

Cope  
et al  
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SPATIAL ASSESSMENT OF ZEBRA MUSSEL DENSITY  
IN THE UPPER MISSISSIPPI RIVER: 1995

A Status Report

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## INTRODUCTION

The invasion of the exotic zebra mussel *Dreissena polymorpha* into the upper Mississippi River was documented on September 12, 1991, with the discovery of an adult zebra mussel in Pool 8 near La Crosse, Wisconsin. Zebra mussels have since been found throughout the upper Mississippi River, from Minneapolis, Minnesota, to Alton, Illinois. Certain tributaries to the Mississippi, including the Illinois and Ohio Rivers, are also heavily infested. The rapid dispersal of the zebra mussel in the Mississippi River and other inland waters can be attributed partly to its high reproductive rate and its planktonic larval stage, which is referred to as a veliger. The spread of zebra mussels has also been enhanced by human activities, such as commercial and recreational navigation.

Although the rapid distribution of the zebra mussel in the upper Mississippi River has been widely documented, there are few accompanying quantitative data on the spatial density distribution of zebra mussels in the river. Therefore, we assessed the density distribution of zebra mussels in the upper Mississippi River during the 1995 growing season, four years after their initial discovery in the river.

## MATERIALS AND METHODS

### *Study Area*

This study was done cooperatively with the U.S. Army Corps of Engineers (St. Paul and Rock Island Districts), who operate and maintain a series of lock and dam structures for navigation on the upper Mississippi River. Zebra mussel samplers were deployed at each lock and dam in the upper Mississippi River from Upper St. Anthony in Minneapolis, Minnesota, to Lock and Dam 16 in Muscatine, Iowa (Table 1). The samplers were emplaced from May 30 to October 19, 1995, a 143-day colonization period. This time period allowed zebra mussels to colonize the samplers throughout their main reproductive period in the upper Mississippi River (Cope et al. 1995) and ensured that all zebra mussels obtained were produced during the 1995 reproductive season--reflecting the zebra mussel infestation potential. Extreme flooding of the upper Mississippi River during the spring of 1995 precluded the deployment of zebra mussel samplers at lock and dam facilities downstream of Lock and Dam 16.

### *Sampler Deployment and Collection*

Commercially available concrete blocks (39.5 cm length X 19 cm width X 19.5 cm height), which are useful substrates for studying the population dynamics of zebra mussels (Mackie 1991; Cope et al. 1993), were used as substrate samplers. At each site, four concrete blocks were deployed on May 30 to June 1, 1995 in the upper

auxiliary lock chamber at a lock and dam. If the deployment of samplers in the upper auxiliary lock chamber was not feasible (Upper St. Anthony, Lower St. Anthony, Lock and Dam 3, Lock and Dam 14, and Lock and Dam 15), suitable areas of similar flow characteristics within the lock structure were used. The concrete blocks were secured by rope to the lock structure and held suspended in the water about 0.5 m above the bottom.

At the end of the deployment period, the four concrete blocks at each site were retrieved (October 13-19, 1995) and examined for the presence of zebra mussels. The concrete blocks and attached zebra mussels were immediately placed into polyethylene bags, transported on ice to the laboratory within 24-48 hours of collection, and placed in a domestic freezer (-20°C) until further descriptive analyses. At the time of processing, a concrete block was removed from the freezer and thawed slightly. All zebra mussels on the block were carefully removed with a stainless steel spatula. The zebra mussels were then placed into glass sorting pans and enumerated.

## RESULTS AND DISCUSSION

The density of zebra mussels continued to increase in the upper Mississippi River during 1995, relative to previous years. We found zebra mussels on samplers at every lock and dam except Upper and Lower St. Anthony, the two sites furthest upstream. Generally, densities of zebra mussels increased at sites 100 miles and further downstream of the Minneapolis-St. Paul, Metropolitan area. Mean densities of zebra

mussels ranged from  $0/\text{m}^2$  at Upper St. Anthony to  $11,432/\text{m}^2$  at Lock and Dam 13 (Table 1).

