9-1999

Internet Access to Virginia Wetland Resource Management Support and Advisory Information

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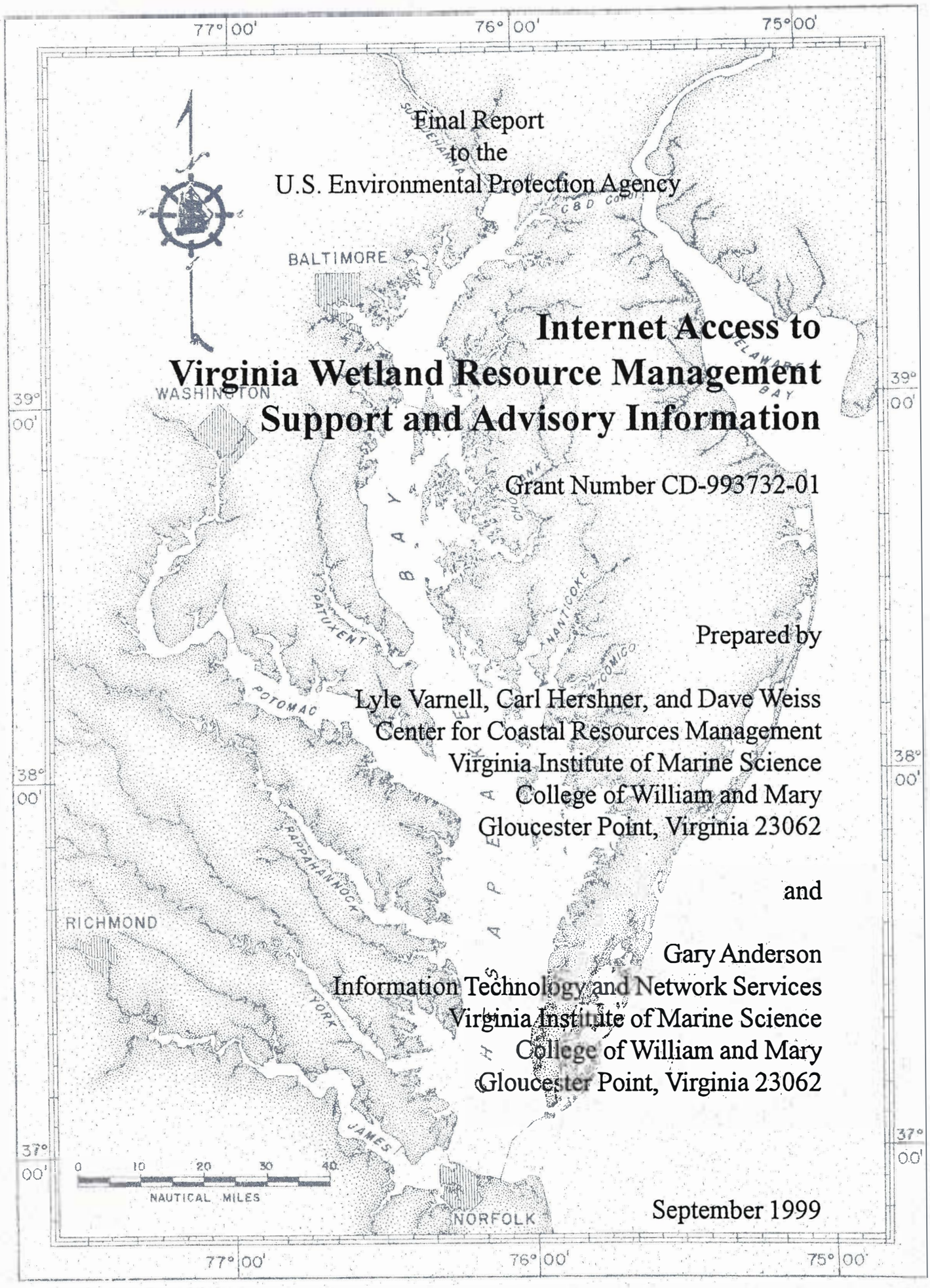

Final Report
to the
U.S. Environmental Protection Agency

Internet Access to Virginia Wetland Resource Management Support and Advisory Information

Grant Number CD-993732-01

Prepared by

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FINAL REPORT

Grant Title Internet Access to Virginia Wetland Resource Management Support and Advisory Information
Assistance # CD993732-01
Budget/Project Period 4/1/97 to 9/30/98
Grantee's Project Officer Jerry Harrison
Project Officer's Telephone # (804) 684-7028

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Federal Funds Expended:	$ 78,952
Federal Funds Remaining:	$ 0

GOALS/OBJECTIVES:

Provide internet access to Virginia cumulative nontidal wetlands impacts data, outreach tidal wetlands education modules, technical reports and newsletters.

