

Biological Diversity Survey of the Flora and Fauna of Fort Monroe and Bethel Reservoir



**John I. Galvez, Ph.D.
Terry W. Black
Gary L. Swihart
Cynthia B. Black**



**U.S. Fish and Wildlife Service
Gloucester Office of Fishery Assistance**

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EXECUTIVE SUMMARY

A survey of the flora and fauna of Fort Monroe and Bethel Reservoir was conducted to provide the Department of the Army with an inventory of the biodiversity of the area. The inventory includes vascular plants and trees, and vertebrates confirmed or suspected to be present in Fort Monroe and adjacent to Bethel Reservoir.

Two-hundred forty-nine species of plants, 10 of trees, 217 of birds, 29 of land mammals, 31 of reptiles and amphibians, 18 of freshwater fishes (Bethel Reservoir) and 42 species of euryhaline fishes (Mill Creek, Fort Monroe) are reported in this inventory.

One endangered, Peregrine Falcon (*Falco peregrinus*), and two threatened, Bald Eagle (*Haliaeetus leucocephalus*) and Piping Plover (*Charadrius melodus*), bird species are listed by the U.S. Fish and Wildlife Service as inhabiting Hampton and York counties, and areas of Fort Monroe and Bethel Reservoir. It is suggested these species be incorporated as part of the Natural Resources Management Plan of Fort Monroe to assure long term protection and compliance with the Endangered Species Act. Every effort should be made to protect habitats where these species are found and to educate residents about their protection.

The primary limitations for flora and fauna are habitat size and exposure to humans at both sites. At Fort Monroe, habitat quality is also an issue due to its origins as a barrier island and its long-term maintenance as a military base. Both sites are biological islands for most species of animals.

During the inventory of the vascular plants of Fort Monroe a plant, red lovegrass (*Eragrostis secundiflora* var. *Oxylepis*), was found for the first time in the Commonwealth of Virginia. This finding is considered a State Record. However, this plant does not warrant special protection. This species is characterized as aggressive, habitat threatening, and an undesirable plant. To ensure that it does not spread and invade critical habitats on the coastal plain, this species should be monitored periodically. If habitats become overrun and threatened, removal in its entirety is recommended.

Bethel Reservoir does offer excellent habitat for aquatic species as evidenced by turtle diversity and the number of otters and aquatic birds. The Reservoir appears to be important to migrating waterfowl. Brick Kiln Creek allows for the migration of fishes, reptiles and amphibians near Bethel.

Animals and plants can be protected against human impacts through education, signs or brochures, and enforcement of rules prohibiting depredation. A Natural Resource Management Plan for Fort Monroe should include measures to minimize the impact from human activities on animals and plants, and assure the maintenance of the biological diversity of this important area of the Chesapeake Bay and the Commonwealth of Virginia.

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INTRODUCTION

This document describes the biological diversity found on Fort Monroe and at Bethel Reservoir. Information on vegetation, fish, amphibians, reptiles, birds and mammals are summarized in tables. All the data compiled in this report was found through field surveys and by searching specialized literature and databases. An effort was made to include the current scientific names of species as reported by the different scientific associations that review them periodically. Several renowned experts helped in this effort to create a flora and fauna database for Fort Monroe. The amphibians and reptiles survey was conducted by Dr. Barbara Savitzky. Patrick Baldwin sampled the flora of Fort Monroe, while personnel from the U.S. Fish and Wildlife Service conducted surveys of birds, fish and mammals.

The purpose of this project was to survey the area and provide an inventory of species of flora and fauna inhabiting Fort Monroe and Bethel Reservoir. This document is an important tool for natural resource managers, scientists, and others interested in the biological diversity of the area. Information available regarding the biodiversity of Fort Monroe and Bethel Reservoir is scarce. The aim of the U.S. Fish and Wildlife Service is to fill a void in biological information needed to assist the Department of the Army in their planning and implementation of adequate natural resource management procedures for Fort Monroe and Bethel Reservoir.

Most animals and plants were identified in the field, although a few were temporarily brought into the office for consultation and confirmation of species. All methods used for trapping and capturing animals were non-lethal, and every effort was made to cause the least trauma possible to the individuals. All animals were released unharmed at the site of capture.

The biodiversity study was conducted under the terms of a memorandum of Agreement between the U.S. Fish and Wildlife Service and Fort Monroe, Virginia. Funding for the study was provided by Military Interdepartmental Purchase Request number M4A4E009.

METHODS

A variety of standard sampling techniques was used for the different taxa of flora and fauna of Fort Monroe and Bethel Reservoir. These methods were employed at locations and times appropriate to the annual activity cycles of the organisms being surveyed. Techniques used for the different taxa are briefly described in each section. In general, the following methods were used:

Visual encounter survey: Areas were walked through in a systematic manner. Ground and above-ground structures such as logs, tree trunks, and vegetation were visually searched carefully. Animal-associated structures such as logs and burrows were torn apart as much as possible, and leaves and other ground cover were raked up. Vegetation was parted to check inside and on the ground at the base. This part of the visual encounter survey is also referred to as the “rip and tear” approach. Areas used by the public, such as Bethel Park, received more gentle treatment: logs and leaf litter were turned over but were returned to their original position. Binoculars (10 x 50) were used to visually search areas not approachable by boat or on foot.

Electrofishing: Fish were collected by electroshocking. A DC electric current was applied to the water to stun fish without causing any harm. As soon as fish reached the surface they were collected by dip-netting.

Dip-netting: Amphibians, especially larvae and fully aquatic species, were effectively sampled by dip-netting with long handled nets into the water. Dip-netting is usually done in conjunction with both visual encounter surveys and electrofishing.

Seining: Brackish water and salt water have high conductivities. At high conductivities, water becomes less resistant than fish, and the current tends to flow around them, resulting in little or no voltage effect. Thus electrofishing is ineffective, and fish are collected by seining. The seine was set in a circular pattern and closed by drawing the moving wall of webbing past the end held in place or attached to a post (Nielsen and Johnson, 1983). Sampling sites were chosen at random along the body of water.

Live trapping: Small mammals were sampled using Sherman aluminum folding live capture traps. Mammals were attracted to the inside by bait made of peanut butter on a cotton ball. Traps were set during the morning and checked 24 hours later. The success with this type of trap was very limited.

Drift fences and funnel traps: This technique catches animals that are active at night or sporadically active that might be missed in the visual encounter surveys and employs low fences buried in the soil or affixed tightly to the soil to intercept animals by forcing them to move along the fence. Funnel traps constructed of screen wire were placed tightly against the fencing at the ends and the middle to capture the animals. Fences were placed in areas traveled by reptiles and amphibians, usually near water. Twenty-five foot long fences constructed of silt fencing were used for easy placement and removal. This technique works well along wetlands and bodies of water (Enge, 1997). Pit-fall traps are used in conjunction with these fences when possible. In this case, the number of roots and soil hardness rendered the placement of pit-falls impractical. The fences were placed parallel to the shore or were used as a T-shaped array of two fences near the shore. To avoid damage or destruction by humans these traps were used in areas along the reservoir not used by people.

Turtle trapping: Traps constructed of chicken wire and baited with canned sardines were used for trapping aquatic turtles. Traps were set in shallow water and held there with monofilament line tied to trees or logs so that turtles would not drown. Traps were checked twice daily. Trap openings were kept small enough to retain smaller turtles and keep out the largest individuals in order to maximize the number of individuals and species captured.

Interviews: Since some species occur sporadically and unpredictably, interviews were conducted from a variety of people to gather information. In addition, several specialists were consulted in order to determine the best sampling methods, identify species, and clarify recent taxonomical changes in the scientific names.

Road cruising: Driving along roads at night is an excellent method of finding live reptiles and amphibians. Road-killed specimens can be found during the day, and also provide evidence of occurrence.

Audio Survey: Birds and other animals were located and identified when possible by their sounds. An electronic sound amplifier (“Bionic Booster”) was used for this purpose.

Geographic Information System (GIS) Application: Aerial color imaging was produced by Stephen Rice using PC Arc-Info and ArcView Software. The landuse data came from the NOAA C-CAP program and was generated at the Oak Ridge laboratory in Knoxville, TN. The data presented was generated from satellite imagery from 1992.

