

# The Virginia Wetlands Report

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## Economics vs. Wetland Protection: How Do Wetland Boards Do It?

*Edited by Tom Barnard*

**I**n a recently published final report entitled, *Assessing the Decision-making Process in Wetlands Resources Management in Virginia*, VIMS researchers Ratana Chuenpagdee, Kirk Havens, Tom Barnard, and Patty Richards report the results of their preliminary examination of how wetlands boards balance wetlands protection against 'necessary economic development'. The following excerpt from their introduction introduces the study.

The Commonwealth of Virginia has enacted laws to regulate development in wetlands and recognizes the unique functions and values associated with these ecosystems. However, the legislation also recognizes the need to balance conservation of the wetlands resource with the need for necessary economic development. The tidal wetlands legislation enacted in 1972 states, "In fulfilling its responsibilities under this ordinance, the board shall preserve and prevent the despoliation and destruction of wetlands within its jurisdiction while accommodating necessary economic development in a manner consistent with wetlands preservation" (Virginia Code Ann. § 28.2).

Similar language appears in the State's recently adopted nontidal wetlands legislation stating, "Whenever the Board considers the adoption, modification, amendment or cancellation of any standard, it shall give due consideration to, among other factors, the economic and social costs and benefits which can reasonably be expected

to obtain as a consequence of the standards as adopted, modified, amended or cancelled" (Virginia Code Ann. § 62.1).

Objective, expert testimony on the extent of tidal wetlands impacts associated with proposed projects is provided to local wetlands boards and to the Virginia Marine Resources Commission (VMRC) by the Virginia Institute of Marine Science. However, it is uncertain to what extent independent advice on economic and social impacts is available to resource managers and regulators. Social and economic considerations are generally proffered by the proponents of a project and resource managers have little or no independent validation of the claims of economic detriments or benefits. This results in a general lack of documentation on the quantity and type of social and economic information used in wetlands decision-making in Virginia. Further, the current management system of wetlands resources is through local wetlands boards, a process by which members of the boards make management decisions using the guidelines and standards provided by the Commonwealth. While environmental considerations are explicitly described in the guidelines, this is not the case with socioeconomic considerations. This study is thus the first step in trying to elucidate how these boards have balanced the environmental charge (for which they have significant guidance) with the socioeconomic charge, where there is nothing available beyond a requirement in the act to accommodate

this factor. For the last thirty years wetlands boards and the VMRC have been averaging approximately 800 shoreline management decisions per year based on the guidance summarized in the forgoing paragraph. The history illuminates a very well provisioned environmental side of the decision-making process but very little in the way of describing how the socio-economic side of the equation is balanced.

*The researchers provisioned their study in two ways. First they set up a sampling scheme and randomly sampled wetland board decisions using the Tidal Wetlands Data base maintained by the Center for Coastal Resources Management at VIMS. A number of cases that had gone through the prescribed appeal process were also chosen in the hope that they would provide greater detailing of the issues of interest. After obtaining case transcripts from the respective wetland board staff persons, a software package was utilized to scan for key words and phrases regarding socio-economics. Second, was an all day workshop designed to obtain from wetlands board members and staff persons the socio-economic issues presently utilized in board deliberations. Appearing in the report excerpts below are some of the results of these two analyses.*

About 40 percent of the [key words and phrases] sampled applications were related to erosion control, with another 25 percent related to shoreline

stabilization. Six main categories were created for analysis of the wetlands board meeting minutes, i.e., societal benefits, societal costs, private benefits, private costs, adjacent property owners' concerns, and concerns for ecological value of wetlands. These headings were chosen after the [board minutes] analysis as they best represented the social and economic concepts, as well as ecological value of wetlands.

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Recurring issues discussed during the board meetings concerning these applications include those related to social and private benefits, e.g., jobs, taxpayer benefits, traffic control, and property protection. Some of the private and public costs discussed were limited access, problems with trash and debris, and high costs for alternative methods. The concerns related to adjacent property owners were separated from the others, as they often seem to be a prominent theme. Ecological concerns, particularly in terms of values of wetlands, wildlife and also aesthetic value were distinguished in the analysis to provide the context for comparison between ecological and socio-economic considerations in the decision-making process.

