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## CAN NUTRIA BE ERADICATED IN MARYLAND?

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**ABSTRACT:** The Presidential Executive Order 13112 for control of invasive species signed by President Clinton illustrates the national concern over the negative impact that nutria (*Myocastor coypus*) and other non-native, invasive species have on the nation's natural resources. Nutria are established in 15 states nationwide and cause damage to agricultural crops and natural ecosystems. Despite efforts to control their populations, nutria are found in Maryland throughout the Eastern Shore and in the Potomac and Patuxent Rivers on the Western Shore. Twenty-three federal, state, and private organizations have combined their efforts to develop a three-year pilot plan for nutria control entitled "Marsh Restoration: Nutria Control in Maryland." In 1999 and 2000, funding became available to begin the first year of the three-year pilot effort. The objectives of the pilot program are to develop accurate population estimates, determine effective trapping strategies to maximize nutria harvest and minimize impacts to non-target species, evaluate the effects of population control on nutria home range and movement patterns, determine how population control affects nutria reproductive behavior, determine if the health of nutria populations is influenced by intense harvest pressure, and monitor the effects of intense nutria harvest on vegetative response. Implementation of the control plan will begin during summer 2000.

**KEY WORDS:** nutria, (*Myocastor coypus*), Maryland, eradication, invasive species, exotic species, non-native species, Blackwater National Wildlife Refuge, Tudor Farms, Maryland Department of Natural Resources, Fishing Bay Wildlife Management Area

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### INTRODUCTION

On February 3, 1999, President Clinton signed Executive Order 13112 to control invasive species and to minimize the economic, ecological, and human health impacts that invasive species cause to agricultural crops and natural ecosystems (Federal Register 1999). Nutria (*Myocastor coypus*) are an invasive and exotic species, first introduced to the United States in 1899 (California) and later introduced into 22 states nationwide (LeBlanc 1994; Hess et al. 1997). As of 1999, nutria were established in 15 states (Bounds 1999). Nutria are semi-aquatic rodents which are native to southern Brazil, Argentina, Bolivia, Chile, Paraguay, and Uruguay (Nowak 1991). Nutria are now found in Europe, Asia, the Middle East, Africa, Japan, Canada, the United States, and South America (Van Der Brink 1968; Corbet 1978; Hall 1981; Hygnstrom 1994). Rat-like in appearance, nutria have two pairs of large, protruding, orange incisors and a long, round, slightly haired tail that comprises up to 35% of their total length (Colona 1999). Average weights of nutria range from 5 to 10 kg, but individuals may reach 17 kg (Nowak 1991). The mammary glands of nutria are uniquely positioned high on the sides and extend in two parallel rows, enabling young to suckle while the adult is swimming. The pelage consists of long, coarse guard hairs, generally brown, and a short, dense, and grayish underfur. Overall, their coloration appears brown or tan, and nutria often blend in with their surrounding environment.

Nutria possess impressive reproductive characteristics which include: reaching sexual maturity at age 4 to 6 months, breeding year-round, averaging four young/litter,

and having up to three litters within a 14-month period. However, litters of up to 13 young have been recorded. Newborn nutria are precocial and capable of surviving away from their mother after only five days of nursing (Nowak 1991).

Biologists report that nutria in Maryland may come into estrus within 48 hours after giving birth, have a gestation period of 130 days, and up to 65% of adult females are pregnant at any point during the year (Colona 1999). Evans (1970) noted that breeding patterns were affected by weather and that mass breeding followed climatic catastrophes. Information in the literature to determine how population dynamics of nutria affect their reproductive behavior and performance is limited. Also, little, if any, research exists on the relationship among nutria health, the impacts of harvest intensity, and population densities.

Historically, the fur harvest industry has had a significant influence on the cultural and economic stability of rural communities throughout the Chesapeake Bay region. Attempts by government agencies to stimulate local economies during the mid-1900s included establishing an experimental fur production facility on Blackwater National Wildlife Refuge in Dorchester County, Maryland.

In 1943, domestic nutria farming was initiated to enhance the local fur industry. However, captive rearing of nutria proved unprofitable and nutria either escaped or were inadvertently released by local landowners (Colona 1999).

Nutria are presently found throughout Maryland's Eastern Shore and in the Potomac and Patuxent Rivers on

the Western Shore (Figure 1) with the largest populations occurring in Dorchester County. Blackwater National Wildlife Refuge estimates nutria numbers between 35,000 to 50,000 animals. Although up to 20% of the population is harvested annually, nutria population growth continues relatively unchecked. At Tudor Farms, Inc., a privately owned farm in Dorchester County, population estimates range from 18,000 to 22,000 nutria (Ras 1999). Despite significant efforts to control nutria with an annual harvest of up to 5,000 nutria per year at Tudor Farms, the nutria population remains unaffected.

