

BRINKHURST
1995



U.S. FISH AND WILDLIFE SERVICE
ENDANGERED SPECIES FIELD OFFICE
ASHEVILLE, NC

Kentucky, North Carolina, South Carolina, Tennessee

FROM: Richard G. Biggins
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TELEPHONE - 704/665-1195
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DATE: February 24, 1995

TO: Steve Ahlstedt
Jim Layzer
Don Hubbs
Dick Neves

SUBJECT: Increased collection effort at Lillard's Mill for Lemiox

Ralph Brinkhurst asked me to review the enclosed report on the assessment of the Lemiox population at Lillard's Mill and consider if an expanded collection effort is justified to the increase the reliability of statistical analysis of this population. I said that I was concerned about the amount of habitat that would be disturbed with an increased effort. He will be sending me an analysis of this issue.

I would like your comments on the enclosed document, the value of his expected outcome, and his methods.

T. Hubbs
D. Neves



United States Department of the Interior

NATIONAL BIOLOGICAL SURVEY

Washington, D.C. 20240
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Post-It™ brand fax transmittal n

To	Dick Biggins
Co.	
Dept.	
Fax #	704/665-2782

MEMORANDUM

To: Dick Biggins, USFWS

From: Dick Neves, NBS

Date: March 6, 1995

Subject: ARC Report for Lillard's Mill

I have reviewed the report on birdwing sampling in 1994 at Lillard's Mill. My personal feeling is that expanded collection effort in 1995 would provide more animals for statistical analyses, but the non-random distribution pattern of birdwings would continue to provide wide variance and confidence intervals in the analyses. Because no statistical analyses are included in this report, claims for the need of more specimens may be premature. At minimum, placing Figures 3, 7 and 8 on the same axes (page) would allow comparison of size distributions among years (ditto for Figures 2, 4, 5 on age distributions). For the data presented, a simple comparison could be a t-test comparing mean lengths among years (1982, 1993, 1994). It seems to me that the 1993 and 1994 data also could be analyzed by chi-square contingency tables, comparing length frequency distributions observed in 1993 and 1994 with expected length frequency distributions in 1982 (TVA data set). Perhaps set 3 or 4 size or age groups to compress the data and reduce the inherent variation due to sampling.

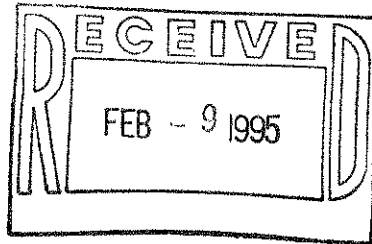
Until Ralph conducts some analyses of the data available, and demonstrates that the number of specimens is woefully insufficient to meet the objective of the study (monitoring a possible trend of decline), the need for expanded collection effort is unsupported.



AQUATIC RESOURCES CENTER

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3 February 1995

Dick Biggins
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USFWS	
ASHEVILLE, NC	
BCC	NAM
<u>PGB</u>	JAR
RRC	NC
JAF	LR
JLN	SE
VGH	

Dear Dick:

I enclose a copy of our latest quantitative study of the birdwing pearly mussel at Lillard's Mill.

From this you will see that we are concerned about the quality of the data because of the low numbers involved. As our work suggests that the population is apparently doing well, we would like to confirm that by inspecting twice the number of specimens (140 rather than 70). This activity would involve about double the manpower (two more people on site, or extending the work for an extra day). I believe that the Tennessee Duck River Agency may be prepared to contribute to the project, which is presently funded by TVA.

I understand that you wish to contact other interested parties about this, some of whom have not seen our report.

Please let me know the consensus so that I can approach Dan Ferry and Steve Parks about the funding.

Your sincerely,

R. O. Brinkhurst
Director Emeritus

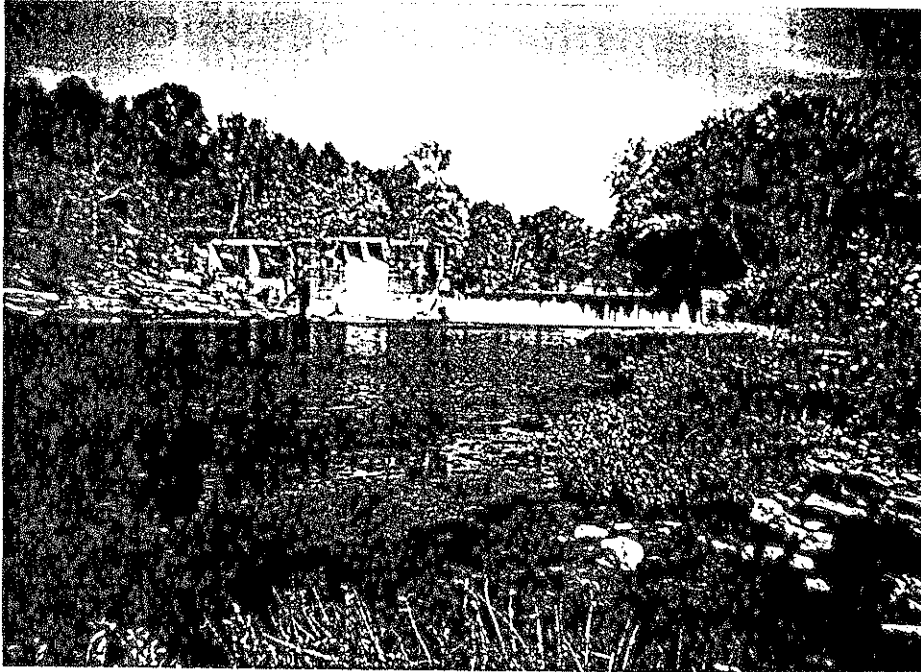
enc: TVA Lillard Mill Quantitative Study
cc: S. Parks
D. Ferry

■ ■ ■ ■ ■ DUCK RIVER MUSSEL SURVEY

LILLARD MILL SITE

QUANTITATIVE DOWNSTREAM ASSESSMENT

1994



Prepared For

Tennessee Valley Authority
Water Management
Knoxville, Tennessee

Prepared By

Aquatic Resources Center
Franklin, Tennessee

November 1994

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ACKNOWLEDGMENTS

J. T. Garner, T. W. Askegaard, L. S. Long, D. Hubbs and A. Jones conducted the field work for this project. R. O. Brinkhurst, R. D. Kathman, J. T. Garner, T. W. Askegaard and P. A. Marrero prepared the report.

INTRODUCTION

In 1993 Aquatic Resources Center (ARC) launched a multi-year program aimed at monitoring the *Lemiox rimosus* population in the Duck River in central Tennessee. *Lemiox rimosus* has been extirpated from much of its range, and is rare in most of the areas where it is still found. Those located near Lillard Mill in the Duck River represent the largest and healthiest known population. This monitoring program is an effort to detect any declines in the population, in order that preventative actions may be taken before the occurrence of irreparable damage.

METHODS

Methods used in the 1994 survey were similar to those used in 1993. Transects were placed at 25 m intervals, beginning 100 m downstream of Lillard Mill dam (Figure 1). Mussel collecting was performed by workers with mask and snorkel, or SCUBA, depending on the water depth. Mussel abundance was determined by excavating 0.25 m² quadrats randomly placed along the transect chain, and collecting all mussels encountered. The substrata were removed from each quadrat to a depth of several centimeters. All mussels collected were identified. All *Lemiox rimosus* were measured, aged and sexed. Shell measurements, including length, height and width were made using Vernier calipers. All mussels were then returned to the stream bed, in as near their original locality as possible.

For the 1994 survey, emphasis was placed on the areas determined to be "good mussel habitat" during the 1993 quantitative survey (ARC 1993). Nineteen additional randomly-placed quadrats were examined between the 25 m interval markers in the best habitat (between transects 4/5, 5/6, 6/7, 7/8 and 10/11) to obtain about the same total number of specimens of *L. rimosus* as last year (70 individuals in 1993 and 71 in 1994) (Figure 1).

35.75 m²

RESULTS

A total of 143 quadrats was examined during the 1994 survey (124 on transects, 19 between transects). Mean density of mussels was basically unchanged between 1993 (17.7 individuals/m²) and 1994 (17.4 specimens/m²). A total of 24 species was recorded, including two (*Actinonaias pectorosa* and *Villosa iris*) which were not found in 1993 (Table 1). One species (*Obovaria subrotunda*) was found in 1993 but not in 1994. The five most abundant species at the site remained the same as in 1993. However, *Lemiox rimosus*, with an increase from 1.5 individuals/m² to 2.0 individuals/m², shifted from fifth to third most abundant. No large changes were apparent in the densities of the remaining species. A comparison of 1993 and 1994 results can be found in Table 2.

No clear indication of age class peaks was evident in the 1994 data (Figure 2). Age seven was the largest class for females. No females in the 12 through 14 year age classes were found, although two in the 15+ year age class were encountered. There appeared to be a slight peak in males at 10 years, however, individuals were spread fairly evenly over all of the age groups, except 15+ years. The peak of males at 15+ is an artifact of combining all of the old specimens encountered.

Length (in 5 mm size classes) was used to compare sizes among specimens (Figure 3). Females were most abundant at the 35 mm size class, with no individuals encountered in the 45 or 50 mm size classes. Three individuals were encountered in the 55 and 60 mm size classes. Males were most abundant at the 50 mm size class.

COMPARISON WITH EARLIER DATA SETS

Data from the original transplant experiment in 1982 and survey data from 1988 were provided by J. Jenkinson (TVA). The 1982 data were based on 4,000 specimens. The size data from that study were summarized as frequency in a series of size classes (20 = 20-24.9 mm, etc.) that are adopted here for easy comparison. The age data were summarized by TVA for the first 498 specimens. A similar small data set was created by ARC by tabulating age and size for the first 146 specimens listed by TVA. The small 1982 data set for size classes was compared to the large 1982 set to obtain an impression of the difference to be expected between the original large data set and the much smaller 1993-1994 ARC data sets. The 1988 data contained size measurements for 69 individuals, comparable to the numbers of *L. rimosus* collected for ARC in each of the last two years (70 for 1993 and 71 for 1994).

Age Distribution

In 1982 the population appears to have been bimodal with respect to age, based on 146 specimens plotted from TVA data by ARC (Figure 4). Females were most abundant at 6-7 and 11-12 years, while males were most abundant at 8 and 12-14 years. The large (4000 specimen) 1982 data set was not summarized by age classes by TVA. However, a sample of 498 of the 4000 was aged by TVA, and showed bimodality with peaks at 8 and 12 years for females, and 6 and 12 years for males.