A one-day workshop was organized as the second step in understanding the importance of social and economic considerations in the current decision-makings by the local wetlands boards. The workshop aimed at obtaining directly from the wetlands board members social and economic issues currently considered in their decisions. This part of the study serves to add and verify the results of content analysis, acknowledging that the wetlands board meeting minutes capture, at best, partial information about the overall considerations in the decision-making process. A total of 48 people attended the workshop. Participants were pre-assigned to four groups, two of which were composed of wetlands board members and two made up of staff persons. The workshop consisted of two major activities, facilitated by VIMS students with previous experience in facilitation. In the morning session, participants in each group were asked to identify social and economic issues that they use in their decisions, and were given a list of example issues as a starting point. Once all issues were listed and discussed, each group selected the five most important issues. Table 1 (on page 4) summarizes the top issues presented by each group, as well as the other issues which emerged during the group discussion.

In addition to issues related to environmental quality, impacts on natural resources, erosion protection of private property, and high costs of suggested

alternatives, other important social and economic issues raised by the workshop participants were the trade-offs between short-term and long-term benefits and costs to society and property owners; and property owner's rights.

Participants were asked to answer questions in reference to how the issue came up in their deliberations; what additional information and sources should boards have in decision-making; and when they have the information, how do they weigh it against wetland impacts? More, equal or less important?

- If the answer is “more”: In what instance will this issue be equal or less important than wetlands impacts?
- If the answer is “less”: In what instance will this issue be equal or more important than wetlands impacts?
- If the answer is “equal”: In what instance will this issue be more important than wetlands impacts? And in what instance will it be less important?

An example of results of this part of the workshop is described in Table 2 (on page 5). In general, participants reported the use of technical reports, scientific assessment and advice from VIMS and VMRC to assist them in their decisions. They also indicated the importance of site visits, site location, personal observation, as well as historical records of the sites and prior permits. Social and economic considerations currently used included actual property value and perceptual value, estimated project costs, past project costs per area, and conversation with applicants and contractors. Desirable information for social and economic considerations indicated by the participants were the valuation of environmental and natural resources, such as value of clean water, recreational and commercial uses, public perception of environmental values, direct economic and indirect impacts of the projects, awareness of the public and their preferences about the issues, and clear definitions regarding legal rights and responsibility of property owners.

In most cases, participants stated that wetlands impacts were more important considerations than social and

*Continued on page 4*

# Wetland Denizens

## The Common Clamworm (*Nereis succinea*)

By Rebecca Jo Thomas

A group of creatures that is often found in the intertidal sand/mud flat wetlands of the Chesapeake Bay and its tributaries is the class of worms called polychaetes. These creatures are also known as bristle worms; worms with many body segments and many “hairs”. Some of these worms build tubes in which they live their entire lives just waiting for their food to come to them on the tide. Others are free living and may be voracious predators.

One of the most ubiquitous of the free-living polychaetes in the Bay is the common clamworm (*Nereis succinea*) of the family *Nereidae*. This “little guy” can grow to a length of six inches but smaller specimens of about an inch are more common (Figure 1). The many “hairs” or “bristles” are actually called parapodia and in addition to allowing the worm to propel itself through the sand and water, they also house the gills used for respiration.

