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The Economic Impact of Zebra Mussels in Florida[1]

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Abstract

Dominant users of Lake Okeechobee water resources are agricultural producers and recreational anglers. These uses will be directly affected should the lake become contaminated with zebra mussels (Dreissena polymorpha). Although not yet in Florida, zebra mussel populations are thriving nearby in Arkansas, Alabama, Kentucky, Louisiana, Mississippi, Missouri, Tennessee, and West Virginia. This document reports results from a 20-year simulation model on the economic impacts of public investment in prevention and eradication. Without public management, the expected net economic impact from zebra mussels is a loss of $244.1 million over 20 years. Public investment in prevention and eradication will reduce expected damages and generate a net expected gain of $188.7 million.

Introduction

Zebra mussels (*Dreissena polymorpha*) are native to southeast Europe. They first arrived in the U.S. Great Lakes in the mid-1980s as free-swimming larvae in the ballast water of a transatlantic ship. Rapid colonization of zebra mussels across North America has been aided by a high level of recreational and commercial boat traffic and a lack of significant predators or competitors. Their success as invaders can also be attributed to a prolific rate of reproduction — females produce 40,000 to one million eggs per year (USCACE, 1992). In a mere 20 years, the zebra mussel has broadcast itself across thousands of miles of U.S. waterways (Figure 1).

The problem with zebra mussels is that they are a bio-fouling organism. They clog water intake pipes, form piles on underwater structures, accelerate corrosion, and sink navigational buoys. Zebra mussels also disrupt aquatic ecosystems by competing for food and habitat and by colonizing submerged plants, logs, and rocks. They can smother slow-moving animals by directly attaching to live shells. A serious concern is the impact of zebra mussels on dwindling populations of endangered native mussels.

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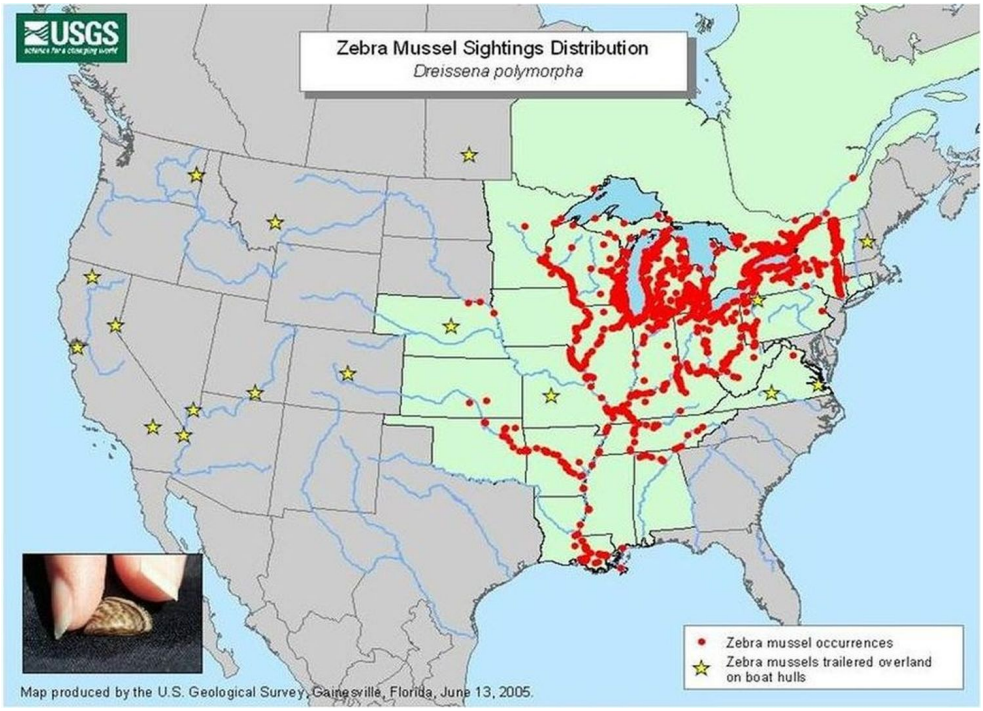

Figure 1. Zebra Mussels in the United States (USGS, 2007)

Will Zebra Mussels Invade Florida?

