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AN EVALUATION OF MUSSEL POPULATIONS IN
THE POWELL RIVER, TENNESSEE AND VIRGINIA

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This report summarizes the results of TVA's recent evaluation of mussels in the Powell River. The investigation was conducted to provide comprehensive, up-to-date information on the distribution and density of endangered species in the reach of the river from the U.S. Route 25E bridge (PRM 65.1) to below Cadet (PRM 176.2). In addition, the results establish, in part, baseline information from which the direction and effectiveness of a TVA program to conserve and enhance Cumberlandian mussels in the Tennessee Valley will be determined.

Methods

Five field crews, each led by a biologist competent in malacology, were assigned approximately 22-mile reaches of river to investigate. Each crew, including two certified scuba divers, floated the entire length of their reach in a small boat. As a crew encountered habitat which, in the opinion of the biologist, had the potential to contain mussel populations, the area was searched by diving, snorkeling, and wading. When mussels were observed, a thorough qualitative evaluation was conducted noting each species present. Sites which proved to have a dense, diverse mussel population were surveyed quantitatively. Presence of endangered species in unusual numbers also led to quantitative evaluation. In both cases the decision was based on the judgment of the biologist.

Quantitative estimates of abundance were made by randomly sampling each site using a square metal frame, which when placed in the substrate, enclosed an area of 0.25 square meter. All mussels within the quadrat were counted by species and returned to the river in approximately the same place from which they were removed. The number of quadrat samples taken at each site varied from 12 to 42 depending on the extent of the mussel bed.

Results

A total of 77 sites were investigated over the 111-mile reach of the Powell River (Table 1). Of these, 15 were evaluated quantitatively with a total of 441 quadrat samples taken. Seventy-four sites yielded one or more species and a maximum of 27 species were found at PRM 94.8, PRM 115.8, and PRM 117.9. In all, 38 species were collected of which 16 were Cumberlandian forms (Table 2). Five of these (Conradilla caelata, Dromus dromas, Fusconaia edgariana, Quadrula intermedia, and Quadrula sparsa) are listed as Endangered by the U.S. Fish and Wildlife Service.

While mussels occurred throughout the 111-mile reach, most of the species were found between PRM 65.1 and PRM 136.1. Above PRM 136.1, only 14 species were observed. Within the more diversely populated lower 70 miles, six sites between PRM 94.8 and PRM 136.1 were found to harbor more than 20 species each. In terms of density, 11 of the 15 quantified sites reported averages of five or more mussels per square meter (Table 3). The three sites with the lowest densities (less than three per square meter) were located at or above PRM 127.2, and the four sites with densities above 10 per square meter were between PRM 99.2 and PRM 126.4. The highest average value of 21.00 mussels per square meter (PRM 119.3) was based on the fewest quadrat samples (12) and may reflect the small number of samples more than the actual average mussel density in that area.

Fresh dead specimens of Conradilla caelata were found in muskrat middens at five sites between PRM 94.8 and PRM 120.7 (Table 4). One living specimen was located at McDowell Ford (PRM 106.5-106.9) but not in the quantitative samples taken there. Ages of six midden specimens (Table 5) show a fairly normal pattern for older individuals but do not include any indication of recent reproduction.

Living and fresh dead specimens of Dromus dromas were found at 17 sites between PRM 80.4 and PRM 126.4. Quantitative samples at two sites (PRM 106.9 and PRM 112.2) gave average densities of 0.10 and 0.20 per square meter, respectively, for this species. Age class data on 11 specimens (Table 5) suggest a normal growth curve but does not include any individuals less than eight years old.

Fusconaia edgariana specimens were observed at 14 sites between PRM 67.0 and PRM 136.1 (Table 4). Living specimens occurred at several of these sites and appeared in quantitative samples at four of them. Average density estimates for F. edgariana ranged from 0.10 specimens per square meter at both PRM 94.8 and 106.5 to 0.31 at PRM 84.8. Age class data on 12 specimens (Table 5) suggest a stable population structure, however, no specimens less than seven years old were included. No specimens of Fusconaia cuneolus were reported during this survey, however, members of this species may have been counted as one or more of the other species in the rather difficult Fusconaia - Pleurobema complex.

