THE IMPACT OF NUTRIA (*Myocastor coypus*) AS AN INVASIVE SPECIES AND ITS POSSIBLE DISTRIBUTION IN WASHINGTON STATE

By

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ABSTRACT

THE IMPACT OF NUTRIA (*Myocastor coypus*) AS AN INVASIVE SPECIES AND

ITS POSSIBLE DISTRIBUTION IN WASHINGTON STATE

Ryan Kruse

Nutria (*Myocastor coypus)* is a rodent native to South America that has been introduced throughout various habitats worldwide, mostly through the fur industry. Nutria are voracious consumers of emergent vegetation and have been known to convert large sections of wetland habitat into standing water through subsequent erosion, and additionally can cause damage to embankments and water control structures due to their burrowing habits. This study reviews nutria infestation in a few locations, such as England, where nutria have been successfully eradicated, and Louisiana, where nutria are a pervasive ecological threat. There is a current lack of information on the range and severity of nutria infestation in Washington State. This thesis uses data from various agencies and GIS to produce a range map of nutria sightings, a map of where nutria have been removed or controlled, and a map showing suitable habitat for nutria infestation. Currently, nutria are distributed across Western Washington, with some evidence showing a few populations East of the Cascades. The habitat suitability map is consistent with all nutria sightings, and shows many areas highly suitable for nutria where nutria have not yet been reported or surveyed. A lack of coordination between agencies responsible for wildlife management and inadequate follow up to sighting reports has resulted in uncertainty of where nutria are present, and whether or not they have been successfully eradicated in some areas. More research, combined with a public awareness campaign and centralized reporting methods could result in better estimates of the abundance and distribution of nutria in Washington State, leading to more effective control.

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Acknowledgments

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Chapter 1:

Introduction

Invasive species are capable of causing a number of ecological disturbances as well as economic problems, and are considered one of the most imminent threats to biodiversity (Chornesky & Randall, 2003). The nature of many invasive species is not well understood, and managing or mitigating for these problems is complicated, particularly in the face of dynamic ecosystems and a changing climate (Chornesky & Randall, 2003; Hellman et al., 2008). Invasive plants and animals may compete for space or nutrients, prey upon native species, or disturb ecological balances in a number of ways. Often, invasive species reproduce faster and reach larger sizes in these new habitats than in their native range (Buckley et al., 2003; Clout & Poorter, 2005). Once an invasive has established a considerable population, it is extremely difficult to remove (Hoagland & Jim, 2006). For this reason, assessing the status of an invasive species in a given region is necessary in order to make decisions regarding whether the species can be controlled or eradicated.

Nutria (*Myocastor coypus*) or the coypu, is a semi-aquatic rodent native to South America that has been introduced to wetland habitats worldwide (Jacoby Carter & Leonard, 2002). Its natural habitat is along rivers and lakes and in marshes and estuaries. Nutria has historically been valued for its fur, which has led to its spread as an invasive species through escapes from fur farms as well as intentional introduction. The animal is considered a pest or nuisance in many areas outside of its native range due to its feeding and burrowing habits (Jacoby Carter & Leonard, 2002).

Because nutria are capable of rapid reproduction and are highly adaptive and capable of increasing their range into new habitats, their detrimental effects are of concern to stakeholders at multiple levels. There is ample evidence that nutria are capable of destroying ecologically valuable wetland and marsh habitat, as well as creating economic costs through crop loss, damage to embankments and dams, and potential flooding (Jacoby Carter & Leonard, 2002).

Attempting to control an invasive population such as nutria is typically expensive, and sometimes futile (Bomford & O'Brien, 1995). It requires an understanding of the extent and significance of the problem in order to understand if the species necessitates control, and if so, how control can be accomplished. Failure to understand the status of an invasive species may allow the species to gain a stronger hold and incur larger damages if action is not taken (Hoagland & Jin, 2006). On the hand, resources could easily be wasted in an attempt to control a species in a manner that is ineffective or unnecessary. Some states, such as Louisiana and Maryland, have already instituted nutria control programs after suffering great ecological damage to nutria infestation (Jacoby Carter & Leonard, 2002). Other states have not studied the effects or extent of nutria infestation in their locality.

Biology and Behavior

Myocastor coypus is known in many countries as coypu, and as nutria in the United States. This caviomorph rodent is native to South America, South of 23 degrees latitude. Nutria look similar to beavers, but are smaller and have a rat-like tail. On average, adults are relatively large (up to 7kg). Other characteristics include webbed hind feet, orange to yellow colored incisor teeth, and reddish-brown fur (Woods et al., 1992). Nutria are adapted to an aquatic lifestyle, but are capable of moving quickly whether on land or in water. They eat primarily aquatic vegetation, but will also consume terrestrial plants, with a possible preference for monocotyledons (Guichón et al., 2003). In its home range in South America, it has been documented to occasionally consume mollusks (Larrison, 1943).

In South America, nutria populations are limited by hunting and the animal is considered of economic value for as a furbearer. Its status as a pest or asset in non-native areas is usually tied to its economic viability as fur bearing species. For example, in areas such as Eastern Europe, where fur is more valued, nutria are considered a resource, whereas in Western Europe, the fur market is smaller and does not outweigh the ecological concerns of nutria presence (Jacoby Carter & Leonard, 2002).

Most areas of nutria invasion are considered to be the result of escape from captive farming, although in some regions nutria were intentionally released as a game animal or for vegetation control (Jacoby Carter & Leonard, 2002). In favorable habitats, nutria populations have been established and have increased in range. The main factor for success in population establishment appears to be temperature, with nutria unable to survive harsh winters (Gosling, 1986). Consecutive days of frost have been shown to cause substantial deaths in both adult and juvenile nutria, and in harsher conditions female nutria have been known to abort litters (Guichón et al., 2003). However, there is evidence that nutria have a high level of behavioral flexibility. Their ability as a tropical species to spread to temperate areas is indicative of this flexibility, and nutria have spread to areas previously considered too cold for survival. Nutria, in a pattern similar to many invasive animals, have been shown to mature earlier and reach larger body sizes in invaded areas than in their native range (Guichón et al., 2003). This may be, in part, an evolutionary response to the temperate conditions experienced in its new habitat.

Nutria are described as preferring stagnant fresh water, but are also known to inhabit salt water and brackish habitat (Jacoby Carter & Leonard, 2002) . They preferentially eat aquatic and semi-aquatic vegetation in their habitats, such as reeds and sedges. However, nutria are capable of consuming a wide variety of vegetation and their diet in a given habitat is highly variable according to what is easily available, including crops adjacent to their habitat (Guichón et al., 2003). Often, these are the losses most easily calculated as a result of nutria infestation.

