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Evaluation of the Mussel Fishery in Wheeler Reservoir, Tennessee River

Zachary H. Bowen^a

*U. S. National Biological Survey
National Ecology Research Center
108 Swingle Hall*

Auburn University, Alabama 36849 USA

Stephen P. Malvestuto

*Fishery Information Management Systems
Post Office Box 3607*

Auburn, Alabama 36831-3607 USA

William D. Davies

*Department of Fisheries and Allied Aquacultures
Auburn University, Alabama 36849 USA*

and

Johnie H. Crance

*U. S. National Biological Survey
National Ecology Research Center
108 Swingle Hall*

Auburn University, Alabama 36849 USA

Abstract-- We evaluated the freshwater mussel fishery on Wheeler Reservoir, a 27,155-hectare mainstream impoundment of the Tennessee River in Alabama. During July 1991 through June 1992, we used a roving creel survey to conduct 285 interviews over 57 weekdays and 12 weekend days. Total harvest during the 12-month survey period was estimated to be 570 metric tons, and included 15 mussel species. The most frequently harvested species were the washboard *Megaloniais nervosa*, Ohio pigtoe *Pleurobema cordatum*, and butterfly *Ellipsaria lineolata*. Harvest peaked in June at 290,414 mussels. Among collection techniques, total estimated effort was highest for divers (71,160 musseler-hours). The total estimated value of the 12-month mussel harvest (in terms of money paid to harvesters) from Wheeler Reservoir was US\$2,119,921.

Introduction

Freshwater mussels provide one of Alabama's most diverse and unique fishery resources. Diversity of freshwater mussel species in Alabama is greater than in any other state (Stansbery 1976). Approximately 80% of the 80-90 species of freshwater mussels found in Alabama are considered endangered, threatened, or of special concern (Stansbery 1976). Nevertheless, since about 1940, the Tennessee River has become the most important source of freshwater mussel shell in the United States (Scruggs 1960). The majority of harvested shell is shipped to Japan for use in the production of nuci for the cultured pearl industry. Approximately 10,000 metric tons of shell are exported annually, and nearly half of that is shipped by one Tennessee exporter (Fassler 1991). Mussel shell exports to Japan are valued at about US\$40 million annually. The annual value of Alabama mussel shell is estimated to be US\$22 million. The number of licensed Alabama-resident musselers has increased from 350 in 1989 to 2,356 in 1991. The number of licensed buyers also has increased.

The impoundment of rivers, pollution, and commercial harvesting are significant factors affecting mussel populations (Isom 1969). The largely undocumented impact of human exploitation on mussel populations and the potential

^aPlease mail correspondence to this address.

for appropriate management make the harvest of mussels important biologically. The harvest and sale of freshwater mussels have provided important income for several generations in the Tennessee Valley. Now we find that mussel populations have not been the subject of focused research and intensive management practices commensurate with that devoted to other state fishery resources. Harvest has been implicated as a cause of mussel decline by several authors (van der Schalie 1938, Isom 1969, Starrett 1971, Oesch 1984, Heath et al. 1988), but there have been few studies documenting harvest for populations in individual reservoirs. Scruggs (1960) estimated that the harvest of Ohio pigtoe *Pleurobema cordatum* from Wheeler Reservoir accounted for 23% of the available population over a 2-year period (1956-1957) where recruitment to the population during this period was less than 1%.

We evaluated the freshwater mussel fishery of Wheeler Reservoir. This is one of the first attempts to document the commercial harvest of freshwater mussels in Alabama. The methods developed for this study could serve as a prototype to assess the value and effects of commercial musseling in other systems.

Methods

Wheeler Reservoir impounds about 119 km of the Tennessee River in Alabama. The reservoir covers 27,155 surface hectares at full pool and has approximately 1,711 km of shoreline. Extensive overbank areas along the old river channel and the tailwaters below Guntersville Dam provide suitable habitat for many mussel species (Ahlstedt and McDonough in press).