In 1993 (Figure 5), a bimodal peak existed only for females, with the largest number in the 7 to 9 and the 15+ year age classes. The number of males was fairly evenly distributed among ages, although no males were found for the 4, 5, 10 and 14 classes. In 1994, the maximum number of male specimens of *L. rimosus* occurred in the 15+ age class (Figure 2). Females were most abundant in the 7 year class, although no numbers exceeded 10 specimens per age class for either male or female except for the males in the 15+ class. Only two females older than 11 years were collected during 1994. However, the one year time lapse between 1993 and 1994 is evident in the shift of the four most abundant age classes. Discounting individuals 14 years or older, the majority of specimens occurred in the 6-9 year age class in 1993, and the 7-10 year class in 1994, reflecting the one year age increase (Figures 2 and 5). This suggests that this age group may be tracked on an annual basis.

The small number of individuals collected and aged during the 1993 and 1994 surveys limits the interpretation which can be done with confidence. It does, however, provide a reasonable estimate of the age, size and sex to be able to assess the survival, growth and reproduction of the Lillard Mill population. The numbers collected also ensure that the population is not being stressed from the sampling itself.

Size Distribution

Length was the size parameter used for comparison in both the TVA and ARC studies. In the 1982 total data set, comprising 4000 individuals, it is apparent that there is a considerable difference between the sexes (Figure 6). Females peak at the 30 mm size class and males peak at the 45 mm class. Females were dominant at 35 mm or less, while males became dominant at 40 mm or greater. In the smaller data set from 1982 (146 individuals, Figure 7) the peak in females shifts to the 35 mm size class, but the difference in sexes is still pronounced, with males dominating the categories ≥ 40 mm. Despite the difference in data set size, the percentage of males collected was similar for each size class.

In 1988 (Figure 8) the peak in female size class remained at 30 mm. Males demonstrated a peak at the 45 mm size class, but the limited number (two males) in the 40 mm size class makes the population appear bimodal. Females dominated the 30 mm class, while males were twice as abundant as females in the 35 mm class. No females were found in any size class > 35 mm.

In 1993 there was no bimodality to the size class distribution, although the difference between sexes was observed, with females and males peaking at the 35 and 50 mm size classes, respectively (Figure 9).

The results of the 1994 survey were similar to those of 1993 in regards to size distribution (Figure 3), with single peaks at the 35 mm and 50 mm size classes for females and males, respectively. The peak for males was much more pronounced in 1994 than 1993. A peak in size class would not necessarily change on an annual basis. A growth of 5 mm in length probably takes longer than one year to occur.

A general trend in the data from all years indicates that females tend to be more abundant in size classes up to approximately 40 mm, while males become dominant in the larger size classes,

generally >40 mm. This reflects the sexual dimorphism occurring in *L. rimosus*, in which males tend to be larger than females.

In our first report we documented the age and size frequencies as percentages without discriminating between the sexes. This was justified on the basis of an inspection of the age/size relationship between the sexes. The apparent slightly larger size of males was discounted because of the small sample size, which made it impossible to test for statistically significant differences. The data presented above suggest that these mussel population may contain both smaller and younger females in comparison to males, which accounts for the similar age/size relationship. Females may divert more of their assimilated food into reproduction and are unable to increase their intake to compensate for this, but they also would have to die at an earlier age than males to produce the population differences observed.

If the sex ratio in the samples was constant, then it would be reasonable to pool data from males and females to compare populations from one year to the next. If reproduction is only successful at 4-5 year intervals (or perhaps at irregular intervals), it should be possible to follow a dominant year class from year to year as it ages and individuals grow. Changes in the position of the peaks in age or size classes can be detected if peaks are distinctive enough and if sample size is large enough. Pooling the data from both sexes would maximize the value of the samples obtained each year, which are small because of the need to minimize disturbance at the Lillard Mill site. Unfortunately, sex ratios have not remained constant in the samples. The large 1982 data set shows a sex ratio of almost 1:1, but in the small 1982 set there were 80 males and 66 females. In 1988 there were 46 males and 23 females, and in 1993 there were 20 males and 49 females. In 1994 the ratio was similar to 1988, with 48 males and 23 females.

The age class data from 1993 (Figure 3) show a very clear maximum in the female population at age 7, and it was hoped that it would be possible to use this as a marker in 1994 and subsequent years. Unfortunately the 1994 data do not follow a pattern that can be related to earlier data, except for the one year shift in the four most abundant age class groups. This suggests that the sample size is too small and that the effort may need to be extended in order to follow population changes (one more survey has been funded at the present level of effort).

In summary, there is no evidence of the *L. rimosus* population declining at the Lillard Mill site. *L. rimosus* was found to be apparently more abundant in 1994 than 1993, although this could be

due to our relatively small sample size. Only one juvenile each was encountered during the 1993 and 1994 surveys, but this can be due to the difficulty in finding smaller individuals with the methods used for the survey (methods which allow more efficient collection of juveniles are more time consuming and disruptive to the habitat). However, almost all of the females were gravid, indicating that reproduction at the site still occurs.

CONCLUSIONS

The sample size of *Lemiox rimosus* at Lillard Mill is too small to allow any statistical determination of differences between data from year to year. The 1995 data will reveal if the four commonest age classes shift once again by one year, which would provide the signal we need to watch for the appearance of a new dominant year class. The spread of the dominant year class across a four year group of age classes may be due to errors in aging in the field or to a prolonged period of suitable "climate" for reproduction.

The population size appears to be smaller than when 4000 specimens were removed in 1982, but most year classes are represented, and many gravid females have been found each year.

The population appears to be generally healthy, but we note that a lack of recruitment to breeding size/age would not be noticed for four to five years as specimens younger than that are not collected by our methods.

REFERENCES CITED

Aquatic Resources Center (ARC). 1993. Duck River mussel survey, Lillard Mill Site, 1993. Report prepared for Tennessee Valley Authority, Knoxville.

TABLE 1

NUMBER OF EACH SPECIES OF MUSSEL AT EACH TRANSECT, LILLARD MILL, DUCK RIVER, TENNESSEE, SEPTEMBER 1994

SPECIES	TRANSECTS													TOTAL	DENSITY ²						
	4	5	6	7	8	8.5	9	9.5	10	10.5	11	12	13			R1-3	R4-6	R7	R8-12	R13-19	
<i>Achnonaias pectorosa</i>						2			1											3	0.1
<i>Amblema plicata</i>		1	4	1	2	3	5	9	6	5	2	3	2	3			3	2		48	1.3
<i>Cyclonais tuberculata</i>	6	11	3	1	12	17	12	14	14	17	2	4	6	6	5	4	2	17		153	4.3
<i>Elliptio dilatata</i>		1				5	3	3	6	7	1	1	4	1	3		3	4		44	1.2
<i>Epioblasma capsaeformis</i>			1	1			1					1		1			1			5	0.1
<i>Fusconaia barresiana</i>	1		1								1	1	1	1			1	1		7	0.2
<i>Lampsilis cardium</i>						1	2			1		2								8	0.2
<i>Lampsilis fasciola</i>	2	1	2	2	1	2		2	1	1		4	1	2	1		3		25	0.7	
<i>Lasmigona costata</i>	2			1	1	1	3	1	2	4	3	2	2		1			4		27	0.8
<i>Lemiox rimosus</i>		2	3	1	2	6	1	4	12	9	4				1	2	13	7		71	2.0
<i>Leptodea fragilis</i>		1				1											1			3	0.1
<i>Lexingtonia dolabellaoides</i>						2		2	4	2				1			2	5		18	0.5
<i>Megalonaias nervosa</i>	1													2						3	0.1

TABLE 1

NUMBER OF EACH SPECIES OF MUSSEL AT EACH TRANSECT, LILLARD MILL, DUCK RIVER, TENNESSEE, SEPTEMBER 1994

SPECIES	TRANSECTS																			TOTAL	DENSITY ²
	4	5	6	7	8	8.5	9	9.5	10	10.5	11	12	13	R1-3	R4-6	R7	R8-12	R13-19			
<i>Obliquaria reflexa</i>	3	2			3			2												10	0.3
<i>Potamilius alatus</i>	2	1			1	2		1									1			9	0.3
<i>Psychobranchius fasciolaris</i>				1		2					1	1							2	7	0.2
<i>Pygonodon grandis</i>									1											1	p
<i>Quadrula cylindrica</i>					1	1			1				1							4	0.1
<i>Quadrula pustulosa</i>		3	2	2	4	3	5	5	13	3	2	2	1			1			4	50	1.4
<i>Trigonia verrucosa</i>		2			1		1	1	2			1					1		2	11	0.3
<i>Truncilla truncata</i>	3	6	3	3	8	11	11	10	8	6	4	5		6	4	3	4		10	105	2.9
<i>Villosa iris</i>												1								1	p
<i>Villosa taeniata</i>		1										2							1	4	0.1
<i>Villosa vanuxemensis</i>		2								1		1				2				7	0.2
Total	20	34	19	14	40	59	42	57	70	56	20	28	22	20	15	12	36	60	624		

² followed by number is random quadrat sampling. See Figure 1 for locations.
 per m²
 = present, <0.05/m²

TABLE 2

AVERAGE DENSITIES FOR ALL SPECIES ENCOUNTERED DURING QUANTITATIVE SAMPLING

SPECIES	TOTAL NUMBER		DENSITY	
	1993	1994	1993	1994
<i>A. pectrosa</i>	0	3	0	0.1
<i>A. plicata</i>	41	48	1.9 (3)	1.3 (5)
<i>C. tuberculata</i>	88	153	4.1 (1)	4.3 (1)
<i>E. capsaeformis</i>	0	5	0	0.1
<i>E. dilatata</i>	27	44	1.3	1.2
<i>F. barnesiana</i>	3	7	0.1	0.2
<i>L. fasciola</i>	11	25	0.5	0.7
<i>L. cardium (L. ovata)</i>	1	8	p	0.2
<i>L. costata</i>	31	27	1.4	0.8
<i>L. dolabelloides</i>	16	18	0.7	0.5
<i>L. rimosus</i>	33	71	1.5 (5)	2.0 (3)
<i>L. fragilis</i>	2	3	0.1	0.1
<i>M. nervosa</i>	12	3	0.6	0.1
<i>O. subrotunda</i>	3	0	0.1	0
<i>O. reflexa</i>	6	10	0.3	0.3
<i>P. alatus</i>	6	9	0.3	0.3
<i>P. fasciolaris</i>	2	7	0.1	0.2
<i>P. grandis</i>	0	1	0	p
<i>Q. cylindrica</i>	1	4	p	0.1
<i>Q. pustulosa</i>	38	50	1.8 (4)	1.4 (4)
<i>T. verrucosa</i>	3	11	0.1	0.3
<i>T. truncata</i>	55	105	2.6 (2)	2.9 (2)
<i>V. iris</i>	0	1	0	p
<i>V. taeniata</i>	1	4	p	0.1
<i>V. vanuxemensis</i>	1	7	p	0.2
Mean density for all species			17.7	17.5

P = present, <math><0.05/m^2</math>

Numbers in parentheses indicate most abundant species.