Zebra mussels were first sighted in Florida in 1998 during an inspection of a bait and tackle shop. Fortunately, the official in charge acted quickly by collecting and destroying the animals before they could spread. No other sightings have occurred since, but in the last decade, zebra mussels have made their way south, creeping ever closer to the Florida border. Populations are thriving in Arkansas, Alabama, Kentucky, Louisiana, Mississippi, Missouri, Tennessee, and West Virginia. According to Drake and Bossenbroek (2004), zebra mussels have a "high" likelihood of appearing in north Florida and a "moderate" likelihood of appearing in south Florida. Hayward and Estevez (1997) judged the rivers in north Florida to be "unsuitable" for zebra mussel propagation because the water is acidic and contains few minerals. In north central Florida and south Florida; however, the waters have low acidity and high mineral content and were judged "suitable" for sustaining zebra mussels.

Will Zebra Mussels Invade Lake Okeechobee?

Lake Okeechobee is a shallow, 448,000-acre lake in south Florida. It is the second-largest lake entirely contained within the United States. The lake is an important commercial shipping route, a valuable source of fresh water, and a major economic and recreational resource (Figure 2). It is the site of major fishing tournaments and supports a viable commercial fishing sector. Five counties surround the lake, all of which pump water for agricultural, industrial, and potable uses. Agricultural irrigation comprises 95% of all Lake Okeechobee water withdrawals.

The likely vectors for conveying zebra mussel to Lake Okeechobee are recreational boaters based on studies in Michigan which show how zebra mussels move between unconnected bodies of water (Johnson and Carlton, 1996; Buchan and Padilla, 1999; Bossenbroek et al., 2001). Twenty-five percent of the boats from zebra mussel-infested lakes in Michigan exited with live zebra mussels in tow (Ricciardi et al., 1994); live zebra mussels were found clinging to aquatic weeds on one of every 275 boats entering uninfested lakes in Michigan (Johnson and Carlton, 1996).

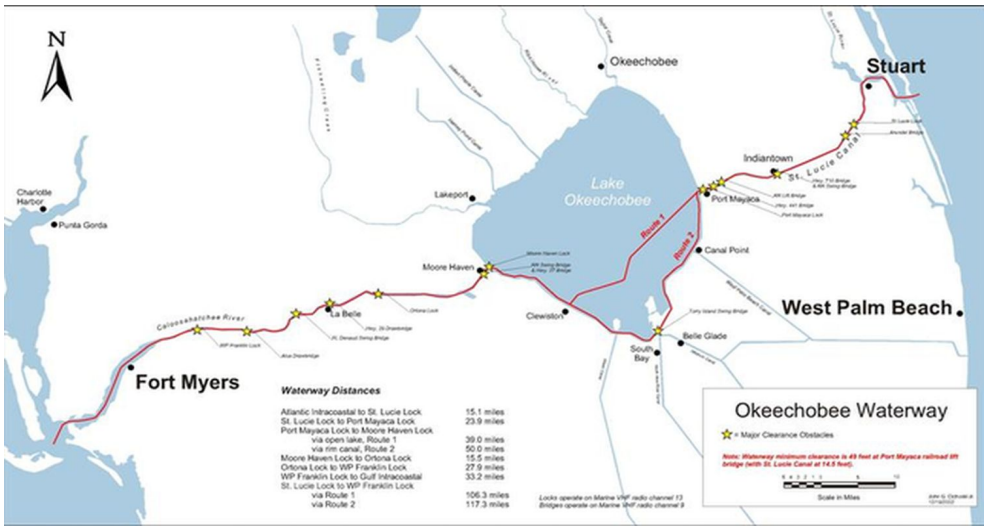

Figure 2. Lake Okeechobee waterway (http://www.saj.usace.army.mil/sfoo/images/maps/owwmap/owwmap.pdf)

What Can Be Done about Zebra Mussels?

