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Historic Wetland Loss in the Elizabeth River

Walter I. Priest, III

Introduction

Since earliest colonial times, the Elizabeth River watershed (located primarily within the cities of Norfolk, Portsmouth, Chesapeake and Virginia Beach) has been the focus of development by maritime interests including shipping, military bases, ship repair yards and other industrial plants. Burgeoning population growth and general commercial development accompanied these maritime facilities. Fueling the creation of this infrastructure consumed many of the natural resources of the river basin, including its wetlands, forests, water quality and fisheries. By the late 1960's and 1970's the effects of this growth were becoming all too apparent, and people with the desire to halt the decline of the Elizabeth began to marshal forces to restore the water body to its former health and productivity. Water quality and wetlands were resources which received attention early in this period, especially from government managers and regulators.

Historically, the tidal wetlands within the Elizabeth River watershed have born the brunt of many of these land use practices, suffering significant losses from dredging, filling, urban development and to a lesser degree, agriculture. Immediately prior to the passage of the state's wetlands protection act in 1972, losses of tidal wetlands in Virginia averaged approximately 600 acres per year, with losses projected to go above 1500 acres per year in the early 1970's (Settle, 1969). After passage of the protective measure, permitted tidal wetland losses dropped to approximately 25 acres per year (Jones and Lynch, 1978). A recent study of wetlands loss in the Elizabeth River region reported losses of estuarine emergent and scrub-shrub marshes of just over 36 acres for the period from 1982 to 1989-90 (Tiner and Foulis, 1994). These losses of habitat and resultant degradation of water quality from pollution have led to significant impacts to the biota of the Elizabeth River that have compromised its function as an estuarine system (Birdsong et al, 1994).

In recent years, the continued loss of tidal wetlands has become an increasingly important issue. Since approximately 1980, most major construction projects approved in the watershed have been required to provide compensatory mitigation to offset tidal wetlands losses. This policy has resulted in the construction of over 30 acres of tidal wetlands in the Elizabeth River since 1982. The vast majority of these projects have been successful at establishing wetlands vegetation (Barnard and Mason, 1990). Additional studies have demonstrated the use of these wetlands as fish and wildlife habitat, their role as a source of primary production to support estuarine food webs, their effectiveness in water quality improvement and as sediment traps (Mason, 1989; Priest and Barnard, 1993; Barnard and Priest, 1993).

Recent efforts by citizen groups such as the Elizabeth River Project and initiatives backed by the Chesapeake Bay Program have stimulated increased interest in reversing the trend in habitat losses in the Chesapeake Bay, in general, and the Elizabeth River, in particular. This study, the results of which are partially reported here, was developed in an effort to aid these restoration activities by quantifying the tidal wetlands losses that have occurred in the relatively recent past and by identifying the geographic location of these losses within the Elizabeth River watershed. The information is designed to provide resource managers with a quantitative perspective on these historic wetland losses and to help with the establishment of management goals. It also identifies former wetland sites that might be amenable to restoration, thereby contributing to the establishment of additional tidal wetlands acreage in the highly impacted watershed.

Methods

Digital coverages of the Elizabeth River watershed were created from United States Geological Survey (USGS) topographic maps. The historical data were obtained from paper photographic copies of historical editions of the maps that covered the Elizabeth River watershed. The surveys for this topographic map series were conducted between 1939 and 1954 with the majority occurring during 1944. For the purpose of this study, the tidal wetlands charted and digitized within this series are referred to as the 1944 wetlands acreage.

The areas considered to be tidal wetlands in the 1944 topographic series were those areas which displayed the map symbol for marsh and appeared to be directly connected to the Elizabeth River. It is assumed that these areas were marsh at the time the

maps were made. Furthermore, it is believed that this is actually a conservative estimate of the extent of the marsh at the time. Experience from the tidal marsh inventory program (Silberhorn and Priest, 1987) has shown that many of the smaller, ~ .25 acre, marshes were not depicted as such on the topographic maps.