PLANNED VS ACTUAL ACCOMPLISHMENTS:

Through this project, Virginia nontidal wetland impacts for 1993-1998 are now readily accessible through the internet. We had initially proposed including data from 1995-1998, but the 1993 and 1994 data sets provided by the Norfolk District Corps were not significantly different from the subsequent time series in terms of completeness and accuracy. Therefore, we undertook the additional work of expanding the proposed time series. We have also redesigned the Tidal Wetlands Impacts Data Home Page to look similar to the Nontidal Home Page. This will reduce confusion to the user when accessing wetlands information from both pages. Links to nontidal wetlands information from the Tidal Home Page have also been updated to target the Nontidal Home Page. Access is provided through the VIMS web page in a hierarchical manner.

Technical documents and education units have also been included as planned. We had proposed to include the previous two years' documents; however, the product contains access to all technical documents produced by the VIMS Wetlands Program since 1990.

The Center for Coastal Resources Management web site (**http://www.vims.edu/ccrm/**) includes the products funded through this, and previous, EPA grants. Additional products beneficial to wetlands and coastal resource management are included which complement the EPA-funded products. VIMS' web page is cataloged on a dozen or more web search engines including Yahoo, Infoseek, Alta Vista, and Excite. Currently, the VIMS web page receives approximately 20,000 page hits per week. Access will also be advertized through the Wetlands Program's outreach publications mailings.

Methods

Cumulative Nontidal Wetlands Impacts Data

Nontidal wetlands data were transferred from the Norfolk District Corps in an ASCII delimited format to VIMS via email attachment. Codes were written (using C language) for reconfiguration of the data for easy sorting and summarization, placement into a Sybase System

XI database, error checking and data "clean-up," and variable coding. Hypertext Markup Language (HTML) and C programs were developed for data querying and summarization. Graphics were created and posted using a common spreadsheet software.

Location recoding was necessary to ensure consistency with the tidal wetlands data, and to provide sorting capabilities by physiographic province.

Education Units

Two existing self-taught educational units were translated into digital format and linked to the Wetlands Program home page. The tests associated with each unit were translated into hypertext markup language (html) and coded for interactive input by the user, including real-time prompts on the accuracy of the answers entered by the user.

Publications

Technical Report series documents and Wetlands Report newsletters were translated into digital format and linked to the Wetlands Program home page.

Results

Cumulative nontidal wetlands impacts data

The web site **http://www.vims.edu/rmap/wetlands/nontidal/** presents the following information:

- a guide to the site including general descriptions of each link included on the Home Page.
- an explanation of data collection and summarization methods
- a data description section
- disclaimer and copyright information
- general data summaries in graphic and tabular format
- an interactive routine which allows selection of losses or compensatory mitigation summaries by nontidal wetland community type (Cowardin classification), permit type, year, and location (locality or physiographic province) for data from 1993-1998
- a link to the document *A review of nontidal wetland projects and impacts in Virginia, 1991-1993* which provides nontidal wetlands impacts data
- an email link for questions and data requests
- an acknowledgment of the Environmental Protection Agency as the funding source on the Home Page footer, and the Norfolk District Corps as a cooperating partner in the project
- a link to the Tidal Wetlands Impacts Data Home Page
- a link to other web resources at VIMS

Page Examples

Home Page (Figure 1): The home page was designed for readability and facilitating rapid links to selected data categories. It was our intent to keep the hierarchical structure to a minimum. This page is accessible through the VIMS Home Page via links to the Center for Coastal Resources Management.

Copyright and Disclaimer (Figure 2): This page describes the legal requirement to identify information sources and the proper methods of citing the information retrieved from this site. This page is displayed prior to delivery of any data menu pages and must be removed by the operator before data can be accessed.

General Data Summaries Selection Page (Figures 3-6): This page provides menus for selection of data summaries for nontidal wetlands impacts by locality and year or physiographic province and year, and graphic displays of losses and compensatory mitigation by Cowardin classification. Examples of output are included.

Query Selection Page (Figures 7-10): The operator is able to select data summaries by Cowardin classification, permit type, year, and location. Examples of output are included.

Education Units

The web site **http://www.vims.edu/ccrm/wetlands/selfeds.html/** supplies the following educational resources (Figures 11, 12, 13):

- *Coastal Shoreline Defense Structures* self taught education unit with accompanying interactive test.

- *Wetland Functions and Values* self taught education unit with accompanying interactive test.

Publications (Figure 14; also includes links to resources not funded by this project and is located at the web site **http://www.vims.edu/ccrm/publications.html)**

The web site **http://www.vims.edu/ccrm/wetlands/techreps1.html** presents the following information:

- VIMS Technical Reports from 1990 to the present. Additionally, all future Technical Reports will be posted on this site (Figures 15 and 16).

