TESTIMONY

For the House Subcommittee on Insular Affairs

Oceans and Wildlife Hearing

On

The Nutria Eradication and Control Act of 2009

Prepared by:

Jonathan A. McKnight

Associate Wildlife Director

Maryland Department of Natural Resources

On behalf of the Maryland Department of Natural Resources, I would like to express our support for the Nutria Eradication and Control Act of 2010. The Act will authorize critically needed funding to finish the highly successful nutria eradication and wetland restoration program in Maryland, and to assist the States of Louisiana, Delaware, Oregon, Virginia, and Washington in developing and implementing similar proven programs.

The Chesapeake Nutria Project is one of a small number of successful exotic invasive species programs in the United States. Since the eradication phase of the project began in 2002, the project has eradicated nutria from over 130,000 acres of wetland habitat in Dorchester, Wicomico, Somerset, Talbot, and Caroline Counties in Maryland.

As nutria populations peaked, this invasive rodent destroyed 7000 acres of tidal marsh at Blackwater National Wildlife Refuge. Total marsh loss for the Chesapeake is much larger, but difficult to quantify. In the late 1990's, a partnership of 27 Federal, State, and private organizations began to investigate the potential for eradicating nutria in Maryland. Beginning in 2000, Federal funding was obtained to initiate a study to develop an eradication strategy and begin to apply that strategy to the eradication of nutria in Maryland. In late 2002, the study phase was complete and eradication measures began in earnest. The project is overseen by the Nutria Management Team, consisting of the U.S. Fish and Wildlife Service (USFWS) Chesapeake Bay Field Office (CBFO), USFWS CMNWRC, U.S. Department of Agriculture Wildlife Services (APHIS/WS), the Maryland Department of Natural Resources (MDNR), the U.S. Geological Survey (USGS), the University of Maryland Eastern Shore (UMES), and Tudor Farms Inc.

Since September of 2002, the Chesapeake Nutria Project has removed over 13,000 nutria from Chesapeake bay coastal marshes, resulting in the protection of approximately 150,000 acres of federal, state and privately owned marshland from further degradation. This effort is currently

being accomplished by 20 full time staff including: 16 eradication specialists, a maintenance mechanic, a part time administrative assistant, a wildlife biologist, an assistant supervisor and a project leader. Together, this team of professionals implements the largest mainland invasive species eradication campaigns in the United States.

The economic and ecological health of the Chesapeake Bay and Delmarva coastal region is closely tied to the health of coastal wetlands. In addition to the ecological impacts, the destruction of wetlands by nutria is costing the Maryland economy $4 million per year resulting from the degradation of agricultural lands, commercial fisheries, water quality, recreational opportunities, and property. An independent economic report estimates that by 2050 the economy will lose $30 million per year if nutria destruction of wetlands is left unchecked.

The effort thus far has demonstrated that eradication is achievable. Now is the time to bring the resources to bear to complete the eradication effort in order for the tidal marshes of the Delmarva Peninsula to be saved and restored. Once nutria are removed, previously infested marshlands have shown a remarkable ability to recover from their effects. Without a continued effort to eradicate nutria from the Delmarva Peninsula they will re-infest areas already trapped and continue to destroy wetlands throughout the region.

In order to fully eradicate nutria from the region, it will be necessary for the project to continue to expand into the remaining five southern Maryland Eastern Shore counties, the Virginia portion of Delmarva, and Delaware. Through this effort, more than 400,000 acres of wetlands will be protected.

Nutria have become established in 17 states throughout the Southern and Northwestern US and cause significant problems for agriculture, aquaculture, nurseries, roads and flood control systems, wetlands, riparian habitats and stream restorations affecting salmon spawning habitat in the Pacific Northwest. The techniques developed and applied on the Chesapeake Bay eradication project can be applied elsewhere to effectively manage nutria populations and the resulting damages. Even where eradication may not be feasible, these methodologies can be applied to achieve targeted control to protect sensitive resources.

Based on the project's accomplishments to date, the eradication plan, and the magnitude of the job ahead, we estimate that the project will require a sustained yearly budget of $2 million annually for approximately five more years through FY2014. This should enable us to maintain our current level of effort and accomplish eradication as planned by 2013.

The funding provided by the Nutria Control Act of 2009 is extremely important in our effort to finally eradicate nutria in Maryland. Moreover, the nature of invasive species control – particularly in the case of the incredibly fecund and adaptable nutria – is that if the program is not brought to completion all of our previous collective efforts and expenditures will have been for naught. Unless we see the task through and remove the second-to-last nutria from the Chesapeake, we will fail – at tremendous cost to the Chesapeake Bay Ecosystem and the people who depend upon it for employment, seafood, recreation, and regional pride.

Potential Economic Losses Associated With Uncontrolled Nutria Populations in Maryland's Portion of the Chesapeake Bay

Prepared for the:

Wildlife and Heritage Service
580 Taylor Avenue
Annapolis, Maryland 21401

By:

SOUTHWICK ASSOCIATES
▶ Fish & Wildlife Economics & Business Consulting
P.O. Box 6435
Fernandina Beach, FL 32035
904 277 9765
www.southwickassociates.com
rob@southwickassociates.com

November 2, 2004

Executive Summary

Nutria (*Myocaster coypus*) are non-native aquatic mammals that are having an unprecedented negative effect on the marshes and ecology of the Chesapeake Bay. Since their introduction in the 1930's, nutria populations have continued to expand. With their high reproductive rate and voracious appetite for marsh grasses and root mats, they are now damaging hundreds of acres of valuable wetlands each year and turning once-vegetated areas into mudflats and open-water. These denuded areas no longer provide rich spawning and nursery grounds and habitat for the many species of shellfish, fish and wildlife that this region is known for. Although the effects of nutria cannot be easily separated from other detrimental factors, they are widely believed to be a large contributing cause of the decline in the quality and extent of Chesapeake Bay wetlands.

As more and more acres of Chesapeake Bay marshes are lost, the resulting declines in commercially and recreationally-valuable species takes a measurable economic toll on the State of Maryland and its citizens. Commercial harvesting of shellfish and finfish, sport hunting and fishing, and wildlife viewing in Maryland all have strong connections to the wetlands of the Chesapeake and these sectors suffer as the marshes deteriorate. In order to assess the economic effects this decline represents, this report analyzed scientific literature, expert opinions and economic indices for commercial and recreational uses of marshland and marsh-associated species in the Maryland portion of the Chesapeake Bay.