Topographic maps from the VIMS tidal marsh inventories of the Elizabeth River watershed (Barnard and Doumlele, 1979; Silberhorn and Dewing, 1989; Silberhorn and Dewing, 1991; Silberhorn and Priest, 1987) were available on stable-base mylar from the VIMS Comprehensive Coastal Inventory Program's (CCI) map archive. The data from this series are referred to as the 1977 wetlands acreage because the majority of the field work for these was conducted between 1976 and 1978. The digitized data for the 1944 and 1977 tidal marsh acreages of the Elizabeth River watershed were converted into Arc/Info coverages representing the mean high water shoreline and wetland areas. See also the companion article by Marcia Berman in this issue's GIS column.

Following the creation of the digital tidal marsh and shoreline coverages for 1944 and 1977, respectively, the tidal marsh coverage was combined with the shoreline to create one map coverage for each period studied. For the analysis, the 1944 and 1977 coverages were superimposed in Arc/Info and compared for differences in areal extent and location.

Results and Discussion

The areas of the polygons created by the boundaries of the tidal marshes in 1944 and 1977 were calculated in Arc/Info (Table 1). Calculations were based on the total watershed, but also reported for the major tributaries. Final map products illustrate where changes in tidal marsh acreage have occurred between 1944 and 1977 and estimate tidal wetland habitat losses for the Elizabeth River watershed (Fig. 1).

The results indicate that significant areas of tidal wetlands have been lost throughout the entire Elizabeth River system. The highest losses and the fastest rate of loss were located in the Southern and Eastern Branches which have been the scene of some of the most intensive industrialization and urbanization in the watershed. In some instances, entire creek systems have been filled, dredged and channelized to the point where they are virtually unrecognizable as a former tidal wetland system. Figure 2 (pages 4-5) illustrates an example of this observation. Here a branch of the Lafayette River was significantly altered during the study period for both residential and commercial purposes.

It is also interesting to note from Table 1 that the total percentage loss of wetlands from 1944 to 1977, averaging all losses from the tributaries and the main stem, is 52%. The best estimate available of the percentage of wetlands lost in the coterminous U.S. since colonial times is 53%. Thus the Elizabeth River lost approximately 50% of its 1944 wetlands total in 33 years and the continental U.S. is estimated to have lost 50% of its original wetlands total in 200 years (1780's to 1980's) (Dahl, 1990). This comparison is not exact but serves to illustrate the rapidity of development, in terms of wetland loss, that did occur within the basin. The wetland losses documented in this study are understandable given the pre-1960's "wetlands are wastelands mind set" and the land use direction established early on for the Elizabeth River. Few question the fact that the loss of wetlands has slowed significantly. Yet to be determined is whether this long term trend of net wetland loss can be reversed and if restoration efforts can successfully restore lost wetland functions that are an integral part of a healthy river system.

The results of this study provide a portion of the framework for a comprehensive tidal wetlands management program within the Elizabeth River

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Table 1. Elizabeth River watershed tidal wetland habitat loss: 1944-1977.

Tributary/Section	1944 Acreage	1977 Acreage	Acreage Lost	% Lost	Rate of Loss (ac/yr)
Willoughby Bay	214.20	80.41	133.79	62%	4.05
Lafayette River	1076.80	488.04	588.76	55%	17.84
Eastern Branch	1379.15	553.77	825.38	60%	25.01
Southern Branch	2625.38	1360.14	1265.24	48%	38.34
Western Branch	1074.43	612.01	462.42	43%	14.01
Main Branch	293.14	118.66	174.48	60%	5.29
Total	**6663.10**	**3213.03**	**3450.07**	**52%**	**104.55**