The web site **http://www.vims.edu/ccrm/wetlands/flora.html** presents the following information:

- VIMS Technical Report Plant Series documents from 1990 to the present. Additionally, all future Plant Series documents will be posted on this site.

The web site **http://www.vims.edu/ccrm/vwrs.html** presents the following information:

- VIMS Wetlands Report newsletters from 1990 to the present. Additionally, all future Wetlands Reports will be posted on this site (Figures 17 and 18).

Conclusions

This web site provides accurate and detailed summarized Virginia nontidal wetlands impacts data to all parties or persons concerned about Virginia nontidal wetlands. Online documentation explaining data retrieval procedures are included. This information will be updated regularly and will be perpetually available.

Outreach education and technical publications are also provided through this web site. Education and publication resources will be perpetually updated and revised.

HIGHLIGHTS:

The project was completed.

POLLUTION PREVENTION ACCOMPLISHMENTS:

NA

DEFICIENCIES/CORRECTIVE ACTION:

None.

VIRGINIA
NONTIDAL WETLANDS IMPACTS DATA

Wetlands - Where it all comes together...

A Guide to this Site | Data Collection Methods | Data Description | General Data Summaries | Design a Data Query | Virginia TIDAL Wetlands Impacts | Report: A Review of Nontidal Wetland Projects and Impacts in Virginia 1991-1993 | Center for Coastal Resources Management | Dept. of Coastal and Ocean Policy

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This site is the result of a cooperative agreement between the United States Army Corps of Engineers, Norfolk District and the Virginia Institute of Marine Science, and is made possible in part by a grant from the United States Environmental Protection Agency.

Any comments, questions or concerns please contact - webmaster@vims.edu

Last Modified: 17 May 1999

Back to Wetlands Program home page

Back to VIMS home page

Figure 1

Graphic and Tabular Summaries of Nontidal Wetlands Impacts

Tables

Total acres of nontidal wetland losses by year and locality

Total acres of nontidal wetland compensation by year and locality

Total acres of nontidal wetland losses by year and physiographic province

Total acres of nontidal wetland compensation by year and physiographic province

Graphs

Acres of nontidal wetland losses by year and Cowardin classification

Acres of nontidal wetland compensation by year and Cowardin classification

Return to Virginia Nontidal Wetlands Impacts Data Home Page

Figure 3

Acres of nontidal wetland losses (all Cowardin classes combined)

Year	Coastal Plain	Piedmont	Mountain	Total
1993	106.72	14.04	6.20	126.96
1994	122.57	19.55	0.00	142.12
1995	277.51	22.89	0.00	300.40
1996	392.25	37.83	0.10	430.18
1997	210.08	21.35	2.53	233.96
1998	218.52	35.03	4.60	258.15
1999	100.14	25.33	1.51	126.98

Return to Nontidal Wetlands General Summaries

Return to Virginia Nontidal Wetlands Impacts Data Home Page

Figure 4

Total acres of nontidal wetland losses (all Cowardin classes combined)

Locality	1993	1994	1995	1996	1997	1998
Albemarle	0.00	0.00	0.00	0.00	0.00	0.04
Accomack	12.15	9.42	3.67	16.35	18.50	1.00
Amherst	0.25	0.00	0.00	1.77	0.01	0.65
Alleghany	0.00	0.00	0.00	0.00	0.00	0.57
Amelia	0.36	2.12	0.16	0.02	0.09	0.25
Appomattox	0.00	0.66	0.00	1.32	0.00	0.00
Arlington	0.00	0.00	0.00	0.00	0.00	0.00
Augusta	0.00	0.00	0.00	0.01	0.87	0.44
Bath	0.00	0.00	0.00	0.00	0.00	0.00
Bedford	0.00	0.72	0.03	0.04	0.09	1.08
Bland	0.00	0.00	0.00	0.00	0.00	0.00
Buchanan	0.00	0.00	0.00	0.00	0.00	0.00
Botetourt	0.00	0.00	0.00	0.00	0.00	0.00
Brunswick	0.95	3.63	0.80	0.22	6.61	0.22
Buckingham	0.00	0.00	0.00	0.00	0.00	0.02
Caroline	0.28	0.20	2.64	3.57	0.00	0.00
Cumberland	0.40	0.00	0.09	0.00	0.02	0.00
Charles City	1.96	1.83	0.69	80.01	1.12	0.10
Chesterfield	2.74	2.47	6.06	9.67	24.89	30.02
Craig	0.00	0.00	0.00	0.00	0.00	0.02
Chesapeake	8.49	12.55	27.51	102.57	51.03	14.56
Clarke	0.00	0.00	0.00	0.00	0.00	0.51
Charlotte	0.00	0.02	0.02	0.02	0.27	0.02
Campbell	0.00	0.29	0.15	1.03	0.38	1.85
Colonial Heights	0.90	0.00	0.74	1.90	0.00	0.00
Carroll	0.00	0.00	0.00	0.00	0.00	0.07
Culpeper	0.01	0.00	0.00	0.00	0.00	0.00
Dickinson	0.00	0.00	0.00	0.00	0.00	0.01
Dinwiddie	4.09	4.09	2.93	2.19	0.62	0.64
Essex	1.16	1.75	0.70	0.02	0.00	0.03
Fairfax	0.00	0.00	0.02	5.20	5.80	14.69
Fredrick	0.00	0.00	0.00	0.00	0.00	0.55
Franklin	0.00	0.00	1.06	1.11	0.97	0.05
Floyd	0.00	0.00	0.00	0.00	0.00	0.21
Fauquier	0.00	0.92	0.00	0.00	0.00	1.14