Nutria have been described as abundant in holding ponds and drainage ditches, and some researchers have provided evidence that the animals thrive in highly eutrophied water systems, such as sewage lagoons near cattle ranches (Brown, 1975). This may be due to a fertilizing effect of polluted water on emergent vegetation, which provides a dense food source for the rodent. For example, in Florida, enriched waters are often choked with the exotic water hyacinth, which nutria utilize heavily (Brown, 1975). However, nutria are thought capable of infesting any wetland habitat, including those that are relatively undisturbed (Usher et al., 1986).

Nutria have a variable home range. Mark-recapture studies in Louisiana have suggested that typically nutria remain within one general area throughout their lives, rarely traveling over 1,200 yards from where they are released. Daily movements of nutria are usually within 200 yards. Some nutria, however, moved large distances: 18 miles within 167 days, and 15 miles within 67 days (Chabreck, 1962). This means nutria are perfectly capable of infesting new areas within a fairly short amount of time, although the majority of the animals may never leave the habitat of their birth. The degree to which nutria spread into new habitats may be dependent on the quality and abundance of the resources in that habitat.

In their native South America, nutria have been described as nocturnal, with an occasional shift towards diurnal behavior when temperatures are colder (Woods et al., 1992). However, research on nutria in temperate areas has described nutria as being most active during dawn and dusk hours (crepuscular). Some tracking of nutria behavior in Louisiana has shown nutria to be most active at night, with activity decreasing through dawn (Chabreck, 1962). It is possible that the crepuscular behavior is a misconception, as unless monitoring includes night hours, nocturnal animals will appear to be most active at dawn and dusk. Behavior may vary from region to region depending on climate.

Nutria typically live around 3 years, but reproduce rapidly. Females can have two litters per year, ranging from 5-13 animals per litter. The average number per litter seems to be highly variable between locations (Brown, 1975). It is this rapid reproduction that allowed nutria to grow from an estimated 20 escaped individuals to a population of twenty million nutria within 20 years in Louisiana. Given the high fecundity of nutria, the chances that even a small number of animals distributing to new habits will lead to infestation is high.

Nutria as a Pest

Nutria pose a number of risks as a non-native species. They are considered voracious consumers of emergent vegetation, eating up to 25% of their body weight per day (Shaffer et al., 1992). They also have a tendency to consume the base or stalk of plants, often uprooting the plant and allowing the unconsumed portions to wash away (Hailman, 1961). This means a population of nutria is capable of converting wetland or marsh habitat into open water within a relatively short amount of time. Areas in which nutria have significantly depleted vegetation are called "eat outs". In addition to herbivory, the swimming channels created by nutria to move through marshland have a fragmenting effect and can accelerate the rates of loss (Shaffer et al., 1992). In some areas these feeding habits have led to the loss of entire wetlands. Louisiana has attributed a loss of over 600,000 acres of coastal wetlands to nutria invasion (Louisiana Fish and Wildlife). England, before beginning a control program, attributed major losses of reed swamp to the feeding habits of nutria (Boorman & Fuller, 1981). Maryland has lost over 7,000 acres of salt marsh in the Blackwater National Wildlife Refuge area, citing nutria pressure along with sea level rise. This habitat is considered vital for nesting waterfowl such as the Maryland state-listed black rail.

Areas in which wetlands are being restored and replanted are of particular concern. For example, wetland restoration in Italy has been slowed as nutria expanded their range into the newly created habitat and depleted the vegetation (Bertolino et al., 2005). The disturbance caused by nutria may favor the establishment of invasive plants through competitive exclusion, as native plants are unable to establish themselves under the pressure of hervibory.

Nutria invasion has the potential to threat rare plants or deplete locally abundant species. In England, the rare water soldier (*Stratiotes aloides)* was nearly included on the IUNC Red List of Endangered Species due to nutria herbivory. Other locally abundant species in England were nearly or completely eliminated from certain localities (Usher et al., 1986).

Nutria are additionally considered an agricultural pest which can affect crops adjacent to their habitats. Crop feeding is more prevalent in winter months, where nutria have been known to feed up to 1.5 km away from their habitats (Usher et al., 1986). A variety of crops have been recorded as affected by nutria, although alfalfa, sugarcane, and rice have been particularly affected. Additionally, they have been reported as destroying fruit and nut trees, and conifers. In some areas, such as Italy, damage by nutria to crops have been calculated in the millions of dollars (Bertolino & Viterbi, 2009).

Nutria burrow into banks and water control devices in order to make their dens. These burrows are usually submerged at the opening and are not easily spotted. These burrows can undermine the stability of these banks, leading to increased erosion and flooding. Burrows are of particular concern for farmland areas and other regions in which water may be at an elevated plain, such as throughout the Netherlands.

Nutria present a further risk as an invasive species as carriers of parasites and dangerous bacteria, including leptospirosis, or tularemia, which can be spread to humans through biting, or contact with the animal or its feces (Waitkins et al., 1985). Bacteria and diseases carried by nutria may be spread to livestock or pets.

The true costs of nutria infestation are often underestimated, as ecological damage, especially to wildlife areas are difficult to price. Nutria may act in tandem with other factors in wetland loss, such as development, deforestation, and water level rise, accelerating wetland loss. Control is considered cost effective if the amount spent controlling the invasive is less than damages that would be suffered without control. However, future costs are difficult to predict, and externalities are likely to be left out of calculations. A cost-benefit analysis may fail to consider the cost of controlling nutria should densities increase.

Figure 1:

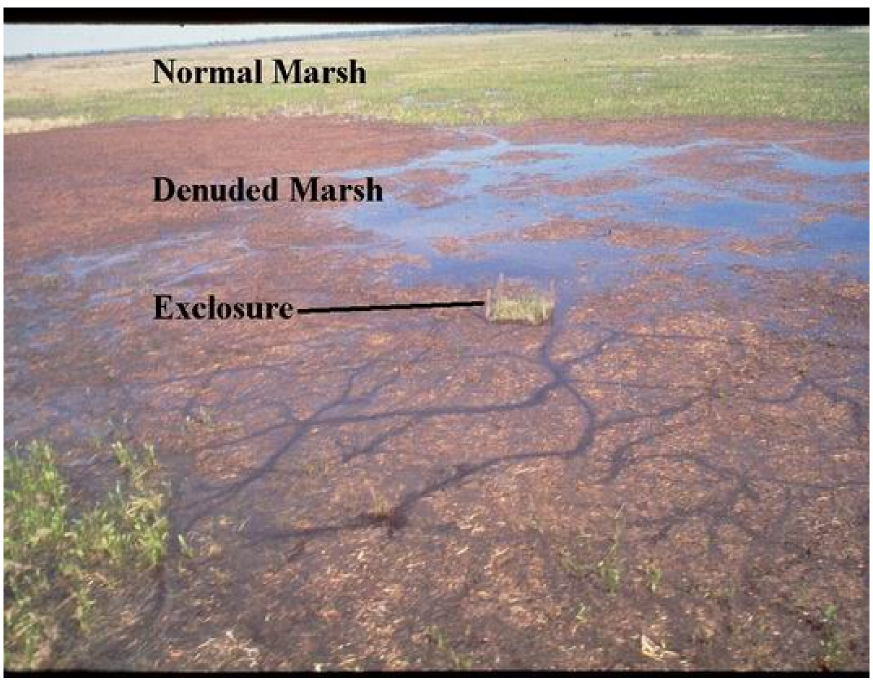

Figure 1: Area photograph of an enclosure experiment in which nutria herbivory has been prevented with fencing. The area surrounding the enclosure demonstrates the degradation of marsh vegetation as a result of nutria feeding. From http://www.nutria.com/site24.php