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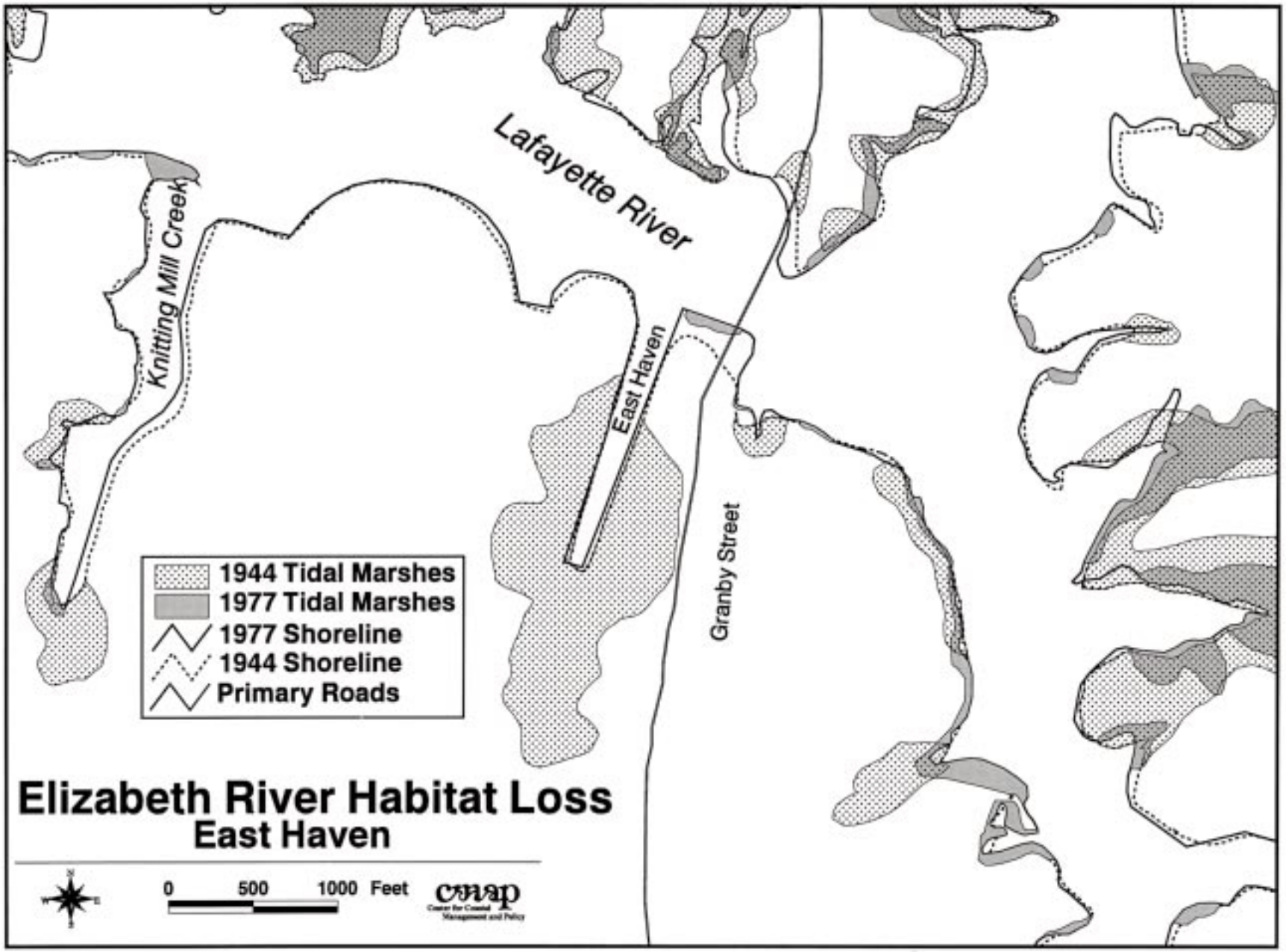
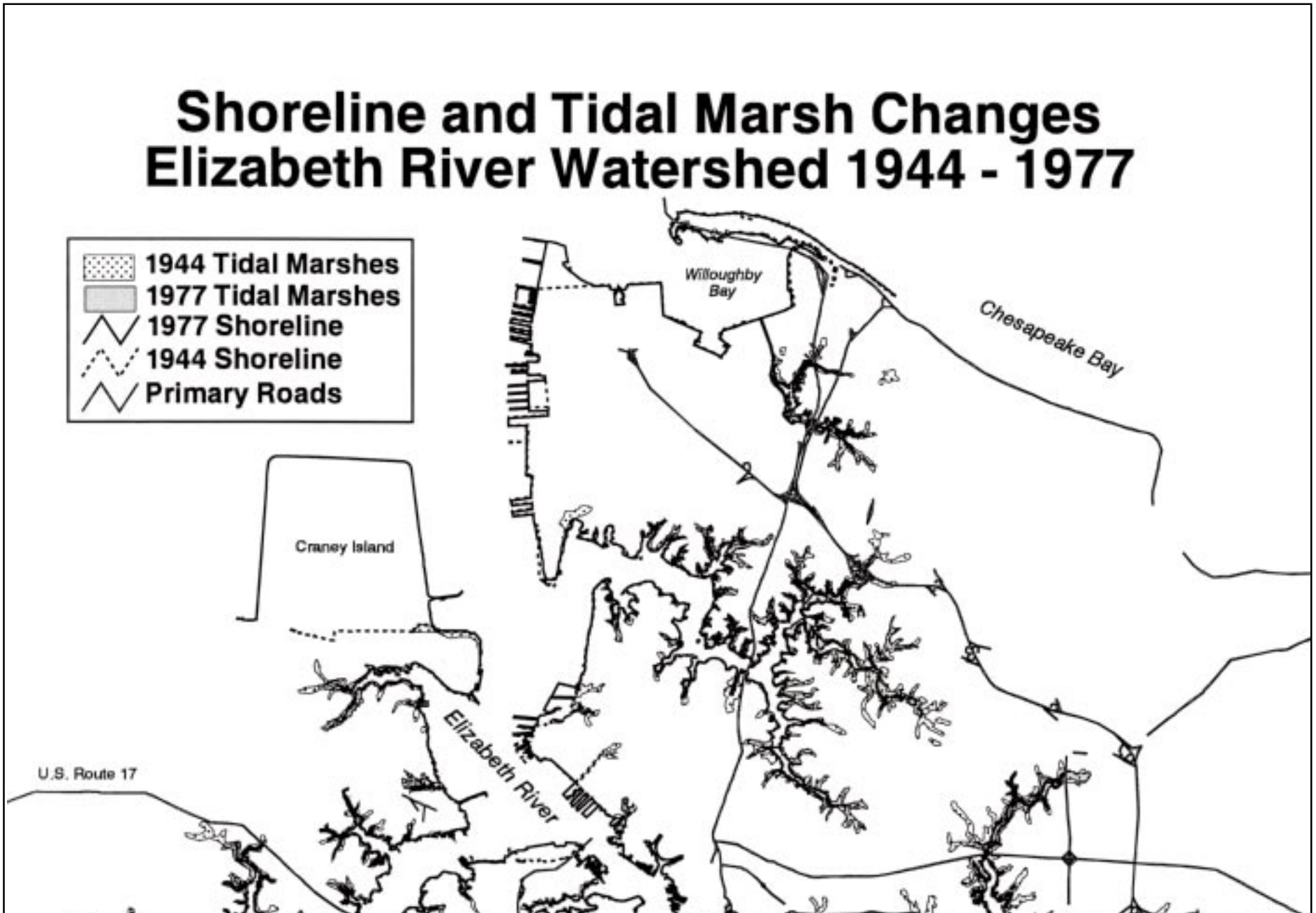