A roving survey was used to collect harvest information; the survey was based on a stratified, nonuniform probability design similar to that described by Malvestuto et al. (1978). Wheeler Reservoir was divided into 13 sequential sections so that a complete circuit of each section could be completed by boat in approximately 1 h. A probability of being surveyed was assigned to each section based on the number of musselers counted during monthly overflights of the reservoir. During July 1991, overflights were conducted over a 2-d period encompassing 1 weekday and 1 weekend day. On each day, the entire length of the reservoir was flown three times, and counts were made at 0900, 1300 and 1600 hours. Due to budget constraints, subsequent monthly overflights were limited to 1 per day at 1100 hours. Boats used by mussel divers were identifiable by the presence of dive flags and air hoses extending into the water. Brail boats (brailers) were identified by the winch and brail apparatus. Waders could be identified by a silt trail left in their path from digging in the substrate and by the presence of a small boat or inner-tube.

Based on the lack of documentation regarding the distribution of musseling activity throughout the year, we decided that the sampling effort should be consistent for a 1-year survey period. Sampling was conducted on alternate weeks each month. A start day was randomly chosen for each week with each day having an equal probability of being selected. The start day and the next two consecutive days made up one sampling run.

For each of the six sample days in a given month, a lake section was randomly selected based on the nonuniform sample probabilities established during monthly overflights. A 6-h sampling day was established (0900-1500 hours) based on overflight data and information from shell buyers. Each sampling day began with a 1-h circuit of the section to determine the number of musselers using the area (0900-1000 hours). This also helped to determine the amount of time to allow for each interview during the next 4 h of sampling. The interview consisted of questions

designed to assess economic and biological factors. We assessed harvest by bringing the catch into the survey boat, separating it by species, and recording the number and weight of each species. During the 4-hour interview block (1000-1400 hours), survey data were collected on prepared interview forms and a complete circuit was made of the section. The sample day concluded with another 1-hour circuit of the section to obtain a second count of active musselers (1400-1500 hours). Morning and afternoon counts were averaged to determine daily effort. Data were analyzed using the Statistical Analysis Systems (SAS Institute 1988).

Results and Discussion

We conducted 285 interviews during July 1991 through June 1992, over 57 weekdays and 12 weekend-days. Seventeen overflights were conducted to determine nonuniform sampling probabilities for the various sections.

Commercial Musseler Characteristics and Activity Patterns

Divers using surface air compressors or boat-mounted bulk tanks comprised 84% of the commercial musselers; the remainder consisted of waders (9%) and brailers (7%). The mean years of experience for musselers was 3.9 (range: <1 month to 46 years). When respondents who had been collecting mussels longer than 3.9 years (N=85) were questioned about the average number of mussels collected per trip over their experience harvesting, 42% perceived no change, 56% perceived a decrease, and 2% reported an increase. Among individuals who had been collecting mussels for over 10 years (N=30), 67% reported a decrease in the average number of mussels collected per trip. When musselers (N=76) were asked their opinion on what they believed was responsible for the increase or decrease in number of mussels harvested per trip, 84% attributed the decrease to overharvest, and 9% attributed the decrease to natural causes or pollution. The remaining 7% had observed an increase in the number of mussels harvested per trip. Those reporting an increase in harvest per trip attributed the increase to their improved ability to locate and harvest mussels as the result of experience.

Estimated effort was highest for divers (71,160 hours), followed by waders (20,261 hours), and brailers (11,058 hours). Diver effort (Figure 1), as indicated by the relative standard errors, was more consistent over time than wader and brailer effort; however, all estimates were highly variable. Catch-per-effort was highest for divers (7.7 kg/h), followed by brailers (6.0 kg/h), and waders (2.0 kg/h). Brailers typically had the highest number of low quality shells in their catch because the method is non-selective.

Mussel Harvest Characteristics

Estimated total harvest of mussels from Wheeler Reservoir during the 1-year sampling period was 570 metric tons (wet-weight) and included 15 species (Figure 2). The most frequently harvested species - the washboard, Ohio pigtoe, and butterfly - contributed 45, 25, and 10% of the total number of mussels harvested. By comparison, Scruggs (1960) observed that during 1956-1957, Ohio pigtoes represented over 80% of the commercial catch on Wheeler Reservoir. Although we observed no federally-listed threatened or endangered species in Wheeler Reservoir during the survey, we did observe two species considered by Stansbery (1976) to be of special concern status (the spectaclecase Cumberlandia monodonta and sheepnose Plethobasus cypheyus) and one as endangered status (the mucket Actinonaias ligamentina).