Figure 5

Fredricksburg	0.00	0.63	8.01	1.53	1.91	0.00
Fluvanna	0.00	0.20	2.88	0.00	0.17	0.27
Giles	0.00	0.00	0.00	0.00	0.08	0.00
Gloucester	0.69	0.90	0.12	0.63	0.00	0.00
Goochland	0.00	0.16	4.70	0.26	6.39	0.38
Greene	0.00	0.00	0.00	0.00	0.00	0.00
Greensville	1.35	0.01	0.76	0.25	2.08	4.97
Grayson	0.00	0.00	0.00	0.00	0.05	0.00
Hampton	1.46	4.72	1.88	28.72	5.82	9.57
Henrico	4.37	4.05	17.53	13.27	13.67	43.41
Highland	0.00	0.00	0.00	0.01	0.00	0.09
Hopewell	0.00	0.00	0.65	0.00	0.00	0.09
Hanover	3.75	0.99	3.96	4.84	7.73	3.50
Halifax	1.67	0.84	1.49	18.03	0.31	1.09
Henry	0.00	0.00	0.00	0.00	0.03	0.13
Isle of Wight	4.66	2.15	59.92	3.02	0.60	1.63
James City	3.02	9.27	5.93	23.14	7.30	5.43
King George	1.40	0.69	4.79	2.14	3.08	0.11
King and Queen	0.00	0.00	0.00	0.00	0.00	7.20
King William	3.70	0.18	4.80	0.91	3.00	0.04
Lancaster	0.00	0.00	0.00	0.00	0.00	0.50
Loudoun	0.00	0.00	0.00	0.01	0.47	9.20
Lee	6.20	0.00	0.00	0.00	0.00	0.01
Louisa	0.54	1.59	0.80	0.00	0.00	0.00
Lunenburg	0.01	0.10	0.01	0.57	0.62	0.03
Mathews	0.00	0.00	0.00	0.00	0.00	0.30
Madison	0.83	0.01	0.00	0.00	0.00	0.02
Mecklenburg	1.19	0.78	1.29	7.50	1.60	5.08
Middlesex	0.00	0.00	0.90	0.00	0.00	0.00
Montgomery	0.00	0.00	0.00	0.00	0.00	0.83
Nelson	0.00	0.00	0.30	0.65	0.00	0.10
Northampton	1.85	2.00	1.25	6.80	0.00	0.10
New Kent	0.32	2.54	3.87	1.26	1.63	1.10
Newport News	1.91	15.56	13.95	1.65	0.94	1.61
Norfolk	0.14	1.38	2.41	0.01	1.15	0.13
Northumberland	0.00	0.00	0.00	0.00	0.00	0.00
Nottoway	1.11	0.58	0.99	0.73	0.07	0.16
Orange	0.12	1.39	1.56	0.56	0.00	0.13