The head of the clamworm (Figure 2) has 4 eyes that detect changes in water chemistry and react to light and

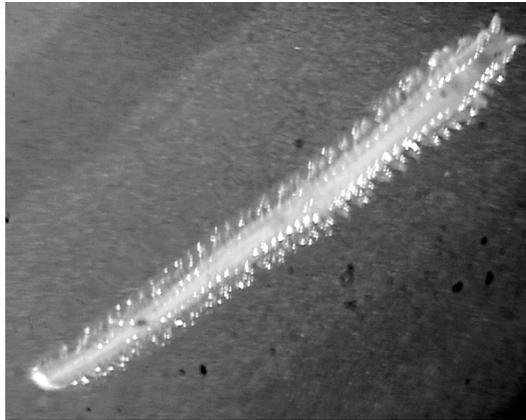


Figure 1.

touch. The worms also possess a keen sense of smell that leads them to their prey which generally consists of other worms as large or larger than themselves, algae, small crustaceans, mollusks (including clams) and detritus. As soon as the food item comes into range, the clamworm thrusts out its proboscis, (an elongate muscle structure complete with claws) grabs the targeted item and snaps everything back into its mouth (Figure 3).

The common clamworm is, in turn, a significant food source for bottom-feeding fishes and crustaceans. Additionally, it has been rumored that if you can risk the pinch of those claws, there is no better bait for finfish such as spot, croaker, winter flounder and others.

On dark nights during spring and early summer, the worm transforms into a reproductive state where the parapodia become enlarged, allowing the worms to swim. They swarm to the surface of the water and release their eggs and sperm, after which the adults drift to the bottom and die, leaving the planktonic larva to develop on their own.

In Greek Mythology, the Nereides were 50 beautiful sea-goddesses who dwelt at the bottom of the sea and had the power to change into any form they chose. I don't know if you would consider these worms beautiful, but I wonder if their ability to change forms helped them get their name.



Figure 2.

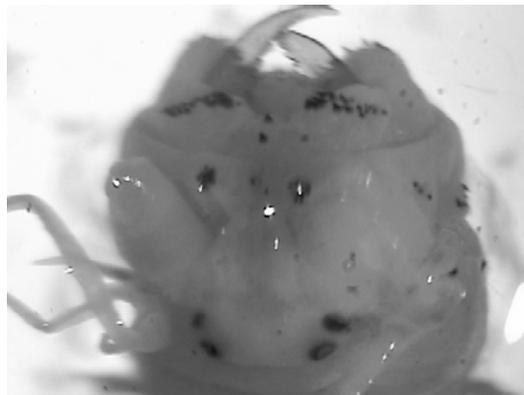


Figure 3.

economic aspects. It was generally noted, however, that in cases where wetlands impacts were low and/or when benefits from economic development were high, social and economic issues may be equally or more important. Of particular interest was the observation that social and economic issues would also be important when the costs of suggested alternatives were too high and unaffordable by the applicants.

On the whole, the study shows that social and economic issues, along with ecological aspects, are considered in the decision-making for wetlands. Issues related to environmental quality and natural resource values, costs of suggested alternatives, short-term and long-term benefits and costs to community members and property owners, and property owners' rights and responsibilities are of particular importance. While information about ecological and

environmental impacts is largely available, social and economic information is still lacking. A framework for incorporating social and economic considerations in the wetlands decision-making process may be therefore a useful guide that can help identify necessary information, suggest means to obtain them and how to integrate them with ecological and environmental factors.

*In addition to the results of the two analytical approaches summarized in this article, the authors propose a preliminary framework through which social and economic issues and values can be incorporated into wetland board deliberations. Space limitations in this newsletter preclude our printing all of this portion of the report. Those who wish to see the entire document can go to the VIMS/CCRM web site and click on Publications.*

The preliminary framework presented in this report is based primarily on the issues observed through content of minutes analysis and those

identified at the workshop. It emphasizes the importance of valuation of natural resources through inputs and participation from stakeholders, mainly property owners and community members. Stakeholder input is particularly significant to an assessment of non-market values of natural resources, and, more importantly, results in greater transparency and consistency in the resource management decisions. The proposed framework would be utilized only after the project has passed the "necessary economic development" threshold.