Literature and Computer Searches: Several computer databases were checked for up-to-date information about the presence (confirmed or suspected) of animals and plants. Virginia Fish and Wildlife Information System (Biota of Virginia or BOVA) was used to determine if additional species listed as present in the area were not found during the sampling periods. The following databases were search for information regarding flora and fauna of this area:

1. Virginia Fish and Wildlife Information System:

(Biota of Virginia or BOVA)

a. Records Database (US Fish & Wildlife Service)

2. American Ornithology Union:

a. Records Database

3. Christopher Newport University :

a. Christopher Newport University Library

b. Department of Biology

4. College of William & Mary:
 - a. Swem Library
 - b. Department of Biology
 - c. Records Database

5. National Audubon Society:
 - a. Records Database

6. Natural Heritage Resources of Virginia:
 - a. Records Database

7. Old Dominion University:
 - a. Old Dominion University Library

8. Smithsonian Institution:
 - a. Records Database

9. University of Maryland:
 - a. University Of Maryland Library
 - b. Department of Biology

10. University of Virginia:
 - a. Records Database

11. USDA (Natural Resources Conservation Service):
 - a. National Plants Database

12. Wildlife Information Online Service:

- a. VSO Bird Atlas
- b. VSO Breeding Bird Atlas
- c. BBS USFWS Breeding Bird Survey
- d. Collections Database
- e. VSO Master Records, *Raven* Report

SITE DESCRIPTION

Fort Monroe is located at the tip of the Virginia Peninsula (37° 1'N and 76° 19' W), and comprises an area of 570 acres. The area has been used as a fortification since the 1700s and is home of the United States Army Training and Doctrine Command, the Joint Warfighting Center, and the United States Army Cadet Command. Satellite imagery data of land use shows that the area presents a high intensity of urban development with a few patches of grassland, exposed lands, and deciduous forest. Estuarine emergent land can be found in areas exposed to Mills Creek (GIS Map 1 - Appendix A).

The main source of potable water for Fort Monroe and Langley Air Force Base is Bethel Reservoir (37° 5'N and 76° 25' W). The reservoir and surrounding land covers an area of 500 acres. Aerial imagery of the land use in Bethel Reservoir shows a high to low intensity of urban development surrounding the reservoir with a few wetland areas (estuarine emergent and palustrine forest) remaining along the perimeter of the body of water (GIS Map 2 - Appendix A). Patches of deciduous, evergreen, and mixed forests are found in areas of the reservoir near Big Bethel Road and near Saunders Road.

BIOGEOGRAPHICAL ANALYSIS OF THE AREA FROM A BIOLOGICAL PERSPECTIVE

The following site description was written by Dr. Barbara Savitzky. It applies to both fauna and flora of this area.

Fort Monroe:

Both Bethel Reservoir and Fort Monroe are extremely elongate reserves that are biological islands, as they are isolated habitats surrounded by barriers to movement such as salt water or highways (Diamond, 1975). Geologically, Fort Monroe is a barrier island that has become connected to the mainland naturally at the north end and artificially at the southwest end via a causeway. Islands are naturally depauperate, particularly of herpetofauna (Dodd, 1987). The following factors contribute to this condition: the island's initial distance from land, exposure to salty winds and

water, natural shortage of freshwater, and the limited types and areas of vegetation needed to provide limited cover and food resources. The area has been used as a fortification off and on since the 1700s and continuously since about 1819 when construction of the fort began. Maintenance of the area as a military base has resulted in only small portions at the north end retaining woodland or meadow habitats. Some areas along old artillery batteries are now being left unmowed and are undergoing succession into meadows; some woody plants are beginning to take hold. All natural areas are quite small and long and narrow producing a low area/perimeter ratio. Thus, the natural areas are highly fragmented into tiny areas of only a few hundred square meters at most, with extensive edges. The relevance of these landscape factors to biodiversity and rates of extinction are discussed in Leslie et al. (1986). These areas are also subject to disturbance by humans and pet dogs and cats. While dogs are not permitted to be free of human control, no such control over cats appears to exist. Direct observation and tracks indicate that cats make use of the natural areas. The shoreline in the southern part of the installation is almost entirely armored by concrete. This limits the use of Mill Creek by many small terrestrial vertebrates. Crevices in the armoring, however, favors small vertebrates that rely on crevices and can tolerate exposure to salt water. The northern area has a natural shoreline and is surrounded by *Spartina* marsh. Several *Spartina* marsh islands that remain above normal high tide occur in Mill Creek. These islands are suitable breeding areas for a number of water birds.

Bethel Area:

Bethel Reservoir is an artificial impoundment of Brick Kiln Creek. The dam is along a natural ridge, Bethel Scarp. Below the dam the creek expands outward into an extensive brackish water marsh that eventually meanders into the Northwest Branch of Back River. The reservoir is almost entirely surrounded by chain link fence almost 3 meters tall, topped by barbed wire in some areas. The fence renders the reservoir impenetrable to people in places although small animals can penetrate easily. The lower reservoir in the vicinity of the dam has a relatively steep, armored shoreline. The upper reservoir has a natural thickly vegetated shoreline in most areas. This portion of the reservoir is shallower with a flatter bottom which becomes exposed during even mild to moderate droughts such as occurred in summer of 1997. This end of the Reservoir offers the most protection for reptiles and amphibians in terms of habitat area and limitations to access by people.

The Middle Reservoir also has some good areas, although the best areas are also inaccessible to researchers.

The terrestrial habitat surrounding the reservoir varies in size and type of habitat, but is generally quite narrow. In many areas, the terrestrial area around the reservoir is less than 5 meters wide and is bordered by roads, commercial development, or residential areas. Freshwater wetlands surround the reservoir in several places. Some of these wetlands are forested, and some are marshes. The forest/woodland areas surrounding the reservoir vary considerably in age and the amount of disturbance. The largest forested area consists of Bethel Park under the jurisdiction of the Army and the associated camping area under the jurisdiction of Langley Air Force Base. This area comprises only a few hundred hectares, however, and is heavily used for recreation. Another fairly extensive tract of mature deciduous forest contiguous with forest outside of the reservoir occurs along the north side of the upper reservoir.

Ephemeral ponds suitable for amphibian reproduction were discovered in the forested area near the dam. The forested area at and just above the Upper Reservoir also contained ephemeral ponds, but these suffered from heavy siltation from the adjacent shopping center and highway (US 17). Those ponds were stagnant and anoxic judging by the oxidized iron sediments that smelled strongly of hydrogen sulfide. This area, comprising several hectares, was judged not suitable for amphibians although one mud minnow was living in the general area.

The reservoir appears to be fairly eutrophic judging by water turbidity, littoral vegetation, observed numbers of invertebrates such as fairy shrimp, and the fish populations. The lake naturally receives a considerable silt load given its Coastal Plains location. Additionally, heavy silt loads from surrounding development were obvious. The lake is stocked with several species of game fish. Photographs at Big Bethel Park and observed catch indicate that game fish frequently grow to several kilograms in size. The reservoir is also heavily used by gulls, ducks, Canada geese and other birds. Flocks of gulls and water fowl frequently consist of hundreds of birds. These birds are undoubtedly attracted by the potential for undisturbed rest and the food supply.

FLORA OF FORT MONROE AND BETHEL RESERVOIR

Trees and plants of Fort Monroe were sampled by Patrick Baldwin (Virginia Native Plant Society). The vegetation was surveyed by dividing the area into 20 plots. Dimensions of the plots varied at each site depending on the conditions and the size required to sample the plant assemblage of interest. Within each plot, all individuals were identified to species. Other typical botanical measurements, such as percent cover, sociability, height and soil properties were not taken. The forest surrounding Bethel Reservoir were surveyed by Andrew Rich (Virginia Department of Forestry) walking through in a systematic manner. All trees were identified to species.

A total of forty species of trees were identified in Bethel Reservoir (Table 1). No plants were found during the survey of the reservoir.

A total of 249 species representing 179 genus and 67 families of plants were found in Fort Monroe (Table 2). Only nine species of trees were identified during the survey. The area has 136 native and 113 introduced plants. This means that 55% of the plant assemblage of Fort Monroe is made up of native species and 45% of introduced species. Twelve of these invasive (introduced) species are listed by the Department of Conservation and Recreation in the Virginia Natural Heritage Fact Sheets. As wetlands have been destroyed, invasive species like *Phragmites australis* has taken over, displacing native plants.

No species listed as endangered, threatened or of special concern were found in Fort Monroe or Bethel Reservoir.