If marshes continue to be lost at the current rate, the financial losses to the State of Maryland and its citizens are summarized in Table E-1 and E-2, below. In Table E-1, it is clear that the direct losses due to declines in commercially and recreationally-valued species alone are considerable annually and over the next 50 years. In Table E-2, it is demonstrated that the losses in environmental services provided by wetlands, and the associated social losses add another layer to the costs.

E-1: Potential Nutria-Related Economic Damages Related to Maryland's Chesapeake Bay Commercial and Sport Fisheries, Hunting and Wildlife Watching, 2001.[1]

	Retail Sales [2]	Total Multiplier Effects [3]	Salaries[5]	Jobs[4]	State Sales & Fuel Tax Revenues[5]	State Income Tax Revenues[5]	Federal Income Tax Revenues[5]
Current Annual Losses:	$1,403,379	$2,870,402	$692,062	31	$58,456	$27,200	$96,281
Potential Annual Loss in 50 years:	$72,942,499	132,688,854	$35,987,235	1,628	$3,039,712	$1,414,403	$5,006,599

[1] These results represent the potential decreases in the state economy created by nutria damages

[2] Includes the dockside value and processing value-added losses for commercial fisheries

[3] Includes multiplier effects for commercial fisheries

[4] Includes job losses in commercial fisheries

[5] Estimates regarding the commercial fishery's state and federal tax revenues, plus their associated salaries and wages, were not available and therefore are not included in Table E-2.

E-2: Environmental and Social Losses Created by Nutria-related Damage to Maryland's Chesapeake Marshes

	Value of Lost Environmental Services
Annual Losses:	
Environmental Services:	$168,709
Social Losses:	$541,079
Potential annual loss in 50 years:	
Environmental Services:	$8,772,843
Social Losses:	$28,136,121

Taken together, the figures represented in Tables E-1 and E-2 present a challenge to the State of Maryland and its citizens. These losses can be mitigated and lessened considerably if marsh loss is slowed by removal of nutria. Otherwise, the economic ramifications of damage to Chesapeake Bay marshes in the past and into the future are costly and will continue to increase unless the necessary actions are taken. The costs of nutria removal are potentially minor compared to the costs to the State if the loss of marsh habitats continues unabated.

Table of Contents:

Acknowledgements

This report was developed for the Maryland Department of Natural Resources under purchase order K00P4200671 by Southwick Associates, Inc. of Fernandina Beach, FL. The authors of this report were Rob Southwick and Pat Foster-Turley, Ph.D. Research and data collection assistance was provided by Angela Crenshaw of the Maryland Department of Natural Resources. A special thank you is extended to the project manager, Jonathan McKnight of the Maryland Department of Natural Resources (DNR) and the many staff members of the DNR and other resource agencies who provided their expertise and knowledge regarding the biology, history and ecology of the Chesapeake Bay.

Definitions

Eat-outs – areas within marshes where nutria activity have eliminated most or all of the vegetation.

Economic value – as used in this text, economic value represents the intrinsic value that people hold knowing something exists. Such values are reflected in the donations people make to assist other people or wildlife, even people and wildlife the donor may never see in person.

Total Multiplier Effects – when someone spends a dollar, that dollar is then respent by the retailer or service provider for more products or supplies, to pay bills and employees, and more. The people and companies receiving a portion of the dollar then respend it as well. Through these rounds of spending, one expenditure 'multiplies' benefiting many people throughout the state economy. The 'total multiplier effect' reports the total value of all rounds of spending that can be tied back to the original retail sale.

Net value - refers to the net benefits remaining with someone after their costs and other negative values have been subtracted. For example, the total value to an individual to go fishing may be $100. The net value is the remaining value once you subtract their out-of-pocket expenses, lost time and any hassles they incur (such as cleaning equipment, hot weather, etc.). If the net value is negative on regular basis, that individual is less likely to fish and will find another recreation that delivers a positive net value.

Social losses – refer to the collective loss society incurs from the loss of wetlands or other public resources. An acre of marsh to one individual may only be worth a few cents, the amount which would be reflected in the total amount the individual would be willing to donate to save the acre of marsh. However, sum the total amounts people are willing to give to conserve the acre of marsh, you will have derived a measure of value, or loss, society would incur if the marsh is actually lost.

I. Introduction

Nutria (*Myocaster coypus*) is a non-native aquatic mammal that has inadvertently been introduced into Maryland wetlands and is proliferating, with negative impacts on natural ecosystems. The purpose of this project is to gain a better understanding of the economic risks posed by uncontrolled nutria populations within Maryland's portion of the Chesapeake Bay.

Most current and potential economic losses associated with nutria relate to their habit of completely eating all marsh grasses and associated root mats within a given area. These damaged areas, know as "eat-outs" are denuded of most plant life and essentially become mud flats, providing less habitat for the spawning and production of fish and shellfish resources. With the loss of root structure, the mud can rapidly wash away, or erode, thus leading to changes in elevation and more salt-water intrusion into freshwater areas. This erosion also reduces productivity in other parts of the Chesapeake by covering hard bottom and oyster beds with sediment, and reducing the amount of sunlight penetrating into the Bay.

Specifically, this project set out to investigate:

(1) The past and current economic damages associated with uncontrolled nutria populations; and
(2) Potential future losses that could be incurred if nutria populations remain unchecked.

Developing precise answers to the above questions would cost hundreds of thousands of dollars, if not millions. Given such costs, detailed research is not advisable and is beyond the scope of this study. Instead, the results presented here are based on best data currently available, combined with best estimates possible from the most qualified experts available to the Maryland Department of Natural Resources. Even then, assumptions are necessary to fill in gaps where data were not available or if expert opinion was not clear. Such assumptions are identified in this text when used, and were based on the best science available.

This report is not intended to be final answer to the many complicated questions surrounding nutria, wetlands and Chesapeake Bay management. More research is needed to fully understand the complex relationships between nutria, wetlands, commercial and recreational pursuits and the overall health of the Chesapeake Bay. It is recognized that many factors other than nutria are leading to the loss of valuable Chesapeake Bay marshes, and that the damage caused by nutria alone cannot easily be isolated. This study aims to highlight the present state of knowledge about the damage to wetlands, with a focus on nutria, and to make projections for the economic costs this damage represents to the taxpayers of the State of Maryland.