APPENDIX A
FIELD DATA SHEETS

Project: 1994 Mussel Survey Location: Duck River mile 179 (Lillard Mill)

Date: 13 September 1994

Transect Number: 4

Transect Position: 100 m downstream of dam

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Lasmigona costata</i>	14						
zero	15						
zero	16						
<i>Cyclonais tuberculata</i>	23						
<i>Lampsilis fasciola</i>	25						
<i>Cyclonais tuberculata</i>	27						
<i>Truncilla truncata</i>	27						
<i>Obliquaria reflexa</i>	28						
<i>Obliquaria reflexa</i>	28						
<i>Obliquaria reflexa</i>	28						
<i>Cyclonais tuberculata</i>	30						
<i>Potamilus alatus</i>	30	4+					
<i>Cyclonais tuberculata</i>	32						
<i>Cyclonais tuberculata</i>	32						
<i>Truncilla truncata</i>	32						
<i>Fusconaita barnesiana</i>	32						

Location: Duck River mile 179 (Lillard Mill)

Project: 1994 Mussel Survey

Date: 13 September 1994

Transect Number: 4 (continued)

Transect Position: 100 m downstream of dam

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Megaloniais nervosa</i>	32						
<i>Lasmigona costata</i>	34						
<i>Cyclonais tuberculata</i>	34						
<i>Truncilla truncata</i>	34						
<i>Potamilius alatus</i>	34						
<i>Lampsilis fasciola</i>	34						

Project: 1994 Mussel Survey
 Date: 14 September 1994
 Location: Duck River mile 179 (Lillard Mill)

Transect Number: R 7
 Transect Position: See location of transect 4 & 5
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Cyclonais tuberculata</i>							
<i>Cyclonais tuberculata</i>							
<i>Cyclonais tuberculata</i>							
<i>Cyclonais tuberculata</i>							
<i>Lemiox rimosus</i>		15+	♂	54	39	22	
<i>Lemiox rimosus</i>		15+	♂	52	41	26	
<i>Villosa vanuxemensis</i>			♀				
<i>Villosa vanuxemensis</i>							
<i>Quadrula pustulosa</i>							
<i>Truncilla truncata</i>							
<i>Truncilla truncata</i>		3+					

Project: 1994 Mussel Survey
 Date: 14 September 1994
 Location: Duck River mile 179 (Lillard Mill)

Transect Number: 5
 Transect Position: 125 m downstream of dam
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Amblyma plicata</i>	31						
<i>Villosa taeniata</i>	31		♀				
<i>Elliptio dilatata</i>	34						
<i>Villosa vanuxemensis</i>	34						
<i>Lampsilis fasciola</i>	34						
<i>Truncilla truncata</i>	40						
<i>Truncilla truncata</i>	40						
<i>Lemiox rimosus</i>	40	9	♂	53	38	24	
<i>Cyclonais tuberculata</i>	46						
<i>Cyclonais tuberculata</i>	46						
<i>Cyclonais tuberculata</i>	46						
<i>Cyclonais tuberculata</i>	46						
<i>Cyclonais tuberculata</i>	46						
<i>Cyclonais tuberculata</i>	46						
<i>Cyclonais tuberculata</i>	46						
<i>Cyclonais tuberculata</i>	46						
<i>Quadrula pustulosa</i>	46						

Project: 1994 Mussel Survey Location: Duck River mile 179 (Lillard Mill)

Date: 14 September 1994

Transect Number: 5 (continued)

Transect Position: 125 m downstream of dam

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Truncilla truncata</i>	46						
<i>Truncilla truncata</i>	46						
<i>Tritogonia verrucosa</i>	46						
<i>Potamilus alatus</i>	46						
<i>Obliquaria reflexa</i>	57						
<i>Obliquaria reflexa</i>	57						
<i>Quadrula pustulosa</i>	57						
<i>Leptodea fragilis</i>	60						
<i>Truncilla truncata</i>	60						
<i>Cyclonais tuberculata</i>	60						
<i>Tritogonia verrucosa</i>	64						
<i>Lemiox rimosus</i>	64	10	♂	49	41	25	
<i>Truncilla truncata</i>	69						
<i>Cyclonais tuberculata</i>	77	1					
<i>Cyclonais tuberculata</i>	80	1					
<i>Cyclonais tuberculata</i>	80	2					
<i>Villosa vanuxemensis</i>	80						

Project: 1994 Mussel Survey

Location: Duck River mile 179 (Lillard Mill)

Date: 13 September 1994

Transect Number: R 5

Transect Position: See location of transect 5 & 6

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Truncella truncata</i>							
<i>Truncella truncata</i>							
<i>Truncella truncata</i>							
<i>Truncella truncata</i>							
<i>Cyclonais tuberculata</i>							
<i>Cyclonais tuberculata</i>							
<i>Elliptio dilatata</i>							
<i>Lemiox rimosus</i>		15+	♂	54	44	25	

Project: 1994 Mussel Survey
 Date: 13 September 1994
 Transect Number: R 6
 Transect Position: See location of transect 5 & 6
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Lasnigona costata</i>							
<i>Cyclonais tuberculata</i>							

Project: 1994 Mussel Survey
 Date: 13 September 1994
 Transect Number: 6
 Transect Position: 150 m downstream of dam
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Lampsilis fasciola</i>	38						
<i>Fusconaia barnesiana</i>	38						
<i>Amblema plicata</i>	38						
<i>Leniox rimosus</i>	38	15+	♂	52	41	26	
<i>Leniox rimosus</i>	38	12+	♂	52	40	23	
<i>Lampsilis fasciola</i>	39						
<i>Leniox rimosus</i>	39	10+	♀	39	27	18	Gravid
<i>Cyclonais tuberculata</i>	53						
<i>Cyclonais tuberculata</i>	53						
<i>Amblema plicata</i>	53						
<i>Amblema plicata</i>	53						
<i>Quadrula pustulosa</i>	57						
<i>Truncilla truncata</i>	57						
<i>Quadrula pustulosa</i>	58						
<i>Truncilla truncata</i>	58						
<i>Amblema plicata</i>	60						
<i>Truncilla truncata</i>	60						
<i>Cyclonais tuberculata</i>	61						

Project: 1994 Mussel Survey
 Date: 13 September 1994
 Transect Number: 6 (continued)
 Transect Position: 150 m downstream of dam
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Epioblasma capsaeformis</i>	61						
zero	65						

Project: 1994 Müssel Survey

Date: 13 September 1994

Transect Number: R 1

Transect Position: See location of transect 6 & 7

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Truncilla truncata</i>							
<i>Truncilla truncata</i>							
<i>Lampsilis fasciola</i>							
<i>Amblema plicata</i>							
<i>Cyclonais tuberculata</i>							

Project: 1994 Mussel Survey
 Date: 13 September 1994
 Transect Number: R 2
 Transect Position: See location of transect 6 & 7
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Truncilla truncata</i>							
<i>Truncilla truncata</i>							
<i>Truncilla truncata</i>							
<i>Elliptio dilatata</i>							
<i>Amblyma plicata</i>							
<i>Cyclonais tuberculata</i>							

Project: 1994 Mussel Survey

Date: 13 September 1994

Transect Number: R 3

Transect Position: See location of transect 6 & 7

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Cyclonais tuberculata</i>							
<i>Cyclonais tuberculata</i>							
<i>Cyclonais tuberculata</i>							
<i>Cyclonais tuberculata</i>							
<i>Lampsilis fasciola</i>							
<i>Truncilla truncata</i>							
<i>Lemiox rimosus</i>		13+	♂	49	40	23	
<i>Lexingtonia dolabelloides</i>							
<i>Fusconaia barnesiana</i>							

Project: 1994 Mussel Survey
 Date: 13 September 1994
 Transect Number: 7
 Transect Position: 175 m downstream of dam
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Cyclonais tuberculata</i>	38						
<i>Lampsilis fasciola</i>	41						
<i>Lampsilis fasciola</i>	45						
<i>Epioblasma capsaeformis</i>	45	5+					
<i>Quadrula pustulosa</i>	45	3+					
<i>Truncilla truncata</i>	45						
<i>Truncilla truncata</i>	45						
<i>Ambelma plicata</i>	48						
<i>Lampsilis cardium</i>	95						
<i>Lasniogona costata</i>	95						
<i>Quadrula pustulosa</i>	95						
<i>Truncilla truncata</i>	95						
<i>Psychobranchus fasciolaris</i>	95						
<i>Lemiox rimosus</i>	95	6+	♂	40	26	15	

Project: 1994 Mussel Survey
 Date: 14 September 1994
 Transect Number: R 8
 Transect Position: See location of transect 7 & 8
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Elliptio dilatata</i>							
<i>Elliptio dilatata</i>							
<i>Trigonia verrucosa</i>							
<i>Potamius alatus</i>							
<i>Truncilla truncata</i>		3+					
<i>Truncilla truncata</i>							
<i>Amblema plicata</i>							
<i>Amblema plicata</i>							
<i>Lemiox rimosus</i>		15+	♂	56	42	25	
<i>Lemiox rimosus</i>		8+	♂	37	28	16	
<i>Lemiox rimosus</i>		15+	♂	49	33	21	
<i>Lemiox rimosus</i>		11+	♂	50	37	23	

Project: 1994 Mussel Survey
Date: 14 September 1994
Transect Number: R 9
Transect Position: See location of transect 7 & 8
Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Lexingtonia dolabelloides</i>							
<i>Leptodea fragilis</i>							
<i>Lampsilis fasciola</i>							

Project: 1994 Mussel Survey
 Date: 14 September 1994
 Transect Number: R 10
 Transect Position: See location of transect 7 & 8
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Truncilla truncata</i>		4+					
<i>Lampsilis fasciola</i>			♀				
<i>Villosa vanuxemensis</i>			♀				
<i>Elliptio dilatata</i>		3+					
<i>Fusconaia barnesiama</i>							
<i>Lemiox rimosus</i>		15+	♂	57	41	23	
<i>Lemiox rimosus</i>		15+	♂	54	37	23	
<i>Lemiox rimosus</i>		10+	♂	54	36	25	