During the flora survey of Fort Monroe, Mr. Patrick Baldwin found Red Lovegrass (*Eragrostis secundiflora* var. *Oxylepis*) for the first time in the State of Virginia. This finding is considered a Virginia State Record as verified by Donna M. E. Ware, Adjutant Associate Professor of Biology (College of William & Mary), Gary Fleming, Vegetation Ecologist (Natural Heritage Foundation of Virginia), and Paul Peterson (Smithsonian Institution, Washington, DC) (Appendix B). This species is characterized as aggressive, habitat threatening and an undesirable plant. It does not warrant

protection and should be monitored periodically to ensure that it does not spread as it likes dunes and sandy coastal habitats and could be a problem on the coastal plain. As in the case of Stendel common reed (*Phragmites australis*) if habitats become overrun and threatened, removal in its entirety is recommended.

Table 1. Trees Found at Fort Monroe and Bethel Reservoir, Virginia

Status: M = Fort Monroe, B= Bethel Reservoir.

COMMON NAME	SCIENTIFIC NAME	LOCATION
Red Maple	<i>Acer rubrum</i>	B
Alder	<i>Alnus serrvulata</i>	B
Devils Walking Stick	<i>Aralia spinosa</i>	B
Camelia	<i>Camelia</i>	B
Ironwood	<i>Carpinus caroliniana</i>	B
Mockernut Hickory	<i>Carya tometosa</i>	B
Southern (common) Catalpa	<i>Catalpa bignioides</i>	M
Hackberry	<i>Celtis occidentalis</i>	B
American Smoketree	<i>Cotinus obovatus</i>	M
Scotch Broom	<i>Cytis scoparius</i>	B
Russian Olive	<i>Eleagnus angustifolia</i>	B
Strawberry Bush	<i>Evonymous americana</i>	B
American Beech	<i>Fagus grandiflora</i>	B
Honey Locust	<i>Gleditsia triacanthos</i>	M
American Holly	<i>Ilex opacia</i>	B
American Holly	<i>Ilex opaca</i>	M
Red Cedar	<i>Juniperus virginianum</i>	B
Setterbush	<i>Leucothoe racemosa</i>	B
Privet Bush	<i>Ligustrum sinense</i>	B

Sweet Gum	<i>Liquidambar styraciflua</i>	B
Yellow Poplar	<i>Liriodemaron tulipifera</i>	B
Coral Honeysuckle	<i>Lonicera sempervirens</i>	B
Japanese Honeysuckle	<i>Lonicera japonica</i>	B
Sweetbay Magnolia	<i>Magnolia virginiana</i>	M
China-berry	<i>Melia azedarach</i>	M
COMMON NAME	SCIENTIFIC NAME	LOCATION
Wax Myrtle	<i>Myrica cyrifera</i>	B
Black Gum	<i>Nyssa sylvatica</i>	B
Sourwood	<i>Oxydendrum arborea</i>	B
Red Bay	<i>Persea barbonia</i>	B
Virginia Pine	<i>Pinus virginiana</i>	B
Loblolly Pine	<i>Pinus taeda</i>	B
Virginia (scrub) Pine	<i>Pinus virginiana</i>	M
Sycamore	<i>Platinus occidentalis</i>	B
Cottonwood	<i>Populus heterophylla</i>	B
Black Cherry	<i>Prunus serotium</i>	B
Willow Oak	<i>Quercus phellos</i>	M
Willow Oak	<i>Quercus phellos</i>	B
Southern Red Oak	<i>Quercus falcata</i>	B
Virginia Live Oak	<i>Quercus virginiana</i>	M
White Oak	<i>Quercus alisa</i>	B
Water Bak	<i>Quercus nigra</i>	B

Black Locust	<i>Robinia pseudoacacia</i>	B
Multiflora Rose	<i>Rosa multiflora</i>	B
Blackberry	<i>Rubus sp.</i>	B
Sassafras	<i>Sassafras albidum</i>	B
Greenbrier	<i>Smilax rotundiflora</i>	B
Bald Cypress	<i>Taxodium distichum</i>	B
Highbush Blueberry	<i>Vaccinium corymbosum</i>	B
Grape	<i>Vitis</i>	B

Legend: M = Fort Monroe

B = Bethel

Table 2. Flora of Fort Monroe, Virginia.

(Status: o = occasional, r = rare, c = common, p = planted or introduced)

FAMILY	SCIENTIFIC NAME	COMMON NAME	STATUS
Polypodiaceae	<i>Asplenium platyneuron</i>	Oakes Ebony Spleenwort	o
Cupressaceae	<i>Juniperus virginiana</i>	Red-Cedar	o
	<i>Thuja occidentalis</i>	Northern White Cedar	r
Pinaceae	<i>Pinus taeda</i>	Loblolly Pine	o
Agavaceae	<i>Yucca filamentosa</i>	Bear Grass	c
Cyperaceae	<i>Carex scoparia</i>	Pointed Bloom Sedge	r
	<i>Carex vulpinoidea</i>	Fox Sedge	r

	<i>Cyperus esculentus</i>	Chufa	r
	<i>Cyperus grayi</i>	Retrorse Flat Sedge	o
	<i>Cyperus retrorsus</i>	Retrorse Flat Sedge	o
	<i>Cyperus filicinus</i>	Manyspike Flat Sedge	o
	<i>Cyperus strigosus</i>	Straw-Color Flat Sedge	o
	<i>Cyperus bipartitus</i>	Slender Flat Sedge	o
	<i>Scirpus americanus</i>	Olney's Bulrush	o
Iridaceae	<i>Sisyrinchium angustifolium</i>	Pointed Blue-Eyed-Grass	r
Juncaceae	<i>Juncus roemerianus</i>	Needlegrass	o
Liliaceae	<i>Allium vineale</i>	Field Garlic	o
	<i>Asparagus officinalis</i>	Wild Asparagus	c
	<i>Hemerocallis fulva</i>	Common Daylily	a
	<i>Ipheion uniflorum</i>	Spring Stargrass	c
	<i>Muscari atlanticum</i>	Starch Grape Hyacinth	o
	<i>Ornithogalum nutans</i>	Star Of Bethlehem	o
	<i>Ornithogalum umbellatum</i>	Star Of Bethlehem	o
	<i>Smilax bona-nox</i>	Greenbriar	c

FAMILY	SCIENTIFIC NAME	COMMON NAME	STATUS
Liliaceae	<i>Smilax rotundifolia</i>	Greenbriar	o
	<i>Nothoscordum bivalve</i>	False Garlic	r
Poaceae	<i>Ammophila breviligulata</i>	American Beachgrass	c
	<i>Andropogon glomeratus</i>	Bushy Bluestem	r

	<i>Andropogon scoparius</i>	Little Bluestem	c
	<i>Anthoxanthum odoratum</i>	Sweet Vernal Grass	c
	<i>Aristida oligantha</i>	Three Awn Grass	c
	<i>Briza minor</i>	Little Quaking Grass	r
	<i>Bromus catharticus</i>	Brome Grass	r
	<i>Bromus tectorum</i>	Brome Grass	c
	<i>Cenchrus tribuloides</i>	Dune Sandbur	c
	<i>Cynodon dactylon</i>	Crab Grass	o
	<i>Dactylis glomerata</i>	Orchard Grass	r
	<i>Dichanthelium dichotomum</i>	Cypress Witchgrass	o
	<i>Dichanthelium oligosanthes</i>	Heller's Witchgrass	o
	<i>Digitaria sanguinalis</i>	Hairy Crabgrass	o
	<i>Distichlis spicata</i>	Salt Grass	o
	<i>Echinochloa crusgalli</i>	Barnyard Grass	r
	<i>Eleusine indica</i>	Yard Grass	r
	<i>Elymus virginicus</i>	Virginia Wild Rye	o
	<i>Eragrostis cilianensis</i>	Stinkgrass	r
	<i>Eragrostis curvula</i>	Lovegrass	a
	<i>Eragrostis spectabilis</i>	Purple Lovegrass	c
	<i>Eragrostis oxylepis</i>	Red Lovegrass	r
	<i>Festuca elatior</i>	Meadow Fescue	r
	<i>Festuca myuros</i>	Fescue	c
	<i>Festuca octoflora</i>	Fescue	o

