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DIRECT COSTS OF ZEBRA MUSSEL DAMAGE  
TO FACILITIES AND EQUIPMENT AT LAKE ERIE

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Introduction

Ohio's North Coast has developed into a major recreational economy with the aid of a large and growing recreational fishery. Based on the Ohio creel, private-boat angler hours increased from 4.6 million in 1975 to 12.4 million in 1988, while the walleye harvest increased from 86,000 in 1975, to 2.1 million in 1977 and 4.9 million in 1988 and the yellow perch harvest remained near its 1975 level of 7 million (Anonymous, 1989). Complementary resources have been improved or developed to attract non-angling visitors. Regional amenities such as the Bass Islands, Cedar Point, Sea World, and Lakeside draw many visitors each year. Many hotels, restaurants, and other non-fishing facilities have been constructed in addition to marinas to support the growing numbers of people who visit the North Coast. There has been substantial investment in residential dwellings such as cottages and condominiums as summer residences.

However, changes in the Lake's ecology threaten the future of the fishery, and potentially the future of the North Coast tourism industry. Of three alien species which have recently invaded the Great Lakes, two, the Zebra Mussel (*Dreissena polymorpha*) and the Spiny Water Flea (*Bythotrephes cederstroemi*), are present in Lake Erie (Dochoda 1990). The Zebra Mussel in particular has threatened the future utility of Lake Erie and the fish populations of the lake. The potential costs of the Zebra Mussel in terms of the change in economic value of Lake Erie and the economic impacts on the

North Coast economy resulting from potential changes in the fish population are unknown. There are no systematic estimates of direct or indirect costs of the Zebra Mussel to marine trades firms, municipal water systems, electric power plants, industrial water users, ports and harbors, or boaters.

There is a major need to develop estimates of both direct and indirect costs imposed by the Zebra Mussel with respect to increased repair costs of boats; damages and repair costs of water intakes for power plants, industrial water users and municipal water systems; increased costs to maintain ports and harbors for port authorities and for marinas; and changes in economic activity of lake related businesses due to the Zebra Mussel. The objective of this study is to estimate direct economic costs imposed by the Zebra Mussel on the various user groups.

#### Survey Procedures

Preliminary questionnaires were prepared for six groups of Lake Erie water users: ports and harbors, commercial shippers, establishments with water intakes (municipal water systems, power plants, and industrial users), marinas, charterboat firms, and private boat owners. A pretest was conducted with each group, followed by the revised survey instrument.

Chart 1. SIX GROUPS WERE EXAMINED

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Ports & Harbors  
Commercial Shippers  
Municipal Water Systems, Power Plants, Industrial Users  
Marinas  
Charterboat Firms  
Private Boat Owners

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Based on pretest results, we concluded that there were no damages to ports and harbors caused by the Zebra Mussel and eliminated them from further

study. Four of the remaining five groups were surveyed in May and June, with private boat owners surveyed in October and November. Mail survey procedures developed and tested by Dillman (1978) were used. These procedures involve three mailings at two-week intervals: 1) the questionnaire with cover letter and return envelop is mailed, 2) a reminder postcard is mailed, and 3) a second questionnaire with revised cover letter and return envelop is mailed.

### Results

Commercial Shippers: The 12 members of the Great Lakes Carriers Associations were surveyed, and all 12 responded. During 1989, 10 of the companies shipped in Lake Erie, 10 in Lake Michigan, 11 in Huron, 9 in Superior, and 4 in Ontario. The time spent in Lake Erie during the 1989 shipping season averaged 32 percent. Only \$1,500 in Zebra Mussel related expenses were reported during 1989 and early 1990. Regular maintenance and preventive actions appear adequate for Zebra Mussel control.

Water Intakes: Ohio EPA provided a list of firms with water intakes including municipal water systems, power plants and industrial users in northeast and northwest Ohio. Of 181 establishments, 89 responded that they do not draw water from Lake Erie. Another 52 respondents (35 water systems, 9 power plants, 8 industrial users) do draw water from Lake Erie. The total response rate was 78 percent.

Ten respondents stated they had damages and/or cleaning and removal costs due to Zebra Mussels. Five reported costs ranging from \$250 to \$50,000. Eight took preventive actions during 1989 and 16 during 1990 as of May. Extra maintenance and cleaning were the primary preventive actions. Total expenses reported for Zebra Mussel damages for 1989 and to May, 1990 was \$210,000, with \$53,000 reported by water intakes in the western basin. One firm reported

\$120,000 in research to assess Zebra Mussel damage and preventive actions. Eight respondents either have made or plan to make physical changes to their intake systems.

Chart 2. 181 FIRMS SURVEYED  
89 respondents have no water intake  
52 firms with water intakes responded

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35 municipal water systems  
9 power plants  
8 industrial users

Water intakes reporting damages: 10 in 1989 and 8 in 1990  
Water intakes reporting protective actions: 8 in 1989 and 16 in 1990  
Total damages and maintenance reported for 1989 and 1990 were \$210,000  
\$53,000 was by water intakes in the western basin

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The results reported by water intake firms are puzzling because they are inconsistent with other reports of Zebra Mussel damages to power plants and the costs of redesigning water intakes to cope with the Zebra Mussel (Stanley, 1990). One of two situations appears to exist. Either the damages to power plants and other firms with water intakes are much less than at first estimated, or the Ohio firms with high damages are not revealing the amount of those damages for whatever reason. In either event, it appears that the costs to water intakes of dealing with the Zebra Mussel are not excessive if sound inspection and maintenance procedures are in place.