Methods to mitigate zebra mussel damages include *prevention, early eradication, and late eradication*. Prevention involves measures to reduce the probability of zebra mussel introduction as well as monitoring to detect the presence of zebra mussels before they cause damage. Early eradication destroys the zebra mussels before they cause damage and late eradication destroys the zebra mussels after they cause damage.

What Is the Economic Impact of Zebra Mussels?

By doing nothing to prevent zebra mussels from entering Lake Okeechobee and/or nothing to arrest propagation after they arrive, ecosystem damages in terms of lost wetland functions will be $219.5 million over 20 years. Private water users will sustain $25.7 million in expected damages from increased maintenance expenditures and recreational anglers will gain $1.1 million in expected fishing benefits. The net present value of *doing nothing* is a loss of $244.1 million.

With a prevention program in place that is 75% effective, the present value of expected ecosystem damages in terms of lost wetland functions will be $62.4 million over 20 years. Private water users will endure $7.2 million in expected damages due to increased maintenance and mitigation expenditures. Recreational anglers will enjoy $0.3 million in expected fishing benefits. The net present value of managing the threat of zebra mussels with prevention is $71.8 million, a gain of $172.2 million over doing nothing. The benefit-cost ratio of prevention is 70:1.

With the intent to eradicate zebra mussels after they arrive and begin causing damages, the present value of expected ecosystem damage in terms of lost wetland functions is $23.8 million. Private water users will absorb expected damages of $1.2 million and recreational fishers will gain $0.12 million in expected fishing benefits. The net present value of late eradication is $210.8 million, a gain of $33.3 million as compared to doing nothing. The benefit-cost ratio of late eradication is 1.2:1.

With a program in place to prevent zebra mussels from arriving and the intent to eradicate them before they begin causing damage, the expected loss in ecosystem functions, damage to private consumptive use, and gain to recreational anglers is $0. The net present value from prevention and early eradication is $55.4, a gain of $188.7 million as compared to doing nothing. The benefit-cost ratio of early eradication is 4.4:1.

A summary of the economic impact of zebra mussel damages with public management appears in **Tables 1 and 2**.

Conclusion

The zebra mussel is expected to reach Florida in the near future and thus poses a threat to consumptive water uses and wetland ecosystem services. Several years ago, the U.S. Army Corps of Engineers (1992) responded to the threat by outlining an education, monitoring, and prevention program for Lake Okeechobee. The program, however, was never funded. While bringing live zebra mussels into Florida is illegal and punishable by fine, there is no other state or federal program to prevent zebra mussels from entering Florida or Lake Okeechobee. In lieu of prevention, eradication post-arrival is an option, albeit a costly one.

The likely arrival of zebra mussels and their potential to induce economic and environmental damage provides strong support for prevention as a management option that is both sensible and economically justified.

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Table 1. Economic impact of zebra mussels with public management: net present value (NPV).

	Public Management			
	Do Nothing	Prevention	Late Eradication	Prevention and Early Eradication
			$ million	
Lost wetland function	–$219.5	–$62.4	–$23.8	–$0.0
Private water use damages	–$25.7	–$7.2	–$1.2	–$0.0
Rrecreational angler gain	+$1.1	+$0.3	+$0.12	+$0.0
Management cost	+$0.0	–$2.5	–$185.9	–$55.4
Net present value (NPV)	–$244.1	–$71.8	–$210.8	–$55.4
Change in NPV	+$0.0	+$172.2	+$33.3	**+$188.7**

Time horizon is 20 years.
Annual discount rate is 2%.

Table 2. Economic impact of zebra mussels with public management: benefit-cost ratio (B:C).

	Public Management			
	Do Nothing	Prevention	Late Eradication	Prevention and Early Eradication
			$ million	
Management benefit	$0	$174.7	$219.2	$244.1
Management cost	$0	–$2.5	–$185.9	–$55.4
B:C (ratio)	0:0	**70:1**	1.2:1	4.4:1

Time horizon is 20 years.
Annual discount rate is 2%.