	<i>Hordeum pusillum</i>	Little Barley	c
	<i>Panicum amarum</i>	Bitter Panic Grass	c
FAMILY	SCIENTIFIC NAME	COMMON NAME	STATUS
Poaceae	<i>Paspalum dilatatum</i>	Dallisgrass	o
	<i>Paspalum notatum</i>	Bahia Grass	r
	<i>Phragmites australis</i>	Stendel Common Reed	c
	<i>Poa annua</i>	Annual Bluegrass	o
	<i>Poa bulbosa</i>	Bluegrass	c
	<i>Setaria geniculata</i>	Knotroot Bristle Grass	o
	<i>Setaria glauca</i>	Yellow Bristle Grass	o
	<i>Sorghum halepense</i>	Johnson Grass	o
	<i>Spartina alterniflora</i>	Big Marsh Cord Grass	o
	<i>Spartina cynosuroides</i>	Upland Cord Grass	c
	<i>Spartina patens</i>	Salt Meadow Cord Grass	c
	<i>Tridens flavus</i>	Purple-Top Tridens	r
	<i>Sporobolus indicus</i>	West Indian Dropseed	c
	<i>Triplasis purpurea</i>	Purple Sandgrass	c
	<i>Uniola paniculata</i>	Sea Oats	c
	<i>Lolium perenne</i>	Perennial Ryegrass	c
Aizoaceae	<i>Mollugo verticillata</i>	Green Carpet-Weed	r
Amaranthaceae	<i>Amaranthus hybridus</i>	Pigweed	r
Anacardiaceae	<i>Rhus copallina</i>	Winged Sumac	o
	<i>Rhus radicans</i>	Poison Ivy	o

Apiaceae	<i>Daucus carota</i>	Queen Anne's Lace	o
	<i>Foeniculum vulgare</i>	Fennel	c
Apocynaceae	<i>Apocynum cannabinum</i>	Clasping-Leaf Dogbane	c
	<i>Vinca major</i>	Periwinkle	c
Aquifoliaceae	<i>Ilex opaca</i>	American Holly	o
	<i>Ilex vomitoria</i>	Yaupon	p
Araliaceae	<i>Aralia spinosa</i>	Hercules Club	o
	<i>Hedera helix</i>	Ivy	r
Asclepiadaceae	<i>Cynanchum laeve</i>	Honeyvine	o
FAMILY	SCIENTIFIC NAME	COMMON NAME	STATUS
Asteraceae	<i>Ambrosia artemisiifolia</i>	Common Ragweed	c
	<i>Artemisia vulgaris</i>	Mugwort	o
	<i>Aster pilosus</i>	White Heath Aster	p
	<i>Aster tenuifolius</i>	Perennial Saltmarsh Aster	o
	<i>Baccharis halimifolia</i>	Groundsel Tree	c
	<i>Borrchia frutescens</i>	Sea Oxeye	c
	<i>Chrysanthemum leucanthemum</i>	Ox-Eye Daisy	o
	<i>Cirsium vulgare</i>	Bull Thistle	o
	<i>Eclipta alba</i>	Yerba Detajo	o
	<i>Erigeron annuus</i>	White-Top Flea Bane	r
	<i>Erigeron canadensis</i>	Hogweed	o
	<i>Eupatorium capillifolium</i>	Dog Fennel	c
	<i>Eupatorium hyssopifolium</i>	Thoroughwort	c

	<i>Aster subulatus</i>	Annual Saltmarsh Aster	r
	<i>Phrhopappus carolinianus</i>	False Dandelion	r
	<i>Eupatorium serotinum</i>	Late-Flowering Thorough-Wort	r
	<i>Gnaphalium obtusifolium</i>	Rabbit Tobacco	c
	<i>Gnaphalium purpureum</i>	Rabbit Tobacco	o
	<i>Heterotheca graminifolia</i>	Silk Grass	c
	<i>Hypochoeris radicata</i>	Cats Ear	o
	<i>Iva frutescens</i>	Maritime Marsh Elder	c
	<i>Lactuca canadensis</i>	Wild Lettuce	o
	<i>Lactuca serriola</i>	Prickly Lettuce	c
	<i>Senecio vulgaris</i>	Common Groundsel	o
	<i>Solidago canadensis</i>	Canada Goldenrod	c
	<i>Solidago sempervirens</i>	Seaside Goldenrod	c
	<i>Sonchus asper</i>	Sow Thistle	r
	<i>Taraxacum officinale</i>	Common Dandelion	c
	<i>Tragopogon dubius</i>	Yellow Goatsbeard	o
FAMILY	SCIENTIFIC NAME	COMMON NAME	STATUS
Asteraceae	<i>Xanthium strumarium</i>	Cocklebur	c
Bignoniaceae	<i>Campsis radicans</i>	Trumpet Vine	o
	<i>Catalpa speciosa</i>	Indian Cigar Tree	o
Boraginaceae	<i>Lithospermum arvense</i>	Stoneseed	r
	<i>Myosotis arvensis</i>	Field Forget Me Not	c
	<i>Myosotis discolor</i>	Forget Me Not	o

	<i>Myosotis verna</i>	Spring Forget Me Not	o
Brassicaceae	<i>Arabidopsis thaliana</i>	Mouse Ear Cress	o
	<i>Barbarea verna</i>	Early Winter Cress	r
	<i>Cakile edentula</i>	Hooker Sea Rocket	c
	<i>Capsella bursa-pastoris</i>	Shepherds Purse	o
	<i>Cardamine hirsuta</i>	Hairy Bitter Cress	c
	<i>Coronopus didymus</i>	Wart Cress	r
	<i>Draba verna</i>	Whitlow Grass	o
	<i>Lepidium virginicum</i>	Pepper Grass	r
Cactaceae	<i>Opuntia humifusa</i>	Prickly Cactus	c
Campanulaceae	<i>Triodanis perfoliata</i>	Venus Looking Grass	r
Caprifoliaceae	<i>Lonicera fragrantissima</i>	Fragrant Honeysuckle	r
	<i>Lonicera japonica</i>	Japanese Honeysuckle	c
	<i>Lonicera maackii</i>	Amur Honeysuckle	c
Caryophyllaceae	<i>Cerastium glomeratum</i>	Chickweed	o
	<i>Sagina decumbens</i>	Trailing Pearlwort	c
	<i>Scleranthus annuus</i>	Knawel	o
	<i>Stellaria media</i>	Common Chickweed	c
Chenopodiaceae	<i>Atriplex patula</i>	Spearscale	o
	<i>Chenopodium album</i>	Pigweed	o
	<i>Chenopodium ambrosoides</i>	Mexican Tea	o
	<i>Salicornia europaea</i>	Slender Glasswort	r
	<i>Salsola kali</i>	Russian Thistle	c

FAMILY	SCIENTIFIC NAME	COMMON NAME	STATUS
Convolvulaceae	<i>Calystegia sepium</i>	Bindweed	r
	<i>Dichondra carolinensis</i>	Carolina Pony-Foot	o
	<i>Ipomoea hederacea</i>	Ivy-Leaf Morning Glory	o
	<i>Ipomoea lacunosa</i>	Small Flower White Morning Glory	o
Cucurbitaceae	<i>Melothria pendula</i>	Creeping Cucumber	o
Ebenaceae	<i>Diospyros virginiana</i>	Persimmon	o
Elaeagnaceae	<i>Elaeagnus pungens</i>	Wild Olive	r
Euphorbiaceae	<i>Croton glandulosus var. septentrionalis</i>	Tooth Lever Croton	r
	<i>Euphorbia helioscopia</i>	Sunspurge	o
	<i>Euphorbia maculata</i>	Milk Purslane	c
	<i>Euphorbia polygonifolia</i>	Seaside Broomspurge	c
Fabaceae	<i>Albizia julibrissin</i>	Mimosa	o
	<i>Cassia chamaecrista</i>	Sleeping Plant	o
	<i>Cassia nictitans</i>	Sensitive Partridge Pea	c
	<i>Centrosema virginianum</i>	Bentham	c
	<i>Gleditsia triacanthos</i>	Honey Locust	o
	<i>Lespedeza capitata</i>	Dusty Clover	r
	<i>Lespedeza cuneata</i>	Chinese Bushcover	c
	<i>Lotus corniculatus</i>	Birdsfoot Trefoil	o
	<i>Medicago lupulina</i>	Black Medic	o
	<i>Medicago minima</i>	Bur Clover	o
	<i>Melilotus alba</i>	White Sweet Clover	o
	<i>Robinia pseudo-acacia</i>	Black Locust	r
	<i>Trifolium arvense</i>	Rabbit foot Clover	c
	<i>Trifolium campestre</i>	Hop Trefoil	o
	<i>Trifolium dubium</i>	Hop Clover	c
	<i>Trifolium pratense</i>	Red Clover	o
	<i>Trifolium repens</i>	White Clover	c
	<i>Vicia sativa</i>	Common Vetch	c
FAMILY	SCIENTIFIC NAME	COMMON NAME	STATUS
Fabaceae	<i>Vicia villosa</i>	Hairy Vetch	o

