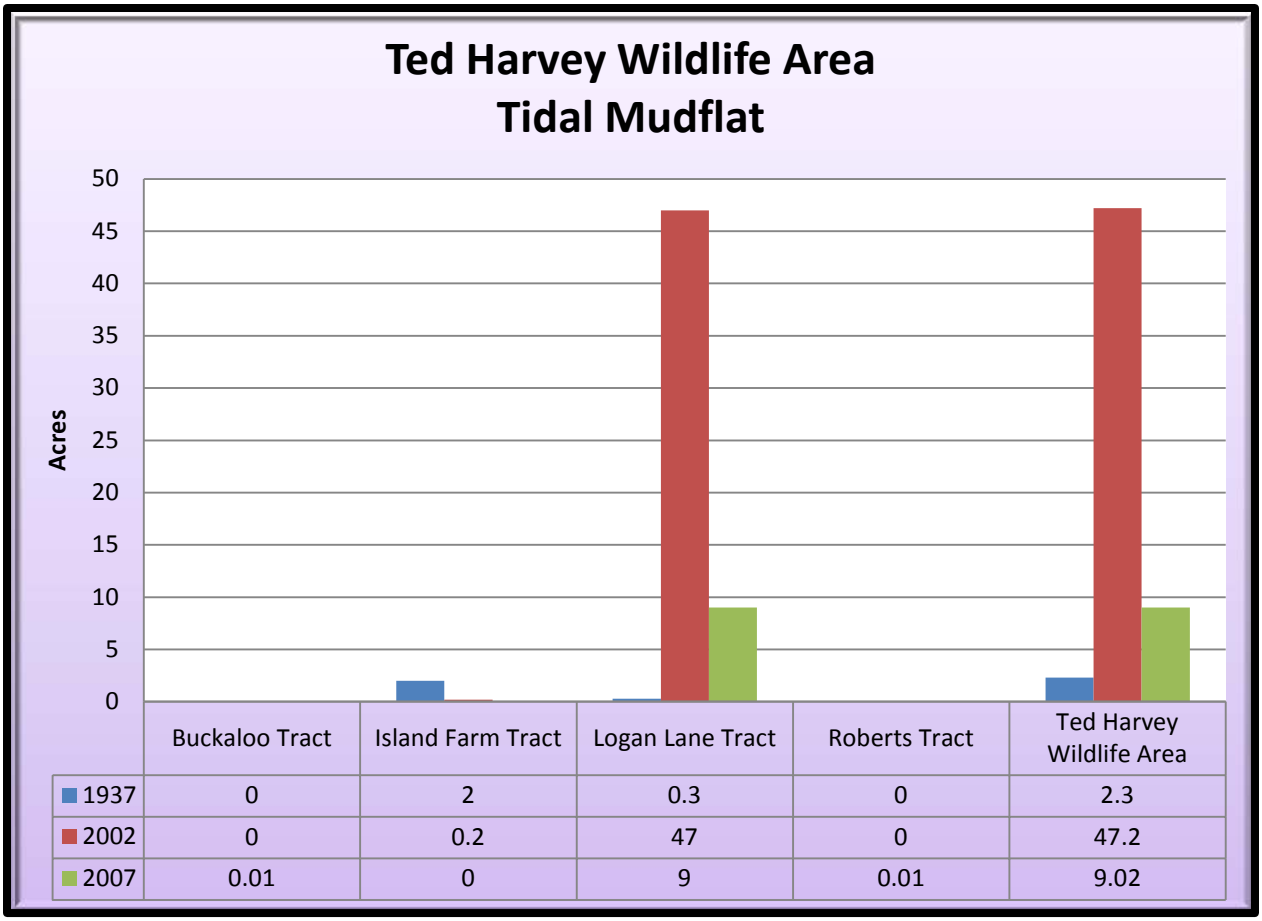


Figure 6.9. Tidal Mudflat at Ted Harvey Wildlife Area (1937, 2002, and 2007)

DNREC Sea Level Rise Analysis (Table 6.24)

All of the current acreage of tidal mudflat will be converted to water with 0.5 m of sea level rise.

Table 6.24. Projected acres of Tidal Mudflat Impacted by Sea Level Rise	
Rise	**Acres**
0.5 m	9 acres
1 m	50 acres
1.5 m	127 acres

Natural Capital (Table 6.25)

Tidal mudflat had an upsurge in 2002 and has since declined. This community often comes and goes and this could be part of its natural cycle.