Quadrula intermedia was found both alive and as fresh shells in muskrat middens at 11 sites on the Powell River (Table 4). These sites were in the river reach from PRM 94.8 to PRM 126.4 and included two locations where Q. intermedia occurred in quantitative samples. At PRM 106.9 this species was estimated to occur in a density of 0.21 per square meter and at PRM 117.3 the average value was 0.10 per square meter. Age class information on eight specimens (Table 5) suggests an evenly-spread population, once again with no individuals less than eight years old.

Specimens of Quadrula sparsa were observed or collected at eight sites between PRM 89.2 and PRM 130.6 (Table 4). At the upstream site a specimen was taken in a quantitative sample, producing an average density

estimate of 0.11 per square meter. The four specimens which were aged (Table 5) ranged from 4 to 12 years old, a sample too small to extrapolate much information about the general population structures.

Although not a formal interest of this survey, the proposed endangered river snail Io fluvialis was occasionally noted at various stations. Sites at which I. fluvialis was reported ranged from PRM 65.1 to PRM 156.8. Quantitative samples at at least five sites included specimens of this species with density estimates ranging from 0.60 specimens per square meter at PRM 84.6 to 5.67 per square meter at PRM 119.3. The average for all 126 quadrat samples at the five sites was 3.30 specimens per square meter.

To summarize, mussels were found to occur throughout the 111-mile reach of the Powell River surveyed in June 1979. Twenty or more species were found at six sites between PRM 94.8 and PRM 136.1, and densities of more than 10 mussels per square meter were found at four sites between PRM 99.2 and 126.4. Specimens of five endangered species (Conradilla caelata, Dromus dromas, Fusconaia edgariana, Quadrula intermedia, and Quadrula sparsa) were found in the river, also generally within the reach PRM 94.8 to PRM 136.1. Density estimates for four of these endangered species were below 0.31 specimens per square meter where they were found in quantitative samples. Conradilla caelata was never found in a quantitative sample. Age class data from some specimens of the endangered species suggest typical population structures, however, young individuals were not observed for most of these species. The proposed endangered river snail Io fluvialis was found to occur throughout much of this reach of the Powell River and was estimated to exist in densities ranging from 0.60 to 5.67 per square meter at five sites between PRM 84.6 and 127.2.

A brief comparison of the Powell River data with data collected recently on the Duck River indicates that mussels occur in a much longer reach of the Powell River and they are much more numerous. In the Duck River mussels were largely restricted to a 35-mile reach (5 or more species) where the overall average density (in mussel beds) was 2.58 per square meter. In the Powell River most mussel species occurred in a 70-mile reach and the overall average density (in mussel beds) was 7.38 per square meter. With regard to the endangered species found in both rivers, Conradilla caelata was more abundant in the Duck River (Duck-24 sites, density estimates up to 1.38 per square meter; Powell-5 sites, zero density estimate) and Quadrula intermedia was more abundant in the Powell River (Duck-3 sites, zero density estimate; Powell-11 sites, density estimates of 0.10 and 0.21 per square meter).

Table 1. Location of all Powell River sample sites in river miles (PRM) and number of species at each site, June 1979.

Powell River Mile	Number of Species
65.1 (U.S. 25E bridge)	4
67.0	17
68.5	3
69.1	2
70.4	12
72.8	18
74.8	6
75.9	9
78.7	3
80.4	19
81.5	9
82.6	6
82.8	1
83.5	13
84.6	16
84.8 (Yellow Shoals Ford)	15
86.8	1
89.2	16
90.5	1
92.4	4
94.8	27
95.6	2
96.5	10
99.0	4
99.2	14
100.3	3
102.0	6
104.4	3
105.2	12
106.5	23
106.9 (Below McDowell Ford Bridge)	19
108.3	15
109.1	8
109.7	5
110.2	23
110.7	3
110.9	2
111.8	5
112.2	2
112.8	14
114.3	15
115.4	12
115.8 (Tenn.-Va. line)	27

Table 1. (Continued)

Powell River Mile	Number of Species
117.3	16
117.9	27
119.3	17
120.7	19
121.6	10
123.4	15
126.4	13
127.2	3
127.6	9
128.5	5
130.6 (Flanary Bridge)	9
131.2	9
136.1	21
138.3	7
138.9	0
140.0	6
142.4	1
143.5	2
144.6	5
145.1	3
145.6	3
147.9	3
149.2	3
149.9 (Below U.S. 58 Bridge)	2
153.4	2
154.3	2
154.7	1
156.8 (Above North Fork Powell River)	3
158.3	0
160.5	2
161.7	0
163.4	1
166.3	8
167.4 (Below Olinger)	4

Table 2. Muscle species occurring in the Powell River (PRM 65.1-PRM 176.2), June 1979.