Thesis Contribution

Nutria have been present in Washington State since the late 1930s, but little is known about their current range, their population numbers, or the severity of their impact as an ecological or economic threat in this region. This thesis contributes by adding to knowledge of this species in the Washington State, including population and range, level of threat, and current degree of management. Furthermore, this thesis draws conclusions on how policy can be improved regarding nutria control in Washington State.

I will begin with a brief overview of this species and its history as an invasive species. I will review nutria infestation in key areas in the US, such as Louisiana and Maryland, and in Europe, and discuss how these regions been affected by nutria, and how they have addressed or failed to address this species. These regions will be presented as case studies in order to inform the outlook of nutria infestation in Washington and the potential for mitigation.

Using sighting data from a number of agencies, I will provide a range map to show the known extent of nutria infestation in Washington, as well as discuss knowledge gaps and communication barriers between agencies involved with this species. Using information about the preferred habitat of nutria, I will present a habitat suitability map to discuss areas in which nutria may be likely to spread. Last I will make conclusions and recommendations in order to address nutria in Washington State.

Chapter 2:

Nutria Infestation by Region

England:

Nutria were first brought to England in 1929 for fur farming, and subsequent escape lead to feral populations. One researcher discussed a few escapes of the animal in 1935, stating "it does not seem as if the coypu would readily establish itself in the first place, and its extermination, if necessary, should not prove difficult" (Warwick, 1935). Nutria were observed to increase their range from the 1940s into the 1960s, and populations were likely around 200,000 animals (Stokstad, 1999).

In the late 1950s, nutria herbivory became a noticeable problem, with damage to crops and the banks of waterways posing economic concern, and the loss of desirable plant species becoming and ecological threat. Loss of crops included the sugar beet, with nutria capable of destroying several acres of the crop by biting off the top of the tap root and subsequently killing the plant. Other affected crops included kale, brussel sprouts, potatoes, and mangolds (Norris, 1967).

While trapping began as early as the 1940s, coordinated attempts to decrease the number of nutria began in the 1960s. Severe winters caused large declines in the populations, but researchers found the populations thrived and returned in milder winters. Using weather models, researchers were able to predict the costs of nutria control with focus on years with mild winters.

In 1981, a ten-year attempt to eradicate nutria began as a cost of 4 million dollars. An Organization called "Coypu Control" was formed, consisting of 24 trappers. Their methods consisted of cage trapping followed by euthanasia. In 1989 the species was considered extinct in the area (Jacoby Carter & Leonard, 2002). England remains the best documented example of a successful effort to eradicate nutria (Jacoby Carter & Leonard, 2002).

Italy

Nutria may have been introduced to Italy as early as 1928, and is now considered widespread in the Northern and Central regions (Bertolino et al., 2005). Damage caused by nutria, particular hampering wetland restoration efforts led to control programs in some regions. A cost benefit analysis of nutria control in Italy from 1995 to 2000 estimated a cost of € 11,631,721 in damage caused by nutria through damage to crops and riverbanks. Over 220,000 animals were removed at a cost of € 2,614,408. However, these efforts failed to control populations or curb the increases in nutria damage. The reason for ineffectiveness of control efforts may have been timing, with managers only attempting to control populations at high densities and after damage had already taken place (Bertolino & Viterbi, 2010).

Attempts to eradicate nutria from Italy have provided evidence that nutria are resistant to population control. An intensive trapping campaign from 1994 to 1996 in a wetland area of Northern Italy resulted in the removal of 8,600 animals, yet failed to reduce the number of nutria present (Cochi & Riga, 2008). Nutria may have counterbalanced severe winters and the trapping campaign with a higher birth rate and lower fetus reabsorption rate, suggesting that nutria are highly capable of resisting population control (Cochi & Riga, 2008).

Trends in the United States:

Ranches farming nutria were established in the United States through the 1930s in Louisiana, Michigan, New Mexico, Ohio, Oregon, Utah, and Washington (Ashbrook, 1948; Jacoby Carter & Leonard, 2002). The fur industry crashed during World War II due to a decline in the price of fur pelts, and many defunct farms simply released the animal (Jacoby Carter & Leonard, 2002). Nutria were also intentionally introduced across the Southeast, where state and federal agencies promoted the animal for weed control. Nutria are currently thought to have stable or increasing populations in at least 15 states, although the number could be as high as 20 (Jacoby Carter & Leonard, 2002). Some states have reported small feral populations that were successfully eradicated; however, these populations may have already been limited by unfavorable habitat conditions. Other states have reported small feral populations that may have died off without eradication efforts (Jacoby Carter & Leonard, 2002). Nutria have shown the ability to spread from state to state, with Maryland populations likely the source of populations in Delaware and populations in Louisiana using gulf waterways to establish populations in the Florida panhandle (Brown, 1975).

Louisiana:

Nutria were first introduced in the New Orleans area in the 1930s, but this small population was thought to have been eradicated. Fur farms beginning in 1938 are thought to be the source of the current nutria population. There are records of nutria escape from farms following hurricane damage to pens and fences in 1940; however, there is some documentation of intentional release prior to that event, possibly to supplement the fur industry. Two years later, populations were observed 78 km away via water from the release site (Jacoby Carter & Leonard, 2002). From these initial founders, nutria reached an estimated population of 20,000,000 by 1960 (Woods et al., 1992). Nutria were reported frequently as destroying levees, wetlands, and agriculture (Jojola et al., 2009). Fur trapping contributed to control populations of feral nutria through the 1960s and 70s. The decrease in the price of fur in the 1980s lead to decreased trapping. Nutria populations again began to rise, as did reports of damage (Jojola et al., 2009). An estimated 80,000 acres of wetland have been damaged by nutria in Louisiana, which is likely an underestimate, as only the most severe damage is detectible via aerial survey (Louisiana Department of Fish Wildlife).