Figure 5 Continued

Page	0.00	0.00	0.00	0.00	0.00	0.13
Petersburg	3.31	0.00	0.75	0.00	1.79	1.05
Prince Edward	0.44	0.14	0.65	0.71	0.18	7.35
Prince George	8.50	2.95	3.00	1.14	1.71	3.81
Powhatan	0.62	0.00	0.23	0.84	0.31	0.05
Poquoson	0.00	0.53	0.37	0.20	0.00	0.00
Portsmouth	0.22	0.14	1.23	3.95	0.46	0.67
Patrick	0.00	0.00	0.00	0.00	0.65	0.14
Pulaski	0.00	0.00	0.00	0.00	0.42	0.00
Pittsylvania	0.10	1.30	1.99	0.00	0.06	0.01
Prince William	0.00	0.00	0.00	0.07	0.15	16.74
Rappahannock	0.00	0.00	0.00	0.00	0.00	0.10
Rockbridge	0.00	0.00	0.00	0.02	0.00	0.34
City of Richmond	0.98	0.00	0.94	0.00	0.00	0.86
Rockingham	0.00	0.00	0.00	0.00	0.00	0.07
Richmond	0.00	0.00	0.15	0.00	0.00	0.00
Roanoke	0.00	0.00	0.00	0.00	0.05	0.33
Russel	0.00	0.00	0.00	0.00	0.25	0.06
Scott	0.00	0.00	0.00	0.00	0.00	0.01
Shenendoah	0.00	0.00	0.00	0.00	0.08	0.16
Smyth	0.00	0.00	0.00	0.00	0.00	0.00
Southampton	4.00	6.34	4.60	8.48	2.04	2.84
Spotsylvania	13.97	3.58	27.27	7.99	3.42	1.68
Stafford	4.35	12.11	15.81	7.73	14.82	2.16
Suffolk	4.86	4.31	7.38	5.13	10.21	23.45
Sussex	0.23	0.37	2.04	3.99	1.43	0.42
Surry	1.10	0.20	0.00	2.06	0.21	0.57
Tazewell	0.00	0.00	0.00	0.00	0.00	0.01
Virginia Beach	7.62	5.98	23.58	38.97	16.95	24.02
Warren	0.00	0.00	0.00	0.04	0.00	0.00
Westmoreland	0.58	0.11	0.01	0.83	0.00	0.32
Williamsburg	0.00	0.44	0.00	1.05	2.03	0.53
Wise	0.00	0.00	0.00	0.02	0.08	0.01
Washington	0.00	0.00	0.00	0.00	0.00	0.00
Wythe	0.00	0.00	0.00	0.00	0.00	0.03
York	2.05	12.23	18.38	3.45	6.69	4.28

Return to Nontidal Wetlands General Summaries

Figure 5 Continued

Nontidal Wetlands Impacts Data Query Design Page

Refer to the Data Description Section for Definitions of Categories

---

Select a **Cowardin Classification:**

◉ **All** Cowardin Classifications

Riverine

○ All
○ Lower Perennial [All Classes ▼]
○ Upper Perennial [All Classes ▼]
○ Intermittent [All Classes ▼]

Lacustrine

○ All
○ Limnetic [All Classes ▼]
○ Littoral [All Classes ▼]

Palustrine

○ All
○ Other [Rock Bottom ▼]

Select a **Permit Category:**

◉ **All** Permit Categories
○ Individual Permits
○ Abbreviated Standard Permits
○ Letters of Permission
○ Regional General [All ▼] Display Regional Number Permit Details
○ Nationwide [All ▼] Display NWP Number Details

Select a **Year:** [1993 ▼]

Figure 7

Select a **Location:** All Virginia Localities

Select a **Summary** of: Losses

Submit Reset

Return to Nontidal Wetlands Impacts Data Home Page

Figure 7 Continued

Query Results

The results for All Permit Categories, All Virginia Localities, 1997

Wetlands Community	Losses (acres)
All Cowardin Classes	233.96

Return to Nontidal Wetlands Query Design Page

Return to Virginia Nontidal Wetlands Impacts Data Home Page

Figure 8

Query Results

The results for Nationwide 26, Coastal Plain Region, 1998

Wetlands Community	Losses (acres)
Palustrine Forested Wetland	53.85

Return to Nontidal Wetlands Query Design Page

Return to Virginia Nontidal Wetlands Impacts Data Home Page

Figure 9

Query Results

The results for Individual Permits, Virginia Beach , 1995

Wetlands Community	Compensation (acres)
All Cowardin Classes	21.20

Return to Nontidal Wetlands Query Design Page

Return to Virginia Nontidal Wetlands Impacts Data Home Page

Figure 10

Wetlands Self-Taught Education Units

Self-paced instructional units designed to provide basic information about the management of Virginia tidal wetland resources.

Clicking on the answers to the test questions will indicate which are correct.

Wetland Functions and Values

Wetland Functions and Values Test

Coastal Shoreline Defense Structures

Coastal Shoreline Defense Strructures Test

Comments? Contact: webmaster@vims.edu
Last modified: **December 14, 1999**

Back to WILLIAM & MARY VIMS VIRGINIA INSTITUTE OF MARINE SCIENCE SCHOOL OF MARINE SCIENCE

Figure 11

Self-Taught Education Unit

Wetland Functions And Values

By Maryann Wohlgemuth

Introduction

Throughout the state of Virginia there is a variety of wetland types which range from tidal marshes and swamps near the coast, to nontidal wetlands found anywhere from the coastal plain to the mountains. Wetlands are found in topographic depressions or along rivers, lakes, and coastal waters. Wetlands, in general, are areas that are wet or have wet soils during some part of the growing season. Wetland soils are **hydric** meaning they have an abundance of moisture. Wetlands are further characterized by the vegetation that they support which is adapted to grow in wet conditions, which is referred to as **hydrophytic** vegetation. Wetland vegetation may include grasses, herbaceous plants (non- woody), shrubs, and trees. **Tidal wetlands** are found along the coastline where they are influenced by daily tidal fluctuations and include vegetated marshes and swamps or nonvegetated mud and sand flats (Figures 1, 2, 3, 4). **Nontidal wetlands** are not influenced by