Table 6.25. Natural Capital of Tidal Mudflat	
Year	**Natural Capital (in 2012 dollars)**
1937	$14,424/year
2002	$296,005/year
2007	$56,442/year

***Water* [42 acres (Figures 6.10-6.11, Tables 6.26-6.28)]**

DEWAP: Nearshore Habitats
NHC: No Equivalent Classification

The amount of water present is the bellwether of sea level rise and has been increasing at an increasing rate (Figure 6.11) at Ted Harvey Wildlife Area. Showing some sedimentation in the wildlife area, some former water areas have become North Atlantic Low Salt Marsh (22 acres) with a smaller amount of Impoundment (6 acres), Irregularly Flooded Eastern Tidal Salt Shrub (2 acres), and Reed Tidal Marsh (1 acre) (Table 6.26). Since 1937, water has inundated 23 acres of North Atlantic Low Salt Marsh, 6 acres of beach, 4 acres of Irregularly Flooded Eastern Tidal Salt Shrub, and 4 acres of Reed Tidal Marsh (Table 6.27).

Table 6.26. What was once Water in 1937 has become X or remained in 2007	
X	**Acreage**
North Atlantic Low Salt Marsh	22 acres
Impoundment	6 acres
Water	3 acres
Irregularly Flooded Eastern Tidal Salt Shrub	2 acres
Reed Tidal Marsh	1 acre
Other vegetation communities/land covers	2 acres

Table 6.27. Water has migrated into X or remained since 1937	
X	**Acreage**
North Atlantic Low Salt Marsh	23 acres
Beach	6 acres
Irregularly Flooded Eastern Tidal Salt Shrub	4 acres
Reed Tidal Marsh	4 acres
Water	3 acres
Other communities/land covers	6 acres

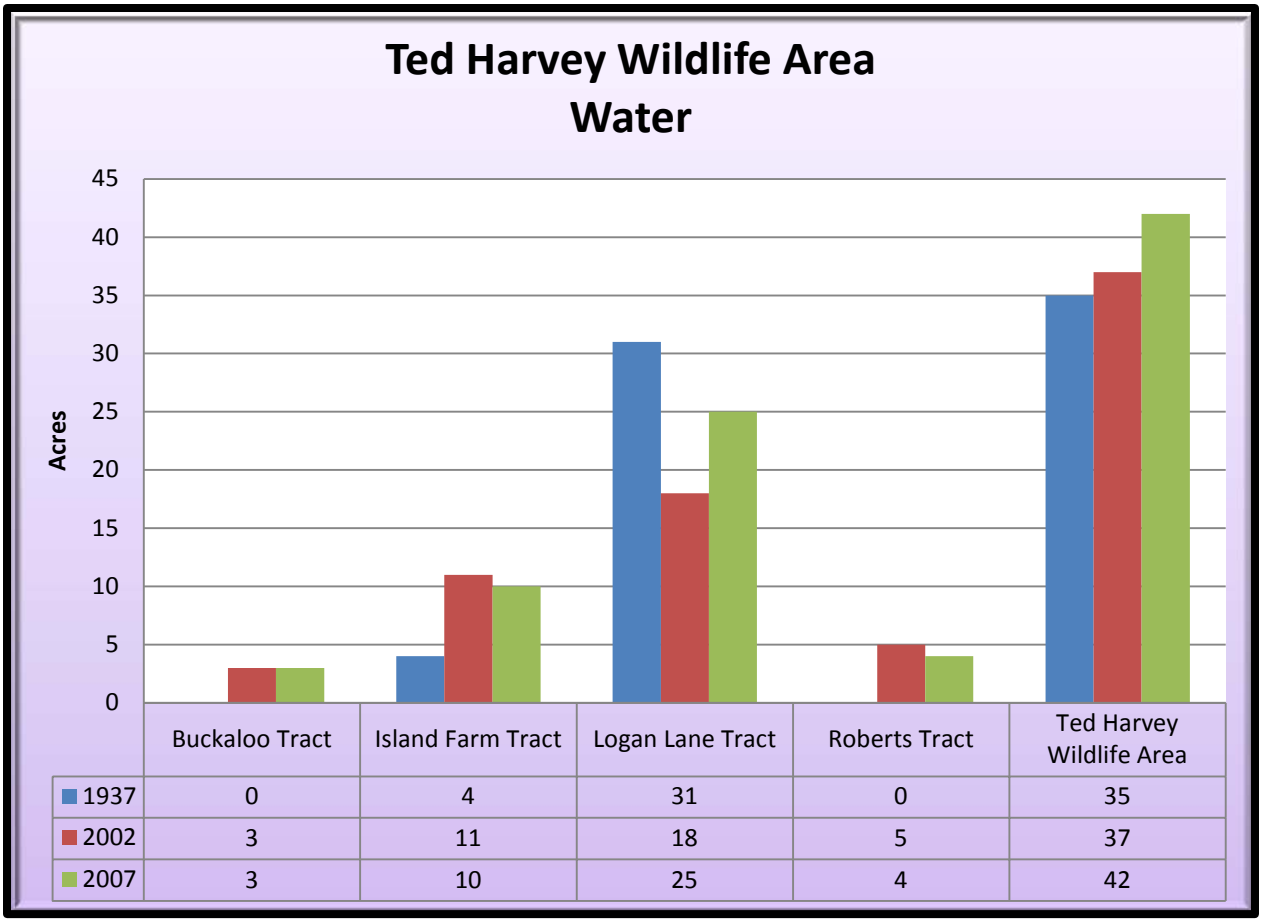


Figure 6.10. Water at Ted Harvey Wildlife Area (1937, 2002, and 2007)