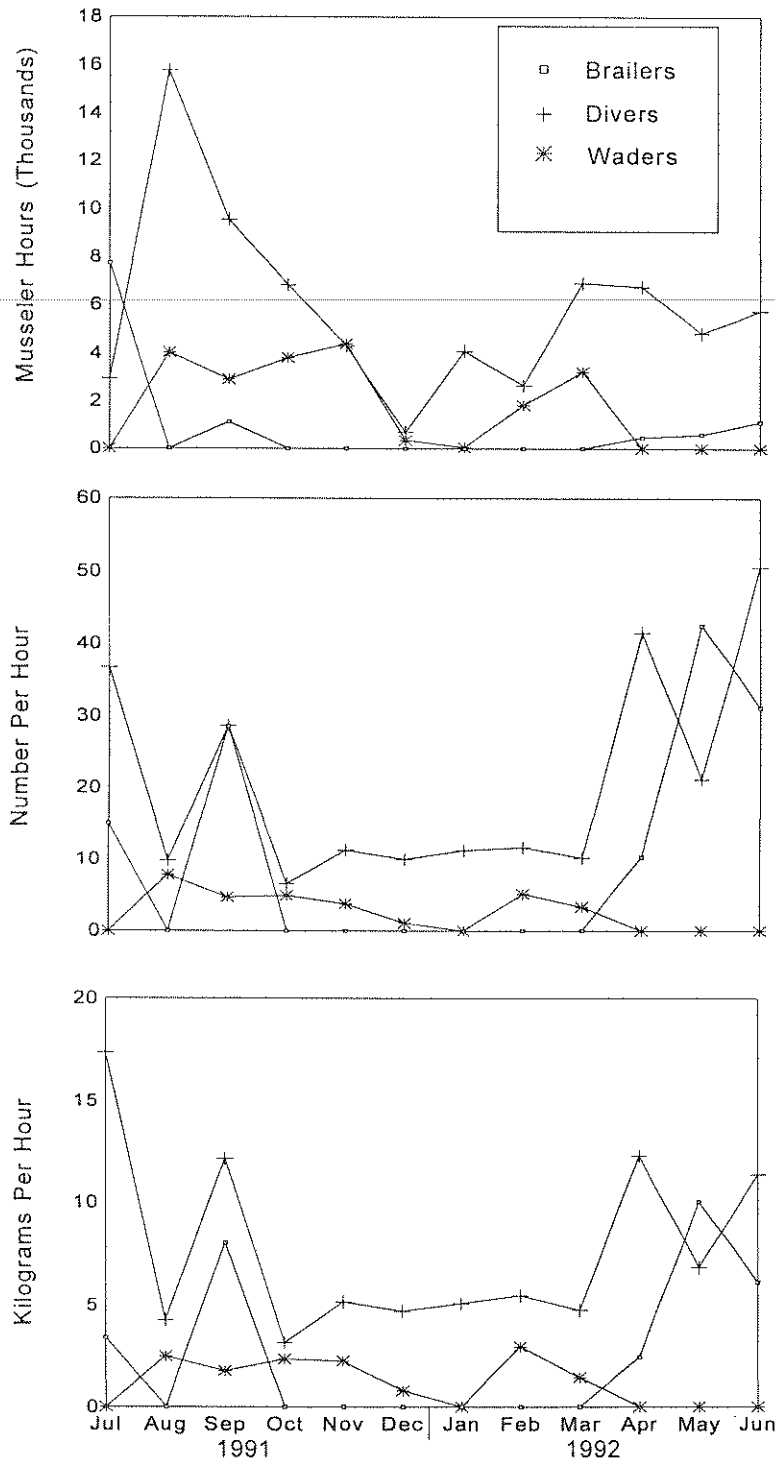


Figure 1. Monthly trends in fishing effort (musseler hours) and catch-per-effort based on survey data collected over all geographical sections of Wheeler Reservoir, July 1991 - June 1992.