The preliminary framework would consist, in its simplest form, of three steps:

*Step 1:* Identifying social and economic issues

*Step 2:* Valuations of prioritized social and economic issues

Monetary valuation of social and economic issues

Non-monetary valuation of social and economic issues

*Step 3:* Integrating ecological, social and economic considerations in wetlands decisions

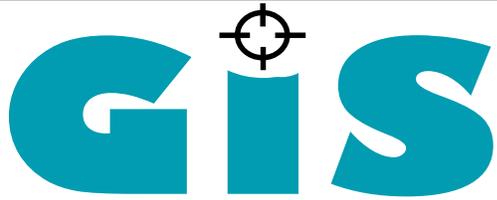
The results from the content analysis and the workshop suggest that social and economic issues are important when making decisions about wetlands. Wetlands board members and related county staffs generally agree that more information is needed to understand social and economic values of wetlands and that a mechanism to assist local wetlands board members to incorporate them in the context of wetlands decisions is desirable. The proposed framework requires participation from major stakeholder groups, particularly property owners, adjacent property owners, community members, and wetlands board members, and technical skills to apply valuation methods.

*It appears that this study represents the first attempt by anyone to assess the socio-economic side of wetlands decision-making in Virginia and*

<b>A. Issues identified as top priority</b>	
Environmental quality/natural resource value	
Erosion protection of private property	
Cost of suggested alternatives	
Short and long-term benefits & costs to community members and to property owner.	
CBPA/Maintaining buffer	
Property owner's rights	
Mitigation costs/success	
Performance Bonds	
Repair vs. Reconstruction	
<b>B. Issues identified as second priority</b>	
<i>Societal cost/benefits</i>	<i>Trade-offs</i>
- Effects on neighboring property owners	- Private vs. community piers
- Issues related to water access	- Aesthetics vs. cost
- Issues related to boat traffic	<i>Legal and procedural issues</i>
- Property assessment / raising taxes	- Enforcement of laws varies by locality
- Number of jobs and employment	- Lack of objectivity by local/state officials, boards
- Benefits to community members	- Collection of fines not enforced
- Flood protection	- Compliance of local gov't /exemption
- Seafood industry value	- Jurisdiction awareness
- Cost of mitigation/compensation/restoration	- Illegal filling (increasing property)
<i>Private costs/benefits</i>	<i>Technological issues</i>
- Improve property value	- Shoreline cleanup
- Private property rights	- Land use
- Economic impact on homeowner	- Siltation/dredging
- Recreational use of private property-groins	- Dredge spoil disposal
- Commercial development	- Technological improvements
- Economic cost of project/application preparation cost	
<i>Ecological value</i>	
- Short & long term benefits/costs of natural vegetation	
- Aesthetic value of the area	
<b>C. Other issues discussed</b>	
Cost of relocating existing structure	Contractor recommendations (cost vs. value vs. impact)
Working around existing site conditions (landscaping)	Increase development infrastructure costs
Public access	Wetlands have resulted from erosion
Adjacent structures	Farms (surface runoff issues)
Long term impacts to adjacent property owners	Political pressures
Maintaining viewshed	Adjacent development
Community improvement as a result of development	Applicants ability to pay

Table 2. Issues identified by workshop participants as important in their decision-making process about wetlands projects

Continued on page 5



# Geographic Information System

## The First Electronic Shoreline Situation Report is Released for the City of Norfolk

By Marcia R. Berman

Growing costs and reduced funding have forced a change in format and distribution of the Shoreline Situation Reports. Traditionally the reports are distributed as hardcopy color maps published in large format map portfolios. The Internet was used only to distribute GIS data and metadata. Since the cost for production can be very high, especially for big localities, hardcopy production could not continue without additional funds. Fortu-

nately internet technology, now widely accessible, provides reasonable alternatives.

The Shoreline Situation Report developed for the City of Norfolk is the first of the series to be published solely on line. Color maps, tables, text report, and GIS data can all be viewed and downloaded from the web. Adobe Acrobat is required. To take advantage of the color maps, color printers must be available on the user end.

“We’re thrilled! We’re going to be using this information as we revise our CBPA (Chesapeake Bay Preservation Act) program” wrote Lee Rosenberg from the City of Norfolk’s Environmental Planning Department in an email message to Marcia Berman, Director of the Comprehensive Coastal Inventory Program who produces the series. The digital shoreline situation report for the City of Norfolk can be viewed at <http://ccrm.vims.edu/gis/norfolk.html>.