Based on a logarithmic scale of zebra mussel colonization (0-10, 10-100, 100-1,000, 1,000-10,000, and  $> 10,000/\text{m}^2$ ), our results show that zebra mussel density can be divided into four colonization categories in the upper Mississippi River. The area with the least colonization ( $0-10/\text{m}^2$ ) was the most upstream reach of the river located in the Minneapolis-St. Paul, Metropolitan area (Upper St. Anthony, Lower St. Anthony, Lock and Dam 1, Lock and Dam 2, and Lock and Dam 3, Figure 1), which had an average zebra mussel density of  $0.8/\text{m}^2$ . Two facilities, Lock and Dam 4 and Lock and Dam 16, were in the  $100-1,000/\text{m}^2$  colonization category with an average density of zebra mussels of  $235/\text{m}^2$ . The reasons for the relatively low colonization rate at Lock and Dam 16 is unexplained, particularly given the high densities of zebra mussels at sites immediately upstream (Table 1). All but one (Lock and Dam 13) of the other 11 lock and dam facilities sampled, had intermediate colonization ( $1,000-10,000/\text{m}^2$ ) with a mean zebra mussel density of  $3,621/\text{m}^2$ . Lock and Dam 13, located near Fulton, Illinois, had the greatest colonization ( $> 10,000/\text{m}^2$ ) by zebra mussels, with an average density of  $11,432/\text{m}^2$ .

The upper Mississippi River is clearly a suitable environment for zebra mussels given the observed densities. However, densities of zebra mussels remain relatively low in the most upstream (Minneapolis-St. Paul, Metropolitan area) reaches of the river.