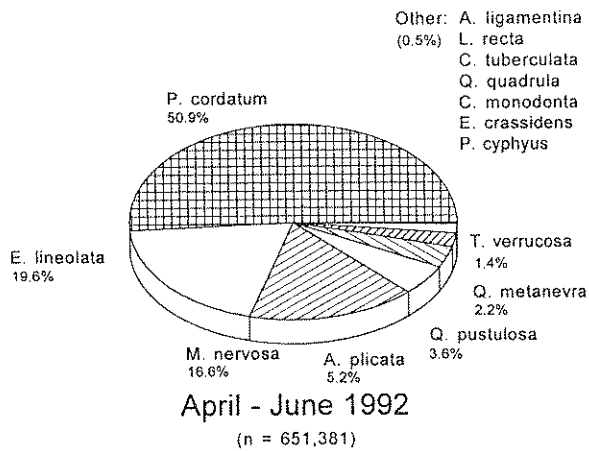
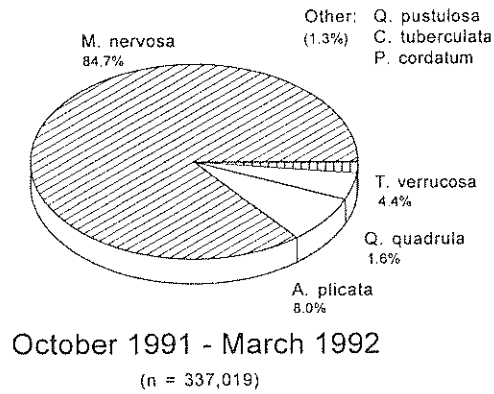
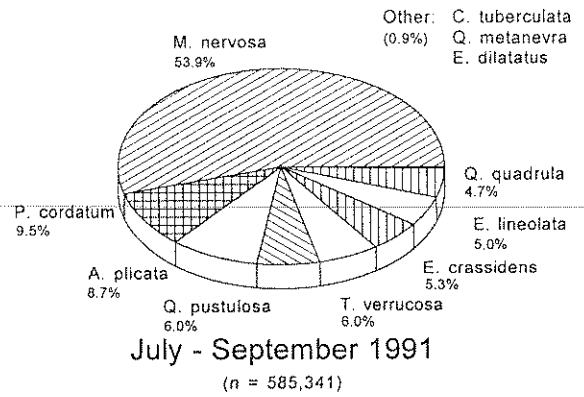


Figure 2. Species composition in the harvest measured in percent for Wheeler Reservoir, Alabama based on commercial musselers interviewed during July 1991 - June 1992 (n = the total number harvested).

Additionally, one zebra mussel Dreissena polymorpha, was collected by a brailer on Wheeler Reservoir below the mouth of Flint River.

The predominant species harvested was the washboard, averaging 76% of the harvest during July 1991 - March 1992. From April 1992 to the end of the study, the Ohio pigtoe and butterfly were the species most frequently harvested, averaging 70.5% of the total number of mussels harvested (Figure 2). Corresponding with this change in species composition, was an increase in fishing effort during April - June 1992 in the riverine stretch below Guntersville Dam (TRM 330 - 349).

The number of mussels harvested per month peaked in June 1992 at 290,414. However, total weight harvested per month peaked in September 1991 at 101,355 kg, which corresponded to the highest price (\$19.80/kg) paid for large number-one grade washboards during the survey period. We believe that musselers were harvesting greater numbers of smaller mussels during June 1992 - mainly Ohio pigtoes and butterflies. The number and weight harvested per hour (Figure 1) further illustrate the increased harvest of smaller mussels during April - June 1992. A sharp decline in harvest occurred following the peak in September (Figure 1). A combination of several factors - including reduced market prices, decreased availability of harvestable mussels, lower water temperatures and inclement weather - were likely responsible for the decrease in harvest. Heavy rains near the end of November 1992 resulted in increased turbidity and higher water levels. Poor harvesting conditions combined with a drastic decrease in prices for washboards caused the monthly harvest to bottom-out during December. Following a gradual increase in harvest during January - March 1992, there was a sharp increase coinciding with increased effort in the riverine area below Guntersville Dam. The only other data on harvest for Wheeler Reservoir (Scruggs 1960) showed that harvest of Ohio pigtoes peaked in April and declined throughout the summer during 1956-1957. Because Scruggs (1960) worked on only one section of Wheeler Reservoir (TRM 308 - 316) and the only method of harvest reported was brailing, direct comparison of catch rates is not possible. During July 1991 - March 1992, musselers harvested an average of 11 mussels per hour. The average harvest rate for April - June 1992 was 32 mussels per hour.

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