*Economics vs. Wetlands Protection continued from page 2*

*the authors have outlined future research needs as well as methods of*

*improving and further balancing wetlands exploitation versus necessary economic need.*

*Questions and inquiries with regard to this study should be addressed*

*to Dr. Ratana Chuenpadgee in the Department of Coastal and Ocean Policy at VIMS. [ratana@vims.edu](mailto:ratana@vims.edu)*

Issue: Environmental quality/natural resource value			Issue: Erosion protection of private property		
Currently used information and sources	Desirable information	Importance of issue compared with wetlands impacts	Currently used information and sources	Desirable information	Importance of issue compared with wetlands impacts
<ul style="list-style-type: none"> <li>- Environmental information, such as flood control, water quality, wildlife, fishery resources, and micro-organisms from VIMS case reports, VMRC staff, wetlands guidelines and other reports, and resource management literature</li> <li>- Neighborhood perceptual value and property value</li> <li>- Site visit or photos</li> </ul>	<ul style="list-style-type: none"> <li>- Socio-economic valuation of environmental issues, e.g., values of spartina marsh in terms of dollars/sq. ft.; value of clean water, recreational uses, property value and commercial uses</li> <li>- Public perception of environmental quality and natural resource value</li> <li>- Acceptable level of erosion</li> <li>- Tide range and water flow measure</li> <li>- Scientific evidence of adverse and detrimental erosion</li> <li>- More specific guidelines, particular from VIMS</li> <li>- Relationship between maintaining wetlands and water quality</li> <li>- GIS maps of water use tied to water quality</li> <li>- Baseline data for all bay/wetland habitats</li> </ul>	<ul style="list-style-type: none"> <li>- Wetlands is always first! But in general, if environmental quality is low wetland impacts are not as important when weighed against other issues. In many cases, these issues are of equal importance.</li> <li>- Need information to consider socio-economic factors related to environmental quality. Such evaluation would tend to quantify and perhaps displace a judgement that is presently qualitative/subjective.</li> </ul>	<ul style="list-style-type: none"> <li>- Technical advice from VIMS/VMRC; SEAS; VIMS shoreline reports and shoreline assessments</li> <li>- Topographic map, aerial photographs, location of project</li> <li>- Soil survey</li> <li>- Personal observation</li> <li>- Erosion rate, impacts of erosion upstream and downstream</li> <li>- Parcel value</li> <li>- Location of project</li> </ul>	<ul style="list-style-type: none"> <li>- History of erosion at the site.</li> <li>- Case studies of similar problems/solutions.</li> <li>- Comprehensive proposal/site plan</li> <li>- Area of land disturbance</li> <li>- Control measures (E&amp;S)</li> <li>- Specific potential impacts (with or without permit)</li> <li>- Proposed stabilization</li> <li>- Costs</li> <li>- Economic impact</li> <li>- Information about indirect impacts.</li> </ul>	<ul style="list-style-type: none"> <li>In general, equally important. It is more important when the wetland impact is minor and the erosion is significant, and less important when the wetland impact is great and the erosion is not presenting an immediate/significant problem.</li> <li>The level of importance depends on: (1) positive/negative impacts to commercial activities (maintain or improve); (2) number of people to benefit; (3) water quality/protection</li> </ul>

Table 2. Currently used information, desirable information and importance of prioritized issues (list A in table 1).

# An Overview of Permitted Tidal Wetland Impacts for 2002

By Karen Duhring

The number of joint permit applications (JPAs) reviewed by local wetlands boards for tidal wetland impacts in 2002 was 1027. This number is slightly higher than last year, but still not as high as the record year in 2000. More than 1000 Joint Permit Applications (JPAs) were reviewed each year for the past five years (Figure 1).