II. Methodology

Based on the high cost of original data collection and field research, this project is based largely upon existing data and expert opinion. Steps included:

1. A thorough search of academic literature was conducted to identify all scientific data relating to the economic value of wetlands and the types of economic losses resulting from marsh damage caused by nutria and other similar factors.

2. A series of informal interviews were held with Maryland Department of Natural Resources staff experts in various aspects of nutria, wetlands and fish and wildlife management in the Chesapeake Bay watershed. In addition, staff within the U.S. Geological Service (USGS) and the U.S. Fish and Wildlife Service's Blackwater National Wildlife Refuge were also contacted with specific questions.

3. Assumptions were developed regarding the impact of nutria on various Chesapeake resources and associated recreational and commercial activities. When precise scientific data were not available, these assumptions were based on available data, the expertise of biologists familiar with Chesapeake Bay and an overall understanding of the biological dynamics involved.

Estimates regarding the potential economic losses resulting from nutria are based on the number of acres currently damaged or having the potential to be damaged by nutria and other factors. With each acre lost, commercial watermen, anglers, hunters, and others lose income, retail sales, and more. In general, this study calculates the typical contribution per acre of marshland or wetland (the terms are used interchangeably), then multiplies these losses by the estimated number of acres either currently or potentially lost to nutria.

Estimated Potential Chesapeake Marsh Loss to Nutria:

The Maryland DNR reports there are 205,815 acres of emergent wetlands in Maryland's portion of the Chesapeake Bay, which represents only about 65% of the wetlands existing in the 1700s (Tiner and Burke, 1995). Bay wetlands have declined for a number of reasons, including development, siltation, pollutants, and introduction of non-native species, among others. This erosion of wetlands continues to this day, with nutria being increasingly viewed as a major contributing factor. Staff with the U.S. Fish and Wildlife Service has estimated that, since the 1930's when nutria were first introduced, 7,000 acres in the 23,054 acre Blackwater National Wildlife Refuge (Blackwater NWR) alone have been destroyed or degraded by nutria combined with other factors. Nutria were seen as a major factor responsible in part for the loss of 500-1000 acres per year when populations were the highest in the late 1980's and early 1990's (Nutria Marsh Damage Reduction, pre-decisional E.A., 2001; personal communications with staff, 2004) until populations were recently controlled through an aggressive trapping program.

Scientific data estimating the nutria-related losses of marsh acreage across the entire Chesapeake coastline are not available. However, to predict the economic losses that

could result from nutria-related damages, such estimates are needed. Therefore, educated opinion from Chesapeake Bay marsh and nutria experts were obtained regarding current and potential nutria-related marsh losses. Expert opinions were then matched with information regarding current and historic marsh losses in the Blackwater NWR where nutria control efforts have recently been aggressively pursued.

Nutria have been the catalyst for much of the refuge's large-scale marsh losses. Nutria remove vegetation, which exposes the remaining mud to erosion. Acres of the lowest-lying grasses along the outer edges of the marsh are the first to wash away due to wave action, which also makes it highly unlikely marsh grasses can be restored on their own. Interior marsh grasses are more likely to grow back once nutria populations are controlled. For example, the U.S. Geological Survey (USGS) reported interior marsh grasses in the Blackwater NWR were being lost at a rate of 3 percent per year from 1997 to 2000. During this time, a trapping program was instituted to reduce nutria numbers. Since then, marsh grass has recovered, with vegetation coverage increasing from 25 percent to nearly 85 percent (personal communications, USGS, 2004).

Regarding historical Blackwater NWR marsh losses, when asked what the historical loss rates might have been if nutria were not present, refuge and USGS expert opinions reported losses could have been 33 to 50 percent lower, with an average of 41.5 percent. Therefore, nutria were not present, instead of losing 7,000 acres over the last 50 years, losses could have been 41.5 percent less, or 2,905 acres. Another way to view this is nutria have been responsible for 2,905 lost acres in the Blackwater NWR over the past 50 years, which represents 17.09 percent of the refuge's historical marsh. Based on this loss accumulating over the last 50 years, on average the refuge has lost 0.33 percent of its marsh acreage to nutria annually. This annual loss rate, 0.33 percent, will be used in this study and is considered conservative, especially when compared to the 3.0 percent annual loss rate for interior marshes as scientifically documented from 1997 to 2000 in the Blackwater NWR. This estimate of annual losses varies per year based on changes in the nutria population and other factors, but still remains a practical estimator of the general damages nutria inflict annually.

III. Results

The loss of Chesapeake Bay wetlands impacts commercial fisheries, sport fishing, hunting, wildlife viewing and other economic generators in the region. Results are presented here regarding the potential economic losses Maryland could experience if nutria expand Bay-wide at levels similar to those previously experienced in the Blackwater National Wildlife Refuge.

A. Commercial Fisheries

Chesapeake Bay is famous for its commercial harvests of blue crabs, oysters and a variety of finfish. To estimate the economic value of these catches, guidelines determined by Heimlich et al (1998) are used. This study states that "once the portion of the tonnage harvested related to the marshland is known, an economist can combine dock prices with estimates of production and harvesting costs to estimate the net economic value of the harvest attributable to marshlands." Therefore, for our study, a simple formula is derived based on Heimlich et al to estimate the impacts to watermen from marshland losses:

$I = H \times P$, where

I = Future income Maryland watermen might receive if marshlands were lost.
H = estimated decrease (in percentage terms) in blue crab/finfish/oyster harvest if Maryland's marshlands were lost.
P = current revenue received by watermen for their catch based on 2002 prices and landings (latest available).

According to fisheries and wetland experts consulted as part of this project, if wetlands and marshlands in the Chesapeake Bay were to disappear, current harvest levels would gradually decrease to the following levels (the H variable in the formula above):

Bluecrab --almost 100%
Finfish – up to 50%
Oysters - up to 50%

Based on the latest dockside data available (NMFS, 2004), current harvest volume and prices for Maryland's Chesapeake Bay waters are presented in Table 1:

Table 1: 2002 Fish and Shellfish Harvests from Maryland's Chesapeake Waters

Species	Metric Tons	Pounds	$*
CRAB, BLUE	11,448	25,237,841	23,949,838
OYSTER, EASTERN	257	566,990	2,172,418
ALL OTHER HARVESTED SPECIES**	12,419	27,379,829	$22,890,783
TOTAL:	24,124	53,184,660	$49,013,039

* This amount reports only the income received by commercial watermen, and does not include the value-added economic activity resulting from processing, wholesale, retail and restaurant sales, which can be substantial.
* Includes clams & other species expected to possibly decline at rates similar to fish and oysters

Based on the formula presented above (I = H x P), which is simply a matter of adjusting Table 1 by the expected harvest declines should Chesapeake wetlands disappear, the resulting annual commercial harvest in the Chesapeake could drop to the levels presented in Table 2. The figures in Table 2 are 74.4 percent lower than 2002 harvests levels.

