CURRENT STATUS OF ENDEMIC MUSSELS IN THE LOWER OCMULGEE AND ALTAMAHA RIVERS

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Abstract. The Altamaha River Basin is well known among malacologists for its high percentage (ca. 40%) of endemic mussels. While little historical data exists to quantify changes in mussel abundance, many biologists believe that some species are declining. We assembled a large database of mussel occurrence records from surveys conducted since 1967 and used this data to assess the current status of endemic mussels in the lower Ocmulgee and Altamaha rivers. The percentage of sites occupied and the ranges of the Altamaha arcmussel, Altamaha spinymussel, and inflated floater have declined over the past 10 years. The remaining endemic mussel species occupy a large percentage of sites and appear to be stable. We recommend the development of a long-term monitoring program for Altamaha basin endemic mussels. Success of this program will require both probability-based sampling to estimate mussel density and detection probabilities along with qualitative sampling to document occurrences at new sites.

INTRODUCTION

Freshwater mussels are important components of aquatic ecosystems as they provide food for many species and filter algae and bacteria from large volumes of water. They are also important indicators of ecosystem health due to their sensitivity to human disturbances. Unfortunately, many of these species are declining as a result of incompatible land use practices, impoundment of rivers, and the introduction of non-native species

Freshwater mussels reach their greatest diversity in the southeastern United States. Ninety-eight mussel species are historically known from Georgia. Neves et al. (1997) indicated that seventy-one species are considered imperiled, with 25 species listed as threatened or endangered under the United States Endangered Species Act (USESA). Seven of Georgia's eight endemic mussel species occur only in the Altamaha Basin. Three endemics, the Altamaha arcmussel (*Alasmidonta arcula*), Altamaha spinymussel (*Elliptio spinosa*), and inflated floater (*Pyganodon gibbosa*) are thought to be declining in abundance, while four other endemic mussels appear to stable. As a result, the current status of the endemic mussels of the lower Altamaha River system was reviewed. This review will provide information to policy makers and regulatory agencies for developing conservation strategies that may affect the persistence and habitat quality of imperiled mussels.

BACKGROUND

The Altamaha River Basin is the largest basin in Georgia (36,976 km^2). Major tributaries in the basin include: the Ocmulgee, Oconee, and Ohoopee rivers (Figure 1). Although historic collections date back to the 1830's, most major surveys have been conducted since the late 1960's (Sickel 1969; Keferl 1981; O'Brien 2002; Skelton et. al. 2002). Sixteen mussel species are reported from these surveys, including seven species that are considered endemic to the basin (Table 1). Several additional, but undescribed species have also been documented from the basin but are not considered in this review (Gene Keferl pers. comm.; Skelton 2004).

The Altamaha spinymussel was recognized as a candidate for listing under the USESA in 2002. The Altamaha arcmussel and the inflated floater have also been recognized as imperiled or vulnerable to imperilment in several conservation assessments (Neves et al. 1997; O'Brien 2002). Elevation of the Altamaha spinymussel to candidate status coupled with the presumed decline of other mussel species has prompted intensive mussel surveys throughout the Altamaha River and its tributaries since 2000. Results from these surveys were compiled in order to assess the current status of the endemic mussels of the Altamaha Basin.

METHODS

Mussel surveys conducted between 1967 and 2004 were incorporated into a GIS database (Figure 1). This database contained detailed locality information, habitat descriptions, and qualitative or quantitative data on the abundance of each mussel species collected at each survey