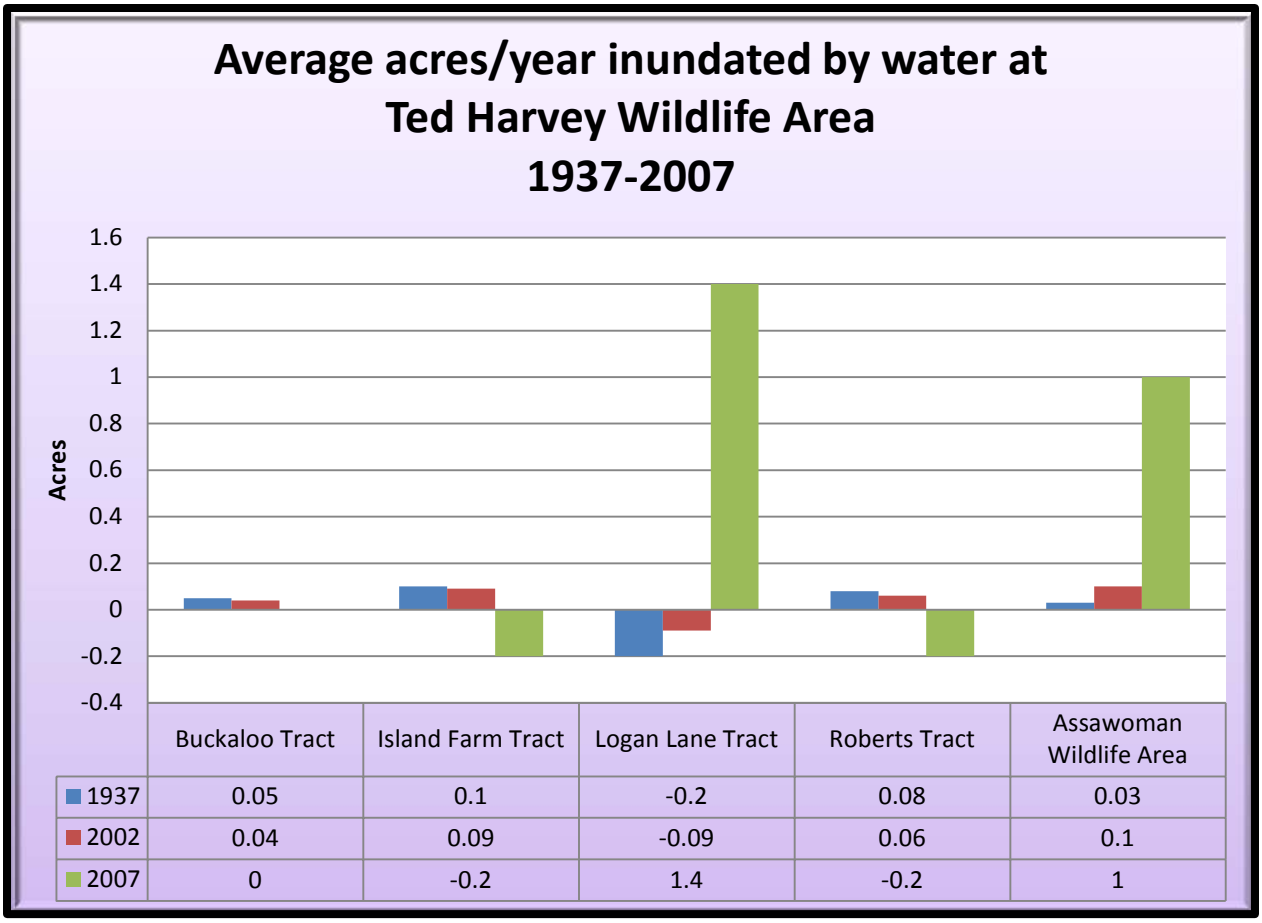


Figure 6.11. Acres of land per year inundated by water at Ted Harvey Wildlife Area (1937-2007)

DNREC Sea Level Rise Analysis

Water coverage is not relevant to the sea level rise scenarios since it is the flooder rather than the floodee.