Project: 1994 Mussel Survey
 Date: 14 September 1994
 Transect Number: R 11
 Transect Position: See location of transect 7 & 8
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Amblyema plicata</i>							
<i>Lampsilis fasciola</i>			♀				
<i>Cyclonais tuberculata</i>							
<i>Epioblasma capsaeformis</i>			♀				
<i>Truncilla truncata</i>							
<i>Leniox rimosus</i>		9+	♀	60	44	25	Gravid
<i>Leniox rimosus</i>		15+	♀	60	42	29	Gravid
<i>Leniox rimosus</i>		15+	♂	60	41	27	

Project: 1994 Mussel Survey
 Date: 14 September 1994
 Transect Number: R 12
 Transect Position: See location of transect 7 & 8
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Lemiox rimosus</i>		8+	♂	53	37	25	
<i>Lemiox rimosus</i>		9+	♀	39	28	28	Gravid
<i>Lemiox rimosus</i>		5+	♂	35	24	14	
<i>Cyclonais tuberculata</i>							
<i>Lexingtonia dolabelloides</i>							

Project: 1994 Mussel Survey
 Date: 13 September 1994
 Transect Number: 8
 Transect Position: 200 m downstream of dam
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard MH)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Potamilius alatus</i>	49						
<i>Cyclonais tuberculata</i>	49						
<i>Truncilla truncata</i>	50						
<i>Quadrula pustulosa</i>	50						
<i>Lampsilis cardium</i>	51						
<i>Truncilla truncata</i>	51						
<i>Leniox rimosus</i>	53	5+	♂	34	23	13	
<i>Quadrula pustulosa</i>	53						
<i>Cyclonais tuberculata</i>	53						
<i>Cyclonais tuberculata</i>	53						
<i>Elliptio dilatata</i>	53						
<i>Cyclonais tuberculata</i>	54						
<i>Cyclonais tuberculata</i>	54						
<i>Obliquaria reflexa</i>	54	1,4 yrs					
<i>Obliquaria reflexa</i>	54						
<i>Obliquaria reflexa</i>	54						
<i>Leniox rimosus</i>	54		♀	37	26	20	Gravid
<i>Amblema plicata</i>	58						

Project: 1994 Mussel Survey
 Date: 13 September 1994
 Transect Number: 8 (continued)
 Transect Position: 200 m downstream of dam
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Cyclonais tuberculata</i>	58						
<i>Cyclonais tuberculata</i>	58						
<i>Cyclonais tuberculata</i>	58						
<i>Truncilla truncata</i>	58	1,3 yrs					
<i>Truncilla truncata</i>	58						
<i>Truncilla truncata</i>	58						
<i>Truncilla truncata</i>	63						
<i>Truncilla truncata</i>	63						
<i>Truncilla truncata</i>	63						
<i>Trigonia verrucosa</i>	63						
<i>Cyclonais tuberculata</i>	63						
<i>Quadrula pustulosa</i>	63						
<i>Ellipio dilatata</i>	63						
<i>Lampsilis cardium</i>	64						
<i>Lasnigona costata</i>	64	3+					
<i>Cyclonais tuberculata</i>	64						
<i>Lampsilis fasciola</i>	64						
<i>Amblema plicata</i>	70						

Project: 1994 Mussel Survey
 Date: 13 September 1994
 Transect Number: 8 (continued)
 Transect Position: 200 m downstream of dam
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Cyclonais tuberculata</i>	70	3+					
<i>Cyclonais tuberculata</i>	73						
<i>Quadrula pusilliosa</i>	73						
<i>Quadrula cylindrica</i>	73	very old 13+					

Project: 1994 Mussel Survey
 Date: 14 September 1994
 Transect Number: 8.5
 Transect Position: Approximately 212 m downstream of dam
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Lampsilis fasciola</i>	47						
<i>Leptodea fragilis</i>	47						
<i>Leniox rimosus</i>	47	15+	♂	53	39	24	
<i>Leniox rimosus</i>	47	12+	♂	56	42	25	
<i>Cyclonais tuberculata</i>	48						
<i>Cyclonais tuberculata</i>	49						
<i>Cyclonais tuberculata</i>	49						
<i>Truncilla truncata</i>	49						
<i>Truncilla truncata</i>	49						
<i>Elliptio dilatata</i>	49						
<i>Ambleria plicata</i>	52						
<i>Ambleria plicata</i>	52						
<i>Ambleria plicata</i>	52						
<i>Ambleria plicata</i>	52						
<i>Cyclonais tuberculata</i>	52						
<i>Cyclonais tuberculata</i>	52						
<i>Lampsilis fasciola</i>	52						
<i>Quadrula pustulosa</i>	52						
<i>Elliptio dilatata</i>	52	4+					

Project: 1994 Mussel Survey
 Date: 14 September 1994
 Transect Number: 8.5 (continued)
 Transect Position: Approximately 212 m downstream of dam
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Elliptio dilatata</i>	52						
<i>Leniox rimosus</i>	52	15+	♂	55	40	25	
<i>Lexingtonia dolabelloides</i>	52						
<i>Cyclonais tuberculata</i>	54						
<i>Cyclonais tuberculata</i>	54						
<i>Cyclonais tuberculata</i>	54						
<i>Cyclonais tuberculata</i>	54						
<i>Cyclonais tuberculata</i>	54						
<i>Cyclonais tuberculata</i>	54						
<i>Quadrula pusillosa</i>	54						
<i>Quadrula cylindrica</i>	54						
<i>Lampsilis cardium</i>	54						
<i>Amblema plicata</i>	54						
<i>Amblema plicata</i>	54						
<i>Truncilla truncata</i>	54						
<i>Truncilla truncata</i>	54						

Project: 1994 Mussel Survey
 Date: 14 September 1994
 Transect Number: 8.5 (continued)
 Transect Position: Approximately 212 m downstream of dam
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Psychobranchnus fascioloris</i>	54						
<i>Psychobranchnus fascioloris</i>	54						
<i>Leniox rimosus</i>	54	15+	♀	59	41	29	
<i>Leniox rimosus</i>	54	11+	♀	38	27	18	
<i>Cyclonais tuberculata</i>	60						
<i>Cyclonais tuberculata</i>	60						
<i>Truncilla truncata</i>	60						
<i>Truncilla truncata</i>	60						
<i>Truncilla truncata</i>	60						
<i>Truncilla truncata</i>	60						
<i>Truncilla truncata</i>	60						
<i>Cyclonais tuberculata</i>	62						
<i>Elliptio dilatata</i>	62						
<i>Potamilius alatus</i>	62						
<i>Potamilius alatus</i>	67						
<i>Truncilla truncata</i>	67						

Project: 1994 Mussel Survey

Location: Duck River mile 179 (Lillard Mill)

Date: 14 September 1994

Transect Number: 8.5 (continued)

Transect Position: Approximately 212 m downstream of dam

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Elliptio dilatata</i>	67						
<i>Cyclonais tuberculata</i>	67						
<i>Lemiox rimosus</i>	68	10+	♂	56	39	23	
<i>Lasmigona costata</i>	69						
<i>Cyclonais tuberculata</i>	69						

Project: 1994 Musset-Survey
 Date: 14 September 1994
 Transect Number: 9
 Transect Position: 225 m downstream of dam (out of boat launch)
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
zero	15						
<i>Amblema plicata</i>	49						
<i>Cyclonais tuberculata</i>	49						
<i>Lasnigona costata</i>	50						
<i>Tritogonia verrucosa</i>	50						
<i>Truncilla truncata</i>	50						
<i>Truncilla truncata</i>	50						
<i>Truncilla truncata</i>	50						
<i>Lemiox rimosus</i>	50	7+	♀	35	24	15	Gravid
<i>Cyclonais tuberculata</i>	53						
<i>Cyclonais tuberculata</i>	53						
<i>Cyclonais tuberculata</i>	53						
<i>Cyclonais tuberculata</i>	53						
<i>Truncilla truncata</i>	53	4+					
<i>Lasnigona costata</i>	53	1.6 yrs					
<i>Amblema plicata</i>	53						
<i>Quadrula pustulosa</i>	53						

Project: 1994 Mussel Survey Location: Duck River mile 179 (Lillard Mill)

Date: 14 September 1994

Transect Number: 9 (continued)

Transect Position: 225 m downstream of dam (out of boat launch)

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Cyclonais tuberculata</i>	54						
<i>Cyclonais tuberculata</i>	54						
<i>Cyclonais tuberculata</i>	54						
<i>Truncilla truncata</i>	54						
<i>Truncilla truncata</i>	54						
<i>Truncilla truncata</i>	54						
<i>Elliptio dilatata</i>	54						
<i>Amblema plicata</i>	54						
<i>Amblema plicata</i>	54						
<i>Quadrula pustulosa</i>	54						
<i>Quadrula pustulosa</i>	54						
<i>Quadrula pustulosa</i>	60						
<i>Lasmigona costata</i>	60						
<i>Epioblasma capsaeformis</i>	60						
<i>Truncilla truncata</i>	60						
<i>Truncilla truncata</i>	60						
<i>Cyclonais tuberculata</i>	60						
<i>Cyclonais tuberculata</i>	60						

Project: 1994 Mussel Survey

Date: 14 September 1994

Location: Duck River mile 179 (Lillard Mill)

Transect Number: 9 (continued)

Transect Position: 225 m downstream of dam (out of boat launch)

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Amblema plicata</i>	63						
<i>Truncilla truncata</i>	63						
<i>Elliptio dilatata</i>	63						
<i>Quadrula pustulosa</i>	68						
<i>Cyclonais tuberculata</i>	72						
<i>Elliptio dilatata</i>	73						
<i>Truncilla truncata</i>	73						

Project: 1994 Mussel-Survey Location: Duck River mile 179 (Lillard Mill)

Date: 14 September 1994

Transect Number: 9.5

Transect Position: Approximately 237 m downstream of dam

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Lemiox rimosus</i>		10+	♂	49	36	23	outside quad.
zero	14						
<i>Cyclonais tuberculata</i>	18						
<i>Amblyma plicata</i>	18						
<i>Amblyma plicata</i>	18						
<i>Amblyma plicata</i>	18						
<i>Lampsilis fasciola</i>	18						
<i>Megaloniais nervosa</i>	20						
<i>Truncilla truncata</i>	20						
<i>Lemiox rimosus</i>	20	11+	♀	42	26	22	Gravid
<i>Megaloniais nervosa</i>	26						
<i>Cyclonais tuberculata</i>	26						
<i>Lemiox rimosus</i>	26	10+	♀	37	24	17	Gravid
<i>Truncilla truncata</i>	27						
<i>Truncilla truncata</i>	27						
<i>Amblyma plicata</i>	27						
<i>Amblyma plicata</i>	27						
<i>Cyclonais tuberculata</i>	27						

Project: 1994 Mussel Survey Location: Duck River mile 179 (Lillard Mill)