Lafayette River
Knitting Mill Creek
East Haven
Granby Street
1944 Tidal Marshes
1977 Tidal Marshes
1977 Shoreline
1944 Shoreline
Primary Roads
Elizabeth River Habitat Loss
East Haven
0
500
1000 Feet
CCMP

Figure 1.


Shoreline and Tidal Marsh Changes
Elizabeth River Watershed 1944 - 1977
1944 Tidal Marshes
1977 Tidal Marshes
1977 Shoreline
1944 Shoreline
Primary Roads
Willoughby Bay
Chesapeake Bay
Craney Island
Elizabeth River
U.S. Route 17

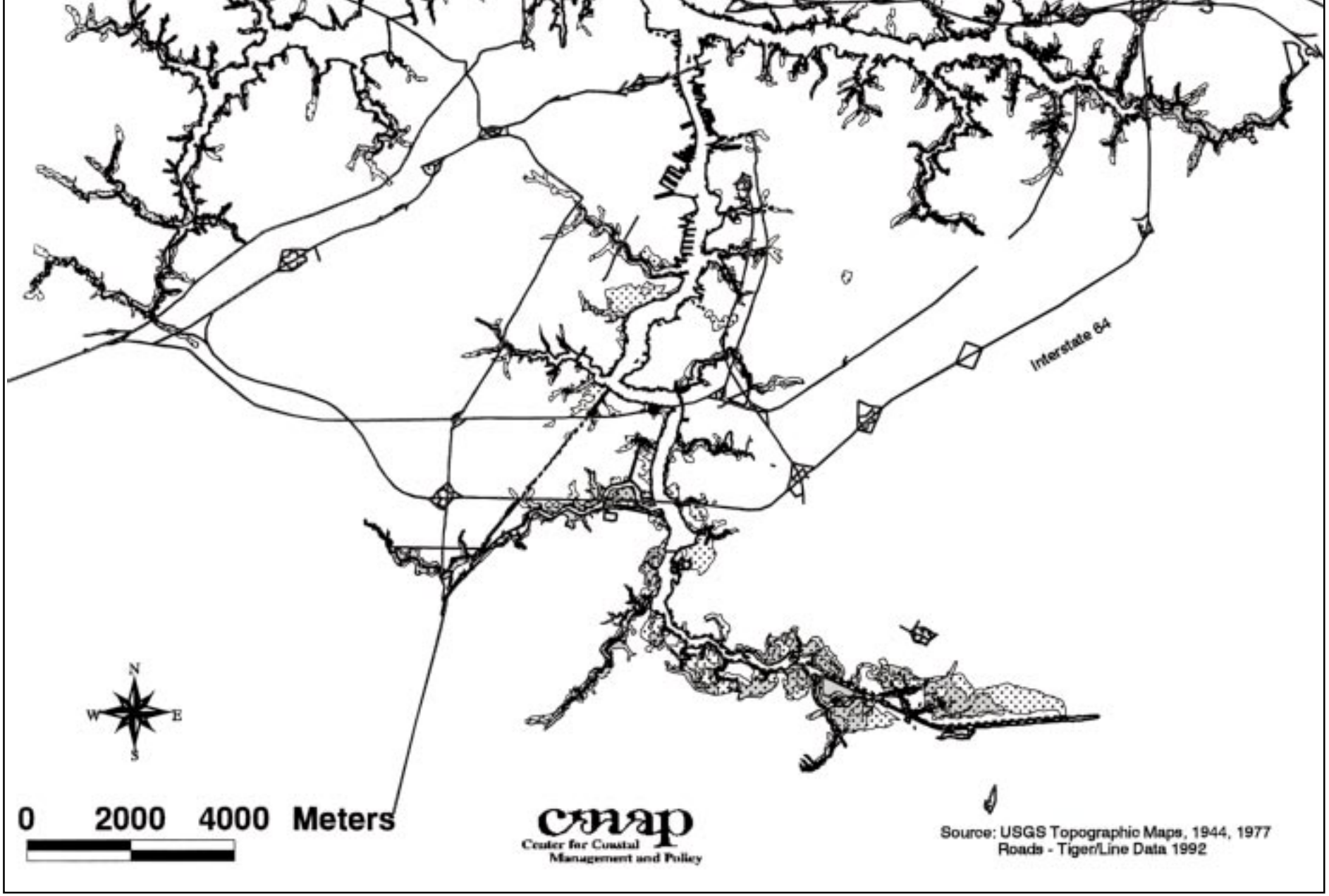

Interstate 64
N
W
E
S
0 2000 4000 Meters
Center for Coastal Management and Policy
Source: USGS Topographic Maps, 1944, 1977
Roads - Tiger/Line Data 1992

Figure 2.