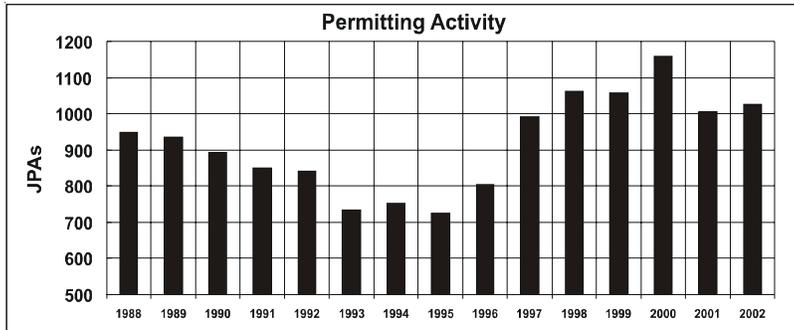


Figure 1. Annual tidal wetland permit application review activity in Virginia.

Scientists from the Wetlands Program visit each application site and enter proposed impact data into a database as part of the application review process. Regulatory decisions about each case are also tracked to estimate permitted tidal wetland impacts. Data collection and entry procedures were improved in 1993 and detailed queries to evaluate cumulative impacts have been updated. This annual summary reports the permitted activities in tidal wetlands during 2002, as well as cumulative impacts over the past 10 years (1993-2002), as indicated by the improved database.

Maintenance of the tidal wetlands database would not be possible without funding from the Virginia Coastal Resources Management Program (NOAA) and the efforts of personnel from both the Wetlands Program and the Comprehensive Coastal Inventory at the Center for Coastal Resources Management at VIMS.

During 2002, local wetlands boards and the Virginia Marine Resources Commission permitted 14.4 miles of new shoreline hardening using either revetments or vertical bulkheads (Figure 2). This is less than last year (16.9 miles) even though more applications were reviewed. This figure is also less than the average for the past ten years (18.5 miles). The preference for sloped revetments continued, with 72% of the total shoreline hardening the result of these structures in 2002.

The database indicates that a total of 74.8 acres of tidal wetland impacts were permitted in 2002. This estimate includes 6.1 acres of vegetated wetlands and 68.7 acres of non-vegetated wetlands. This amount

exceeds the previous annual average of 38.6 acres of permitted impacts. The trend for more impacts to occur in non-vegetated than in vegetated wetlands has continued for the past 8 years.

Almost half of the permitted impact area in 2002 was the result of beach nourishment projects, with 36.4 acres (49%) attributed to this activity. Other activities with notable impact areas include aquatic disposal of dredged material (14.9 acres), dredging in tidal wetlands (8.5 acres), new revetments (7.3 acres), temporary impacts (2.6 acres), breakwaters (1.7 acres) and bulkheads (1.8 acres).

Some activities and associated impacts do not remove wetland areas from the marine environment. These impact areas are distinguished from those activities that result in the permanent loss of tidal wetlands. Temporary alterations and conversions from one type of marine habitat to another are defined as "impacts." "Fill" is defined as the permanent loss of tidal wetlands through conversion into upland habitat.

The "fill" area estimated by the database for 2002 is 6.8 acres, compared to an "impact" area of 74.8 acres. Activities in 2002 that account for the fill areas include revetments

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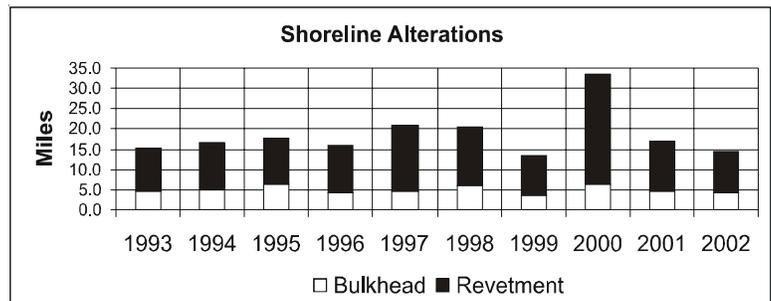


Figure 2. Annual miles of tidal shoreline in Virginia hardened using bulkhead or revetment.