Natural Capital (Table 6.28)

Water capital has been increasing as more land is inundated.

Table 6.28. Natural Capital of Water

Year	Natural Capital (in 2012 dollars)
1937	$501,650/year
2002	$530,315/year
2007	$601,980/year

APPENDIX I: STATE RARE VEGETATION RANKING CRITERIA

Ranks are based on a system developed by The Nature Conservancy and Natureserve to measure the relative rarity of vegetation communities within a given state. State rarity ranks are used to prioritize conservation and protection efforts so that the rarest of vegetation communities receive immediate attention. The primary criteria for ranking vegetation communities are the total number of documented occurrences with consideration given to the total number of occurrences and total amount of acreage in the state. Ranks for vegetation communities are updated annually and are based on current knowledge and mapping being done for the Guide to Delaware Vegetation Communities.

State Rank

S1 Extremely rare (i.e., typically 5 or fewer occurrences statewide), or may be susceptible to extirpation because of other threats to its existence.

S1.1 Only a single occurrence or population of the species is known to occur. (this rank is only applied to plants.)

S2 Very rare, (i.e., typically 6 to 20 occurrences statewide), or may be susceptible to extirpation because other threats to its existence.

S3 Rare to uncommon, not yet susceptible to extirpation but may be if additional populations are destroyed. Approximately 21 to 100 occurrences statewide.

S4 Common, apparently secure in the state under present conditions.

S5 Very common, secure in the state under present conditions.

SH Historically known, but not verified for an extended period (usually 15+ years); there are expectations that the species may be rediscovered.

SX Extirpated or presumed extirpated from the state. All historical locations and/or potential habitat have been surveyed.

SU Status uncertain within the state. Usually an uncommon species which is believed to be of conservation concern, but there is inadequate data to determine the degree of rarity.

SNR Unranked

SNA Not Applicable

SW Weedy vegetation or vegetation dominated by invasive alien species (this rank is only applied to natural communities).

SM Vegetation resulting from management or modification of natural vegetation. It is readily restorable by management or time and/or the restoration of original ecological processes (this rank is only applied to natural communities).

APPENDIX II: SGCN SPECIES EXPECTED FOR KEY WILDLIFE HABITATS

SGCN Species expected in Beach and Dune Habitats			
Species	**Common Name**	**Class**	**Tier**
Cincindela dorsalis media	white tiger beetle	Insect	1
Cincindela lepida	little white tiger beetle	Insect	1
Malaclemys terrapin terrapin	Northern diamondback terrapin	Reptile	1
Charadrius melodus	Piping plover	Bird	1
Haematopus palliatus	American Oystercatcher	Bird	1
Arenaria interpres	ruddy turnstone	Bird	1
Calidris canutus	Red knot	Bird	1
Calidrius alba	sanderling	Bird	1
Sterna hirundo	common tern	Bird	1
Sterna antillarum	least tern	Bird	1
Rynchops niger	black skimmer	Bird	1
Chordeiles minor	common nighthawk	Bird	1
Cincindela dorsalis	Eastern beach tiger beetle	Bird	2
Cincindela hirticolis	beach-dune tiger beetle	Bird	2
Melitara prodenialis	a snout-moth	Bird	2
Drasteria graphica atlantica	Atlantic graphic moth	Bird	2
Schinia spinosae	a noctuid moth	Bird	2
Falco peregrinus	peregrine falcon	Bird	2
Pluvialis squatarola	black-bellied plover	Bird	2
Catoptrophorus semipalmatus	willet	Bird	2
Calidris pusilla	semi-palmated sandpiper	Bird	2
Calidris maritima	purple sandpiper	Bird	2
Calidris alpina	dunlin	Bird	2
Larus marinus	great black-backed gull	Bird	2
Piplio erythrophthalmus	Eastern towhee	Bird	2
Passerculus sandwichensis	savannah sparrow	Bird	2

SGCN Species expected in Early Successional Upland Habitats			
Species	**Common Name**	**Class**	**Tier**
Nicrophorus americanus	American burying beetle	Insect	1
Callophrys irus	frosted elfin	Insect	1
Papaipema maritima	maritime sunflower borer moth	Insect	1
Terrapene carolina	Eastern box turtle	Reptile	1
Lampropeltis triangulum	milk snake	Reptile	1
Branta canadensis	Canada goose (migratory)	Bird	1
Circus cyaneus	Northern harrier	Bird	1
Bartramia longicauda	upland sandpiper	Bird	1
Scolopax minor	American woodcock	Bird	1
Asio flammeus	short-eared Owl	Bird	1
Chordeiles minor	common nighthawk	Bird	1
Lanius ludovicianus	loggerhead shrike	Bird	1
Dendroica discolor	prairie warbler	Bird	1