Recorded History was Revolutionized By a Wetland Plant

Pamela Mason

Still being discovered and interpreted even today, manuscripts made of papyrus provide invaluable information about the ancient history of the Middle East and Europe. Papyrus is not only the commonly used name for the "paper" made from a wetland plant, but is also the species name of the plant itself, *Cyperus papyrus*. The papyrus plant is a perennial sedge with a heavy root system and triangular stem which can grow to a height of fifteen feet. Formally found in such abundance along the banks of the Nile River that the hieroglyphic symbol for the plant was also the symbol for the Kingdom of Lower Egypt, the plant is now almost extinct in Egypt (Information Please 1999).

All parts of the plant were used, roots were used for fuel and the pith was eaten. The stems were used to make sandals, boxes, twine and cloth, and notably, river craft and writing materials. The method for making a smooth surfaced writing paper from papyrus was perfected around 1500 B.C. Papyrus was in great demand in the Middle East and Europe. Papyrus gradually lost favor during the times of the Roman Empire as it was replaced by rag and wood pulp paper. The use of papyrus "paper" was discontinued about the 8th century A.D.

Renewed interest in papyrus was sparked by Thor Heyerdahl's Ra expeditions of 1969 and 1970. The Ra expeditions were attempts to cross the Atlantic ocean in boats constructed of papyrus. As papyrus was the preferred boat building material of ancient Egyptians for Nile River craft, Heyerdahl wanted to demonstrate the possibility of Egyptian exploration of the Western Hemisphere. In response to the growing interest in papyrus, the papyrus industry was revived in the early 1970's. Papyrus plants had to be brought from Sudan and Ethiopia, as papyrus had been extirpated in Egypt. Today, the method employed to produce papyrus sheets to very similar to the ancient method. The approach is fairly simple, but labor intensive. Plant stalks are cut by hand and bundled for transport to nearby work areas. Typically, only the lower two feet of the stem is wide enough to be suitable for making paper. The outer green material is removed and the pith is sliced into strips. The strips are wetted, beaten to expose the fibers and trimmed again. Finally, the strips are laid side by side in two layers at right angles, to form a sheet. The sheet is then pressed to remove moisture. Many sheets may be joined, end to end, to form a scroll. (Raizen 1995)

Since the first discovery was made in 1947, tens of thousands of papyrus and leather scroll fragments have been found in caves associated with ancient settlements scattered along the Red Sea. Collectively known as the Dead Sea Scrolls, they include manuscripts of Books of the Old Testament. The durability of papyrus has allowed for the survival of ancient scrolls which provide valuable literary and historical information on Egyptian, Greek, Roman and many other ancient civilizations. Wetlands have played a significant role in human history from the earliest times up to the present. It would be difficult to argue however, that this ecosystem ever had a greater influence than when this single hydrophyte was used from everything from writing to shipbuilding.

References:

"Papyrus" from the Columbia Encyclopedia, Fifth Edition. ©1993. Information Please LLC. 1999. http://www.infoplease.com/ce5/CE039428.html. (June 24, 1999)

Raizen, Esther. 1995. Papyrus: the gift of the Nile. The Center for Middle Eastern Studies, The university of Texas at Austin. http://menic.utexas.edu/menic/cmes/out/papyrus/papyrus.html.

"The Dead Sea Scrolls." Information Please LLC. 1999. http://www.infoplease.com/ipa/A0193627.html. (June 24, 1999)

Wetland Loss in the Elizabeth River continued from page 2

System. First, it puts the remaining tidal wetlands in a quantitative and geographic perspective relative to the losses of the recent past. This provides the basis necessary to direct the focus of restoration efforts to those areas that have experienced the greatest losses and would stand to benefit most from restoration.