Marine Trades: Ohio Sea Grant Advisory Service maintains a mailing list of marinas. Of 91 marinas surveyed, 42 responded, for a response rate of 46 percent. Seven reported damages during 1989 and two during 1990 as of May. Total reported damages were \$4,600. Six of 42 marina operators in 1989 and 9 in 1990 reported taking preventive actions which cost about \$12,000 in total.

Similar to ports and harbors, marinas appear to have small direct costs resulting from the Zebra Mussel. The indirect effects through increased prevention and maintenance sales to charterboat and private boat owners, potentially offset by reduced participation at Lake Erie from these groups, will likely have much larger economic impacts on marinas than these direct costs of damages and prevention.

Chart 3. 91 MARINAS SURVEYED  
42 marinas responded

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Marinas reporting damages: 7 in 1989 and 2 in 1990  
Total reported damages = \$4,600

Marinas reporting preventive actions: 6 in 1989 and 9 in 1990  
Total reported prevention costs = \$12,000

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Charterboat Firms: The Ohio Department of Natural Resources maintains a list of licensed charter captains. A total of 71 charter captains out of 96 responded to the charter questionnaire, for a response rate of 74 percent. No captains reported Zebra Mussels causing damage their boats. However, 38 took preventive actions during 1989 and 45 during 1990. Nearly all of these have used preventive paints, and about one-half reported extra maintenance. Mean expenditures for preventive paints were \$121 in 1989 and \$160 in 1990. Extra maintenance expenditures average \$63 in 1989 and \$74 in 1990. Based on our 1985 survey of charterboat firms (Lichtkoppler et al. 1987), Zebra Mussel prevention and maintenance expenditures add two to four percent to the mean operating expenses of the average charter firm.

Chart 4. 96 CHARTERBOAT FIRMS SURVEYED  
71 charterboat firms responded

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NO captains reported Zebra Mussel damage in 1989 or 1990

Captains reporting preventive actions: 38 in 1989 and 45 in 1990

Prevention expenses:	1989	1990
Paints or coatings:	\$121	\$160
Maintenance & Cleaning:	\$63	\$74

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Private Boat Owners: A list of 300 boat owners was obtained through the Ohio Division of Watercraft. A total of 262 private boaters were surveyed in October, 1990, of which 139 responded by December 3. There is little evidence that boaters reduced participation between 1989 and 1990. Fifty-one percent used their boat in Lake Erie during 1990 as compared to 52 percent in 1989. Of the 34 respondents who docked their boats in the water each year, the mean time docked was 5.6 months in 1990 compared to 5.4 in 1989. Of those who did not dock their boats, twenty-eight respondents reported their boats were in the water an average of 18 days during 1990 as compared to 24 reporting 24 days during 1989. However, this reduction could have been due to weather as well as the Zebra Mussel.

One respondent reported Zebra Mussel damage during 1990, and one during 1989. Fifteen respondents in 1989 and 25 in 1990 took actions to reduce Zebra Mussel damage to their boats. In 1990, 15 used protective paints, 9 used extra maintenance and cleaning, 6 used on trailer storage and 5 used dry rack storage. Mean expenditures for protective paints were \$149 in 1989 and \$111 in 1990. Protective paint expenditures ranged from \$20 to \$400. Mean maintenance and cleaning expenses were \$83 in 1989 and \$138 in 1990.

Chart 5. 262 PRIVATE BOAT OWNERS SURVEYED  
139 private boat owners responded

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Respondents using boat on Lake Erie: 71 in 1989, 70 in 1990

Respondents reporting damages: 1 in 1989 and 1 in 1990

Respondents taking preventive actions: 15 in 1989 and 25 in 1990

Prevention expenses:	1989	1990
Paints or coatings:	\$149	\$111
Maintenance & Cleaning:	\$83	\$138

Dry rack and on-trailer storage were also used to prevent infestation

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Implications

The Zebra Mussel does not appear to be a major problem for operations of the six groups represented here. Additional maintenance and prevention costs must be incurred, but these costs do not appear to be excessive. Sound maintenance and prevention procedures appear adequate to keep Zebra Mussel damages under control.

However, several charter captains and marina operators reported reduced business because of fear and reduced expenditures by tourists, which 13 respondents attributed to the Zebra Mussel. The scientific community has probably caused some of the fear; it appears to be time to take a positive and constructive approach to coping with Zebra Mussel damages. Tourists and other users of Lake Erie can continue to use and enjoy Lake Erie if they are aware of appropriate procedures to protect their in-the-water equipment. At the same time, preventing the direct damages from the Zebra Mussel does not address the longer term issues about the impact of the Zebra Mussel on the ecology of the Lake and the resulting impacts on recreational participation.



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