Table 2: Potential Fish and Shellfish Harvests from Maryland's Chesapeake Waters if all Marshlands Were Lost (based on 2002 harvest data)

Species	Metric Tons	Pounds	$*
CRAB, BLUE	0	0	0
OYSTER, EASTERN	129	283,495	$1,086,209
ALL OTHER HARVESTED SPECIES**	6,210	13,689,915	$11,445,392
TOTAL:	6,338	13,973,410	$12,531,601

* This amount reports only the income received by commercial watermen, and does not include the value-added economic activity resulting from processing, wholesale, retail and restaurant sales, which can be substantial.
** Includes clams & other species expected to possibly decline at rates similar to fish and oysters

Please note that there are some caveats to the calculation above. If wetlands were to suddenly and completely disappear, harvests would not immediately drop to the predicted levels reported above. The drop would occur over a period of several years. How many years, no one knows, but academic journals and fisheries experts queried as part of this project indicate harvest reductions would increase over some period of time until the potential maximum reported in Table 2 is reached. The total loss reported in Table 2 may not happen in the first year, though based on the limited knowledge in this area, it possibly could. In addition, until more is known about the complex relationships between

fish and shellfish populations and marshlands, it is possible that actual losses to watermen's income from marshland losses could range higher or lower from the estimates produced here.

Multiplier effects: The loss to Maryland's economy would be greater than the lost income to commercial watermen. The landing of fish and shellfish start additional rounds of economic activity as the harvest is processed, packaged and distributed in state and out of state. Very little information was available regarding the potential economic impacts of seafood processing and distribution, but estimates can be made based on a study reporting the potential economic impacts of blue crab processing in Maryland (Lipton & Sullivan, 2002). Information within this study indicates the value of crab meat increases by 97 percent from the time it is landed live until the time it is shipped from the processor, packaged and ready for consumption. In addition, the total economic impact to the State economy is 2.61 times greater than the value of the live crab when landed. That is, for every dollar spent by a processor for live crabs, the Maryland economy actually experiences $2.61 in economic activity. Based on these projections, estimates of the economic impacts of Chesapeake shellfish and fish harvests are presented in Table 3:

Table 3: Estimated Economic Impact, Statewide, After Processing and Multiplier Effects

Species	Dockside Value:	Processing Value-Added:	Multiplier Effects:	Total Value to Maryland Economy	Total Jobs Dependent On Bay Harvests
CRAB, BLUE	$23,949,838	$23,176,959	$15,476,625	$62,603,423	278
OYSTER, EASTERN	$2,172,418	$2,102,312	$1,403,838	$5,678,569	25
ALL OTHER HARVESTED SPECIES*	$22,890,783	$22,152,081	$14,792,253	$59,835,117	265
TOTAL:	$49,013,039	$47,431,353	$31,672,717	$128,117,109	568

** Includes clams & other species expected to possibly decline at rates similar to fish and oysters

Please note that the figures in Table 3 are rough estimates only and may be considered minimum, too. Assumptions are made that the value-added and multiplier effects for bluecrab processing are the same for fish and oysters, which may or may not be true. In addition, additional value-added impacts and multiplier effects occur when processed seafood is handled by wholesalers, retailers and restaurants. These impacts are not included in the table above due to a lack of information, but are real and should be taken into consideration when reviewing the seafood industry.

Recognizing the lack of sound data relating to the volume of commercial harvests that would be lost for each acre of wetlands lost, we must assume a linear relationship. Specifically, if wetlands decrease $\times$ percent, then commercial harvests would also decrease $\times$ percent. Therefore, if nutria populations across the Bay remain unchecked as they were in the Blackwater refuge for years, annual commercial fisheries harvests could

decrease an additional 0.33 percent annually (see Chapter II). Likewise, over the next 50 years, total commercial fisheries losses could reach 17.09 percent annually. Table 4 summarizes the potential annual and long-term losses to the Maryland economy and seafood industry posed by nutria.

Table 4: Estimated Nutria-Imposed Economic Damages Related to Maryland's Chesapeake Bay Commercial Fisheries, Based on 2002 Harvest and Income Levels

	Dockside Value:	Processing Value-Added:	Multiplier Effects:	Total Value to Maryland Economy	Total Jobs Dependent On Bay Harvests
Annual Losses:					
CRAB, BLUE	-$79,034	-$76,484	-$51,073	-$206,591	-0.9
OYSTER, EASTERN	-$7,169	-$6,938	-$4,633	-$18,739	-0.1
ALL OTHER HARVESTED SPECIES*	-$75,540	-$73,102	-$48,814	-$197,456	-0.9
TOTAL:	-$161,743	-$156,523	-$104,520	-$422,786	-1.9
Potential 30-50 year losses:					
CRAB, BLUE	-$4,093,027	-$3,960,942	-$2,644,955	-$10,698,925	-47.5
OYSTER, EASTERN	-$371,266	-$359,285	-$239,916	-$970,467	-4.3
ALL OTHER HARVESTED SPECIES*	-$3,912,035	-$3,785,791	-$2,527,996	-$10,225,822	-45.4
TOTAL:	-$8,376,328	-$8,106,018	-$5,412,867	-$21,895,214	-97.1

* These results represent the decreases imposed by the presence of nutria. For example, it is estimated that commercial crabbers would have earned $79,034 more in 2002 if nutria were not present in the Chesapeake, and by 2050, if nutria populations increase bay-wide at the rate experienced in the Blackwater NWR and all other factors hold steady, annual crabber income will be $4.093 million less (17% less) than otherwise possible, in 2002 dollars.