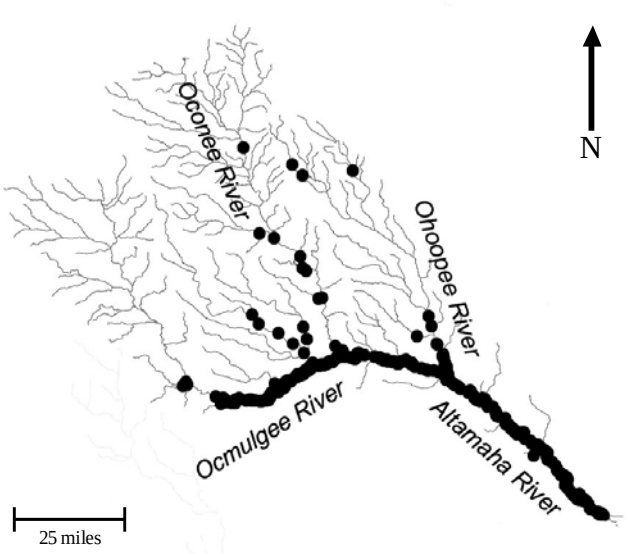
site. This database was used to determine the percentage of sites occupied by each endemic species. The data were also used to assess changes in the linear extent of occupied habitat. All analyses were based on live individuals.

We used all collection records to calculate the percentage of sites occupied before and after 2000. Since a large number of collections occurred from 1990 to 1995 and from 2000 to 2004, we also conducted a test for a temporal change in the number of sites occupied between these two time periods (Strayer and Smith 2003). For each site that was sampled during both time periods, we determined if the site was occupied during the first period but not the second (hereafter an "extinction") or occupied during the second period but not the first (hereafter a "colonization"). We then compared the frequency of extinctions and colonizations with a chi-square test evaluated at alpha = 0.10. The assumption of the test was that sampling efforts are comparable between the two time periods. This assumption was evaluated by comparing the number of collections made at each site during the two time periods. Although timed effort was not available for all sites, we also compared the mean number of person-minutes spent searching for mussels during each collection. Lastly, gross changes in the linear extent of occupied habitat were examined by comparing the upstream and downstream extent of occurrences before and after 2000. If the upstream and downstream extent of occurrences differed by 10 km or less, the linear range of the species was not considered to have changed between the two time periods. This analysis was limited to a subset of the study area where extensive survey points were located during both time periods.

RESULTS

The database included collection records from 241 sites sampled before 2000 and 120 sites sampled after 2000. Most sites occurred between the Ocmulgee River near Jacksonville, GA and the Altamaha River near Darien, GA before 2000; however, sites sampled after 2000 extended only to Doctortown, GA. Sites also occurred in the Oconee and Ohoopee rivers and smaller tributaries prior to 2000 (Figure 1). Thus, range assessments were restricted to the linear extent of occupied habitat between Jacksonville downriver to Doctortown. Data collected from recent surveys on the Ohoopee River (Stringfellow and Gagnon 2001) and the Little Ocmulgee River (Skelton 2004) are not included in any of the quantitative analyses.

Thirty-nine sites that were sampled during the first period were resampled after 2000. These sites extended



from the Ocmulgee River near Lumber City, GA downstream to Doctortown on the Altamaha River. Fifty surveys were completed before 2000 and 51 were completed after 2000 (several sites were surveyed repeatedly). In addition, the mean person-minutes spent searching sites was similar between the two sampling periods, indicating that assumption of comparable sampling effort between the periods was met.

Overall, the percentage of sites occupied by the Altamaha arcmussel was low during both periods, but fewer sites were occupied after 2000 (Table 1). Declines were evident when considering the 39 sites that were used sampled during the early 1990s and early 2000s (Table 2). In fact, this species was presumably extirpated from more sites than any other mussel species. Prior to 2000, Altamaha arcmussels occurred upstream to approximately Jacksonville. However, after 2000, no live individuals were collected within a 15 km reach downstream of Jacksonville. The downstream extent of occupied habitat did not change between the two time periods.

The percentage of sites occupied by the Altamaha spinymussel was also low, but did not decline when all records were compared (Table 1). However, analysis of the 39 sites indicated that the spinymussel was lost from significantly more sites than it colonized between the early 1990's and the early 2000's (Table 2). The linear extent of occupied habitat of this species did not appear to change between the two time periods.