Nutria in Louisiana are likely the dominant force in destroying wetland habitat and preventing the reestablishment of vegetation in marshland and swamp forests (Woods et al., 1992). Plants such as the bald cypress, and *Spartina sp.* have been reportedly destroyed as fast as they are planted, disrupting efforts to conserve habitat. Large and rapid loss of coastal wetlands led the Louisiana government to institute a bounty program to thin nutria populations: the Coastwide Nutria Control Program in 2002. Since the instatement of the program, the number of impacted wetland sights and total impacted areas has dropped to as low as 6,900 acres. The program initially offered 4 dollars for a nutria tail, raising to 6 dollars to registered participants (Jojola et al., 2009). Before the inception of the program, nutria harvest in Louisiana was around 25,000 pelts a year. A few seasons later, numbers were as high as 375,000 nutria harvested per year, with a stated goal of 400,000 nutria harvested annually (Sheffels & Sytsma, 2007). Other methods of encouraging nutria harvest used by the Louisiana government include advertising nutria as a delicacy (Sheffels & Sytsma, 2007).

Maryland:

Nutria were introduced to the eastern shore of Maryland in the early 1940s, and have since spread across the coastal marshes, including the Backwater National Wildlife Refuge (Dixon, 2012). Much of the refuge consists of floating vegetation on top of fluid mud; nutria herbivory damages the root mats that hold the marsh together, cause it to break up and wash away with tidal action. Initial populations within the refuge were as low as 150 animals, which has increased to around 50,000 nutria today (Stokstad, 1999). The animals are estimated to cause 2.8 million dollars of damage, mostly through the loss of hunting, fishing, and hiking opportunities. Over the past 40 years, the refuge has lost 7,000 acres of salt marsh to nutria herbivory. The fragile marsh systems provide valuable nesting habitat for water fowl, as well as habitat for varieties of fish and crustaceans.

A two year program, hiring 15 trappers, has been reported to have eliminated the rodents from the refuge at a cost of 2 million dollars (Fahrenthold, 2004). Control efforts were modeled after the successful eradication program in England and included efforts to research populations, reestablish wetlands, and educate the public. Although the

Blackwater Refuge may be free of nutria, the animal continues to have a presence across Maryland.

Oregon:

Nutria farms were established in Oregon in the 1930s and 40s, including in the Portland and Tillamook areas. There may have been as many as 600 farms raising nutria at this time (Sheffels & Sytsma, 2007). Feral nutria have spread across Oregon, and trapping records indicate that feral nutria have been present on either side of the Cascade mountain range (Winter & Lewis, 2001). Research has suggested that it is the burrowing habits of nutria, such as damage to water control devices that are the primary concern of nutria infestation in the Pacific Northwest, as opposed to the ecological destruction in Louisiana and Maryland (Sheffels & Sytsma, 2007).

The Center for Lakes and Reservoirs at Portland State University was assigned in 2001 to develop an Oregon Aquatic Species Management Plan, which would include outreach, prevention, detection, research, and mitigation protocol. Accurate communication and documentation were established as important goals in order to address nutria efficiently. The CLR conducted a 'Nutria Management in the Pacific Northwest' workshop and produced a range map focusing on nutria density, mostly in Oregon, but including some regions of Washington.

Researchers in Oregon conducted an enclosure controlled herbivory study to analyze the effects of nutria feeding habits in the area. While herbivory was observed on some of the study sites, the research remained inconclusive due to insufficient data (Sheffels & Sytsma, 2007).

Washington State:

Feral nutria were first described in Washington State as early as 1941 from pelts collected near Woodinville, Washington. Although information on the locations of nutria farms is limited, records exist for farms in Seattle, Bothel, Maple Valley, Bellingham, and Bremerton (Larrison, 1943). It is likely that animals escaped or were eventually released from some or all of these locations. In the 1940s, nutria sightings in various areas within Washington were documented in the primary literature, including Lake Washington, tributaries of the Snohomish and Skykomish Rivers, and the headwaters of Snoqualmie in the Cascade Range (Ashbrook, 1948). There is evidence that nutria are spread across the Pacific Coast from Oregon into British Columbia (Jacoby Carter & Leonard, 2002).

Observations made by researchers Phu T. Van and Filip Tkaczyk at the University of Washington provide some data on local vegetation consumed by nutria. Nutria were observed consuming a number of native plants, such as willow (*Salix)* species, cattail (*Thypha),* native rush (*Juncus)*¸ as well as non-native species such as Himalayan blackberry (*Rubus discolor)*, Yellow Iris (*Iris pseudocorus)*, Queen Anne's lace *Daucus carota)*, and canary reed grass (*Phalaris arundinacea)* (Van & Tkaczyk, 2007*)*.

Reports of nutria damage include herbivory within habitat restoration attempts, such as a project in the Vancouver area, which may have lost 400,000 dollars to nutria

(Sheffels & Sytsma, 2007). Newly established or restored habitat may be the most sensitive to nutria herbivory. However it is likely that erosion and damage to embankments and water control devices that may incur the largest and most immediate costs due to nutria infestation. Nutria populations in the Pacific Northwest, particularly Washington, may be concentrated in canals and other human modified bodies of water, as opposed to the coastal marshes and wetland habitats infested by nutria in Southern Washington (Sheffels & Sytsma, 2007).

Residents in Washington, such as along the Sammamish River, have reported nutria feeding out of vegetable gardens, with a fondness for cabbage (Larrison, 1943). The degree to which nutria will consume crops may hinge upon distance from the water and the availability of aquatic plants near the waterway (Guichón et al., 2003). If a buffer of vegetation is allowed to grow between the water and an agricultural field or garden it may provide optimal foraging and prevent nutria from seeking terrestrial plans, even if they are highly nutritious.

Nutria Control in Washington:

Currently the Washington Department of Fish and Wildlife has focused on other invasive species such as the zebra mollusk, and has taken the strategy of encouraging the pubic to take a lead on nutria control on a local basis. Some landowners and associations have made efforts to control nutria, such as Skagit County, and residents in Portage Bay, such as the Seattle Floating Homes Association. Skagit County has taken particular interest in eradicating nutria, as damage to embankments is a frequent occurrence in some areas. A variety of agricultural and wildlife groups managed to raise money for nutria control and employ a trapper in the area.

Costs of nutria control are the responsibility of the land owner. WDFW recommends a few extermination options, such as the USDA Wildlife Services, which eliminates nutria using trapping and shooting at a cost of around 43 dollars per hour. There are no established methods of tracking the range or population levels of nutria in Washington. WDFW has published a report, "Living with Nutria" which gives advice on dealing with the animals from building protective devices for gardens or repelling the animals by blocking their burrows. The website does not give a method for reporting nutria presence.

Overview:

Nutria have been proven as damaging, costly pests in a variety of regions. Areas that have calculated the costs of nutria estimate high damages when populations are dense. In areas where nutria is considered a pest, damages are reported from wetland loss, crop damages, and destruction of levees and irrigation devices. Costs have been calculated from crop loss and repairs, although the ecological damage caused by nutria is difficult to price, except through lost recreational opportunities and damages to tourism. Hunting and trapping pressures are capable of suppressing a population to rates that are considered tolerable, but the appeal of nutria as a furbearer or for meat is limited by low demand. The success of eradication efforts depends on the density of nutria.