B. Recreational Fishing:

Economic impacts:

In order to analyze the effect of nutria on the economics of recreational fishing, as is the case with the commercial fishing analysis above, it is assumed that the rate of Chesapeake marshland loss will equal the loss of fishing activity. Specifically, if wetlands decrease × percent, then recreational harvests would also decrease × percent. We know this not to be exactly true. Fisherman do not plan their fishing time based on the acreage of healthy marshlands, but instead use factors such as personal time available, expected catch rates, weather, competing recreational choices, and more. All these factors work together to determine levels of annual sportfishing activity. Regardless, declining habitat will lead to less sportfishing activity, but until information is developed explaining how much sportfishing activity is lost for each marshland acre lost, the same assumption equaling marshland losses to sportfishing losses in percentage terms must be used here.

Two sources of economic impact data for Maryland saltwater fishing were identified. The first source, produced by the National Marine Fisheries Service, provides statewide saltwater fishing impacts for 1998. Estimates from this study regarding the amount of dollars spent annually in Maryland for marine sportfishing are two times larger than the reported in the second source, a state-by-state examination of the economic impacts of sportfishing, including marine fishing, provided by the American Sportfishing Association (ASA) for 2001. The two studies used different methodologies, and without engaging in a comprehensive and costly examination of the two, it is not possible to discern which is the more accurate to use. Therefore, recognizing the ASA also provides more up-to-date economic impact estimates (jobs, income, tax revenues, etc.) in addition to angler expenditure estimates, the ASA expenditure estimates are used in this analysis.

Table 5: Marine Sportfishing Economic Impacts for Maryland, 2001 (American Sportfishing Association, 2001):

Retail Sales	Total Multiplier Effect	Salaries & Wages	Jobs	Sales & Motor Fuel Taxes	State Income Taxes	Federal Income Taxes
$335,934,459	$640,964,531	$165,036,290	6,981	$18,727,532	$6,023,710	$25,664,989

These numbers reflect both Chesapeake fishing and Atlantic coastal fishing activities in Maryland. An estimate of the percentage of marine angling activity occurring in Maryland's Chesapeake waters was needed to adjust the statewide angling estimated downward to reflect Chesapeake fishing only. This adjustment was made using Bay sportfishing license sales data combined with estimates of total marine anglers. There were 369,826 resident and non-resident marine anglers in Maryland, as reported by the USFWS's 2001 National Survey, who fished a total of 3,168,919 days. Maryland DNR records for 2000 show 239,364 Bay licenses were sold, which represents 64.7 percent of all marine anglers in Maryland. Therefore, 64.7 percent of the economic impacts reported for all marine fishing in Maryland is assumed to be created by fishing in the Bay's waters. These impacts are listed in Table 6.

Table 6: Maryland's Chesapeake-Specific Marine Sportfishing Economic Impacts, 2001:

Retail Sales	Total Multiplier Effect	Salaries & Wages	Jobs	Sales & Motor Fuel Taxes	State Income Taxes	Federal Income Taxes
$217,437,322	$414,871,436	$106,821,578	4,518	$12,121,604	$3,898,913	$16,611,950

By applying the long-term and annual rates of marshland losses to nutria, as reported in the methodology section, we derive estimates of the total sportfishing-related economic damages caused by nutria eat-outs. Table 7 presents these impacts.

Table 7: Economic Nutria-Imposed Economic Damages Related to Maryland's Chesapeake Bay Marine Sportfishing (based on 2001 levels)*

	Retail Sales	Total Multiplier Effects	Salaries	Jobs	State Sales & Fuel Tax Revenues	State Income Tax Revenues	Federal Income Tax Revenues
Annual Losses:	$714,542	$1,363,350	$351,037	15	$39,834	$12,813	$54,590
Potential annual loss in 50 years:	$37,156,201	$70,894,207	$18,253,923	772	$2,071,368	$666,255	$2,838,689

* These results represent the decreases imposed by the presence of nutria. For example, it is estimated that businesses serving anglers would have received $714,532 more in sales revenues in 2001 if nutria were not present, and by 2050, if nutria populations increase bay-wide at the rate experienced in the Blackwater NWR and all other factors hold steady, annual retail receipts will be $37.2 million less.

Economic Values:

Economic impacts (jobs, retail sales, tax revenues, etc.) help explain how people's recreational activities affect the economy. Such measures do not explain the benefits that anglers receive from their activity. Anglers are not motivated to fish because their activities create tax revenue, they fish because they like to. In other words, they receive personal satisfactions from their angling activity. These personal satisfactions are measured using a term referred to as "economic value" or just "value." These values are mostly measured using surveys. The surveys attempt to identify the net value an angler receives from his or her fishing activities. Net value is often expressed in dollar terms, and reflects the level of satisfaction retained after the trip is over and all costs (money and time) have been paid. For example, an angler's value for a fishing trip may be $110, which includes $50 in fuel and tackle, plus $50 worth of time - time that could have been spent doing something else such as golf or working to earn more money. The net value is $10, which is the amount left over after expenses have been paid, and is a measure of satisfaction derived from the fishing trip. If the net values for a person's fishing experiences are consistently negative, that person will not remain an angler.

Several studies have been done that measured the economic value of marshlands/wetlands based on people's sportfishing activities in these habitats. Estimates regarding the loss of marshlands provided data showing that $871.39/acre/year is the value of recreational fishing for marsh and estuarine-dependent fish on the Florida east coast (Bell, 1997; Kazmierczak, 2001). On Florida's west coast, estimates for estuarine dependent fishing was lower, only $132.11/acre (Bell, 1997; Kazmierczak, 2001). Woodward and Wui (2001) in their analysis of 39 separate studies came up with an average of $470.36/acre/year for recreational fishing for all marshland habitats combined. Other studies presented values for combined marshland hunting and fishing services ranging from $83.99 to $616.46/acre/year (Kazmierczak, 2001). Both the Kazmierczak and Woodward and Wui studies incorporated data from around the United States with most studies focused on the Southeast and the Midwest. Since the Woodward and Wui

study was the most comprehensive and focused only on recreational fishing and not hunting, their figure of $470.36/acre/year is chosen for use in our analysis. Therefore, in terms of this study:

- Each acre of marsh eaten by nutria or destroyed by other causes is assumed to diminish the satisfaction Maryland residents and visitors receive from marine sportfishing by $470.36 per acre per year.
- Each year, with 0.33 percent of Chesapeake marshes potentially destroyed by nutria (676 acres), angler satisfaction with Chesapeake fishing decreases by $318,000.
- Over the next 50 years, if nutria damage continues in the Bay as experienced in the Blackwater NWR, total reductions in angler satisfaction could decrease by $16.5 million (in 2001 dollars).