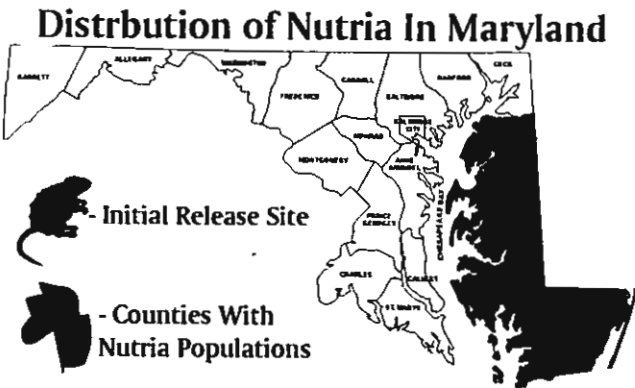


Figure 1. Distribution of nutria in Maryland, March 2000.

However, nutria eradication has been successful in Great Britain. Dr. L. M. Gosling led an eradication campaign which resulted in the successful elimination of nutria from Great Britain. Control efforts in Great Britain demonstrated that eradication of this species is dependent upon knowing how, when, and where to harvest. Understanding behavioral and reproductive traits, and how these traits change in response to intense harvest pressure, will allow researchers to identify strategies to control or eradicate nutria. Such information is particularly important considering that previous researchers in Europe and the United States have reported that nutria control becomes more difficult as population densities decrease (Lowery 1974; Gosling and Baker 1988; Gosling and Baker 1989; Ras 1999).

Efforts to control nutria in Maryland have been ongoing for over a decade. In 1989, both the Maryland Department of Natural Resources (DNR) and the U.S. Fish and Wildlife Service (FWS) initiated a rebate program whereby trappers were paid \$1.50 for each nutria tail they turned in. This money was then applied to offset the cost of leasing state or federal lands for trapping up to the amount of the bid. In 1990, both the DNR and FWS began research projects to estimate nutria numbers. In 1993, the DNR formed the first multi-agency task force to address the problems nutria were causing in Maryland's wetland habitats. Senate Bill 27 was passed in the Maryland General Assembly which provided limited funding for nutria control efforts. In 1994, the Maryland Department of Natural Resources

(DNR) invited Dr. Gosling from Great Britain to assess the nutria situation in Maryland. Dr. Gosling stated that nutria could be controlled in Maryland if additional information was collected on how nutria behave and reproduce in Maryland's habitats which are distinctly different from habitats found in Great Britain. In 1995, the DNR, FWS, and the U.S. Geological Survey (USGS) began a cooperative research project to quantify the impacts that nutria have on wetland vegetation. This study also was designed to investigate the recuperative characteristics of marsh ecosystems in the absence of nutria (Colona 1999). As of March 2000, this study is still ongoing, and the preliminary results are encouraging. In June 1997, the DNR and FWS convened the "Nutria Control Summit" in which representatives from 17 federal, state, and private organizations were invited to develop ideas for nutria eradication in Maryland. In July 1998, a three-year pilot plan entitled "Marsh Restoration: Nutria Control in Maryland" was developed and approved by 17 federal, state, and private partners (Bounds 1998). The objectives of the plan were to: 1) develop methods and strategies to reduce nutria populations in Chesapeake Bay wetlands to the point where they are unable to maintain a sustainable population; 2) restore marsh habitats; and 3) promote public understanding of the importance of preserving Maryland's wetlands. The plan had four components: nutria management, nutria research, public education, and a wetland restoration demonstration project. The overall budget necessary to implement the plan over three years was estimated at \$3.8 million. However, the partners identified \$902,280 of in-kind contributions to support this initiative and sought additional funding of \$2.9 million from federal, state, and private sources to implement the plan. First year implementation was estimated at almost \$1.4 million. H.R. 4337 was introduced by Congressman Wayne Gilchrest during the 105<sup>th</sup> Congress and was enacted as Public Law 105-322 on October 25, 1998. PL 105-322 authorized the Secretary of the Interior to appropriate up to \$2.9 million, beginning in fiscal year 2000, to achieve the objectives of the nutria plan. In 1999, the partners were successful in obtaining an 1890 Institution Research Capacity Building Grant from the U.S. Department of Agriculture for almost \$300,000 for a portion of the nutria research component of the nutria plan. In the fiscal year 2000 budget, Congress earmarked \$500,000 in the U.S. Fish and Wildlife Service budget to support implementation of the first year of the pilot program. The partners agreed to combine these resources (approximately \$800,000) to begin implementation of the first year of the three-year pilot program at a reduced scale (\$1.4 million was originally requested). The partners decided to proceed with nutria management and nutria research activities at the reduced funding level. In addition, the partners agreed to contribute additional in-kind services to carry out public education activities. However, funding for the wetland restoration demonstration component of the plan is not currently available. As of March 2000, the partnership has expanded and now includes 23 federal, state, and private partners (Table 1).