	<i>Strophostyles helvula</i>	Annual Woolly Bean	c
Fagaceae	<i>Quercus phellos</i>	Wild Oak	r
	<i>Quercus virginiana</i>	Live Oak	c
Fumariaceae	<i>Fumaria officinalis</i>	Earth Smoke	o
Geraniaceae	<i>Erodium cicutarium</i>	Storksbill	o
	<i>Geranium carolinianum</i>	Carolina Cranesbill	c
	<i>Geranium dissectum</i>	Cranesbill	o
Hypericaceae	<i>Hypericum hypericoides</i>	St. Andrew's Cross	o
Juglandaceae	<i>Juglans nigra</i>	Black Walnut	r
Lamiaceae	<i>Glechoma hederacea</i>	Ground Ivy	c
	<i>Lamium amplexicaule</i>	Henbit	c
	<i>Lamium purpureum</i>	Red-Headed Henbit	c
	<i>Monarda punctata</i>	Horsemint	c
	<i>Prunella vulgaris</i>	Heal-All	o
Lauraceae	<i>Sassafras albidum</i>	Sassafras	o
Magnoliaceae	<i>Magnolia grandiflora</i>	Bay Bull	r
Malvaceae	<i>Anoda cristata</i>	Crested Anoda	r
	<i>Kosteletzyka virginica</i>	Virginia Seashore Mallow	r
Meliaceae	<i>Melia azedarach</i>	China Berry	r
Moraceae	<i>Morus alba</i>	White Mulberry	r
	<i>Morus rubra</i>	Red Mulberry	r
Myricaceae	<i>Myrica cerifera</i>	Wax Myrtle	c
Oleaceae	<i>Ligustrum ovalifolium</i>	Privet	r

	<i>Ligustrum sinense</i>	Loureiro	r
Onagraceae	<i>Oenothera biennis</i>	Common Evening Primrose	o
	<i>Oenothera humifusa</i>	Spreading Evening Primrose	c
	<i>Oenothera laciniata</i>	Cut-Leaved Oenothera	c
Oxalidaceae	<i>Oxalis rubra</i>	Redwood Sorrel	r
FAMILY	SCIENTIFIC NAME	COMMON NAME	STATUS
Oxalidaceae	<i>Oxalis stricta</i>	Wood Sorrel	o
Passifloraceae	<i>Passiflora incarnata</i>	Passion Flower	r
	<i>Passiflora lutea</i>	Passion Flower	r
Phytolaccaceae	<i>Phytolacca americana</i>	Pokeweed	o
Plantaginaceae	<i>Plantago aristata</i>	Bracted Plantain	c
	<i>Plantago lanceolata</i>	English Plantain	o
	<i>Plantago rugellii</i>	Black-Seed Plantain	r
	<i>Plantago virginica</i>	Pale-Seed Plantain	c
Plumbaginaceae	<i>Limonium carolinianum</i>	Sea Lavender	o
Platanaceae	<i>Platanus occidentalis</i>	American Sycamore	p
Polygonaceae	<i>Polygonum aviculare</i>	Prostrate Knotweed	o
	<i>Polygonum pensylvanicum</i>	Pennsylvania Smartweed	r
	<i>Rumex acetosella</i>	Sheep Sorrel	c
	<i>Rumex conglomeratus</i>	Clustered Dock	o
	<i>Rumex crispus</i>	Curly Dock	r
Portulacaceae	<i>Portulaca amilis</i>	No Common Name	c
	<i>Portulaca oleracea</i>	Common Purselane	c

Ranunculaceae	<i>Clematis terniflora</i>	Japanese Virgin's Bower	o
	<i>Ranunculus abortivus</i>	Small Flowered Buttercup	o
	<i>Ranunculus bulbosus</i>	Bulbous Buttercup	c
Rosaceae	<i>Duchesnea indica</i>	Indian Mock-Strawberry	o
	<i>Prunus serotina</i>	Wild Cherry	o
	<i>Rosa multiflora</i>	Multiflora Rose	r
	<i>Rubus argutus</i>	Serrate-Leaf Blackberry	c
Rubiaceae	<i>Diodia teres</i>	Buttonweed	c
	<i>Diodia virginiana</i>	Virginia Buttonweed	o
	<i>Galium aparine</i>	Cleavers	o
	<i>Sherardia arvensis</i>	Madder	o
Salicaceae	<i>Populus deltoides</i>	Carolina Poplar	o
FAMILY	SCIENTIFIC NAME	COMMON NAME	STATUS
Salicaceae	<i>Salix nigra</i>	Swamp Willow	r
Scrophulariaceae	<i>Agalinis purpurea</i>	Large Purple False-Foxglove	r
	<i>Linaria canadensis</i>	Toadflax	o
	<i>Verbascum blattaria</i>	Moth Mullein	o
	<i>Verbascum thapsus</i>	Woolly Mullein	o
	<i>Veronica persica</i>	Birdseye Speedwell	c
	<i>Veronica arvensis</i>	Speedwell	c
Solanaceae	<i>Datura stramonium</i>	Jimson Weed	o
	<i>Solanum carolinense</i>	Bull Nettle	o
Tamaricacea	<i>Tamarix gallica</i>	Tamarisk	o

Ulmaceae	<i>Celtis laevigata</i>	Sugar Berry	c
	<i>Ulmus rubra</i>	Red elm	r
Valerianaceae	<i>Valerianella locusta</i>	Latterade	c
	<i>Valerianella radiata</i>	Corn Salad	c
Verbenaceae	<i>Verbena urticifolia</i>	White Vervain	r
	<i>Verbena brasiliensis</i>	Brazilian Vervain	o
Violaceae	<i>Viola arvensis</i>	Violet (species)	c
	<i>Viola rafinesquii</i>	Field Pansy	c
Vitaceae	<i>Ampelopsis brevipedunculata</i>	Porcelain Berry	r
	<i>Parthenocissus quinquefolia</i>	Virginia Creeper	c
	<i>Vitis aestivalis</i>	Summer Grape	r
	<i>Vitis rotundifolia</i>	Muscadine	c

Status: c = common

r = rare

o = occasional

p = planted (introduced)

FISHES OF FORT MONROE AND BETHEL RESERVOIR

Fish were sampled in the waters of Mill Creek adjacent to Fort Monroe and in the waters of Bethel Reservoir. Waters of Bethel Reservoir were sampled using a electrofishing boat equipped with a Smith-Root Type VI-A electrofisher unit. This unit was powered by a 6.2 KW generator that supplied pulsated DC current. Stunned fish were collected with a dipnet, identified to species, and released unharmed.

The high salinity content and high conductivity of Mill Creek rendered electrofishing ineffective. Thus, fish species composition in Mill Creek was determined using a 30.5 meter x 1.8 meter seine. Sampling sites were chosen at random along the body of water, and were areas near the Walker Army Airfield, boat ramp, and cove near the campground.

A total of 18 fish taxa representing twelve families were identified in Bethel Reservoir (Table 3). The most common species of fish were largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), redear sunfish (*L. Microlophus*), yellow perch (*Perca flavescens*), and black crappie (*Pomoxis nigromaculatus*). Based on species status described by Jenkins and Burkholder (1993), native species comprised 85% of those encountered. No species listed as endangered, threatened, or of special concern were found in this reservoir.

A total of 19 species representing 12 families were found in waters of Mill Creek adjacent to Fort Monroe (Table 4). The area is a suitable nursery and spawning habitat for estuarine fishes. The most common species were Atlantic menhaden (*Brevoortia tyrannus*), spot (*Leiostomus xanthurus*), silver perch (*Bairdiella chrysoura*), striped killifish (*Fundulus majalis*), Atlantic silverside (*Menidia menidia*), and white mullet (*Mugil curema*). Nine migratory fish species, including striped bass (*Morone saxatilis*) were collected in the area. Species status, migratory nature and life stages using the area can be found in Table 5. No species listed as endangered, threatened or of special concern were found in Mill Creek. Nevertheless, this area is important spawning and nursery habitat for anadromous fishes.