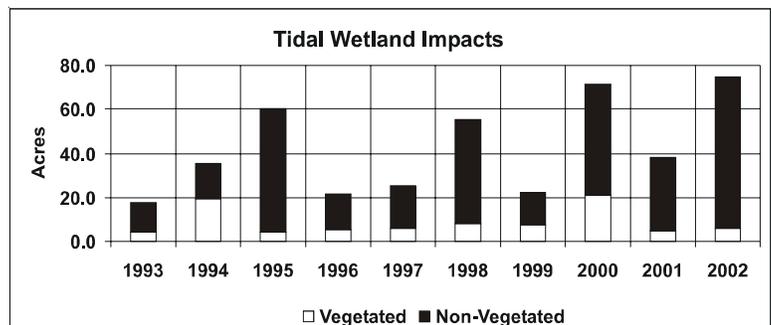


Figure 3. Annual permitted vegetated and non-vegetated tidal wetland impacts.

## The Tropical Potato

By Pam Mason

Most of the world's population subsist on only a handful of foods, starchy grains and roots. Interestingly, two of these important foods are wetland species. The single most important crop is cultivated rice (See *The Virginia Wetlands Report* Spring 1995 Vol.10 No.2) The other, for some tropical cultures and about 10% of the world's population, is taro. In the popular literature it is also referred to by dasheen, or cocoyam. There is some debate over the proper nomenclature for the plant commonly called taro. The question arises whether the taro and dasheen are two varieties of the same species (*Colocasia esculenta* var.

*antiquorum* and var. *esculenta*) or two different species (*Colocasia esculenta* and *Colocasia antiquorum*). Seemingly oblivious to the scientific debate, the consumption of the plant persists.

Taro is a member of the Araceae family - including popular houseplants philodendron and anthurium - as well as the pickerelweed of Virginia's tidal freshwater wetlands. Taro leaves are one to two meters long, upright and arrow-shaped, a shape commonly called "elephant ears." The leaves emanate from the underground stem, the corm.

It is thought that taro is native to the lowlands (wetlands) of Malaysia and may have been the first of all cultivated plants. Estimates place production in India prior to 5000 B.C., and Greek and Roman historians record it use. The genus



name *Colocasia* is the ancient Greek word for taro. Taro is fast growing and propagation is easy, using setts (the lower part of the leaf stalk and upper part of the corm), sucker corms, or whole corms. Harvest is about 10 months after planting. Taro may be cultivated under both wet and dry conditions. However, permanently wet soils appear to producer a higher yield (Chay-Prove and Goebel 1999)

Taro is consumed in Egypt, tropical areas of Africa, the West Indies, southeast Asia and the Pacific Basin. While the corm is the portion most typically consumed by humans, the leaves are also eaten. While similar to the Irish potato in many regards, a nutritive comparison finds taro to be higher in protein, calcium and phosphorus, and rich in vitamins A and C. Taro starch grains are smaller than those of other root vegetables, and thus highly digestible. Taro flour makes a good substitute for people with allergies to other cereals (Lee 1999). Containing one or more acrid, irritating compounds, taro must be cooked to destroy the toxins. Taro is prepared typically by boiling, but is also baked, roasted or made into cakes. Sliced thinly and deep fried, taro chips are an alternative to potato

### Callaloo

Traditionally this Caribbean soup is made with taro root leaves (*Colocasia esculenta*, 'dasheen' leaves) but spinach can be substituted. Serves 4-6

2 ounces Salt pork, diced	8 ounces Okra, chopped
1 medium Onion, diced	1/2 teaspoon Thyme
2 cloves Garlic, minced	8 ounces Crabmeat
1 pound <i>Colocasia esculenta</i> (dasheen) leaves, chopped	1 cup Coconut milk
6 cups Chicken broth	Salt and pepper to taste

Heat the pork in a large, heavy soup pot. Add the onion and garlic and cook until just soft. Stir in the spinach and cook for 1 minute. Add the broth, thyme, and okra. Bring to a boil, reduce the heat and simmer for 20 minutes. Stir in the coconut milk and crab. Simmer for 15 minutes longer. Check the seasoning. Serve warm.