There are many conflicting factors currently impacting the quality of Chesapeake fishing and ecosystem health. For example, advances in the control of sediment and pollution runoff improve conditions, while a growing human population offsets many gains. The impacts from nutria are just one of the many factors impacting fisheries and Bay health. Therefore, even though the effects of nutria may be partially offset by marshland restoration efforts in other locations, or magnified by sedimentation issues, the gains that can be earned by minimizing the nutria problem are real and worth addressing.

C. Hunting and Trapping:

Much of Maryland's hunting and trapping occurs in, or is dependent on, Chesapeake Bay marshlands. Information regarding the total fur harvest within Chesapeake marshlands was not available. However, one source of hunting expenditure and economic impact estimates was identified, The Economic Importance of Hunting In America, produced by the International Association of Fish and Wildlife Agencies (IAFWA) in 2002. This source provides estimates for 2001 and is comparable to the American Sportfishing Association study used in the recreational fishing portion of this report. Table 8 presents the statewide Maryland hunting impacts.

Table 8: IAFWA's Hunting Economic Impacts for Maryland, 2001:

Retail Sales	Total Multiplier Effect	Salaries & Wages	Jobs	Sales & Motor Fuel Taxes	State Income Taxes	Federal Income Taxes
$161,375,339	$300,995,052	$69,414,648	2,617	$7,378,111	$2,624,037	$11,695,355

These figures must be adjusted to reflect hunting within Chesapeake marshlands. An assumption is made that most marshland-related hunting is for waterfowl and migratory birds. While some hunting occurs for other types of game, it is not possible to develop a sound estimate for any species except waterfowl and migratory birds. Therefore, the estimates developed should be considered conservative due to the exclusion of non-bird hunting (deer, for example) within marshlands and the exclusion of trapping.

The first step was to adjust the statewide hunting impacts to reflect migratory bird and waterfowl hunting only. The data source for the IAFWA, the 2001 National Survey of Fishing, Hunting and Wildlife Recreation, had too little data to permit details regarding the number of migratory bird hunters and their expenditures. However, an earlier survey was available for 1996. It is assumed that the proportion of all Maryland hunting activity assigned to migratory birds has remained steady since 1996. The 1996 survey reports 12 percent of all hunting activity (based on days of hunting) in Maryland was for migratory birds. Therefore, 12 percent of hunting's contributions to Maryland's economy is assigned to migratory bird hunting. An alternate method of determining the percentage of hunting activity associated with migratory birds was available, but was not used. This method, based on the ratio of federal waterfowl stamps sold to Maryland hunters compared to total hunting licenses sold in Maryland, is regarded as less accurate knowing that many waterfowl hunters also hunt other game. There would have been no way to know if a waterfowl hunter spent 10 percent or 90 percent of his hunting time pursuing waterfowl. The preferred method automatically accounts for this important issue.

The next step was to estimate the percentage of statewide migratory bird hunting activity that occurred within the Chesapeake Bay and its marshlands. Best expert opinion from Maryland DNR staff indicate about 80 percent of Maryland's migratory bird hunting takes place within Chesapeake marshlands. Based on these figures of 12 percent and 80 percent respectively, the estimated economic impacts of migratory bird hunting within the Chesapeake are presented in Table 9.

Table 9: Maryland's Chesapeake Migratory Bird Hunting Economic Impacts, 2001:

Retail Sales	Total Multiplier Effect	Salaries & Wages	Jobs	Sales & Motor Fuel Taxes	State Income Taxes	Federal Income Taxes
$15,497,965	$28,906,590	$6,666,358	251	$708,570	$252,004	$1,123,184

As used in the fisheries analyses, it is assumed that the rate of Chesapeake marshland loss will equal the loss of hunting activity. Specifically, if wetlands decrease × percent, then hunting activity will decrease × percent, too. Based on the damage rates historically experienced in the Blackwater NWR, it is assumed that nutria have the capacity to destroy 17.09 percent of the Chesapeake's coastal marshes in the next 50 years, and 0.33 percent annually. Table 10 presents the potential damage to Maryland's economy as a result of nutria-related lost hunting opportunities:

Table 10: Economic Nutria-Imposed Economic Damages Related to Maryland's Chesapeake Bay Hunting, 2001*

	Retail Sales	Total Multiplier Effects	Salaries	Jobs	State Sales & Fuel Tax Revenues	State Income Tax Revenues	Federal Income Tax Revenues
Annual Losses:	$50,929	$94,993	$21,907	1	$2,329	$828	$3,691
Potential annual loss in 50 years:	$2,648,329	$4,939,626	$1,139,163	43	$121,082	$43,063	$191,932

* These results represent the decreases imposed by the presence of nutria. For example, it is estimated that businesses serving hunters would have received $50,929 more in sales revenues in 2001 if nutria were not present, and by 2050, if nutria populations increase bay-wide at the rate experienced in the Blackwater NWR and all other factors hold steady, annual retail receipts will be $2.6 million less.

D. Wildlife Viewing:

Consisting of wildlife viewing, photography and feeding, watchable wildlife recreation is a popular outdoor activity in Maryland. The U.S. Fish and Wildlife Service (FWS) generated estimates of the economic impacts created in Maryland by wildlife viewers and their expenditures in their report titled "The 2001 National and State Economic Impacts of Wildlife Watching." These are summarized in Table 11. Overall, Maryland was the ninth highest ranked state in the U.S. in 2001 in regards to the volume of economic activity attributable to watchable wildlife recreation, and third after California and Florida in terms of economic impacts created by non-residents visiting the state to view, feed or photograph wildlife. For the area surrounding the Blackwater National Wildlife Refuge, a site that has suffered heavy damage from nutria, it is estimated that wildlife watchers bring in about $15 million annually.

Table 11: USFWS's Wildlife Watching Economic Impacts for Maryland, 2001:

Retail Sales	Total Multiplier Effect	Salaries & Wages	Jobs	Sales & Motor Fuel Taxes	State Income Taxes	Federal Income Taxes
$862,700,000	$1,772,900,000	$571,900,000	24,667	$29,200,000	$24,300,000	$68,100,000

As with the hunting and fisheries components of this study, extra steps and assumptions were needed to adjust the statewide estimates (Table 11) to reflect activity attributable to Chesapeake Bay wetlands. The data source for the FWS study, the 2001 National Survey of Fishing, Hunting and Wildlife Recreation (2001 Survey), provides some insights. First, the FWS study reports expenditures and economic impacts related to all activity statewide, including impacts related to people enjoying wildlife in their yards and within one mile of their homes. While many people certainly live within one mile of Chesapeake marshlands, expenditures and economic impacts typically related to activities within one mile of home were excluded. This was necessary as it is not possible within the scope of this project to determine the percentage of these expenditures related to

Chesapeake wetlands versus people's backyards and neighborhoods. Overall, this adjustment reduces the FWS total reported expenditures by 15.1 percent. Table 12 presents the total expenditures made in Maryland in 2001 and those expenditures excluded as being typically associated with home-related activities.