Date: 14 September 1994

Transect Number: 9.5 (continued)

Transect Position: Approximately 237 m downstream of dam

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Lasmigona costata</i>	27						
<i>Lampsilis fasciola</i>	27						
<i>Lexingtonia dolabelloides</i>	27						
<i>Quadrula pustulosa</i>	33						
<i>Quadrula pustulosa</i>	33						
<i>Quadrula pustulosa</i>	33						
<i>Cyclonais tuberculata</i>	33						
<i>Potamilus alatus</i>	33						
<i>Truncilla truncata</i>	33						
<i>Truncilla truncata</i>	33						
<i>Elliptio dilatata</i>	33						
<i>Obliquaria reflexa</i>	33						
<i>Lexingtonia dolabelloides</i>	33						
<i>Lemiox rimosus</i>	33	15+	♂	61	37	30	
<i>Truncilla truncata</i>	34						
<i>Truncilla truncata</i>	34						
<i>Truncilla truncata</i>	34						
<i>Cyclonais tuberculata</i>	34						

Project: 1994 Mussel Survey
 Date: 14 September 1994
 Location: Duck River mile 179 (Lillard Mill)

Transect Number: 9.5 (continued)
 Transect Position: Approximately 237 m downstream of dam
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Cyclonais tuberculata</i>	34						
<i>Cyclonais tuberculata</i>	34						
<i>Cyclonais tuberculata</i>	40						
<i>Cyclonais tuberculata</i>	40						
<i>Cyclonais tuberculata</i>	40						
<i>Cyclonais tuberculata</i>	40						
<i>Cyclonais tuberculata</i>	40						
<i>Cyclonais tuberculata</i>	40						
<i>Quadrula pustulosa</i>	40						
<i>Quadrula pustulosa</i>	40						
<i>Elliptio dilatata</i>	40						
<i>Elliptio dilatata</i>	40						
<i>Tritogonia verrucosa</i>	40						
<i>Amblema plicata</i>	40						
<i>Cyclonais tuberculata</i>	46						
<i>Cyclonais tuberculata</i>	46						
<i>Obliquaria reflexa</i>	46						
<i>Amblema plicata</i>	46						
<i>Amblema plicata</i>	47						

Project: 1994 Mussel Survey Location: Duck River mile 179 (Lillard Mill)

Date: 13 September 1994

Transect Number: 10

Transect Position: 250 m downstream of dam (downstream edge of boat launch)

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Quadrula pustulosa</i>	9	6					
<i>Ambelma plicata</i>	9						
<i>Quadrula pustulosa</i>	16						
<i>Quadrula pustulosa</i>	16						
<i>Ellipio dilatata</i>	17						
<i>Cyclonais tuberculata</i>	17						
<i>Quadrula pustulosa</i>	18						
<i>Lasmigona costata</i>	18						
<i>Cyclonais tuberculata</i>	18	5					
<i>Ambelma plicata</i>	22						
<i>Lemiox rimosus</i>	22	6+	♀	34	23	16	Gravid
<i>Ambelma plicata</i>	35						
<i>Ambelma plicata</i>	35						
<i>Cyclonais tuberculata</i>	35						
<i>Truncilla truncata</i>	35						
<i>Lemiox rimosus</i>	35	13+	♂	52	38	24	
<i>Lemiox rimosus</i>	35	7+	♂	47	33	20	
<i>Lemiox rimosus</i>	35	8+	♀	35	24	16	Gravid

Project: 1994 Mussel Survey

Date: 13 September 1994

Transect Number: 10 (continued)

Transect Position: 250 m downstream of dam (downstream edge of boat launch)

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Lemiox rimosus</i>	35	7+	♀	34	24	16	Gravid
<i>Pygodon grandis</i>	52						
<i>Ellipio dilatata</i>	52						
<i>Amblema plicata</i>	52						
<i>Amblema plicata</i>	52						
<i>Quadrula pustulosa</i>	52						
<i>Quadrula pustulosa</i>	52						
<i>Cyclonais tuberculata</i>	52						
<i>Lexingtonia dolabelloides</i>	52	adult					
<i>Lexingtonia dolabelloides</i>	52	adult					
<i>Trigonia verrucosa</i>	52						
<i>Truncilla truncata</i>	52						
<i>Truncilla truncata</i>	52						
<i>Truncilla truncata</i>	52						
<i>Truncilla truncata</i>	52						
<i>Lemiox rimosus</i>	52	7+	♀	39	27	19	Gravid
<i>Lemiox rimosus</i>	52	9+	♀	41	28	20	Gravid
<i>Cyclonais tuberculata</i>	57						

Project: 1994 Mussel Survey

Location: Duck River mile 179 (Lillard Mill)

Date: 13 September 1994

Transect Number: 10 (continued)

Transect Position: 250 m downstream of dam (downstream edge of boat launch)

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Cyclonais tuberculata</i>	57						
<i>Cyclonais tuberculata</i>	57						
<i>Cyclonais tuberculata</i>	57						
<i>Cyclonais tuberculata</i>	57						
<i>Quadrula pustulosa</i>	57						
<i>Quadrula pustulosa</i>	57						
<i>Lexingtonia dolabelloides</i>	57						
<i>Lexingtonia dolabelloides</i>	57						
<i>Triogonia verrucosa</i>	57						
<i>Truncilla truncata</i>	57						
<i>Truncilla truncata</i>	57						
<i>Truncilla truncata</i>	57						
<i>Lemiox rimosus</i>	57	9+	♂	49	36	22	
<i>Lemiox rimosus</i>	57	13+	♂	56	40	25	
<i>Lemiox rimosus</i>	57	12+	♂	53	38	23	
<i>Cyclonais tuberculata</i>	58						
<i>Cyclonais tuberculata</i>	58						
<i>Cyclonais tuberculata</i>	58						

Measurements in mm

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Project: 1994 Mussel Survey

Date: 13 September 1994

Transect Number: 10 (continued)

Transect Position: 250 m downstream of dam (downstream edge of boat launch)

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Cyclonais tuberculata</i>	58						
<i>Cyclonais tuberculata</i>	58						
<i>Quadrula pustulosa</i>	58						
<i>Quadrula pustulosa</i>	58						
<i>Quadrula pustulosa</i>	58						
<i>Quadrula pustulosa</i>	58						
<i>Quadrula pustulosa</i>	58						
<i>Quadrula pustulosa</i>	58						
<i>Lasmigona costata</i>	58						
<i>Elliptio dilatata</i>	58						
<i>Lemiox rimosus</i>	58	14+	♂	54	40	25	
<i>Elliptio dilatata</i>	61						
<i>Elliptio dilatata</i>	61						
<i>Lemiox rimosus</i>	61	5+	♀	32	22	14	Gravid
<i>Lampsilis fasciola</i>	71						
<i>Quadrula cylindrica</i>	71						
<i>Elliptio dilatata</i>	71						

Project: 1994 Mussel Survey
 Date: 14 September 1994
 Transect Number: 10.5
 Transect Position: Approximately 262 m downstream of dam
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Lemiox rimosus</i>	8	15+	♂	49	36	24	
<i>Cyclonais tuberculata</i>	8						
<i>Cyclonais tuberculata</i>	8						
<i>Cyclonais tuberculata</i>	8						
<i>Elliptio dilatata</i>	8						
<i>Truncilla truncata</i>	8						
<i>Lexingtonia dolabelloides</i>	8						
<i>Lampsilis fasciola</i>	8						
<i>Lampsilis cardium</i>	8						
<i>Ambelena plicata</i>	11						
<i>Ambelena plicata</i>	11						
<i>Ambelena plicata</i>	11						
<i>Cyclonais tuberculata</i>	11						
<i>Cyclonais tuberculata</i>	11						
<i>Cyclonais tuberculata</i>	11						
<i>Cyclonais tuberculata</i>	11						
<i>Truncilla truncata</i>	11	2+					
<i>Truncilla truncata</i>	11						

Project: 1994 Mussel Survey
 Date: 14 September 1994
 Transect Number: 10.5 (continued)
 Transect Position: Approximately 262 m downstream of dam
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Lexingtonia dolabelloides</i>	11						
<i>Cyclonais tuberculata</i> (2 sps.)	13						
<i>Elliptio dilatata</i>	13						
<i>Quadrula pustulosa</i>	13						
<i>Lemiox rimosus</i>	13	15+	♂	57	40	26	
<i>Cyclonais tuberculata</i>	21						
<i>Elliptio dilatata</i>	21						
<i>Lemiox rimosus</i>	21	15+	♂	60	42	27	
<i>Lasmigona costata</i>	30						
<i>Truncilla truncata</i>	30						
<i>Villosa vauxemensis</i>	30						
<i>Lemiox rimosus</i>	30	3+	juv	34	22	13	
<i>Lemiox rimosus</i>	30	8+	♂	52	38	24	
<i>Lemiox rimosus</i>	30	8+	♂	51	38	26	
<i>Lemiox rimosus</i>	30	15+	♂	58	42	28	
<i>Lemiox rimosus</i>	33	15+	♂	56	44	27	
<i>Lasmigona costata</i>	33						
<i>Truncilla truncata</i>	33						

Measurements in mm
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Project: 1994 Mussel Survey

Date: 14 September 1994

Transect Number: 10.5 (continued)

Transect Position: Approximately 262 m downstream of dam

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Cyclonais tuberculata</i>	36						
<i>Cyclonais tuberculata</i>	36						
<i>Elliptio dilatata</i>	36						
<i>Lemiox rimosus</i>	43	10+	♀	39	24	22	Gravid
<i>Cyclonais tuberculata</i>	43						
<i>Truncilla truncata</i>	43						
<i>Cyclonais tuberculata</i>	47						
<i>Cyclonais tuberculata</i>	47						
<i>Cyclonais tuberculata</i>	47						
<i>Elliptio dilatata</i>	47						
<i>Elliptio dilatata</i>	47						
<i>Amblema plicata</i>	47						
<i>Amblema plicata</i>	47						
<i>Amblema plicata</i>	47						
<i>Elliptio dilatata</i>	53						
<i>Lasmigona costata</i>	53						
<i>Lasmigona costata</i>	53						
<i>Lasmigona costata</i>	53						
<i>Quadrula pustulosa</i>	53						
<i>Quadrula pustulosa</i>	53						

Measurements in mm

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Project: 1994 Mussel Survey
 Date: 14 September 1994
 Transect Number: R 13
 Transect Position: See location of transect 10 & 11
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Cyclonais tuberculata</i>							
<i>Cyclonais tuberculata</i>							
<i>Cyclonais tuberculata</i>							
<i>Lasmigona costata</i>							
<i>Triogonia verrucosa</i>							