Table 1. Federal, state, and private partners in Maryland's nutria control partnership.

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<b>FEDERAL PARTNERS</b>	U.S. Fish and Wildlife Service Blackwater National Wildlife Refuge Chesapeake Bay Field Office
	U.S. Geological Survey, Biological Resources Division Maryland Cooperative Fish and Wildlife Research Unit Patuxent Wildlife Research Center
	U.S. Department of Agriculture Wildlife Services
	U.S. Army Corps of Engineers Baltimore District
	National Civilian Conservation Corps Americorps
	U.S. Congressman Wayne T. Gilchrest
<b>STATE PARTNERS</b>	Maryland Department of Natural Resources Maryland Department of the Environment University of Maryland Eastern Shore University of Maryland College Park
<b>PRIVATE PARTNERS</b>	Tudor Farms, Inc. Ducks Unlimited, Inc. National Fish and Wildlife Foundation National Trapping Association Friends of Blackwater National Wildlife Refuge Maryland Fur Trappers Association Salisbury Zoo The Wildlife Society (Maryland/Delaware Chapter) International Association of Fish and Wildlife Agencies Chesapeake Bay Foundation National Aquarium, Baltimore

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## OBJECTIVES

The objectives of the nutria research and management activities are:

- A. Analyze nutria densities and develop population estimates;
- B. Determine the most efficient and effective trap types and trapping strategies to optimize intense nutria harvest, achieve nutria population reduction, and minimize impacts on non-target species;
- C. Evaluate the effects of population reduction on home range and movement patterns of nutria;
- D. Determine how intense harvest affects nutria reproductive behavior and performance;
- E. Ascertain if decreasing population density affects the health of nutria; and
- F. Monitor the effects of intense nutria harvest on vegetative response of native plant species.

## STUDY AREAS

We will have treatment and control areas at three study sites: a federal partner (Blackwater NWR, managed by the U.S. Fish and Wildlife Service), a state partner (Fishing Bay WMA, managed by the Maryland DNR), and a private partner (Tudor Farms). Treatment areas will be subject to intensive harvest pressure and control areas will have no nutria harvest. In each treatment area we plan to create a "sink" in which our goal will be to have no nutria survivorship. We believe inclusion of a sink in each treatment area is necessary for the following reasons: 1) to determine if an area of zero population can be established; 2) to accurately monitor immigration and emigration; and 3) to evaluate the effect of population reduction on nutria reproduction, home range movements, and health.

The control area at Blackwater NWR will be east of Maple Dam Road in Squirrel Point, Wolfpit Pond, and Goose Pond and the treatment area will be west of Maple Dam Road in Barbados Pond, Otter Pond, and Blackwater Pond with the sink in Round Pond. The control area at Fishing Bay WMA will be Management Area 5 and the treatment area will be Thorofare Marsh with the sink in the Three Ox Bow Region of the Transquaking River. At Tudor Farms Inc., the control area will be west of Hurlock Neck in Beaver Dam and Cobb Creek and the treatment area will be east of Hurlock Neck in Hurlock Creek, Pound Marsh, and Storr Marsh with the sink in Powells Gut.

## METHODS

To estimate nutria populations, we plan to mark and release 250 adult nutria/treatment and control area (125 adult males and 125 adult females/area) prior to treatment (intensive harvest) with the addition of 50 adults/area (25 adult males and 25 adult females) every three months (250 animals/treatment and control area x 3 study sites: Total = 1500 nutria with the addition of 300 animals every three months). We will use mark/recapture population models to develop population estimates in the treatment and control areas.

To evaluate the effects of population control on home range and movement patterns of nutria, we plan to radiocollar 20 to 30 adult nutria in each treatment and control

area (10 to 15 adult male and 10 to 15 adult female/treatment and control area x 3 study sites: Total = 120 to 180 animals). All home range and movement data will be subjected to Shaprio-Wilk goodness of fit tests (Sokal and Rohlf 1995). We will compare differences in the annual, seasonal, and daily estimates of activity areas between nutria in the treatment and control areas and between sexes using the Wilcoxin two-sample test (Sokal and Rohlf 1995). Core activity areas determined by home range estimates will be compared by analysis of variance (ANOVA) procedures. Population data and overall annual, seasonal, and 24 hr movement areas will be subjected to analysis of covariance for evaluation of the effects of population dynamics on home range and movement patterns.