Even though Mill Creek was thoroughly sampled, several fish species reported in the literature as present in the Lower Chesapeake Bay were not seen. These species that could use Mill Creek during some part of the year as spawning or nursery habitat are listed in Table 6.

Table 3. Fish Collected in the Waters of Bethel Reservoir, Virginia.

Family/Species	Scientific Name	Number	¹ Occurrence	² Status
CENTRARCHIDAE				
Largemouth Bass	<i>Micropterus salmoides</i>	44	F	IP
Bluegill	<i>Lepomis macrochirus</i>	48	F	I
Pumpkinseed	<i>Lepomis gibbosus</i>	1	F	N
Redear Sunfish	<i>Lepomis microlophus</i>	42	F	I
Warmouth	<i>Lepomis gulosus</i>	P	R	NI
Black Crappie	<i>Pomoxis nigromaculatus</i>	10	F	N
ICTALURIDAE				
Brown Bullhead	<i>Ameiurus nebulosus</i>	1		N
ESOCIDAE				
Chain Pickerel	<i>Esox niger</i>	6	R	N
CLUPEIDAE				
Gizzard Shad	<i>Dorosoma cepedianum</i>	3	F	N
CYPRINIDAE				
Golden Shiner	<i>Notemigonus crysoleucas</i>	4	O	N
Common Carp	<i>Cyprinus carpio</i>	P	O	I
APHREDODERIDAE				
Pirate Perch	<i>Aphredoderus sayanus</i>	1	R	N
PERCIDAE				
Yellow Perch	<i>Perca flavescens</i>	11		N
MORONIDAE				
White Perch	<i>Morone americana</i>	4	F	ME
UMBRIDAE				
Eastern Mudminnow	<i>Umbra pygmae</i>			N
POECILIDAE				
Eastern Mosquitofish	<i>Gambusia affinis</i>		F	N
GASTEROSTEIDAE				
Threespine Stickleback	<i>Gasterosteus aculeatus</i>			ME
ANGUILLIDAE				
American Eel	<i>Anguilla rostrata</i>	P	F	ME

¹ Based on historical data collected by the Gloucester Office of Fishery Assistance:

F = Frequent O = Occasional R = Rare

P = Reported during the 1986 fish surveys of Bethel Reservoir.

² Based on Jenkins, R. E. and N. M. Burkhead. 1993. Freshwater fishes of Virginia. American Fisheries Society, Bethesda, Maryland:

N = Native I = Introduced NI = Regarded as native, but possibly introduced

IP = Regarded as introduced, but possibly native

ME = Marine or estuarine with native and/or introduced freshwater occurrence or population.

Table 4. Fish and Invertebrates Collected in Mill Creek, Fort Monroe, Virginia.

Family/Species	Scientific Name	Number
<u>Fish</u>		
ENGRAULIDAE		
Broad Stripe Anchovy	<i>Anchoa hepsetus</i>	5
Bay Anchovy	<i>Anchoa mitchilli</i>	22
SCIAENIDAE		
Silver Perch	<i>Bairdiella chrysoura</i>	62
Spotted Sea Trout	<i>Cynoscion nebulosus</i>	1
Spot	<i>Leiostomus xanthurus</i>	195
Atlantic Croaker	<i>Micropogonias undulatus</i>	3
CLUPEIDAE		
Atlantic Menhaden	<i>Brevoortia tyrannus</i>	372
Gizzard Shad	<i>Dorosoma cepedianum</i>	16
CYPRINODONTIDAE		
Sheepshead Minnow	<i>Cyprinodon variegatus</i>	1
Mummichog	<i>Fundulus heteroclitus</i>	29
Striped Killifish	<i>Fundulus majalis</i>	59
GOBIIDAE		
Naked Goby	<i>Gobiosoma boscii</i>	1
ATHERINIDAE		
Atlantic Silverside	<i>Menidia menidia</i>	30
MORONIDAE		
Striped Bass	<i>Morone saxatilis</i>	10
MUGILIDAE		
White Mullet	<i>Mugil curema</i>	26
HAEMULIDAE		
Pigfish	<i>Orthopristis chrysoptera</i>	1
BOTHIDAE		
Summer Flounder	<i>Paralichthys dentatus</i>	2
BELONIDAE		
Atlantic Needlefish	<i>Strongylura notata</i>	2
SYNODONTIDAE		
Inshore Lizardfish	<i>Synodus foetens</i>	1
<u>INVERTEBRATES</u>		
PORTUNIDAE		
Blue Crab	<i>Callinectes sapidus</i>	2

Table 5. Origin, Migratory Nature, and Life Stages of Fishes Occurring in Mill Creek,

Fort Monroe, Virginia.

Species	Species' Origin		Migratory Nature		Life Stage Use		
	Native	Exotic	Non-Migratory	Migratory	Spawning	Larval/Juvenile	Adult
Striped Anchovy <i>Anchoa hepsetus</i>	X		X		X	X	X
Bay Anchovy <i>Anchoa mitchilli</i>	X		X		X	X	X
Silver Perch <i>Bairdiella chrysoura</i>	X			X (1)		X	X
Spotted Sea Trout <i>Cynoscion nebulosus</i>	X		X		X	X	X
Spot <i>Leiostomus xanthurus</i>	X			X (2)		X	X
Atlantic Croaker <i>Micropogonias undulatus</i>	X			X (2)		X	X
Atlantic Menhaden <i>Brevoortia tyrannus</i>	X			X (2)		X	X
Gizzard Shad <i>Dorosoma cepedianum</i>	X		X			X	X
Sheepshead Minnow <i>Cyprinodon variegatus</i>	X		X		X	X	X
Mummichog <i>Fundulus heteroclitus</i>	X		X		X	X	X
Striped Killifish <i>Fundulus majalis</i>	X		X		X	X	X
Naked Goby <i>Gobiosoma boscii</i>	X		X		X	X	X
Atlantic Silverside <i>Menidia menidia</i>	X		X		X	X	X
Striped Bass <i>Morone saxatilis</i>	X			X (4)		X	X
White Mullet <i>Mugil curema</i>	X			X		X	X
Pigfish <i>Orthopristis chrysoptera</i>	X			X	X	X	X
Summer Flounder <i>Paralichthys dentatus</i>	X			X		X	X
Atlantic Needlefish <i>Strongylura notata</i>	X			X (3)	X	X	X
Inshore Lizardfish <i>Synodus foetens</i>	X		X		?	X	X

1 = Adults overwinter and spawn in the Lower Chesapeake Bay and Atlantic Ocean.

2 = Adults overwinter and spawn in the Atlantic Ocean.

3 = Adults overwinter in the Lower Chesapeake Bay and/or Atlantic Ocean.

4 = Anadromous species.

Table 6. Fish Reported in the Literature as Present in the Lower Chesapeake Bay but not Found During Sampling of Mill Creek, Fort Monroe, Virginia.

Species	Scientific Name
American Shad	<i>Alosa sapidissima</i>
Alewife	<i>Alosa pseudoharengus</i>
Blueback Herring	<i>Alosa aestivalis</i>
Hickory Shad	<i>Alosa mediocris</i>
Threadfin Shad	<i>Dorosoma petenense</i>
American Eel	<i>Anguilla rostrata</i>
Black Drum	<i>Pogonia chromis</i>
Black Sea Bass	<i>Centropristis striata</i>
Bluefish	<i>Pomatomus saltatrix</i>
Brown Bullhead	<i>Ameiurus nebulosus</i>
White Catfish	<i>Ameiurus catus</i>
Cobia	<i>Rachycentron canadum</i>
Eastern Silvery Minnow	<i>Hybognathus regius</i>
Eastern Mosquitofish	<i>Gambusia holbrocki</i>
Rough Silverside	<i>Membras martinica</i>
Spottail Shiner	<i>Notropis hudsonius</i>
Hogchoker	<i>Trinectes maculatus</i>
Kingfish	<i>Menticirrhus spp.</i>
Spanish Mackerel	<i>Scomberomorus maculatus</i>
Striped Mullet	<i>Mugil cephalus</i>
Weakfish	<i>Cynoscion regalis</i>
White Perch	<i>Morone americana</i>
Yellow Perch	<i>Perca flavescens</i>

MAMMALS OF FORT MONROE AND BETHEL RESERVOIR

Small mammals were collected using Sherman aluminum folding live capture traps. Bait made of peanut butter on a cotton ball was used to attract the animals to the trap. Twenty-four hours after setting the bait, traps were checked for animals. As expected, the human impact in the area and the habitat condition limited the number of animals trap. The areas were walked through in a systematic manner. Ground and above-ground structures were visually searched carefully for tracks, marks and footprints. Animal-associated structures such as logs and burrows were checked for specimens. Personnel interviews as well as computer-aid searches of the Virginia Fish and Wildlife Information System (BOVA) helped indentified confirmed and suspected species.