Project: 1994 Mussel-Survey
 Date: 14 September 1994
 Transect Number: R 14
 Transect Position: See location of transect 10 & 11
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Truncilla truncata</i>							
<i>Truncilla truncata</i>							
<i>Truncilla truncata</i>							
<i>Truncilla truncata</i>							
<i>Cyclonais tuberculata</i>							
<i>Cyclonais tuberculata</i>							
<i>Trigonia verrucosa</i>							
<i>Quadrula pustulosa</i>							

Measurements in mm

Project: 1994 Mussel Survey
 Date: 14 September 1994
 Transect Number: R 15
 Transect Position: See location of transect 10 & 11
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Cyclonais tuberculata</i>							
<i>Cyclonais tuberculata</i>							
<i>Lasnigona costata</i>							
<i>Lasnigona costata</i>							
<i>Lampsilis cardium</i>							
<i>Fusconda barnesiana</i>							
<i>Elliptio dilatata</i>							
<i>Truncella truncata</i>							
<i>Lemiox rimosus</i>		7+	♀	37	27	18	Gravid

Project: 1994 Mussel Survey
 Date: 14 September 1994
 Transect Number: R 16
 Transect Position: See location of transect 10 & 11
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Cyclonais tuberculata</i>							
<i>Cyclonais tuberculata</i>							
<i>Lasnigona costata</i>							
<i>Villosa taeniata</i>							
<i>Lexingtonia dolbelloides</i>							
<i>Lexingtonia dolbelloides</i>							
<i>Lemiox rimosus</i>		12+	♂	55	39	24	

Project: 1994 Mussel Survey
 Date: 14 September 1994
 Transect Number: R 17
 Transect Position: See location of transect 10 & 11
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Amblema plicata</i>							
<i>Cyclonais tuberculata</i>							
<i>Cyclonais tuberculata</i>							
<i>Quadrula pustulosa</i>							
<i>Truncilla truncata</i>							
<i>Psychobranchus fasciolaris</i>							
<i>Psychobranchus fasciolaris</i>							
<i>Leniox rimosus</i>		11+	♂	52	37	22	
<i>Leniox rimosus</i>		15+	♂	57	45	29	outside quad

Project: 1994 Mussel Survey
 Date: 14 September 1994
 Transect Number: R 18
 Transect Position: See location of transect 10 & 11
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Cyclonais tuberculata</i>							
<i>Cyclonais tuberculata</i>							
<i>Elliptio dilatata</i>							
<i>Elliptio dilatata</i>							
<i>Truncilla truncata</i>							
<i>Limnox rimosus</i>		8+	♀	37	27	18	Gravid
<i>Limnox rimosus</i>		7+	♂	51	39	23	

Project: 1994 Mussel Survey

Location: Duck River mile 179 (Lillard Mill)

Date: 14 September 1994

Transect Number: R 19

Transect Position: See location of transect 10 & 11

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Cyclonais tuberculata</i>							
<i>Cyclonais tuberculata</i>							
<i>Truncilla truncata</i>							
<i>Truncilla truncata</i>							
<i>Truncilla truncata</i>							
<i>Ambleria plicata</i>							
<i>Quadrula pustulosa</i>							
<i>Quadrula pustulosa</i>							
<i>Leniox rimosus</i>		7+	♀	35	24	18	
<i>Lexingtonia dolabelloides</i>							

Project: 1994 Mussel Survey Location: Duck River mile 179 (Lillard Mill)
 Date: 13 September 1994
 Transect Number: 11
 Transect Position: 275 m downstream of dan (upstream tip of downstream island)
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
zero	5						
<i>Quadrula pustulosa</i>	7						
<i>Lasnigona costata</i>	12						
<i>Lasnigona costata</i>	30						
<i>Cyclonais tuberculata</i>	30						
<i>Quadrula pustulosa</i>	30						
<i>Leniox rimosus</i>	33	10	♂	54	38	22	
<i>Leniox rimosus</i>	33	10	♂	49	39	24	
<i>Leniox rimosus</i>	33	7	♀	37	25	16	Gravid
<i>Cyclonais tuberculata</i>	33						
<i>Lasnigona costata</i>	33						
<i>Fusconaita barnesiana</i>	40						
<i>Psychobranchus fasciolaris</i>	40						
<i>Leniox rimosus</i>	42	8	♀	34	24	15	Gravid
<i>Truncilla truncata</i>	42						
<i>Truncilla truncata</i>	42						
<i>Amblyema plicata</i>	42						
<i>Truncilla truncata</i>	44						

Project: 1994 Mussel Survey

Date: 13 September 1994

Transect Number: 12

Transect Position: 300 m downstream of dam (downstream island)

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
zero	4						
<i>Cyclonais tuberculata</i>	13						
<i>Truncilla truncata</i>	13						
<i>Villosa laeniata</i>	13		♀				Gravid
<i>Villosa laeniata</i>	13		♀				Gravid
<i>Cyclonais tuberculata</i>	14						
<i>Truncilla truncata</i>	14						
<i>Cyclonais tuberculata</i>	24						
<i>Truncilla truncata</i>	27						
<i>Lampsilis fasciola</i>	28	old	♀				
<i>Lampsilis fasciola</i>	35						
<i>Trigonia verrucosa</i>	35						
<i>Lampsilis fasciola</i>	43						
<i>Truncilla truncata</i>	43						
<i>Quadrula pustulosa</i>	43						
<i>Cyclonais tuberculata</i>	43						
<i>Fusconia barnesiana</i>	43						
<i>Lampsilis cardium</i>	44						

Measurements in mm

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Project: 1994 Mussel Survey
 Date: 13 September 1994
 Transect Number: 12
 Transect Position: 300 m downstream of dam (downstream island)
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Psychobranchus fasciolaris</i>	44						
<i>Villosa vanuxemensis</i>	50	5+					
<i>Villosa iris</i>	51						
<i>Elliptio dilatata</i>	51						
<i>Lasnigona costata</i>	51						
<i>Quadrula pustulosa</i>	53						
<i>Truncilla truncata</i>	53						
<i>Lampsilis fasciola</i>	53	2+					
<i>Potamilius alatus</i>	53						
<i>Lasnigona costata</i>	53						
<i>Lampsilis cardium</i>	53						

Project: 1994 Mussel Survey
 Date: 13 September 1994
 Transect Number: 13
 Transect Position: 325 m downstream of dam (downstream island)
 Workers: Garner, Askegaard, Long, Hubbs, & Jones

Location: Duck River mile 179 (Lillard Mill)

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Quadrula cylindrica</i>	3						
<i>Amblema plicata</i>	4						
<i>Lemiox rimosus</i>	9	5	♀	34	22	14	Gravid
<i>Amblema plicata</i>	9						
<i>Quadrula pusulosa</i>	9						
<i>Cyclonais tuberculata</i>	10						
<i>Elliptio dilatata</i>	14						
<i>Elliptio dilatata</i>	14						
<i>Epioblasma capsaeformis</i>	15	4					
<i>Elliptio dilatata</i>	15						
<i>Elliptio dilatata</i>	15	adult					
<i>Lasnigona costata</i>	15						
<i>Lemiox rimosus</i>	15	15+	♂	52	35	23	
<i>Cyclonais tuberculata</i>	19						
<i>Cyclonais tuberculata</i>	19						
<i>Amblema plicata</i>	19						
<i>Lampsilis fasciola</i>	19						
<i>Lemiox rimosus</i>	26	15+	♂	48	32	21	

Project: 1994 Mussel Survey

Location: Duck River mile 179 (Lillard Mill)

Date: 13 September 1994

Transect Number: 13

Transect Position: 325 m downstream of dam (downstream island)

Workers: Garner, Askegaard, Long, Hubbs, & Jones

Species	Quad. #	Age	Sex	Length	Height	Width	Comments
<i>Lasnigona costata</i>	27						
<i>Cyclonais tuberculata</i>	27						
<i>Elliptio dilatata</i>	27						
<i>Cyclonais tuberculata</i>	28	adult					