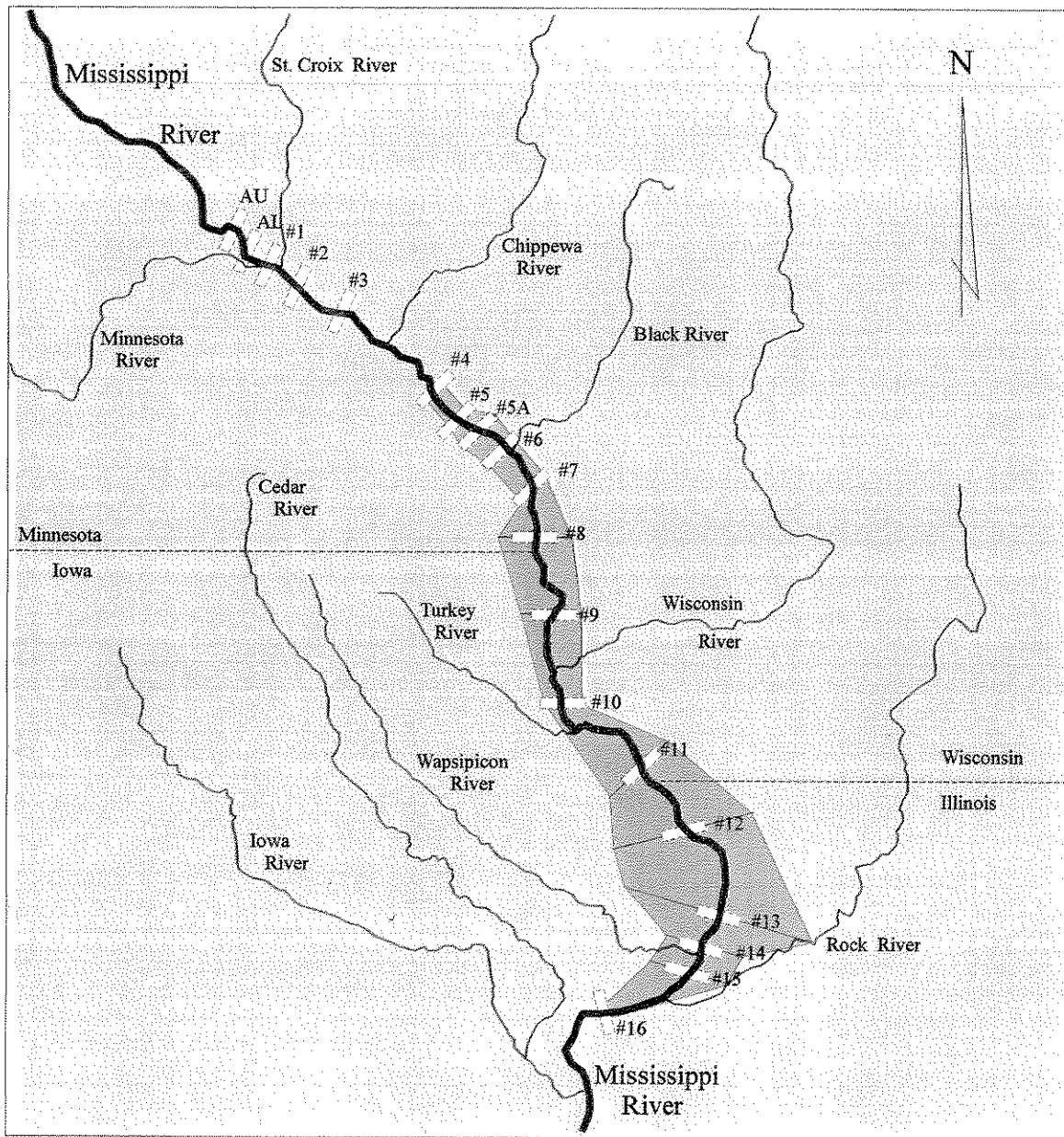
## REFERENCES

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- Mackie, G. L. 1991. Biology of the exotic zebra mussel, *Dreissena polymorpha*, in relation to native bivalves and its potential impact in Lake St. Clair. *Hydrobiologia* 219:251-268.

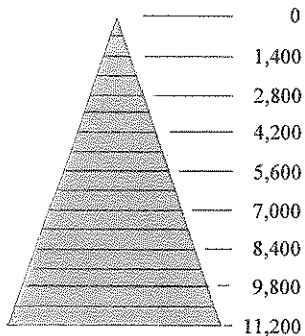
Table 1. Mean density (standard error in parentheses) of zebra mussels collected from U.S. Army Corps of Engineers Lock and Dam facilities in the upper Mississippi River during 1995.

Lock and Dam code	Location	River mile	No. of samples	Mean density of zebra mussels (no./m <sup>2</sup> )
AU	Upper St. Anthony Minneapolis, MN	853.7	3	0.0 (--)
AL	Lower St. Anthony, Minneapolis, MN	853.4	3	0.0 (--)
1	St. Paul, MN	847.6	2	1.0 (1.0)
2	Hastings, MN	815.2	4	1.0 (0.6)
3	Red Wing, MN	796.9	3	2.0 (0.0)
4	Alma, WI	752.8	4	211 (46)
5	Whitman, MN	738.1	4	1,417 (79)
5A	Winona, MN	728.5	4	2,831 (496)
6	Trempealeau, WI	714.3	4	1,999 (355)
7	Dresbach, MN	702.5	4	2,342 (343)
8	Genoa, WI	679.2	4	4,478 (498)
9	Lynxville, WI	647.9	4	3,649 (498)
10	Guttenberg, IA	615.1	4	1,919 (228)
11	Dubuque, IA	583.0	4	4,666 (575)
12	Bellevue, IA	556.7	3	8,304 (120)
13	Fulton, IL	522.5	4	11,432 (1,044)
14	Davenport, IA	493.3	4	4,232 (395)
15	Rock Island, IL	482.9	2	3,993 (1,509)
16	Muscatine, IA	457.2	3	258 (45)

# Spatial Assessment of Zebra Mussel Density in the Upper Mississippi River.



Zebra Mussels per Square Meter



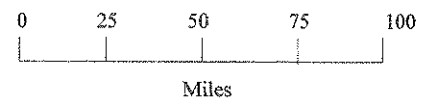
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Samples Collected: 6/1995 to 10/1995

Samples Processed: 1/1996 to 4/1996

Cartographer: Ron Hayden, RLS

Date: 4/25/1996



• 1 or 2 mussels  
per square meter.

AU Upper St. Anthony Falls  
AL Lower St. Anthony Falls  
#5A Lock and Dam Number