- Actinonaias carinata (Barnes 1823)
- *Actinonaias pectorosa (Conrad 1834)
- Alasmindonta marginata Say 1818
- Amblema costata (Barnes 1823) = A. plicata (Say 1817)
- +*Conradilla caelata (Conrad 1834) = Lemiox rimosus (Rafinesque 1831)
- Cyclonaias tuberculata (Rafinesque 1820)
- +*Dromus dromas (Lea 1834)
- *Dysnomia brevidens (Lea 1831)
- *Dysnomia capsaeformis (Lea 1834)
- Dysnomia triquetra (Rafinesque 1820)
- Elliptio crassidens (Lamarck 1819)
- Elliptio dilatatus (Rafinesque 1820)
- *Fusconaia barnesiana (Lea 1838)
- +*Fusconaia edgariana (Lea 1840) = F. cor (Conrad 1834)
- Fusconaia subrotunda (Lea 1831)
- Lampsilis fasciola (Rafinesque 1820)
- Lampsilis ovata (Say, 1817)
- Lasmigona costata (Rafinesque 1820)
- Lastena lata (Rafinesque 1820) = Hemistena lata (Rafinesque 1820)
- Leptodea fragilis (Rafinesque 1820)
- Leptodea leptodon (Rafinesque 1820)
- *Lexingtonia dolabelloides (Lea 1840)
- Ligumia recta (Lamarck 1819)
- *Medionidus conradicus (Lea 1834)
- Plethobasus cyphus (Rafinesque 1820)
- *Pleurobema oviforme (Conrad 1834)
- Proptera alata (Say 1817) = Potamilus alatus (Say 1817)
- Ptychobranhus fasciolaris (Rafinesque 1820)
- *Ptychobranhus subtentum (Say 1825)
- Quadrula cylindrica (Say 1817)
- +*Quadrula intermedia (Conrad 1836)
- Quadrula pustulosa (Lea 1831)
- +*Quadrula sparsa (Lea 1841)
- Strophitus rugosus (Swainson 1822) = S. undulatus (Say 1817)
- Villosa iris (Lea 1829)
- *Villosa nebulosa (Conrad 1834)
- *Villosa taeniata (Conrad 1834)
- *Villosa vanuxemensis (Lea 1838)

*Cumberlandian Form (16)

+Endangered Species (5)

Table 3. Mean number of mussels per square meter in the Powell River, June 1979.

Powell River Mile	x
72.8	7.10
81.5	3.00
84.6	8.00
84.8	6.46
94.8	7.70
99.2	10.90
106.9	5.64
112.2	7.20
117.3	11.14
119.3	21.00
126.4	10.88
127.2	2.20
130.6	5.22
136.1	2.12
166.3	2.20

Table 4. Locations where Cumberlandian species were collected in the Powell River (PRM 65.1-PRM 176.2), June 1979.

Actinonaias pectorosa

Occurrence Location (PRM)	65.1	67.0	69.1	70.4	72.8	75.9	78.7
Number/m ²	NE*	NE	NE	NE	0.70	NE	NE
	80.4	81.5	83.5	84.6	84.8	89.2	94.8
	NE	0.80	NE	1.80	0.46	NE	0.10
	96.5	99.2	105.2	106.5	106.9	108.3	109.1
	NE	1.60	NE	NE	1.03	NE	NE
	110.2	111.8	112.2	112.8	114.3	115.4	115.8
	NE	NE	1.60	NE	NE	NE	NE
	117.3	117.9	119.3	120.7	121.6	123.4	126.4
	4.86	NE	10.00	NE	NE	NE	12.67
	128.5	130.6	131.2	136.1	138.3	144.6	147.9
	NE	2.22	NE	NS	NE	NE	NE
	154.3	156.8					
	NE	NE					

Conradilla caelata

Occurrence Location (PRM)	94.8	106.5	115.4	115.8	120.7
Number/m ²	NS**	NE	NE	NE	NE

Dromus dromas

Occurrence Location (PRM)	80.4	94.8	105.2	106.5	106.9	109.7	110.2
Number/m ²	NE	NS	NE	NE	0.10	NE	NE
	112.2	112.8	114.3	115.4	115.8	117.3	117.9
	0.20	NE	NE	NE	NE	NS	NE
	119.3	123.4	126.4				
	NS	NE	NS				