FIGURE 1
SAMPLING LOCATIONS
DUCK RIVER, LILLARD MILL, SEPTEMBER 1994

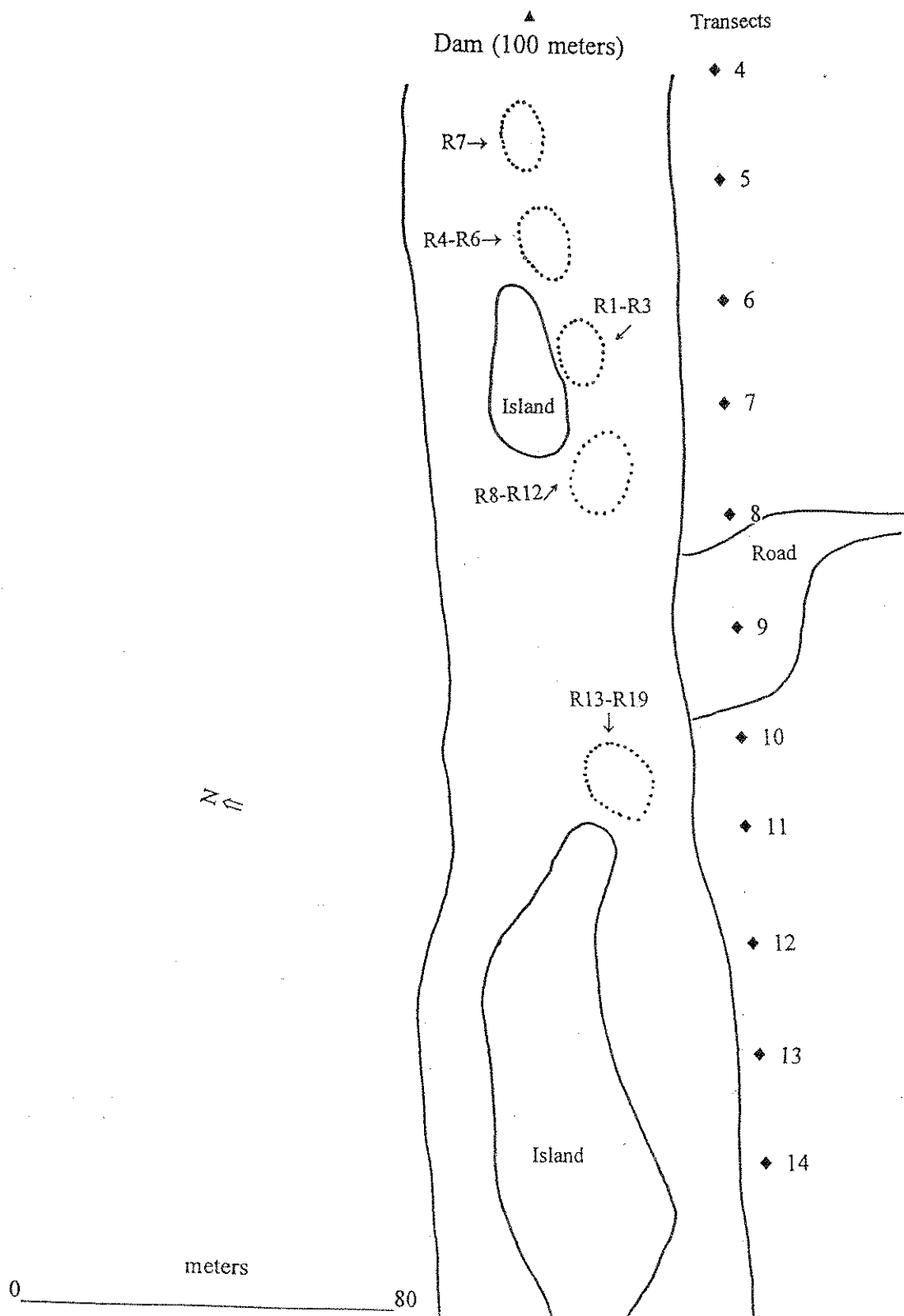
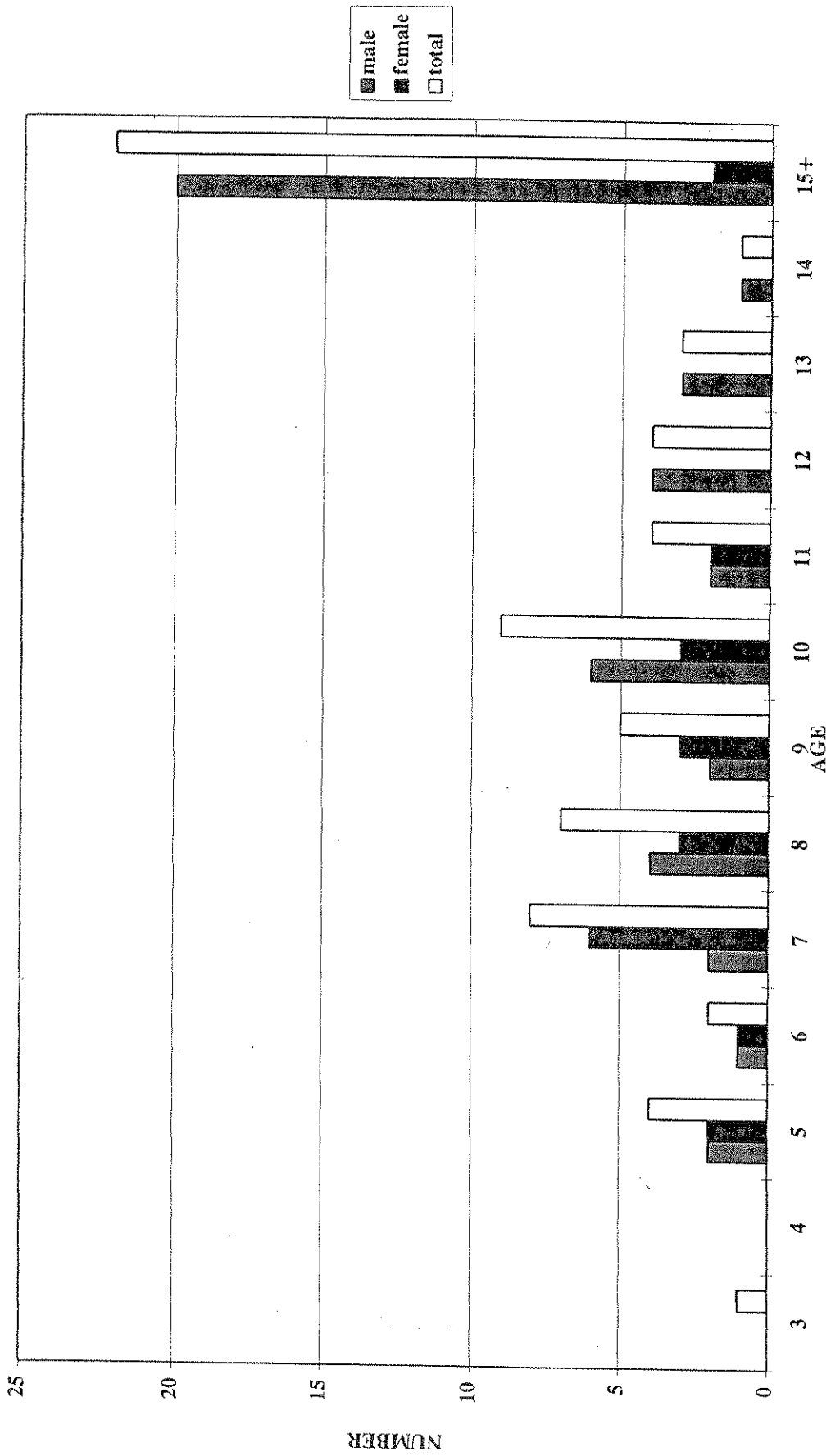


FIGURE 2

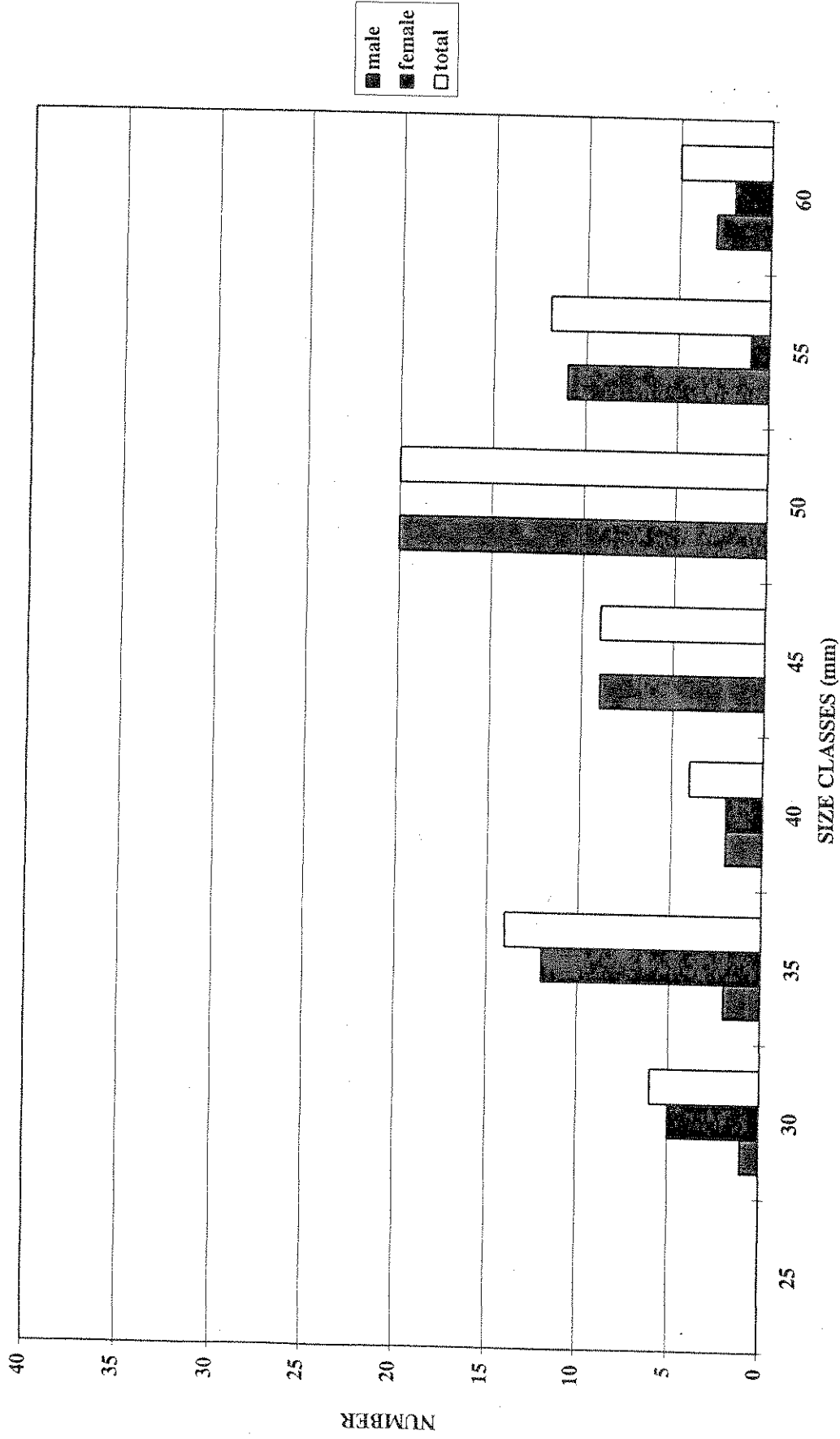
Lemiox rimosus AGE DISTRIBUTION, 1994 (70 specimens)



One of 71 total specimens was an unaged female and therefore not included in this figure.

FIGURE 3

Lemiox rimosus SIZE DISTRIBUTION, 1994 (70 SPECIMENS)



One of 71 total specimens was a juvenile and therefore not included in this figure.