Table 12: Wildlife Watching Expenditures in Maryland, 2001:

	All Maryland Wildlife Watching Expenditures	Maryland Wildlife Watching Expenditures Made Away from Home:
Food	$57,731,000	$57,731,000
Lodging	$36,531,000	$36,531,000
Transportation	$30,482,000	$30,482,000
Other travel costs	$4,949,000	$4,949,000
Binoculars & scopes	$5,163,000	$5,163,000
Film and developing	$13,881,000	$13,881,000
Photographic equipment	$33,911,000	$33,911,000
Day packs	$4,603,000	$4,603,000
Bird food	$65,454,000	*excluded*
Food for other wildlife	$13,253,000	*excluded*
Nest boxes, feeders & baths	$12,337,000	*excluded*
Other misc equipment*	$2,029,000	*excluded*
Auxiliary equipment**	$10,914,000	*1/2 retained*
Special equipment***	$544,743,000	$544,743,000
Magazines and books	$2,515,000	*1/2 retained*
Membership dues	$13,699,000	*1/2 retained*
Land leasing & purchase	not available	not available
Plantings	$10,492,000	*excluded*
	$862,687,000	**$731,994,000**

* = field guides, other small items

** = includes tents, camping gear, backpacking equipment, etc.

*** = vehicles, boats, motor homes and other big-ticket items

While there are certainly additional amounts of activity occurring upland from the Bay involving species dependent in part on Chesapeake marshlands, there are no reasonable means to identify these activities. Such additional amounts of activity are not included in this study. Therefore, the next step was to separate the amount related to activities occurring within Chesapeake marshlands from the statewide totals. The 2001 Survey does not provide data directly related to this need, but it does report that 50 percent of participants visit marshlands, swamps and similar sites. This does not mean 50 percent of all activity occurs at such sites as the same people often visit uplands, the coast or other sites. Until better data becomes available, it will be assumed that 20 percent of all statewide wildlife watching activity is associated with the Chesapeake Bay and its marshlands.

Table 13 presents the revised FWS economic impact estimates. These estimates are revised using the data presented in Table 11, adjusted downward 15.1 percent to reflect economic activity related to wildlife watching away from home (Table 12), then reduced

again to reflect the 20 percent of statewide economic activity assumed to be associated with Chesapeake marshlands.

Table 13: Maryland's Chesapeake-Specific Wildlife Watching Economic Impacts, 2001:

Retail Sales	Total Multiplier Effect	Salaries & Wages	Jobs	Sales & Motor Fuel Taxes	State Income Taxes	Federal Income Taxes
$146,486,460	$301,038,420	$97,108,620	4,188	$4,958,160	$4,126,140	$11,563,380

As used in the fisheries and hunting analyses, it is assumed that the rate of Chesapeake marshland loss will equal the loss of wildlife watching activity. Based on the estimates presented earlier that nutria potentially can destroy 17.09 percent of the Bay's marshes in the next 50 years at a 0.33 percent annual rate, Table 14 estimates the economic damages nutria could inflict on Maryland's economy by reducing wildlife watching opportunities:

Table 14: Economic Nutria-Imposed Economic Damages Related to Maryland's Chesapeake Bay Wildlife Watching Activities, 2001:

	Retail Sales	Total Multiplier Effects	Salaries	Jobs	State Sales & Fuel Tax Revenues	State Income Tax Revenues	Federal Income Tax Revenues
Annual Losses:	$481,384	$989,272	$319,118	14	$16,294	$13,559	$38,000
Potential annual loss in 50 years:	$25,031,951	$51,442,154	$16,594,149	716	$847,262	$705,085	$1,975,978

* These results represent the decreases imposed by the presence of nutria. For example, it is estimated that businesses serving wildlife watchers would have received $481,384 more in sales revenues in 2001 if nutria were not present, and by 2050, if nutria populations increase bay-wide at the rate experienced in the Blackwater NWR and all other factors hold steady, annual retail receipts will be $25.0 million less.

The estimated losses presented in Table 14 are based on an additional assumption. We do not know how many marsh acres would have to be lost before people start reducing their visits and expenditures. The relationship between lost wetlands and lost visits may not be linear, which is probably the case, but the linear relationship is used in this analysis to remain consistent with the other analyses within this study.

E. Environmental Benefits and Marshland Value

Wetlands and marshes provide a variety of environmental services beyond providing habitat for commercially important species. Wetlands also provide habitat for endangered and threatened species, often those that are inconspicuous and particularly sensitive to environmental changes. The loss of these species represents a loss in biodiversity that is difficult to quantify in economic terms, but important to human quality of life nonetheless. In a more direct fashion, coastal wetlands provide protection from storm damage to residential and commercial areas further inland and provide flood control. Healthy vegetated wetlands also provide recharge, filtering and purification of water supplies in the aquifer, and ultimately for human consumers.

A number of researchers have used a variety of methods to try to quantify these assorted environmental services and the values vary considerably from study to study depending on the type of analysis conducted. The summary work by Kazmierczak (2001) provides details on some of these methods, and then compares and analyzes data from eight peer-reviewed studies that present values for habitat and species protection services beyond the value from fisheries and hunting. In U.S. coastal zone marshlands, these ranged from a low of $168.96/acre/yr (yr. 2000 $$) to a high of $403.16/acre/yr. with a mean of $249.44/acre/yr. In conclusion, Kazmierczak states that "Geographic location and type of marshland appeared to have a relatively minor impact on the estimated values."