Table 4. (Continued)

Dysnomia brevidens

Occurrence Location (PRM) Number/m ²	70.4 NE	72.8 0.40	80.4 NE	84.6 0.20	89.2 NE	94.8 NS	102.0 NE
	106.5 NE	106.9 0.10	108.3 NE	110.2 NE	114.3 NE	115.4 NE	115.8 NE
	117.3 0.38	117.9 NE	119.3 NS	120.7 NE	126.4 NS	136.1 NS	

Dysnomia capsaeformis

Occurrence Location (PRM) Number/m ²	81.5 NS	84.6 NS	99.2 0.30	106.5 NE	110.2 NE	112.2 0.40	112.8 NE
	114.3 NE	115.4 NE	117.3 0.29	117.9 NE			

Fusconaia barnesiana

Occurrence Location (PRM) Number/m ²	94.8 0.10	106.5 NE	108.3 NE	109.1 NE	110.2 NE	112.2 0.80	112.8 NE
	114.3 NE	115.3 NE	115.7 NE	117.3 0.19	117.9 NE	119.3 NS	120.7 NE
	121.6 NE	123.4 NE	126.4 0.75				

Fusconaia edgariana

Occurrence Location (PRM) Number/m ²	67.0 NE	72.8 NS	80.4 NE	84.6 NS	84.8 0.31	94.8 0.10	106.5 NE
	106.9 0.10	110.2 NE	112.2 0.20	115.7 NE	117.9 NE	120.7 NE	136.1 NS

Lexingtonia dolabelloides

Occurrence Location (PRM) Number/m ²	117.9 NE
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Table 4. (Continued)

Medionidus conradicus

Occurrence Location (PRM) Number/m ²	67.0 NE	72.8 NS	75.9 NE	80.4 NE	81.5 0.40	83.5 NE	84.7 0.6
	84.8 NS	94.8 0.10	99.0 NE	99.2 1.00	100.3 NE	106.5 NE	106. 0.2
	110.2 NE	112.2 0.80	112.8 NE	114.3 NE	115.3 NE	115.7 NE	117. 1.4
	117.9 NE	119.3 1.00	120.7 NE	121.6 NE	123.4 NE	126.4 0.88	127. NS
	130.6 0.22	136.1 NE	156.8 NE				

Pleurobema oviforme

Occurrence Location (PRM) Number/m ²	65.1 NE	110.2 NE	114.3 NE	115.7 NE
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Ptychobranthus subtenum

Occurrence Location (PRM) Number/m ²	67.0 NE	70.4 NE	72.8 0.10	80.4 NE	83.5 NE	84.6 0.80	94 0.
	105.2 NE	109.7 NE	110.2 NE	112.2 0.60	115.7 NE	117.9 NE	119 0.
	123.4 NE	136.1 NS					

*

Quadrula intermedia

Occurrence Location (PRM) Number/m ²	94.8 NS	105.2 NE	106.5 NE	106.9 0.21	110.2 NE	115.7 NE	115 0
	117.9 NE	119.3 NS	123.4 NE	126.4 NS			

Table 4. (Continued)

Quadrula sparsa

Occurrence Location (PRM)	89.2	94.8	106.5	108.3	110.2	112.2	115.7
Number/m ²	NE	NS	NE	NE	NE	NS	NE
	130.6						
	0.11						

Villosa nebulosa

Occurrence Location (PRM)	117.9	120.7
Number/m ²	NE	NE

Villosa taeniata

Occurrence Location (PRM)	106.5	131.2
Number/m ²	NE	NE

Villosa vanuxemensis

Occurrence Location (PRM)	94.8	106.5	110.9	131.2	136.1	140.8	160.5
Number/m ²	NS	NE	NE	NE	NS	NE	NE
	163.4	166.3					
	NE	1.40					

* No quantitative evaluation.

** Not in quantitative sample.

Table 5. Number of specimens per age class of endangered species in the Powell River, June 1979.

Age Class	<i>Conradilla caelata</i>	<i>Dromus dromus</i>	<i>Fusconaia edgariana</i>	<i>Quadrula intermedia</i>	<i>Quadrula sparsa</i>
1					
2					
3					
4					1
5					
6					
7			2		
8		3	1	1	1
9		1	1	1	1
10	2	2	2		
11	1	1	2	1	1
12	1	2	2	1	1
13					
14					
15	1	1		1	
16					
17				1	
18			1		
19			1	2	
20	1	1			