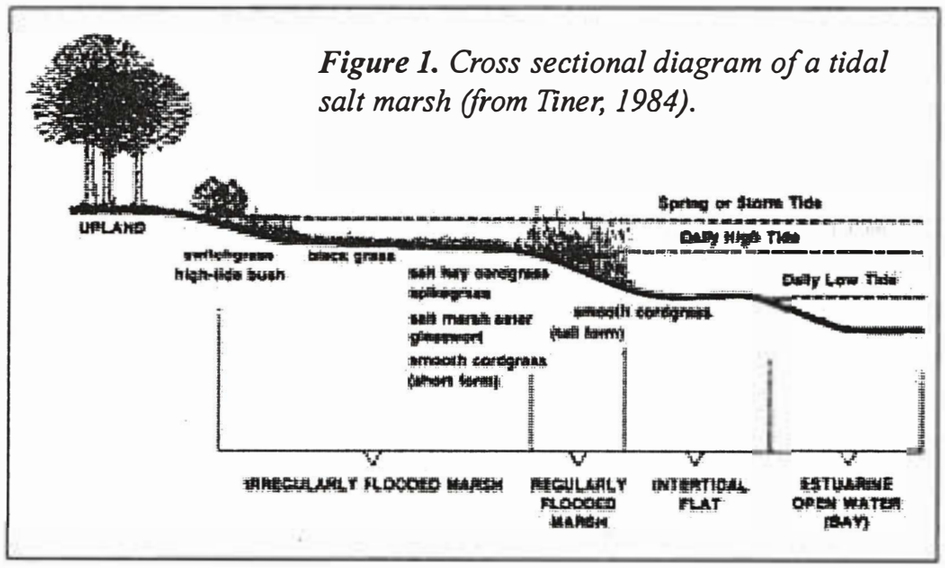

Figure 1. *Cross sectional diagram of a tidal salt marsh (from Tiner, 1984).*

Figure 2. *Vegetated tidal wetland.*

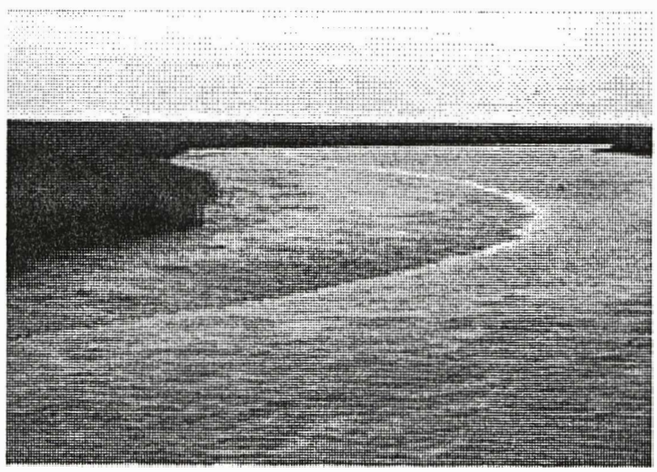

Figure 3. *Non-vegetated mud flat.*

Wetland Functions and Values
Exam Questions

1. The two distinct types of wetlands, TIDAL and NONTIDAL, differ from each other based on their interaction with the change in elevation (rising and falling) of their water source.
   True
   False

2. Which three of the following components are necessary in order to label an area a "wetland"?
   a. trees
   b. water (hydrology)
   c. hydric soils
   d. shrubs
   e. hydrophytic plants

3. The Chesapeake bay watershed receives ground water from which of the following areas?
   a. all those areas adjacent to the tidal waters of the Bay
   b. lands in Maryland and Virginia that drain towards the Bay
   c. the 64,000 square mile area that extends north into New York and west to the Appalachian mountains
   d. all of the above

4. Which of the following wetland functions/values are related specifically to maintaining water quality in the Bay?
   a. removal of pollutants
   b. flood protection
   c. trapping of sediment
   d. nursery areas for young fish
   e. groundwater recharge and discharge
   f. nutrient recycling and uptake

5. Nutrients are only removed by wetland plant uptake. Soils are not effective in improving water quality through nutrient removal.
   True
   False