Twenty-nine species of mammals were found in area. Of this number, 24 species were identified as inhabiting Fort Monroe while 15 species were seen in Bethel Reservoir. All the species are common to the Peninsula. No species listed as endangered, threatened, or of special concern were found in this area.

Table 7. Mammals Found at Fort Monroe and Bethel Reservoir, Virginia.

COMMON NAME	LATIN NAME	LOCATION	STATUS ¹
Shorttail Shrew	<i>Blarina brevicauda</i>	M, B	s
Beaver	<i>Castor canadensis</i>	B	c
Starnose Mole	<i>Condylura cristata</i>	M, B	s
Least Shrew	<i>Cryptotis parva</i>	M, B	s
Opossum	<i>Didelphis virginiana</i>	M, B	c
River Otter	<i>Lutra canadensis</i>	M, B	c
Woodchuck	<i>Marmota monax</i>	B	s
Striped Skunk	<i>Mephitis mephitis</i>	M, B	s
Meadow Vole	<i>Microtus pennsylvanicus</i>	M	s
Evening Bat	<i>Nycticeius humeralis</i>	M	s
Whitetail Deer	<i>Odocoileus virginianus</i>	B	c
Muskrat	<i>Ondata zibeticus</i>	M	c
Marsh Rice Rat	<i>Oryzomys palustris</i>	M	s
White-Footed Mouse	<i>Peromyscus leucopus</i>	M	s
Eastern Pipstrel	<i>Pipistrellus subflavus</i>	M	s
Pine Vole	<i>Pitymys pinetorum</i>	B	s
Raccoon	<i>Procyon lotor</i>	M, B	c
Eastern Harvest Mouse	<i>Reithrodonotomys humulis</i>	M	c
Eastern Mole	<i>Scalopus aquaticus</i>	M	s
Gray Squirrel	<i>Sciurus carolinensis</i>	M, B	c
Hispid Cotton Rat	<i>Sigmodon hispidus</i>	M	s
Southeastern Shrew	<i>Sorex longirostris</i>	M, B	s
Marsh Rabbit	<i>Sylvilagus palustris</i>	M	s
Cottontail Rabbit	<i>Sylvilagus floridanus</i>	M, B	c
Southern Bog Lemming	<i>Synaptomys cooperi</i>	M	s
Eastern Chipmunk	<i>Tamias striatus</i>	M	c
Gray Fox	<i>Urocyon cieroargenteur</i>	B	c
Red Fox	<i>Vulpes fulva</i>	M, B	s
Meadow Jumping Mouse	<i>Zapus hudsonius</i>	M	s

¹ STATUS : c = Confirmed s = Suspected M = Fort Monroe B = Bethel Reservoir

BIRDS OF FORT MONROE AND BETHEL RESERVOIR

Birds were sampled during the Spring of 1996 by walking in a systematic manner through

Fort Monroe and Bethel Reservoir. Individuals were located and identified by a visual survey using 10x50 binoculars, and when possible by their sounds using an electronic sound amplifier. All individuals were identified to species. Historical records and computer assisted searches were performed on different databases, including the Virginia Fish and Wildlife Information System (BOVA), to determine if additional species listed as present (confirmed or suspected) in the area were not found during the sampling period. Teta Kain (Virginia Society of Ornithology and Virginia Regional Editor of the Christmas Bird Count for the National Audubon Society) reviewed the bird list and provided the most recent update of scientific names. Data from air surveys for mid-winter waterfowl counts around Fort Monroe was provided by Gary Costanzo (Waterfowl Program Leader, Virginia Department of Game and Inland Fisheries).

A total of 217 species of birds (129 genus) belonging to 42 families were found in the area. It is remarkable to see that more than half of all bird species described in Virginia can be found in this area of the State. Of this number, 68 species uses the area as breeding grounds. One endangered bird species, the Peregrine Falcon (*Falco peregrinus*), and two threatened species, the Bald Eagle (*Haliaeetus leucocephalus*) and the Piping Plover (*Charadrius melodus*), are found in this area.

During the 1994 mid-winter waterfowl air-survey count for Fort Monroe, 150 scaups (*Aythya affinis*) and 35 mallards (*Anas platyrhynchos*) were recorded. In 1995, no scaups were found, but 45 mallards, 42 buffleheads (*Bucephala albeola*), 37 brants (*Branta bernicla*), 15 oldsquaw (*Clangula hyemalis*) and 2 common goldeneyes (*Bucephala clangula*) were counted. In 1997, 24 mallards, 107 buffleheads, and 4 common goldeneyes were recorded. On 12 January 1998, the Waterfowl Program reported 53 buffleheads, 5 mallards and 5 red-breasted mergansers (*Mergus serrator*). This area of the Peninsula also frequently holds scoters (*Melanitta* Spp.), canvasback (*Aythya valisineria*), and wigeons (*Anas americana*), but none of them were observed during these waterfowls counts (Gary Costanzo, Personal Communication).

The bird list (Table 8) follows the order of the American Ornithological Union *Check-list of North American Birds* (1983). The following legends are used in Table 8:

Status Legend:

SR = summer resident
SV = summer visitor
T = transient
WR = winter resident
WV = winter visitor
YR = year-round resident

Occurrence Legend:

a = abundant, widely distributed, easy to find;
c = can be found rather easily in expected habitats at expected times of the year;
u = challenging to locate, even in expected habitats at expected times of the year
o = very difficult to find in expected habitats during expected time
r = recorded only once every 2-3 years
x = only 1-5 records of occurrence
* = Breeding species
(LT) = Threatened species
(LE) = Endangered species

AMPHIBIANS AND REPTILES OF FORT MONROE AND BETHEL RESERVOIR

Standard herpetological techniques were employed at locations and times appropriate to the annual activity cycles of reptiles and amphibians. The general approach for carrying out the inventory is described in Heyer et. al (1994) and Campbell and Christman (1982), and most of the methods described here are described in various sections of this reference work. Methods are listed in terms of the frequency of use. Field work officially commenced in mid-March and continued until mid-November although some field work was done in February prior to the formal beginning of the study.

Visual encounter survey: This technique was the most basic and universally used technique for amphibians and reptiles. All areas were searched in this manner, and it was used at all times of the year. Many areas were searched in this manner repeatedly.

Dip-netting: This was done at various times throughout the year in all habitats along the Reservoir including ephemeral bodies of water adjacent to the Reservoir.

Drift fences and funnel traps: Drift fences and/or funnel traps were left set up for 2-9 days continuously in each of the following areas: forested area near the water treatment plant on the Lower reservoir; a patch of both wet and mesic forest along Upper Reservoir, in a marsh below the dam, and on the batteries at Fort Monroe.

Turtle trapping: Trapping was done in the late summer and autumn in the Upper and Middle reservoir and in the marsh below the dam almost continuously from Sept. 9- Nov. 2, 1997

Interviews: Since some species occur sporadically and unpredictably, we sought information from a variety of people including ground crews and pest management personnel at the base, Carl Styles at Bethel Park, people who used to live at the Fort Monroe, and people who frequently visit Fort Monroe and Big Bethel Reservoir for recreational purposes. One knowledgeable family living along

the Upper Reservoir was also interviewed.

Hatching eggs: A technique that was not planned to be used, but ended up using, was hatching eggs found during visual encounter surveys. Eggs were hatched at Old Dominion University in incubators in moist vermiculite. Hatchlings were released near the site of egg deposition in the Upper reservoir.

Road cruising: Driving along roads at night was an excellent method of finding live reptiles and amphibians. Road-killed specimens can be found during the day and also provide evidence of occurrence. This technique was done several times throughout the study. Roads were also checked for road-killed reptiles and amphibians whenever possible and was done in all months.

The bulk of the work was accomplished in early to mid-spring through early summer and in the autumn as these periods coincide with the major periods of activity for reptiles and amphibians. Work continued into November since the summer had been so dry, and the weather remained mild. Work in other areas indicated that reptiles were maintaining high levels of activity, and some species of amphibians were commencing activity. Some ignorance were moving into hibernacula near water for the winter.