The percentage of sites occupied declined more for inflated floaters than for any other mussel species (Table 1). In addition, this species was represented at few overall sites. The inflated floater was lost from more sites than it colonized after 2000, but this was not statistically significant. The downstream extent of its range did not differ after 2000, but the upstream extent of its range decreased by 37 km.

The Altamaha slabshell, Altamaha lance, Georgia elephantear, and Altamaha pocketbook occurred at a relatively high percentage of sites before (36-56 %) and after 2000 (66-87%; Table 1). All of these species showed increases (18-49%) in the percentage of sites occupied between the two time periods (Table 1). There was no evidence to suggest that the number of sites occupied by any of these species declined among the 39 sites sampled in the early 1990's and 2000's (Table 2). In addition, the upstream and downstream extent of occurrences did not change after 2000 for any of these species.

DISCUSSION AND RECOMMENDATIONS

The Altamaha arcmussel, Altamaha spinymussel, and inflated floater are rare throughout the lower Ocmulgee and Altamaha Rivers. Synthesis of recent data indicates that the percentage of sites occupied within these rivers has declined since the early 1990's. The linear extent of occupied habitat in the Ocmulgee River has declined for the Altamaha arcmussel and inflated floater. While range contractions were not documented for the Altamaha spinymussel, Stringfellow and Gagnon (2001) failed to collect this species from Ohoopee River sites that were occupied in the early 1990's. Although the inflated floater is rare within the mainstem habitats that were targeted in these surveys, the habitat preferences of this species suggest that backwaters and oxbows should be targeted in future surveys. The remaining endemic species appear to be stable throughout the lower Ocmulgee and Altamaha Rivers.

We recommend the development of a long-term monitoring program for Altamaha basin mussels. The database we developed for this assessement will provide a useful foundation for such a program and should be continually updated. The presence-absence analyses we carried out may also be useful in future assessments. Because this procedure examines both colonizations and extirpations, it allows for more informed assessments than those that only compare occupancy rates at historically known sites. Future assessments can be improved by using methods that allow estimation of detection probabilities and mussel densities. Finally, our database illustrates a need for additional or updated surveys in the Oconee River, the Ocmulgee River above Jacksonville, The Altamaha River below Doctortown, and many tributary streams.

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Table 1. Number and percent of sites occupied by Altamaha basin mussels before and after 2000. Site occupancy is based on surveys conducted at 241 sites sampled before 2000 and 120 sites sampled after 2000

		Site Occupancy			
		Pre-2000		Post-2000	
Scientific Name	**Common Name**	**Sites**	**%**	**Sites**	**%**
Alasmidonta arcula	Altamaha arcmussel	52	22	19	16
Elliptio dariensis	Georgia elephantear	87	36	80	67
Elliptio hopetonensis	Altamaha slabshell	136	56	90	75
Elliptio shepardiana	Altamaha lance	116	48	79	66
Elliptio spinosa	Altamaha spinymussel	24	10	14	12
Lampsilis dolabraeformis	Altamaha pocketbook	90	37	104	87
Pyganodon gibbosa	Inflated floater	40	17	7	6

Table 2. Presence-absence data for 39 sites that were sampled from 1990-1995 and from 2000-2004. The number of sites occupied during the first period (Present), the number of sites occupied during the first period but not the second (Extinctions), and the number of sites occupied during the second period but not the first (Colonizations) are reported each species. The frequency of colonizations and extinctions was compared using a using a X^2 test with alpha=0.10.

Common Name	Present	Colonizations	Extinctions	X^2	P-Value
Altamaha arcmussel	27	1	22	17.4	<0.001
Georgia elephantear	28	4	6	0.1	0.751
Altamaha slabshell	35	3	6	0.4	0.505
Altamaha lance	35	3	7	0.9	0.343
Altamaha spinymussel	13	3	11	3.5	0.061
Altamaha pocketbook	32	6	3	0.4	0.505
Inflated floater	12	3	9	2.1	0.150

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