6. All wetlands provide All of the functions/values listed on page three in the educational unit.
   True
   False

Figure 13

Publications

CCI Program
CW Program
Wetlands Program
Staff

- Wetlands Technical Reports
- Wetlands Flora Reports
- Wetlands Management Handbook
- Tidal Marsh Inventories
- Virginia Wetlands Reports
- Virginia Wetland Permits
- Self-taught Education Units

Figure 14

Wetlands Technical Reports

Sort by title, first author, or report date:

Sort by:

⊙ Title ⊙ Author ⊙ Date

View Reports

- Advances in Wetland Status and Trends Monitoring - Cumulative Error Comparisons. No. 96-6, June 1996- S. Nelson
- An Assessment of Aquatic Wildlife Utilization Between Created and Natural Tidal Salt Marshes- No. 93-2, March 1993- Havens and Varnell
- Animals of the Intertidal Sand and Mud Flats- No. 90-1, June 1990- Havens
- Coastal Resources and the Permit Process: Definitions and Jurisdictions- No. 91-2, February 1991- Bradshaw
- Compensatory Mitigation Within the Tidal Wetlands of Virginia- No. 90-7, December 1990- Barnard and Mason
- Cummulative Impacts of Shoreline Construction Activity on Tidal Wetlands in Virginia- No. 90-3, Aug. 1990- Priest, Wohlgemuth, Havens, Barnard, & Bradshaw
- Current Trends in Ecologic-Economic Valuation of Wetlands- No. 92-8, Aug. 1992- Mitchell and Grignano
- Detritus: Mother Nature's Rice Cake- No. 96-10, Oct. 1996 - Mason and Varnell
- Ecotourism: Tripping with Mother Nature- No. 95-2, Feb. 1995 - Barnard
- Field Testing the Proposed Federal Wetlands Delineation Manual- No. 92-2, Feb. 1992- Perry, Bradshaw, and Havens
- Methods of Risk Analysis: Traditional and Ecological Approaches. No. 96-8. August 1996. J. Buie
- Monitoring of Compliance with Permits Granted by Local Wetlands Boards- No. 90-A, August 1990- Bradshaw
- Natural Resources Management In Coastal Virginia- No. 93-6, July 1993- Pam Mason
- Oldest Operating Wetland Mitigation Bank in the US - No. 97-7, Oct. 1997 - Barnard, Hershner, and Greiner
- Plant Adaptations to Saturated Soils and the Formation of Hypertrophied Lenticels and Adventitious Roots in Woody Species. No. 96-2, February 1996- K. Havens
- Plowing Through the Muck: A Review of Wetland Assessment/Evaluation Methods- No. 93-11, November 1993 - Melissa Chaun
- Primary Producers and Decomposers of Intertidal Flats- No. 91-4, April 1991- Wohlgemuth

Figure 15

Wetlands Program
Technical Report
February 1999
No. 99-2

VIMS Shoreline Permit Database Impacts and Alterations Summary 1988 - 1992

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Summary

The permitted impacts to tidal vegetated wetlands in Virginia for the period of 1988-1992 were approximately 18 acres per year.

The permitted impacts to tidal nonvegetated wetlands in Virginia for the period of 1988-1992 were approximately 21 acres per year.

A total of approximately 79.5 miles of riprap and approximately 53 miles of bulkhead were permitted over the five year period.

Introduction

The management of wetland resources has always been hampered by the lack of knowledge regarding the rates of wetlands loss from permitted activities. These statistics have usually been the most intractable data to acquire because of the numerous agencies involved in the permit process, the frequent modifications of permit applications and the difficulties involved with ensuring the inclusion of all projects proposed. The development of this database which documents tidal wetland losses in Virginia will provide a number of new perspectives on the management process. First, it can help determine the effectiveness of management efforts by documenting the permitted losses of tidal wetlands. Secondly, it will allow an assessment of the cumulative impact of incremental wetland losses on the resource as a whole. Thirdly, the data are a critical baseline element necessary to assess the Commonwealth's relationship to the goal of "no net loss" of wetlands, a current management priority. Lastly, interpretation of these data may illuminate trends in construction activity or impacts requiring special management attention.