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# Calendar of Upcoming Events

- April 13-16, 2003** Inaugural National Conference on Coastal and Estuarine Habitat Restoration. Hyatt Regency Inner Harbor. Baltimore, MD. Abstract deadline is 9/13/02. Contact Heather Bradley at (703)524-0248 or email hbradley@estuaries.org
- June 8-13, 2003** Society of Wetland Scientists 24<sup>th</sup> Annual Meeting, New Orleans. Changing Landscapes and Interdisciplinary Challenges. Contact Lisa Gandy at (501) 225-1552 or gandylc@swbell.net
- July 13-17, 2003** Coastal Zone 03. Coastal Zone Management Through Time. Baltimore, MD. Deadline for abstracts is 9/16/02. Contact Jan Kucklick at (843) 740-1279 or email Jan.Kucklick@noaa.gov

*An Overview of Permitted Tidal Wetland Impacts for 2002 continued from page 6*

(3.4 acres), bulkheads (1.8 acres), breakwaters (0.8 acres), and general fill (0.5 acres). The annual average amount of fill during the past decade was about 11.8 acres.

The database indicates that the area of mitigated wetlands in 2002 was 0.9 acres. The annual average amount of tidal wetland mitigation during the past decade was about 1.8 acres. The tidal wetlands database only tracks compensatory mitigation wetlands authorized or required by the state and local permitting process. There may be other wetland creation and restoration projects in the Commonwealth not accounted for in these data.

The database indicates there has been a net loss of tidal wetlands in the Commonwealth. If the area of compensatory mitigation is compared to the cumulative impact area (422 acres), then the overall net loss of tidal wetlands appears to be significant. If only the cumulative fill area is considered, then this discrepancy is reduced (Figure 4). In the past decade, the cumulative fill in tidal wetlands was approximately 118 acres, yet only 17.7 acres of compensatory mitigation was required to offset this loss during the same time period.

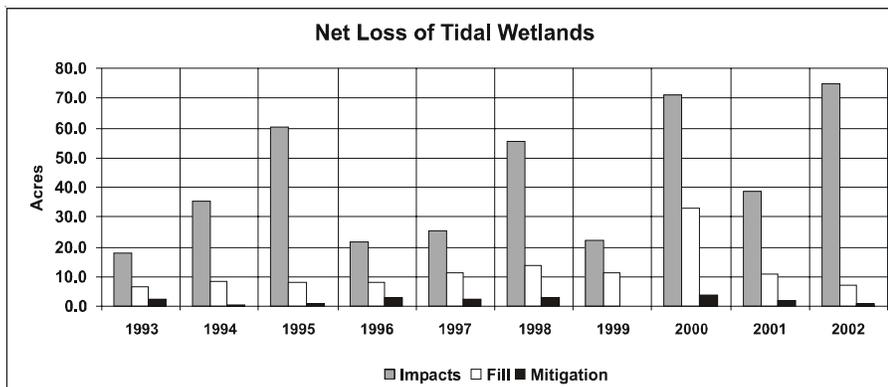


Figure 4.

*The Tropical Potato continued from page 7*

chips and are often included in “gourmet” chips.

Perhaps the most well-known use of taro is for making poi, the subsistence staple of the Hawaiian Islands. Poi is made by pounding the corm into a thick paste, which is dried, reconstituted with water, kneaded and aged. Poi is wrapped in taro leaves and baked for the ceremonial feast, luau, the Hawaiian name for the taro leaf.

In the West Indies, the leaves of the taro (dasheen) are called calaloo and are used to make a traditional gumbo type soup.

In Hawaii, the preferred method of taro production is permanently wet terraces called lo’i. The production of wet taro is labor intensive, a disincentive to the establishment of new farms. Equally important to the labor issue, water rights disputes have “dried” up the terraces as water has been diverted to sugar cane and residential use. The future of Hawaiian taro production will depend upon solutions to labor and water issues.