Nutria populations in Washington are likely underreported due to the low level of public education, and a lack of centralized phone number or place for citizens to report sightings. Nutria has become a concern for some localities, although others have made no effort to control nutria. Nutria on private property may not be recognized, or ever reported WDFW, or the National Aquatic Invasives Database.

Eradication has been proven possible, but requires attention at a large scale, sufficient funds, and communication between agencies. Small and isolated populations are easiest to address, but are likely to become re-infested. Success is most likely if control efforts are implemented in a timely manner, before populations become unmanageable. Infestation is difficult to predict, with some areas experiencing rapid increases in population, and some areas retaining a stable but consistent nutria presence. Costs are difficult to document, and the lack of research in the Pacific Northwest has kept the impacts of nutria infestation an unknown in this area.

Methods:

Current Range/Presence Maps

Nutria sightings and reports were collected across multiple agencies, such as the Washington State Invasive Species Council, U.S.D.A., U.S.G.S., W.D.F.W., and Portland State University Center for Lakes and Wetlands. These sightings come from various efforts to document the presence of nutria, including citizen reporting via hotline and email, historical documentation, wildlife biologist reports, and documentation of eradication efforts. Because there is no coordinated effort to document nutria populations, or set protocol for surveying population levels, nutria density was not accessed. Sightings collected from the USG Nonindigenous Aquatic Species database were available on a 12th level watershed level (HUDC12). Other reports, such as those collected by WDFW were limited to nearest populated area. These levels were plotted separately to show confirmed infected watersheds as polygons and reports from populated areas as points. The separate plotting has the additional benefit of displaying discrepancies between agencies on known nutria infestation. Locations of documented nutria farms are also displayed on the range map; these historical farms were discussed in Larrison (1943), and are likely the source of much of the current nutria infestation in Washington. Sightings prior to 1980 with no more recent reports of infestation were documented separately

Nutria Control:

Wildlife Services of the U.S.D.A provided records of nutria shot or trapped by their agency in each Washington State city/town. Information beyond this, such as addresses, was not available because this information would be protected by a federal agency. Locations were plotted in G.I.S, showing total number of nutria removed per area. This map provides the most information on density by giving a minimum number of nutria present before eradication in a given city or town. It also provides some information on nutria awareness, as control is requested by public and private entities.

Habitat Suitability:

Using overlays of GIS data from the Washington State Department of Ecology and habitat parameters from past researchers, maps were produced in ARC GIS highlighting suitable habitat for nutria in Washington. These parameters were based upon minimum temperature as discussed by Gosling et al. (1983), and access to bodies of water. A buffer was created around all major streams, lakes, and water bodies, using a shapefile from the USGS Geospatial Database. This buffer was 1,200 yards, the average maximum daily range of nutria from Nofio-Clements (2009). The clip tool in ArcGIS was applied to these buffer zones to select areas with an average daily minimum temperature of 39 degrees or more. This was based upon data from Gosling (1983, 1986), which found that nutria activity began to noticeably slow when temperatures fell under 4 degrees Celsius (39.2 degrees Fahrenheit). Average daily minimum was chosen as an ideal temperature parameter in order to show areas with prolonged exposure to cold temperatures. Watersheds at the 12th level the included any of these buffer zones were selected using a select by attributes tool in ArcGIS. Graduated colors feature areas with the least severe minimum temperatures.

This map provides an estimation of where nutria populations could be supported within Washington State. This can be compared to known infested areas, which will provide information on the accuracy of the habitat suitability model (are nutria in areas that the model does not deem suitable?), as well as make predictions about where nutria are likely to be reported in the future (are there suitable areas not yet reporting nutria?).

Analysis of Mitigation/Awareness

Nutria are reported to different agencies in Washington State and the PNW. Eradication options are available through USDA Wildlife Services, but are conducted by individual request and cost. The current status of nutria regulation, control, public education, and tracking are discussed and compared with other U.S. states to contrast policy and discuss efficiency of various programs. The effectiveness of eradication efforts, such as in Maryland, Louisiana, and the U.K. are discussed in order to provide information on the suitability of various policy for Washington.

It is possible to make conclusions based on available data about the level of awareness and level of attention for nutria infestation in Washington State. Differences in documentation demonstrate at what level agencies are coordinated and in communication about where nutria are present and what impacts they are having on Washington State.

Chapter 3:

Results and Discussion:

Range Map

Nutria populations are evident throughout Western Washington, with a few scattered populations reported in the Eastern half, such as in the Yakima Valley and Spokane River (Figure 2).

Infestations are common along the mouth of the Columbia River, and the eastern shore of the Puget Sound. Infested watersheds range in size from large lakes and rivers to smaller creeks and wetlands. Most reports come from populated areas, such as along the I-5 corridor and around larger towns and cities. This is not necessarily because nutria populations are denser in these regions, but is likely due to higher visibility and proximity to the public. Populations in rural areas may be under reported, as there is less human traffic to observe nutria.

The towns reporting nutria represents the most recent of data, from 2007 to the present, with the per watershed data based off data prior to 2007. The more recent reports show nutria in new areas. This could represent either an expansion in extent of nutria infestation, or an increase in public reporting.

Historical nutria farms explain much of potential current distribution of nutria. Nutria farms in King and Skagit County could have led to the introduction and subsequent spread of the animals in areas such as Lake Washington. Nutria farms in Oregon (not pictured on the map) could have been the source of nutria infestations along the Columbia River, and possibly as far North as Olympia.

Figure 2:

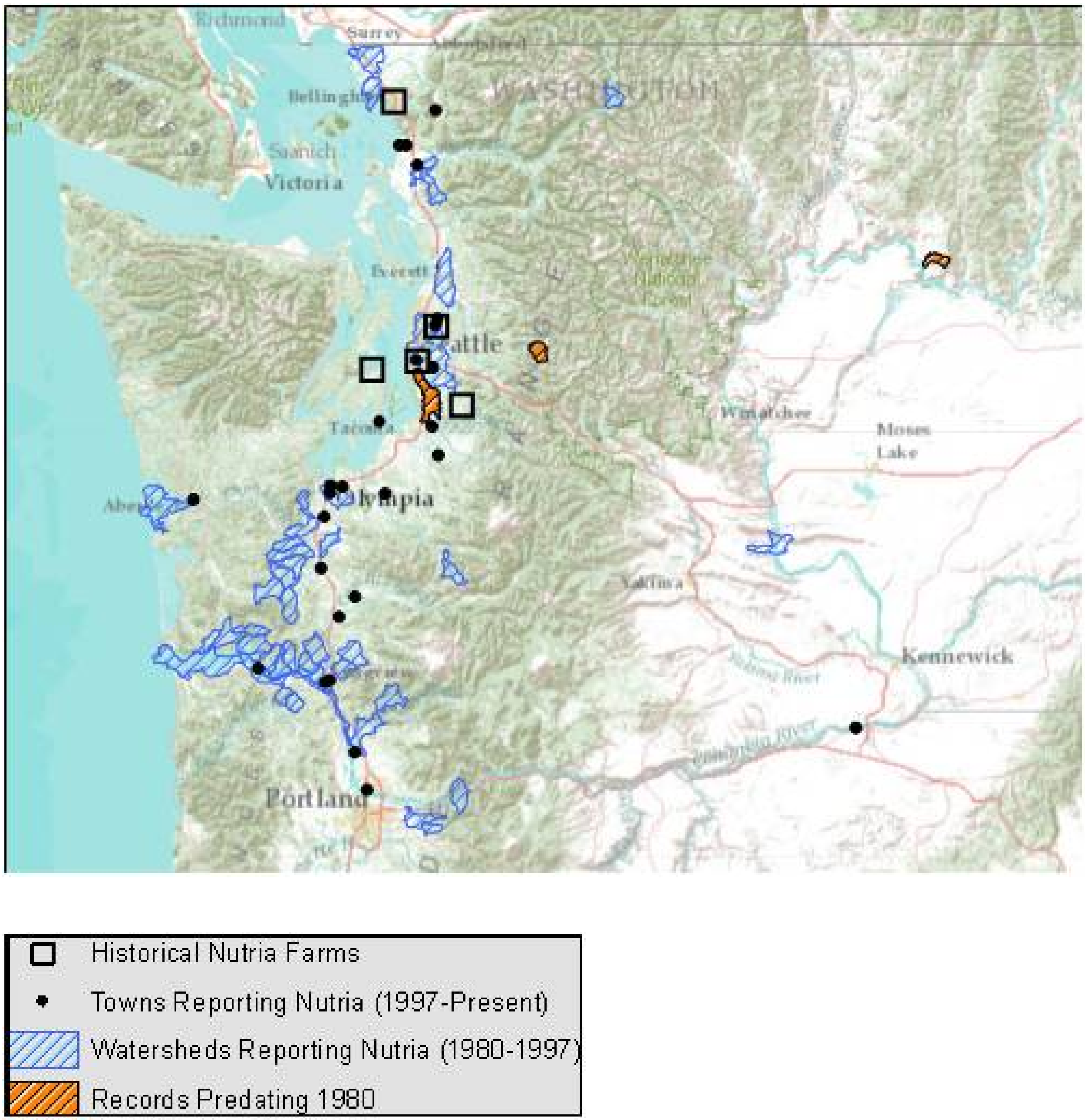

Figure 2: Nutria sightings within Washington are displayed, with polygons representing watersheds on the HUD12 level, and points reflected nearest town reporting nutria. Squares represent historical nutria farms. Sightings predating 1980 are displayed separately.

Nutria Removal Map:

Extermination data on nutria provides minimal data on population density. Over the past few years, over 300 nutria have been removed from Seattle, over 100 from Vancouver, and hundreds more from towns along the Columbia River (Figure 2).

Unlike the extermination data from the USDA, the sighting reports used to generate the range map often do not involve confirmation by a qualified person. Because this information comes from a variety of sources, mostly public sightings, animals are susceptible to misidentification as nutria, mainly muskrat and beaver. Without further investigation by a wildlife biologist or qualified person, sightings can only be considered probable. However, sightings are relatively consistent with where nutria have been removed. The range of muskrats in Washington is much greater and includes areas which have never generated nutria sightings, even if by mistake.

Because nutria are removed by request rather than requirement, these numbers may indicate that large populations exist in regions of Washington that are not attempting to control nutria. Nutria have been confirmed and spotted in many areas, but the densities at which they exist remain unknown. While there is evidence that nutria thrive in eutrophied systems, they are perfectly capable of inhabiting and degrading pristine habitat. There is evidence this has occurred in Washington, with nutria reported in creeks and wetlands in the foothills of the Cascades, in rural Lewis County, and near hiking trails along the Snohomish River.

The greatest economic threats, however, may come from irrigated agricultural areas, such as Skagit County. This is one area which has taken initiative on nutria control. The Skagit Nutria Advisory Committee provides an example of cooperation between stakeholders, such as the Nature Conservatory, Skagit Land Trust, and the Western Washington Agricultural Association. The website for the SNAC states that no nutria have been confirmed since 2007 and has deemed the trapping efforts as a likely success. Indeed, no nutria have been removed from Skagit County since 2007, however, data from the WDFW Invasive Species Council includes sightings from 2010 in Skagit County. These are in separate areas than where nutria have been removed in prior years.

Inconsistencies between agencies highlight a lack of communication or proper documentation regarding nutria infestation. While regional Fish and Wildlife offices claim no nutria are present in Eastern Washington (*pers comm.*, Howard L. Ferguson), reports to the Washington State Fish and Wildlife office include sightings in the Yakima area. It is possible as one source claimed, that the populations there may have been thinned or eliminated by a long period of freezing days in the late 1970s (Sheffels and Systma, 2007). Recent sightings of nutria in the Yakima area have been reported to WDFW, but it is possible these sightings were misidentified, such as from muskrats.

Figure 3:

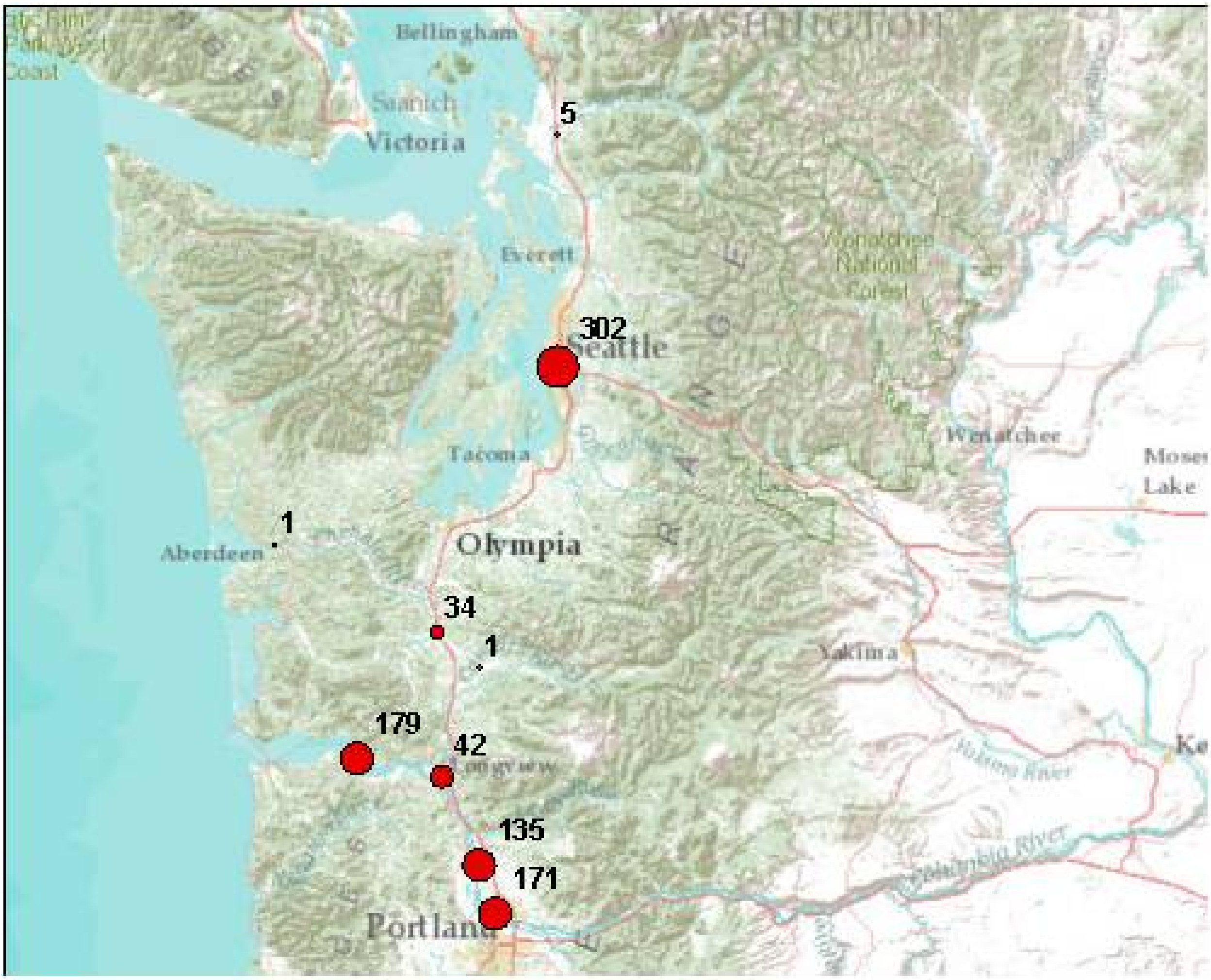

Figure 3: Number of nutria removed by the USDA wildlife services are displayed with graduated symbols by nearest populated area. Nutria were removed via trapping or shooting.

Suitable Habitat:

The suitable habitat for nutria based upon parameters for minimum temperature and distance from water explains most of the distribution of nutria sightings (Figure 2). Some inconstancies can be explained by levels of scale regarding bodies of water, with nutria being sighted in creeks and wetlands that are too small to be included in the National Hydrology Dataset. Additionally, there are a few areas in which nutria have been spotted that are outside the expected range based upon minimum temperature. This could mean a number of things: that nutria are capable of inhabiting these areas, that the nutria had extended its range in warmer months, or that the animal sighted was not a nutria.

The nutria spotted in the Five Lakes area of the Okanogan seems to be an outlier, isolated from other infestations and in a region colder than expected. This sighting dates back to the 1940s, and was documented in the primary literature as coming from a Native American trapper, who trapped the species instead of the targeted muskrat (Larrison, 1943). There are further reports coming from this region, including a sighting by the wife of the Forest Supervisor of the Colville Reservation, spotting a dog carrying a nutria carcass. The Five Lakes sighting provides an interesting anecdote. It is impossible to confirm that this sighting was nutria rather than muskrat, although a trapper familiar with the species may indeed have been qualified to distinguish between these animals. The nutria may have been an isolated outbreak, such as from a farming operation, which would have in theory not survived harsh winters. It is also possible that populations persist in the area and are not being reported to any agency.

The suitable habitat map is constrained by a few factors, mainly, that nutria may be capable of pushing into colder regions providing they can avoid sustained periods of freezing temperatures. These colder regions may also provide foraging opportunities in warmer months before the nutria retreat to core habitat for breeding or wintering. Another factor is that nutria are capable of finding habitat in drainage ditches, irrigation canals, and small ponds, such as on private property. This may open up the available habitat for nutria to areas at considerable distance from major streams, lakes or wetlands.

Although nutria are capable of living in a variety of habitats, including brackish water, this map does not distinguish between bodies of water based upon salinity. This distinction was not made in order to include coastal wetlands and areas such as the San Juan Islands. However, future suitability models may further refine nutria habitat to eliminate open salt water and other areas, which would not provide vegetated areas. Further refinement of this model could include using confirmed nutria sightings as epicenters from which nutria might spread into new areas, or putting focus on areas such as dairy farms which may provide eutrophied drainage ditches and other suitable nutria habitat.

A model created by Bertonlino and Ingegno (2009) analyzed current nutria habitat in Italy in order to project habitat suitability to other areas. This model found that nutria preferred certain types of farmland over others, and avoided woodland or urban areas. As the habitat in Italy is vastly different from Washington State, it is difficult to apply such conclusions. A similar model for the Pacific Northwest would further refine this suitability model, but would require a large dataset describing the habitat where nutria are known to exist. Such a dataset does not yet exist.

Figure 4:

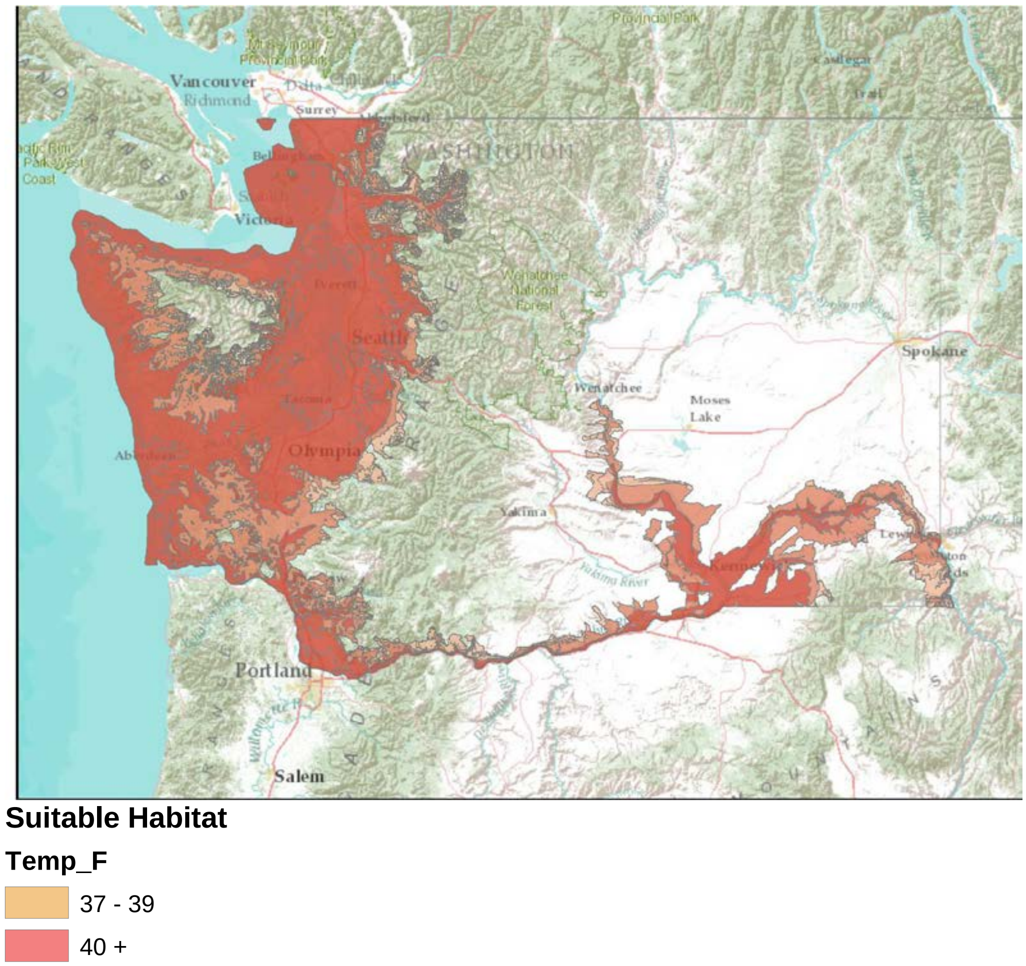

Figure 4: Suitable habitat for nutria infestation in Washington is displayed, based off of a distance from water parameter (<1200 yards), and an average minimum daily temperature parameter (>39 degrees F). Average minimum daily temperatures of over 50 degrees F are shown in darker red to display optimal habitat.

Conclusions and Recommendations:

Considering that nutria have been present in Washington State for over 60 years, there is relatively little information on their distribution, density, range, and ecological impacts. Washington offers a somewhat unique opportunity to research nutria, as its population dynamics and ecological interactions may differ from other regions with more pervasive nutria infestations, such as Louisiana. There are indications that nutria in this region may have significant costs, particularly in areas of wetland reestablishment. These could have direct impacts on state funding, such as in the success of wetland mitigation sites conducted by the Washington State Department of Transportation. Damage to embankments and water control structures could inflict costs on private land owners, or even cause damage on larger scales. This kind of damage to private residence has been seen in the Union Bay area of Seattle.

Nutria populations likely remain low in Washington State, as opposed to Louisiana and Maryland where populations reach the millions. Studies on the success of invasive species eradication find that the goal of eradication is most feasible when populations are detected an addressed at an early stage (Rahel et al., 2008). Furthermore, climate change has been associated with increased range and severity of invasive species (Rahel et al., 2008). The Washington State Department of Fish and Wildlife recognizes nutria as a problem and encourages control efforts, but does not directly manage or fund nutria control. This is due to limited department resources and a focus on high priority invasive species, such as the zebra and quagga mussel, (*pers comm.,* Alan Pleus). Unfortunately, much of the public is still unfamiliar with nutria and unlikely to report their presence or hire a wildlife manager.

The lack of a centralized reporting method, such as a single hotline for reporting nutria, and a shortage of communication between agencies regarding where nutria have been reported, has led to uncertainty in where nutria remain, where they have been eradicated, and where they have yet to spread. A single hotline for reporting sightings, with documented follow up, would create more accurate information on the range of nutria while reducing reports based upon muskrats or beaver. Although information on nutria density would aid control or eradication efforts, no method for estimating the population in Washington currently exists. While a statewide survey could be expensive and overly ambitious, some local sampling may be a reasonable method of understanding population densities in Washington. Only a few studies have been conducted on nutria herbivory preferences and impacts in the Pacific Northwest. Further enclosure studies in infested areas are needed in order to determine how nutria herbivory affects biomass and productivity in Washington wetlands. It is possible that the damage caused by nutria to these ecosystems is significant and quantifiable.

Due to low population levels, a bounty system in Washington is not likely feasible, or would require a high reward amount to compensate participants. Trapping is a more safe method than shooting, particularly since the majority of nutria sightings come from around populated areas. The eradication efforts conducted in Maryland and England required teams of wildlife control experts working over multiple years. Skagit County claims similar success by hiring a control expert over a few seasons, although this was in a few small, isolated areas. Controlling populations in areas such as Union Bay near Seattle could require more intense efforts. One of the most important factors for the outlook of nutria control in Washington is detection. This could be accomplished by providing nutria identification guides to individuals familiar with the wetland ecosystems in Washington, such as local biologists, birdwatchers, wildlife enthusiasts, and duck hunters.

The process of detecting nutria, particularly in sensitive areas, could be focused to areas with a higher likelihood of nutria presence. Habitat suitability models, such as the one produced for this paper can be compared to sighting reports. For example, nutria have been found in the Columbian River area, as well as Grays Harbor near Aberdeen. It is likely the Grays Harbor population originated from nutria crossing over Willapa Bay, which lies between these two areas. Therefore, Willapa Bay would be an area with a high likelihood of nutria infestation, and also has high ecological value as an estuary. Sensitive wildlife areas may be the most prudent regions to search for nutria infestation to minimize ecological consequences. The habitat suitability model suggest that's nutria have a wide array of available habitats. Further research could attempt to understand any possible constraints that have prevented nutria from expanding their range to suitable but previously uninhabited areas. Such restraints could include quality of vegetation, or barriers to migration. This analysis would require that these areas are confirmed as being free of nutria infestation.

While nutria eradication has shown a degree of success in some areas of Washington, i.e., Skagit County, it is uncertain if intense nutria removal would produce results if applied to areas in southern Washington, where nutria are likely more widespread and at higher numbers. Some efforts in Italy have proven futile, but these populations may have been much higher than any known population in Washington State. Further difficulty comes with preventing the reestablishment of nutria after population thinning or eradication, such as nutria along the Columbia River or in Oregon repopulating areas in Southern Washington. A combined effort with Oregon may be a necessity, and is plausible given the preexistence of nutria control efforts in Oregon.

There is a great deal of unknown regarding nutria in Washington, which reflects a greater lack of understanding in how invasive species behave in general. Researching nutria in Washington has a great benefit of adding to scientific knowledge of how invasive species spread and impact ecosystems, and furthermore how they can be managed, controlled, or eradicated. The current status of nutria in Washington, although not entirely clear, may be optimal for eradication efforts, before this species pushes into new and highly sensitive areas, or populations explode. At minimum, a public awareness campaign, centralized reporting hotline, and thorough documentation are necessary next steps for informed policy making.

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