Methods

This report summarizes data from 1988-1992 that were collected by personnel from the Wetlands Advisory Group at the Virginia Institute of Marine Science. It is almost always based on a visit to the site to assess the anticipated impacts. Impacts to tidal wetlands are classified by date, locality, immediate water body, primary waterway, watershed, type and extent of proposed activity, and wetland community type. These data are entered into a computer database and a report is generated which summarizes

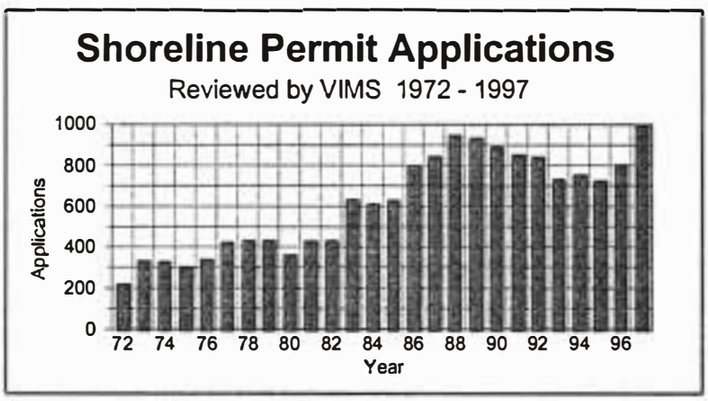

Figure 1.

Virginia Wetlands Reports

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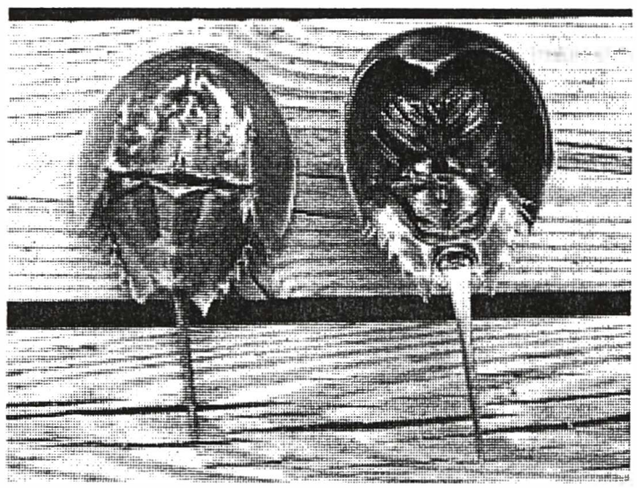
Horseshoes Anyone?

By Tom Barnard and Lyle Varnell

No, this article is not about the venerable old summertime game played at picnics and other large outdoor gatherings for hundreds of years. It is about a very familiar east and gulf coast marine organism known commonly as the horseshoe crab and more formally as *Limulus polyphemus*. The horseshoe crab is called such due to the horseshoe-like shape of its outer shell or carapace and the fact that it was once thought to be a true crustacean. If you know anything else at all about the horseshoe crab, it is probably that it is more closely related to spiders, ticks and scorpions (arachnids) than to crabs (crustaceans). In addition to the North American stocks, other large horseshoe crab populations are found along the coast of southeast Asia and associated islands such as Japan. Within the mid-Atlantic bight of the Atlantic coast of North America the largest spawning populations occur in Delaware Bay with a significant, yet smaller spawning population in Chesapeake Bay. The fact that this arthropod has significant economic, medical and ecological value in Virginia and may be experiencing a population decline has elicited concern from a variety of groups with highly divergent interests. These range from Audubon and wildlife groups to watermen to the biomedical community.

From an ecological perspective, *L. Polyphemus* adults and juveniles are an important component in the diet of juvenile loggerhead turtles which summer in and around the Chesapeake Bay. The eggs and larvae are significant seasonal food sources for commercially important finfish and shellfish as well as other marine food web components. Additionally, large numbers of shorebirds apparently time their spring migration to the Arctic to fuel up on horseshoe crab eggs and larvae before beginning the final leg of their journey to the northern nesting areas. These species include the red knots, turnstones and sanderlings and their Delaware Bay stop is said to be the only one they make between South America and the Arctic. The New Jersey Audubon Society sees protection of shorebirds on Delaware Bay as a hemispheric responsibility and the protection of the horseshoe crab as an integral part of this effort because of its importance as a food source for the birds.



Dorsal (top) and ventral (underside) views of the horseshoe crab.

There is also a major human health link with *L. Polyphemus*. In the late 1960's scientists from Johns Hopkins University found that horseshoe crab blood clots in the presence of certain toxins produced by specific bacteria. The crab clotting agent, Limulus Amoebocyte Lysate (LAL) has become a world wide standard for bacterial contamination screening, helping to insure the purity of laboratory produced fluids intended for human use. Since horseshoe crabs can not presently be cultured (they may take 10 to 12 years to mature), wild stocks are required for collection of the blood. Approximately 1/3 of each organism's blood is harmlessly removed and the animal is returned to the water.

In Virginia, *L. Polyphemus* is commercially exploited as bait for the conch and eel pot fisheries in Chesapeake Bay. Crabs are landed in Virginia from offshore and local waters and more recently are reported to have come from Delaware Bay also. Over 578,000 pounds (256,000 individuals) were landed in Virginia in 1998 according to the Virginia Marine Resources Commission (VMRC). At the present time, the Asian-Pacific and European markets for conch and eel are very strong and