Secondly, it provides the locations of former wetlands having the greatest potential to be successfully reestablished through restoration efforts. These areas, which once supported various wetland communities, have the potential advantage of a continuing hydrological link with the watershed that could make restoration efforts more effective and efficient at restoring lost wetland functions and values.

Thirdly, by focusing restoration efforts in former wetland areas, the study enables restoration programs to avoid the public perception of converting established habitats, such as riparian forest buffers into wetlands. And because many converted wetlands never fully recover ecologically and remain disturbed habitats of relatively low ecological value, the loss of existing natural function can be minimized.

Finally, by identifying and enabling existing programs to select former wetland sites of appropriate landscape position, significant size, and level of

GIS Applications for Wetlands Restoration in the Elizabeth River Watershed

Marcia Berman

Among other things, the Elizabeth River Project seeks to restore water quality and habitat to support living resources within the watershed. GIS is playing an important role in these ongoing activities. It has been used successfully to gather existing data which support the various research and management goals of the project.

Water quality impacts to the Elizabeth River are rooted in both point and non-point sources. The land use in the watershed contributes significantly to both of these impacts. GIS was used to model the potential pollutant load based on land use, and assumed loading rates associated with various land practices. Local government and city zoning maps were digitized into a GIS; using a standard zoning designation which allowed each city to be compared to its neighbors. The acreage was calculated for each land use type, and the loading factors were applied.

At VIMS, GIS techniques were used to locate potential sites for the restoration of wetlands habitat in the watershed. Restoration, by definition, attempts to bring the environment back to some previously desired condition. Wetlands restoration, recreates wetlands in areas where wetlands have been filled, degraded, or severely impacted. To that end, ideal sites for wetlands restoration are theoretically sites where wetlands once existed.

Within the Elizabeth River Watershed, the historic position of tidal wetlands can be traced through an analysis of historic charts which depict the position of wetlands observed at the time of publication. United States Geological Survey maps dating from the 1920s, the 1940s, and the 1970s were acquired to trace the position of the wetlands spanning nearly fifty years of development in the watershed.

Each map was digitized using GIS software, by tracing the position of the illustrated marshes with an electronic digitizer. Each survey year was recorded as a separate digital record. The most recent survey, from the late 1970s was then compared with the older surveys to see where the position of wetlands has changed. Wetlands present in the earliest surveys, but absent in the most recent data suggest an impact through either natural or human activities. The relative cause/effect relationship is usually easy to determine. Sites which have been filled or impacted due to development pressures can now be evaluated as a potential candidate for restoration.

Restoration requires opportunity to replace the current land use with a wetland. Restoration also requires that the present landscape still retain some of the features which originally allowed it to support a wetlands in the past. Hydrology, for example, would be essential in the restoration activity. In searching for sites, the hydrology of the setting must be considered, and connectivity to a hydrologic source must be possible. There must also be a willingness on the part of the current property owner to convert the parcel or parcels to a wetland.

Within the Elizabeth River Watershed, potential sites have been identified by using GIS techniques to analyze for historic wetland locations which are presently non-wetland sites. These areas have been evaluated in a number of different ways to determine their ability for supporting a wetland today. Several proposals have been prepared in the hope that funding availability would allow this activity to proceed.

disturbance, the study supports economy of scale and the reestablishment of natural function that make wetlands restoration a very effective tool for habitat and water quality improvement within the Elizabeth River watershed.

Editor's Note:

Due to space limitations, we have not included a list of the references cited in the text of the original study. If you would like to have a copy of the bibliography, please contact the author or the VWR editor at VIMS.

Additional Readings

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Tiner, R.W. and D.B. Foulis. 1994. Wetland trends in selected areas of the Norfolk/Hampton region of Virginia (1982 to 1989-90). U.S. Fish and Wildlife Service. Hadley, MA. Ecological Services Report R5-93/16. 18 pp.