Ammodramus henslowii	Henslow's sparrow	Bird	1
Cincindela scutellaris	festive tiger beetle	Insect	2
Atrytonopsis hianna	dusted skipper	Insect	2
Satyrium liparops	striped hairstreak	Insect	2
Satyrium liparops strigosum	stiped hairstreak	Insect	2
Callophrys gryneus	juniper hairstreak	Insect	2
Speyeria aphrodite	aphrodite fritillary	Insect	2
Speyeria idalia	regal fritillary	Insect	2
Boloria bellona	meadow fritillary	Insect	2
Paratrea plebeja	trumpet vine sphinx	Insect	2
Calyptra canadensis	Canadian owlet	Insect	2
Acronicta rubricoma	a dagger moth	Insect	2
Papaipema rigida	rigid sunflower borer moth	Insect	2
Cirrhophanus triangulifer	a noctuid moth	Insect	2
Schina septentrionalis	a noctuid moth	Insect	2
Plegadis falcinellus	glossy ibis	Bird	2
Cygnus columbianus	tundra swan	Bird	2
Coragyps atratus	black vulture	Bird	2
Colinus virginianus	Northern bobwhite	Bird	2
Pluvialis squatarola	black-bellied plover	Bird	2
Coccyzus erythropthalmus	black-billed cuckoo	Bird	2
Chaetura pelagica	chimney swift	Bird	2
Colaptes auratus	Northern flicker	Bird	2
Empidonax minimus	least flycatcher	Bird	2
Tyrannus tyrannus	Eastern kingbird	Bird	2
Toxostoma rufum	Brown thrasher	Bird	2
Dendroica pensylvanica	Chestnut-sided warbler	Bird	2
Icteria virens	Yellow-breasted chat	Bird	2
Piplio erythrophthalmus	Eastern towhee	Bird	2
Spizella pusilla	field sparrow	Bird	2
Pooecetes gramineus	vesper sparrow	Bird	2
Passerculus sandwichensis	savannah sparrow	Bird	2
Ammodramus savannarum	grasshopper sparrow	Bird	2
Dolichonyx oryzivorus	bobolink	Bird	2
Cryptotis parva	least shrew	Bird	2

SGCN Species expected in Coastal Plain Upland Forest			
Species	**Common Name**	**Class**	**Tier**
Cicindela patruela consentanea	Northern barrens tiger beetle	Insect	1
Callophrys irus	frosted elfin	Insect	1
Catocala antinympha	sweetfern underwing	Insect	1
Catocala lacrymosa	tearful underwing	Insect	1
Terrapene carolina	Eastern box turtle	Reptile	1
Eumeces laticeps	broadhead skink	Reptile	1
Cemophora coccinea	scarlet snake	Reptile	1
Elaphe guttata	corn snake	Reptile	1
Lampropeltis triangulum	milk snake	Reptile	1

Haliaeetus leucocephalus	Bald eagle	Bird	1
Accipiter cooperii	Cooper's Hawk	Bird	1
Buteo platypterus	broad-winged hawk	Bird	1
Asio otus	long-eared owl	Bird	1
Melanerpes erythrocephalus	red-headed woodpecker	Bird	1
Certhia americana	brown creeper	Bird	1
Hylocichla mustelina	wood thrush	Bird	1
Wilsonia citrina	hooded warbler	Bird	1
Sciurus niger cinereus	Delmarva fox squirrel	Mammal	1
Discus catskillensis	angular disc	Gastropod	2
Cicindela patruela	Northern barrens tiger beetle	Insect	2
Cicindela unipunctata	one-spotted tiger beetle	Insect	2
Photuris frontalis	a firefly	Insect	2
Erynnis martialis	mottled duskywing	Insect	2
Erynnis baptisiae	wild indigo duskywing	Insect	2
Battus philenor	pipevine swallowtail	Insect	2
Polygonia progone	gray comma	Insect	2
Caripeta aretaria	a geometer moth	Insect	2
Tolype notialis	a lasiocampid moth	Insect	2
Hemileuca maia maia	the buckmoth	Insect	2
Cisthene kentuckiensis	Kentucky lichen moth	Insect	2
Cisthene tenuifascia	a lichen moth	Insect	2
Grammia phyllira	phyllira tiger moth	Insect	2
Zale metata	a noctuid moth	Insect	2
Catocala flebilis	mournful underwing	Insect	2
Catocala residua	residua underwing	Insect	2
Catocala cerogama	Yellow banded underwing	Insect	2
Acronicta exilis	Exiled dagger moth	Insect	2
Acronicta lithospila	Streaked dagger moth	Insect	2
Papaipema araliae	Aralia shoot borer moth	Insect	2
Papaipema baptisiae	Wild indigo borer moth	Insect	2
Lepipolys perscripta	A noctuid moth	Insect	2
Scincella lateralis	Ground skink	Reptile	2
Heterodon platirhinos	Eastern hognose snake	Reptile	2
Lampropeltis getula	Common kingsnake	Reptile	2
Storeria occipitomaculata	Redbelly snake	Reptile	2
Virginia valeriae	Smooth earth snake	Reptile	2
Agkistrodon contortix	Copperhead	Reptile	2
Coragyps atratus	Black vulture	Bird	2
Strix varia	Barred owl	Bird	2
Caprimulgus vociferus	whip-poor-will	Bird	2
Colaptes auratus	Northern flicker	Bird	2
Myiarchus crinitus	Great crested flycatcher	Bird	2
Sitta pusilla	Brown-headed nuthatch	Bird	2
Vireo flavifrons	Yellow-throated vireo	Bird	2
Dendroica dominca	Yellow-throated warbler	Bird	2
Mniotilta varia	Black-and-white warbler	Bird	2
Seiurus motacilla	Louisiana waterthrush	Bird	2