To determine how population control affects nutria reproductive performance and to examine the health of the nutria population, we will live capture five males and five females from each age group (i.e., immature and adult) each month from each area (20 animals/treatment and control area x 3 study sites: Total = 120/month) for subsequent necropsy. These animals will be collected between the 10th and 20th of each month. We will compare these observations with random checks made in the field on harvested animals. At the time of euthanasia, animals will be examined for external parasites and lesions, blood, urine, and fecal samples will be collected, and body weights and measurements will be recorded. Necropsy and tissue sampling procedures will be similar to those described by Willner et al. (1979), but modified to include complete blood count (CBC) and standard blood chemistry profiles, and examination of internal organs and tissues for gross lesions associated with infectious and parasitic diseases. If lesions indicative of infectious disease are encountered, standard diagnostic procedures will be followed to determine the causative etiological agent. To evaluate physiological responses to harvest intensity, body condition index, adrenal index, and splenic index will be determined (Willner et al. 1979). These data, the incidence of infectious or parasitic disease, and population data will be subjected to analysis of covariance to test if the health of the population is related to harvest intensity. Differences between treatment and control areas will be evaluated by ANOVA procedures.

The testes will be removed, separated from the epididymides, and weighed. Smears of the fluid from the testes and cauda epididymides will be examined for the presence of sperm. Vaginal smears will be taken and examined for the presence of sperm to evaluate reproductive activity. Female reproductive tracts will be removed, weighed, and examined for gross indications of pregnancy (i.e., presence of embryos, embryo resorption, and placental scars). Ovaries will be prepared and sectioned by standard histological procedures and examined for Graafian follicles, ruptured follicles, and corpora lutea. These data will be used to establish the relationship among gonadal steroids in urine, feces, and blood and gonadal function.

Portions of the urine, feces, and blood serum collected from nutria at the time of euthanasia will be stored at -20°C until assayed. Estrogen, progesterone (females only), and testosterone (males only) will be

extracted from fecal samples and prepared for quantitative analysis by the method of Brown et al. (1994). Urinary estrogen will be extracted as described by Monk et al. (1975). Progesterone and testosterone in feces and serum, and estrogen in urine and serum, will be measured by radioimmunoassay (RIA; Mollett et al. 1976). Measurement of these steroids in urine, feces, and serum by enzyme immunoassay (EIA) will be by the procedure of Bravo et al. (1990).

Differences in the quantities of steroids measured by RIA and EIA as well as correspondence among urinary, fecal, and serum steroids will be evaluated by ANOVA procedures. Quantities of gonadal steroids in urine, feces, and serum, and the gonadal function data will be subjected to multiple regression analysis to elucidate the temporal patterns of gonadal steroid secretion in nutria during their reproductive cycle. Differences between treatment and control areas will be evaluated by ANOVA procedures.

We will analyze trapping strategies to determine the most efficacious trap types and methods to optimize harvest of nutria and to minimize impacts on non-target species. We will identify trap locations with a grid system that is currently employed by Blackwater NWR; we will monitor and record trap locations using a geographic information system.

We will hire 12 research trapper technicians (technicians) to conduct the intensive harvest at the treatment areas. Four technicians will be assigned to each of the three treatment areas. We will randomly assign trap types to each treatment area and trap types will be rotated among technicians. We plan to employ a variety of trapping strategies including saturation and perimeter trapping. We will use random saturation trapping when marking animals for recapture during the first year of the three-year pilot program. We will use perimeter trapping during intensive harvest which will begin in the second year and continue through the third year of the pilot program.

#### IMPLEMENTATION

We will begin hiring the 12 research trapper technicians during spring 2000 and plan to hire two graduate research assistants during July 2000. Initially, the technicians and graduate students will work together to live capture, mark, and release 1500 nutria. All technicians and graduate students will be trained in trapping techniques and safety procedures for handling live animals. This project has been approved by the University of Maryland's Institutional Animal Care and Use Committee. In addition, an environmental assessment (EA) is currently being developed by a federal partner, Wildlife Services, Animal and Plant Health Inspection Service, of the U.S. Department of Agriculture.

Public outreach activities have been ongoing since July 1998 when the nutria plan was first developed. The partners have given presentations to Congressional staff, federal and state agencies, trapping associations, local interest groups, and members of the press (television, newspapers, and radio). A nutria program coordinator was selected in early 2000.

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