Acknowledgments

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Calendar of Upcoming Events

September 23-25	**International Conference of the Society for Ecological Restoration, San Francisco, CA.** Contact Deborah Amshoff at (805) 634-9228. Also see: www.sercal.org/ser99.htm
October 7-8, 1999	**10th Annual Virginia GIS Conference, Abingdon, Virginia** Southwest Virginia Higher Education Center Conference info: www.institute.virginia.edu/vapdc
November 2-5	**Second Annual Wetlands Regulatory Workshop. Atlantic City, NJ.** Abstracts due by May 22. Contact: Ralph Spagnolo at (215) 814-2718. or Spagnolo.ralph@epamail.epa.gov
November 3-5	**Wetlands for Wastewater Recycling. Baltimore, MD.** For additional information, contact: Environmental Concern Incorporated P.O. Box P, St. Michaels, MD 21663; consult@wetland.org

Virginia Horseshoe Crab Management Update

Tom Barnard and Lyle Varnell

A number of noteworthy things have happened and actions have been taken on the horseshoe crab management front since we wrote of the various use conflicts within the mid-Atlantic states in our winter/spring issue of the newsletter (Vol. 14, No. 1). This article offers a quick update and is not intended to be a detailed account of these activities. Please see the last issue of the newsletter for background information and an explanation of the issues involved with the management of this living marine resource.

As detailed in our previous newsletter, the Virginia Marine Resources Commission (VMRC) held a public hearing in late February and as a result issued regulations prohibiting the taking of horseshoe crabs within a thousand feet of the mean low water line during the horseshoe crab primary spawning period of May 1 through June 7. The Commission also set requirements for the mandatory reporting of horseshoe crab catch by commercial fishermen. Additionally, the commissioners established a study committee made up of representatives of the various stakeholder groups, scientists and managers but refused to set any limit on Virginia landings for 1999.

At its March meeting, the Marine Resources Commission heard from its *ad hoc* panel, and after mature discussion of the various issues, set a landings cap of 710,000 crabs for Virginia. It does not matter where the crabs are caught. This, combined with the two actions described in the paragraph above, constitute Virginia's regulatory actions for 1999 with regard to the horseshoe crab resource.

Meanwhile, the Atlantic States Marine Fisheries Commission (ASMFC), the federally sponsored body responsible for setting fishery management plans (FMP's) for marine resources, has been reviewing horseshoe crab state management proposals for the east coast region. In March, based on the recommendations of its Technical Committee, the ASMFC Management Board determined that 5 of the 17 Atlantic states had adequately addressed the horseshoe crab FMP. Virginia was one of the 5 along with New Jersey, Delaware, Maryland and South Carolina.

In other activities since our last newsletter, an article in the May 22 edition of the Newport News *Daily Press* quotes statements by Secretary of the Interior, Bruce Babbitt that are highly critical of Virginia's actions in protecting the horseshoe crab. Babbitt criticized Virginia for not doing enough to protect the animals and as a result for "leading a race to the bottom." Babbitt stated that the protective actions of New Jersey, Delaware and Maryland are being undermined by Virginia.

On the scientific front, the Virginia Institute of Marine Science, in cooperation with the VMRC, has begun a survey to identify and document critical horseshoe crab spawning habitat in the Virginia portion of the Chesapeake Bay. Funded by the Virginia Coastal Program, the study has begun in the Middle Peninsula and Northern Neck areas. The research involves documenting the horseshoe crab Habitat Suitability Index (HSI) spawning factors for most of the Chesapeake Bay beaches. Scientists are measuring beach slope, sediment characteristics, soil moisture, depth of sand and beach width for over 300 beaches in the Virginia portion of the Bay.

Also, scientists and volunteers from Delaware and New Jersey are surveying horseshoe crab spawning beaches in Delaware Bay during this year's spawning season to try and determine if the species' numbers are declining. The effort is to make the annual census statistically valid and therefore of greater value to resource managers.

The horseshoe crab issue in Virginia has quieted down slightly from the frenzied action of February, March and April. With the mandated change in landing statistics in Virginia however, the issue will be revisited next year. New information will be available, but given the history of the use conflicts surrounding this resource, controversy will no doubt again assume center stage.