Oporornis formosus	Kentucky warbler	Bird	2
Piranga olivacea	Scarlet tanager	Bird	2
Piplio erythrophthalmus	Eastern towhee	Bird	2
Icterus galbula	Baltimora oriole	Bird	2
Lasionycteris noctivagans	Silver-haired bat	Mammal	2
Lasiurus borealis	Eastern red bat	Mammal	2
Lasiurus cinereus	Hoary bat	Mammal	2
Canis latrans	coyote	Mammal	2
SGCN Species expected in Coastal Plain Forested Floodplains and Riparian Swamps			
Species	**Common Name**	**Class**	**Tier**
Satyrium kingi	King's hairstreak	Insect	1
Clemmys guttata	Spotted turtle	Reptile	1
Terrapene carolina	Eastern box turtle	Reptile	1
Nerodia erythrogaster	Plainbelly water snake	Reptile	1
Nycticorax nyticorax	Black crowned night-heron	Bird	1
Nyctanassa violacea	yellow-crowned night-heron	Bird	1
Buteo platypterus	Broad-winged hawk	Bird	1
Melanerpes erythrocephalus	Red-headed woodpecker	Bird	1
Hylocichla mustelina	Wood thrush	Bird	1
Parula americana	Northern parula	Bird	1
Setophaga ruticella	American redstart	Bird	1
Limnothlypis swainsonii	Swainson's warbler	Bird	1
Amblyscirtes aesculapius	Lace-winged roadside-skipper	Insect	2
Libytheana carinenta	American snout	Insect	2
Anacamptodes pergracilis	Cypress looper	Insect	2
Chloropteryx tepperaria	Angle winged emerald moth	Insect	2
Manduca jasminearum	Ash sphinx	Insect	2
Dolba hyloeus	Black alder or pawpaw sphinx	Insect	2
Haploa colona	A tiger moth	Insect	2
Orgyia detrita	A tussock moth	Insect	2
Catocala unijuga	Once-married underwing	Insect	2
Catocala praeclara	Praeclara underwing	Insect	2
Parapamea buffaloensis	A borer moth	Insect	2
Papaipema stenocelis	Chain fern borer moth	Insect	2
Gomphaeschna antilope	Taper-tailed darner	Insect	2
Gomphaeschna furcillata	Harlequin darner	Insect	2
Sympetrum ambiguum	Blue-faced meadowhawk	Insect	2
Enallagma weewa	Blackwater bluet	Insect	2
Hemidactylum scutatum	Four-toed salamander	Amphibian	2
Pseudotriton montanus montanus	Mud salamander	Amphibian	2
Hyla chrysoscelis	Cope's gray treefrog	Amphibian	2
Rana virgatipes	Carpenter frog	Amphibian	2
Opheodrys aestivus	Rough green snake	Reptile	2
Thamnophis sauritus	Eastern ribbon snake	Reptile	2
Agkistrodon contortix	copperhead	Reptile	2
Ardea herodias	Great blue heron	Bird	2
Casmerodius albus	Great egret	Bird	2

Egretta thula	Snowy egret	Bird	2
Egretta caerulea	Little blue heron	Bird	2
Egretta tricolor	Tricolored heron	Bird	2
Bubulcus ibis	Cattle egret	Bird	2
Plegadis falcinellus	Glossy ibis	Bird	2
Buteo lineatus	Red-shouldered hawk	Bird	2
Strix varia	Barred owl	Bird	2
Vireo flavifrons	Yellow-throated vireo	Bird	2
Protonotaria citrea	Prothonotary warbler	Bird	2
Helmitheros vermivorus	Worm-eating warbler	Bird	2
Oporornis formosus	Kentucky warbler	Bird	2
Piranga olivacea	Scarlet tanager	Bird	2
Icterus galbula	Baltimore oriole	Bird	2
Lasionycteris noctivagans	Silver-haired bat	Mammal	2
Nycticeius humeralis	Evening bat	Mammal	2