Based on the Kazmierczak analysis, a figure of $249.44/acre/yr is used to determine environmental services in our study. Based on the Blackwater NWR's nutria-related marsh losses of 17.09 percent over the past 50 years, Chesapeake's coastal marshes in Maryland could potentially lose 35,170 of its 205,815 acres of emergent marshes over the next fifty years. At $249.44/acre/year, Maryland could lose environmental services worth $8,773,000 each year by 2054. This loss rate represents a 0.33 percent annual loss rate. In other words, Maryland may be losing an additional $168,709 in environmental services to nutria each year for each 676 acres lost to nutria, measured in constant 2001 dollars. Please note that the *costs* of replicating these environmental services are unknown, and may be higher or lower than their *value*.

Table 15: Environmental and Social Losses Created by Nutria-related Damage to Maryland's Chesapeake Marshes

	Value of Lost Environmental Services
Annual Losses:	
Environmental Services:	$168,709
Social Losses:	$541,079
Potential annual loss in 50 years:	
Environmental Services:	$8,772,843
Social Losses:	$28,136,121

Another potential, straightforward method to estimate the social value of marshland is based on the cost for the State to purchase marsh acres to be owned in public trust. The Maryland DNR currently pays $800 per acre for marshland (per personal communications with Maryland DNR, 2004). Maryland could lose $28.1 million worth of marshes by 2054. With each additional 676 acres lost each year, Maryland's citizens lose $541,000 in value based on 2004 costs.

If the natural services provided by the Bay's marshes are lost, they will have to be made up with increased public and private investments for more seawalls, water filtration and sewage treatment facilities, increased marine management such as sediment control, oyster and fisheries restoration, and more. Such activities can be costly compared to the cost of preventing marsh loss.

IV. Conclusions

This analysis provides dollar figures for the potential loss of Chesapeake Bay wetlands due to the damaging activities of non-native nutria. The numbers are based on existing data and biological assumptions and indicate the large-scale nature of this problem. Table 16 presents the combined estimated economic losses caused by nutria eat-outs and other factors responsible for the degradation of marshlands. These estimates include damages to commercial and sport fisheries, hunting, and wildlife viewing.

Table 16: Potential Nutria-Related Economic Damages Related to Maryland's Chesapeake Bay Commercial and Sport Fisheries, Hunting and Wildlife Watching, 2001.[1]

	Retail Sales [2]	Total Multiplier Effects [3]	Salaries[5]	Jobs[4]	State Sales & Fuel Tax Revenues[5]	State Income Tax Revenues[5]	Federal Income Tax Revenues[5]
Annual Losses:	$1,403,379	$2,870,402	$692,062	31	$58,456	$27,200	$96,281
Potential annual loss in 50 years:	$72,942,499	132,688,854	$35,987,235	1,628	$3,039,712	$1,414,403	$5,006,599

[1] These results represent the potential decreases in the state economy created by nutria damages

[2] Includes the dockside value and processing value-added losses for commercial fisheries

[3] Includes multiplier effects for commercial fisheries

[4] Includes job losses in commercial fisheries

[5] Estimates regarding the commercial fishery's state and federal tax revenues, plus their associated salaries and wages, were not available and therefore are not included in Table 15.

While equally important, the dollars reported for environmental services cannot be combined with the other activities as they represent the *value* of environmental services, which may be different than the actual *costs* of replicating these services. Environmental values are discussed in the previous section and presented in Table 15. In 50 years, with the current rate of marsh loss due to nutria activity, the loss in environmental services may amount to almost $9 million with resulting social losses of more than $28 million.

Given the scale of these numbers, it is important to control nutria soon to prevent further undue losses to the environment and citizens of the State of Maryland. The longer it takes to address nutria problems, the greater the long-term costs will be. For example, watermen would have earned $79,000 more from crab harvests in 2002 if nutria were not present, and if no controls are put in place, by 2050 under current trends, watermen will loose over $4 million annually in harvests. For recreational fishing, it is estimated that businesses serving anglers currently receive $714,532 less in annual sales revenues due to nutria damages, and by 2050, annual retail receipts will be $37.2 million less. Clearly, actions are needed to minimize the economic losses attributable to nutria.

Bibliography

American Sportfishing Association, January 2003, "Sportfishing in America, Values of Our Traditional Pastime." Alexandria, Virginia.

Batie, S.S. and J.R. Wilson, 1978, "Economic values attributable to Virginia's coastal wetlands as inputs in oyster production," Southern Journal of Agricultural Economics, 10(1):111-118.

Bell, F.W., 1997, "The economic valuation of saltwater marsh supporting marine recreational fishing in the Southeastern United States," Ecological Economics 21: 243-254.

Heimlich, R.E, K.D. Wioebe, R. Claassen, D. Gadsby, and R.M. House, 1998, "Wetlands and Agriculture: Private Interests and Public Benefits", Agricultural Economics Report No. 765, Economic Research Service, USDA available on the web at www.wer.usda.gov/publications/aer765.

International Association of Fish and Wildlife Agencies, January 2003, "The Economic Importance of Hunting in America." Washington, D.C.

Kazmierczak, R.F., 2001a, "Economic Linkages Between Coastal Wetlands and Habitat/Species Protection: A Review of Value Estimates Reported in the Published Literature," Agricultural Economics and Agribusiness Staff Paper 2001-01 available on the web at www.agecon.lsu.edu/faculty_staff/FacultyPages/Kazmierczak/SP2001-01

Kazmierczak, R.F., 2001b, "Economic Linkages Between Coastal Wetlands and Hunting and fishing: A Review of Value Estimates Reported in the Published Literature," Agricultural Economics and Agribusiness Staff Paper 2001-03, available on the web at www.agecon.lsu.edu/faculty_staff/FacultyPages/Kazmierczak/SP2001-03_Fishing.pdf

Lipton, D.W., S. Sullivan, January 2002, "The Economic Impact On Maryland's Crabmeat Processing Industry Of Proposed Regulations: A Possession Restriction On Sponge Crabs And Crabs Smaller Than 5-1/4 Inches," Maryland Sea Grant Extension Program, UM-SG-SGEP-2002-01. Department of Agricultural and Resource Economics, University of Maryland, College Park.

Tiner, R.W. and D.G. Burke, 1995, "Wetlands of Maryland", U.S. Fish and Wildlife Service, Hadley, Massachusetts.

USDA, May 2001, Nutria Marsh Damage Reduction, pre-decisional E.A, available on the web at www.fws.gov/r5cbfo/nutria.pdf

Woodward, R.T. and Y.S. Wui, 2001, "The economic value of wetland services: a meta-analysis, Pg 257-270 in Ecological Economics, Vo. 37, Issue 2.