Most animals were identified easily in the field although a few were temporarily brought back to Christopher Newport University (CNU) to be keyed out using Ballinger and Lynch (1983), and Conant and Collins (1991). All animals were released at the site of capture although two anuran larvae were killed and preserved in order to identify them. Additionally, one sick turtle found on shore was housed at CNU until its natural death three days later; it is preserved at CNU.

All of the techniques used resulted in the identification of at least one species, except for the audio survey. Species found, common name, life stage, and origin are listed in Table 9. Animals found were adults unless otherwise noted. Sea turtles are not included in this report as they do not utilize habitat at Fort Monroe although they frequently wash up on the beach at Fort Monroe (Mary Shively, personal communication).

As expected, due to habitat degradation, urban development, and human presence, reptiles or amphibians were not found on Fort Monroe. All the information gathered came from Bethel Reservoir.

Reptiles and amphibians species historically found in the lower Peninsula are listed in Table 10. This information was obtained from Mitchell (1994), Conant and Collins (1991), Virginia Fish and Wildlife Information System data (Barbara Savitzky, personal communications, 1998). Amphibians were neither expected nor found at Fort Monroe due to its barrier island origins and lack of habitat suitable for reproduction.

Table 9. Origin and life stages of reptiles and amphibians occurring in Bethel Reservoir, Virginia.

Species	Species' Origin		Life Stage Use				
	Native	Exotic	Adult	Spawning	Larval	Juvenile	Metamorph
Class: AMPHIBIA							
Common Bullfrog <i>Rana catesbiana</i>	X		X	X	X		
Green Frog <i>Rana clamitans</i>	X		X	X	X		
Red-backed Salamander (Red-back and Lead-back Morphs) <i>Plethodon cinereus</i>	X		X			X	X
American Toad <i>Bufo americanus</i>	X		X	X			
Class: REPTILIA							
Black Rat Snake <i>Elaphe obsoleta</i>	X		X				
Eastern Worm Snake <i>Carphophis amoenus</i>	X		X				
Northern Water Snake <i>Nerodia sipedion</i>	X		X				
Five-lined Skink <i>Eumeces fasciatus</i>	X		X	X			
Ground Skink <i>Scincella lateralis</i>	X		X				
Common Snapping Turtle <i>Chelydra serpentina</i>	X		X				
Eastern Box Turtle <i>Terrapene carolina</i>	X		X				
Eastern Mud Turtle <i>Kinosternon subrubrum</i>	X		X				
Eastern Musk Turtle <i>Sternotherus odoratus</i>	X		X	X	X		
Eastern Painted Turtle <i>Chrysemys picta</i>	X		X				
Red-bellied Turtle <i>Pseudemys rubriventris</i>	X		X				
Yellow-bellied Slider <i>Trachemys scripta scripta</i>	X		X				
Red-eared Slider <i>Trachemys scripta elegans</i>		X	X				
Hybrid Slider <i>Trachemys scripta scripta x elegans</i>		X	X				

Table 10. Amphibians and Reptiles Not Found During the Survey and Potentially Inhabiting Fort Monroe or Bethel Reservoir, Virginia.

FAMILY	SCIENTIFIC NAME	COMMON NAME	LOCATION ¹
<u>Class AMPHIBIA</u>			
Ranidae	<i>Rana palustris</i>	Pickerel Frog	B
Hylidae	<i>Hyla versicolor</i>	Gray Tree Frog	B
	<i>Pseudacris triseriata</i>	Upland Chorus Frog	B
Amphiumidae	<i>Amphiuma means</i>	Two-toe Amphiuma	B
Ambystomidae	<i>Ambystoma opacum</i>	Marble Salamander	B
<u>Class REPTILIA</u>			
Emydidae	<i>Malaclemys terrapin</i>	Diamondback terrapin	B
Skinkidae	<i>Eumeces inexpectatus</i>	Southeastern Five-line Skink	B
Colubridae	<i>Coluber constrictor</i>	Black Racer	B
	<i>Ophedrys aestivus</i>	Rough-green Snake	M, B
	<i>Nerodia sipedon</i>	Northern Watersnake	B
	<i>Nerodia erythrogaster</i>	Red-bellied Watersnake	B
	<i>Thamnophis sirtalis</i>	Common Garter Snake	B
	<i>Virginia valeriae</i>	Eastern Earth Snake	B

¹ Location: M = Fort Monroe B = Bethel Reservoir

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS AND RECOMMENDATIONS

The inventory of flora and fauna of Fort Monroe and Bethel Reservoir was accomplished by conducting field surveys, by searching databases, literature and historical records, and by interviewing several known experts.

One endangered and two threatened birds are known in the areas of Fort Monroe and adjacent Bethel Reservoir. The endangered Peregrine Falcon (*Falco peregrinus*), and threatened Bald Eagle (*Haliaeetus leucocephalus*) and Piping Plover (*Charadrius melodus*), are listed as inhabiting this area. As part of the Endangered Species Act (ESA), all listed species should be protected, and it is suggested that these species be incorporated as part of the Natural Resources Management Plan of Fort Monroe to assure long term protection. Every effort should be made to permanently protect habitats where these species are found.

The highest diversity of a single phyla corresponds to the birds. Of 411 known bird species in the state of Virginia, 217 are found in this area or 53% of the total. Twenty-nine out of 80 species of land mammals (36%) are seen in this area, and 23% of the reptiles and amphibians reported for Virginia are found in or around Bethel Reservoir. Only 249 species of plants were found out of 2700 known species. As expected in an impoundment only 8.5% of the freshwater fish species known for the state are found in Bethel Reservoir. The number of reptiles and amphibians inhabiting Fort Monroe and Bethel Reservoir is smaller than expected, although the turtle diversity is quite good.

The primary limitations for flora and fauna are habitat size and exposure to humans at both sites. At Fort Monroe, habitat quality is also an issue due to its origins as a barrier island and its long-term maintenance as a military base. Both sites are biological islands for most species of animals. The possibilities for maintaining viable population sizes for terrestrial reptiles and amphibians is very limited due to limitations of habitat size and extreme fragmentation, and the limitations of immigration potential due to barriers to movement such as roads, human development, and salt water.

Red Lovegrass (*Eragrostis secundiflora* var. *Oxylepis*) and Stendel common reed (*Phragmites australis*) are introduced flora. Both are characterized as aggressive, habitat threatening and undesirable plants. To ensure that they do not spread and invade critical habitats on the coastal plain, these two species should be monitored periodically. If habitats become overrun and threatened, removal in its entirety is recommended.

Bethel Reservoir does offer excellent habitat for aquatic species as evidenced by turtle diversity and the number of otters and aquatic birds. The Reservoir appears to be important to migrating aquatic birds. Brick Kiln Creek and other drainages around Bethel allow for the possibility of fish, reptiles and amphibians migrations. Thus, maintenance of viable populations of amphibians and reptiles is quite feasible as long as terrestrial areas needed for nesting continue to receive some protection. It is assumed that maintenance of water quality will continue as the Reservoir is a source of drinking water for Bethel and Langley Air Force Base. However, the influx of silt loads and pollutants from US 17, and development such as shopping centers, needs better control.

Terrestrial fauna can be protected against human depredation through education, signs or brochures and enforcement of rules prohibiting depredation. Raccoons are serious predators on birds, reptiles and amphibians, as well as on their eggs. Control of raccoon populations might be advisable for the protection of these animals as well as water quality and other health issues.

Fort Monroe offers excellent opportunities to a number of species including aquatic birds, otters, and monarch butterflies during migration. Many of these species have been State or national conservation concerns in recent years (Terwilliger, 1991). Fort Monroe could also offer excellent habitat to lizards. The batteries surrounded by dunes or soil offer potential shelter. Leaving areas unmowed should provide further cover and increase available insect prey. Planting of native plants appropriate to the island environment would be advisable for controlling the successional process. This may help limit the invasion of unwanted exotic species (Leslie et al., 1996). Planting vegetation selected to provide food and cover to wildlife would greatly enhance the environment. People would

benefit from the aesthetic as well as wildlife potential.

The number of predators is simply too high to allow viable populations of many small vertebrates, including birds. Maintaining and even fostering the existence of naturalized corridors for movement by small animals onto the site from the north would be helpful. The marshes are important habitat for many species of vertebrates. A final suggestion for the benefit of all wildlife would be the establishment of small freshwater pools along the north end.

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APPENDIX

APPENDIX B

***Eragrostis oxylepis* AS A STATE RECORD**