SGCN Species expected in Freshwater Tidal Marshes			
Paones massasoit chermockii	Chermock's Mulberry Wine	Insect	1
Nannothemis bella	Elfin Skimmer	Insect	1
Clemmys guttata	Spotted Turtle	Reptile	1
Podilymbus podiceps	Pied-billed grebe	Bird	1
Nycticorax nycticorax	Black-crowned night heron	Bird	1
Nyctanassa violacea	Yellow-crowned night heron	Bird	1
Pandion haliaetus	osprey	Bird	1
Lycaena hyllus	Bronze copper	Insect	2
Papaipema birdii	Umbellifer borer moth	Insect	2
Libellula axilena	Bar-winged skimmer	Insect	2
Argia bipunctulata	Seepage dancer	Insect	2
Nehalennia gracilis	Sphagnum sprite	Insect	2
Botaurus lentiginosus	American bittern	Bird	2
Ixobrychus exilis	Least Bittern	Bird	2
Ardea herodias	Great blue heron	Bird	2
Casmeridius albus	Great egret	Bird	2
Egretta thula	Snowy egret	Bird	2
Egretta caerulea	Little blue heron	Bird	2
Egretta tricolor	Tricolored heron	Bird	2
Bubulcus ibis	Cattle egret	Bird	2
Anas platyrhynchos	mallard	Bird	2
Rallus elegans	King rail	Bird	2
Porzana carolina	sora	Bird	2
Dolichonyx oryzivorus	bobolink	Bird	2

SGCN Species expected in Impoundments			
Species	**Common Name**	**Class**	**Tier**
Podilymbus podiceps	Pied-billed grebe	Bird	1
Branta canadensis	Canada goose (migratory)	Bird	1

Anas rubripes	American black duck	Bird	1
Pandion haliaetus	osprey	Bird	1
Actitus macularia	Spotted sandpiper	Bird	1
Cygnus columbianus	Tundra swan	Bird	2
Anas platyrhynchos	mallard	Bird	2
Anas clypeata	Northern shoveler	Bird	2
Aythya valisneria	canvasback	Bird	2
Aythya marila	Greater scaup	Bird	2
Aythya affinis	Lesser scaup	Bird	2
Bucephala albeola	bufflehead	Bird	2
Lophodytes cucullatus	Hooded merganser	Bird	2
Pluvialis squatarola	Black-bellied plover	Bird	2
Himantopus mexicanus	Black-necked stilt	Bird	2
Catoptrophorus semipalmatus	willet	Bird	2
Calidris pusilla	Semipalmated sandpiper	Bird	2
Calidris alpina	dunlin	Bird	2

SGCN Species expected in Nearshore Habitats			
Species	**Common Name**	**Class**	**Tier**
Callinectes sapidus	Blue crab	Crustaceans	1
Limulus polyphemus	Horseshoe crab	Arachinids	1
Pristis pectinata	Smalltooth sawfish	Fish	1
Acipenser brevirostrum	Shortnose sturgeon	Fish	1
Acipenser oxyrinchus	Atlantic sturgeon	Fish	1
Caretta caretta	Loggerhead sea turtle	Reptile	1
Chelonia mydas	Atlantic green turtle	Reptile	1
Lepidochelys kempii	Kemp's Ridley sea turtle	Reptile	1
Branta canadensis	Canada goose (migratory)	Bird	1
Pandion haliaetus	Osprey	Bird	1
Phocoena phocoena	Harbor porpoise	Mammal	1
Balaenoptera physalus	Fin whale	Mammal	1
Megaptera novaeangliae	Humpback whale	Mammal	1
Balaena glacialis	Northern right whale	Mammal	1
Cetorhinus maximus	Basking shark	Fish	2
Carcharodon carcharias	White shark	Fish	2
Carcharhinus obscurus	Dusky shark	Fish	2
Squatina dumeril	Atlantic angel shark	Fish	2
Alosa mediocris	Hickory shad	Fish	2
Apeltes quadracus	Fourspine stickleback	Fish	2
Eretmochelys imbricata imbricate	Hawksbill	Reptile	2
Pelecanus occidentalis	Brown pelican	Bird	2
Phalacrocorax carbo	great cormorant	Bird	2
Phalacrocorax auritus	Double-crested cormorant	Bird	2
Cygnus columbianus	Tundra swan	Bird	2
Branta bemicla	brant	Bird	2

Aythya valisineria	Canvasback	Bird	2
Aythya americana	Redhead	Bird	2
Aythya marila	Greater scaup	Bird	2
Aythya affinis	Lesser scaup	Bird	2
Clangula hyemalis	Oldsquaw	Bird	2
Melanitta nigra	Black scoter	Bird	2
Melanitta perspicillata	Surf scoter	Bird	2
Melanitta fusca	White-winged scoter	Bird	2
Bucephala albeola	bufflehead	Bird	2

SGCN Species expected in Tidal High Marsh Habitats			
Species	**Common Name**	**Class**	**Tier**
Problema bulenta	rare skipper	Insect	1
Pero zalissaria	a geometer moth	Insect	2
Acontia delecta	a noctuid moth	Insect	2
Papaipema birdi	umbellifer borer moth	Insect	2
Brachymesia gravida	four-spotted pennant	Insect	2
Nycticorax nycticorax	black-crowned night-heron	Bird	1
Nyctanassa violacea	yellow-crowned night-heron	Bird	1
Anas rubripes	American black duck	Bird	1
Circus cyaneus	northern harrier	Bird	1
Laterallus jamaicensis	black rail	Bird	1
Asio flammeus	short-eared owl	Bird	1
Cistothorus platensis	sedge wren	Bird	1
Ammodramus caudacutus	saltmarsh sharp-tailed sparrow	Bird	1
Ammodramus maritimus	seaside sparrow	Bird	1
Botaurus lentiginosus	American bittern	Bird	2
Ixobrychus exilis	least bittern	Bird	2
Ardea herodias	great blue heron	Bird	2
Casmerodius albus	great egret	Bird	2
Egretta thula	snowy egret	Bird	2
Egretta caerulea	little blue heron	Bird	2
Egretta tricolor	tricolored heron	Bird	2
Bubulcus ibis	Cattle egret	Bird	2
Porzana carolina	sora	Bird	2
Fulica americana	American coot	Bird	2
Tyto alba	barn owl	Bird	2
Cistothorus palustris	marsh wren	Bird	2

SGCN Species expected in Tidal Low Marsh Habitats			
Species	**Common Name**	**Class**	**Tier**
Problema bulenta	rare skipper	Insect	1
Malaclemys terrapin terrapin	Northern diamondback terrapin	Reptile	1
Podilymbus podiceps	Pied-billed grebe	Bird	1
Nycticorax nycticorax	Black-crowned night-heron	Bird	1

Branta canadensis	Canada goose (migratory)	Bird	1
Anas rubripes	American black duck	Bird	1
Nyctanassa violacea	yellow-crowned night-heron	Bird	1
Circus cyaneus	northern harrier	Bird	1
Arenaria interpres	Ruddy turnstone	Bird	1
Asio flammeus	short-eared owl	Bird	1
Calidris canutus	Red knot	Bird	1
Sterna hirundo	Common tern	Bird	1
Sterna forsteri	Forster's tern	Bird	1
Rhnchops niger	Black skimmer	Bird	1
Ammodramus caudacutus	Saltmarsh sharp-tailed sparrow	Bird	1
Ammodramus maritimus	Seaside sparrow	Bird	1
Cicindela marginata	Margined tiger beetle	Insect	2
Pero zalissaria	A geometer moth	Insect	2
Acontia delecta	A noctuid moth	Insect	2
Brachymesia gravida	Four-spotted pennant	Insect	2
Pelecanus occidentalis	Brown pelican	Bird	2
Phalacrocorax carbo	Great cormorant	Bird	2
Phalacrocorax auritus	Double-crested cormorant	Bird	2
Ardea herodias	Great blue heron	Bird	2
Casmerodius albus	Great egret	Bird	2
Egretta thula	Snowy egret	Bird	2
Egretta caerulea	Little blue heron	Bird	2
Egretta tricolor	Tricolored heron	Bird	2
Bubulcus ibis	Cattle egret	Bird	2
Plegadis falcinellus	Glossy ibis	Bird	2
Anas platyrhynchos	mallard	Bird	2
Falco peregrinus	Peregrine falcon	Bird	2
Rallus elegans	King rail	Bird	2
Fulica americana	American coot	Bird	2
Pluvialis squatarola	Black-bellied plover	Bird	2
Himantopus mexicanus	Black-necked stilt	Bird	2
Catoptrophorus semipalmatus	Willet	Bird	2
Calidris pusilla	Semipalmated sandpiper	Bird	2
Calidris alpina	dunlin	Bird	2
Sterna nilotica	Gull-billed tern	Bird	2
Tyto alba	Barn owl	Bird	2
Cistothorus palustris	Marsh wren	Bird	2