FIGURE 4

Lemiox rimosus AGE DISTRIBUTION, 1982 SMALL DATA SET (146 SPECIMENS)

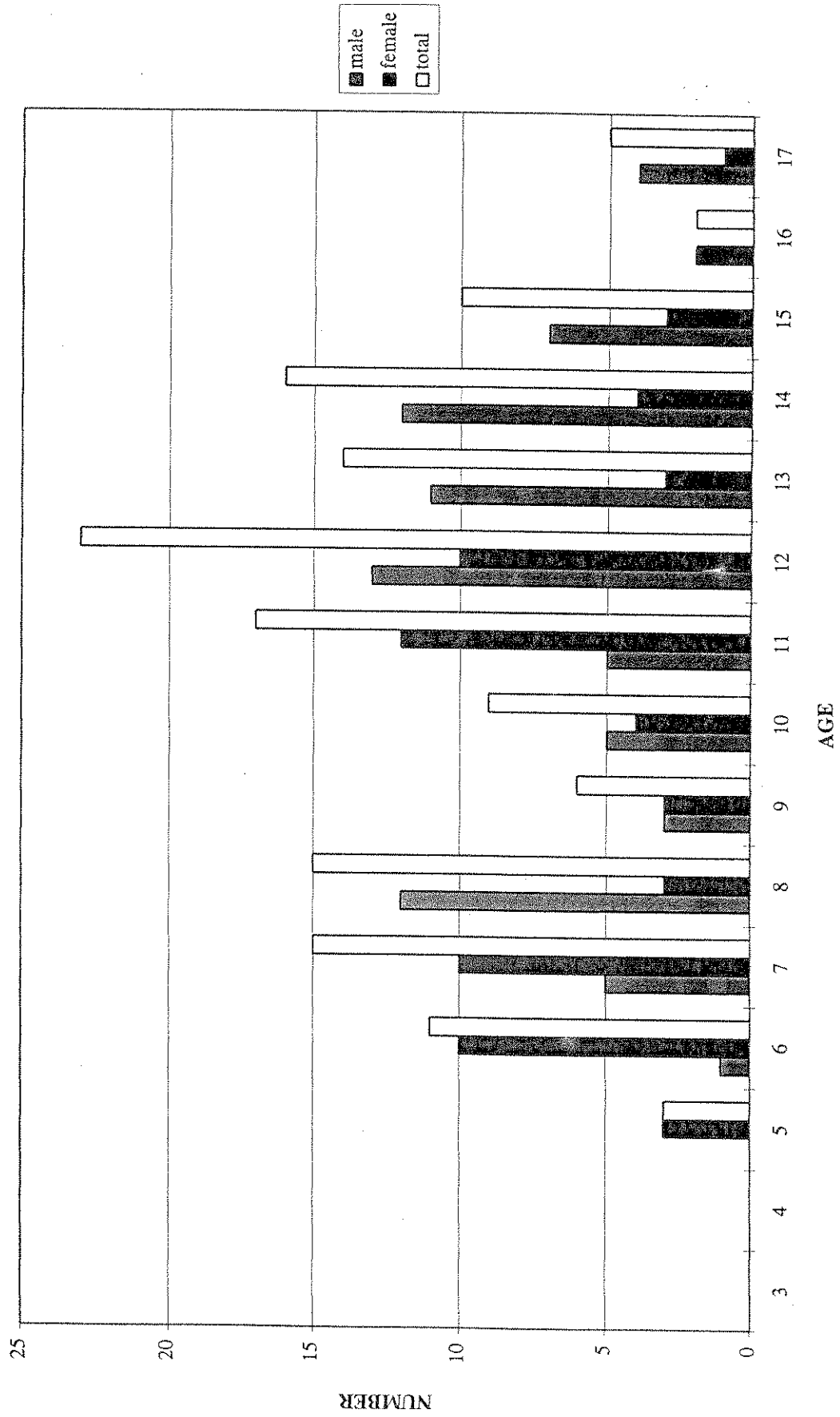
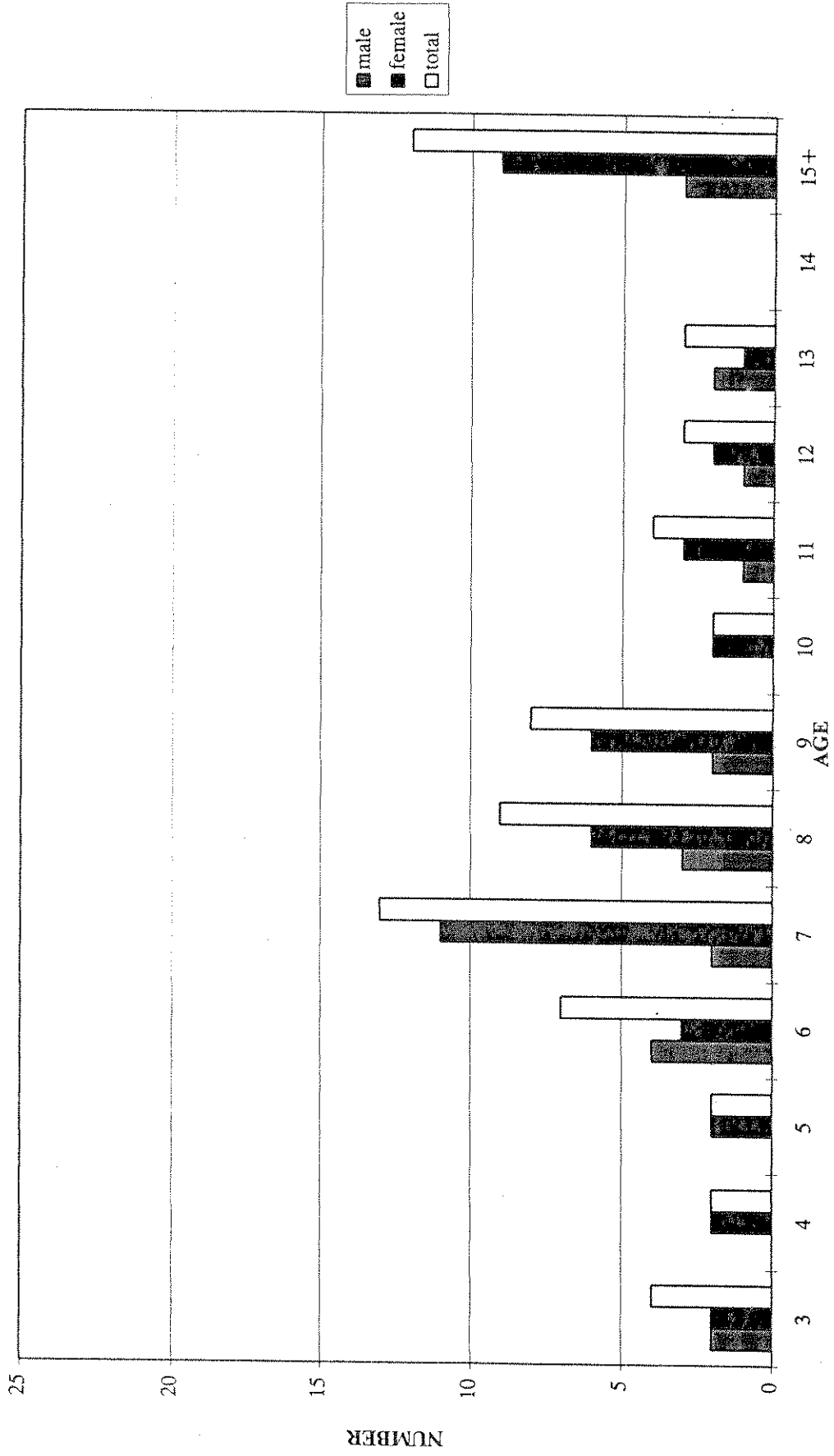


FIGURE 5

Lemiox rimosus AGE DISTRIBUTION, 1993 DATA (70 specimens)



One of 70 total specimens was a juvenile and not included in this figure.

FIGURE 6

Lemiox rimosus SIZE DISTRIBUTION, 1982 TOTAL (4000 SPECIMENS)

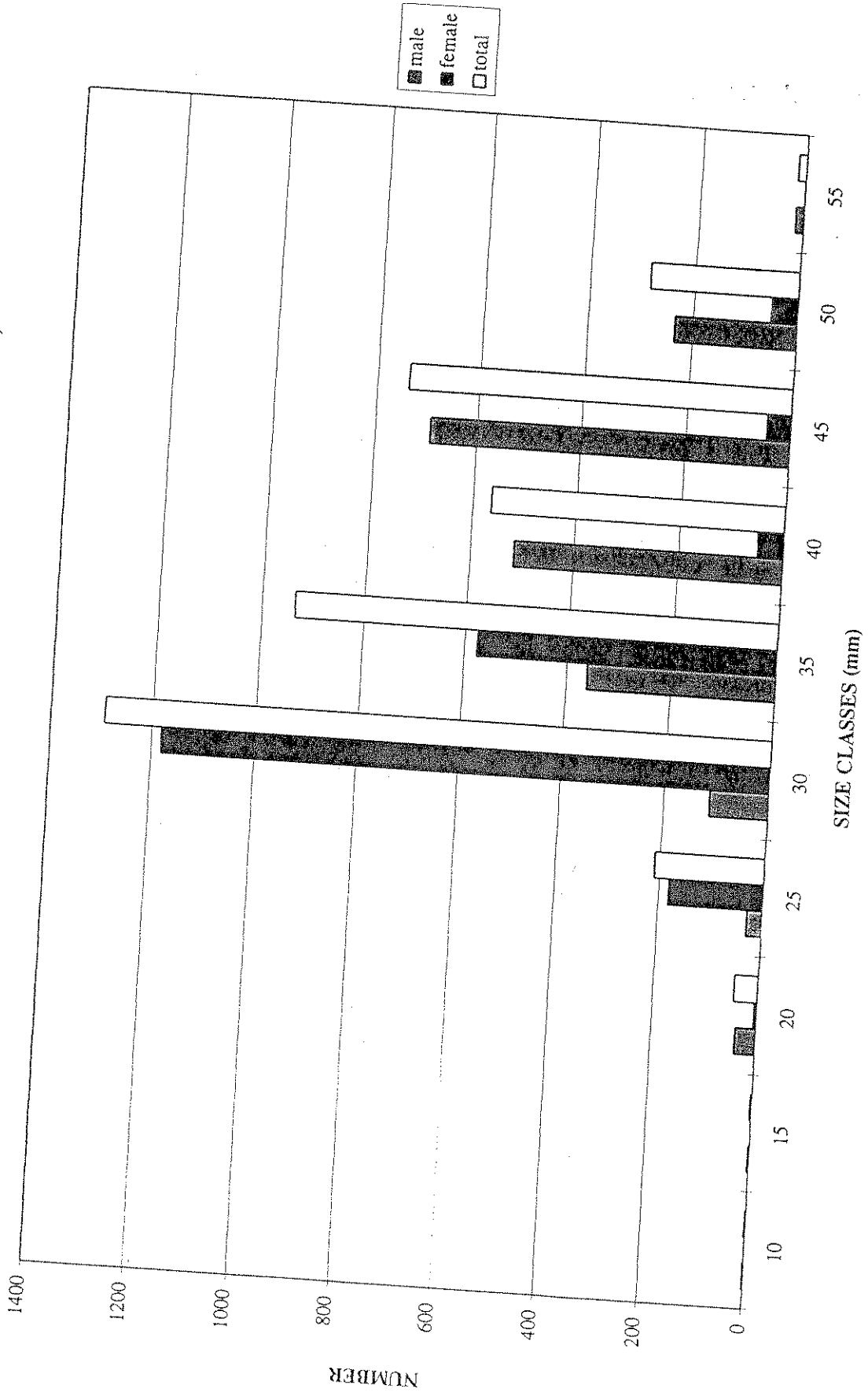


FIGURE 7

Lemiox rimosus SIZE DISTRIBUTION, 1982 SMALL DATA SET (146 SPECIMENS)

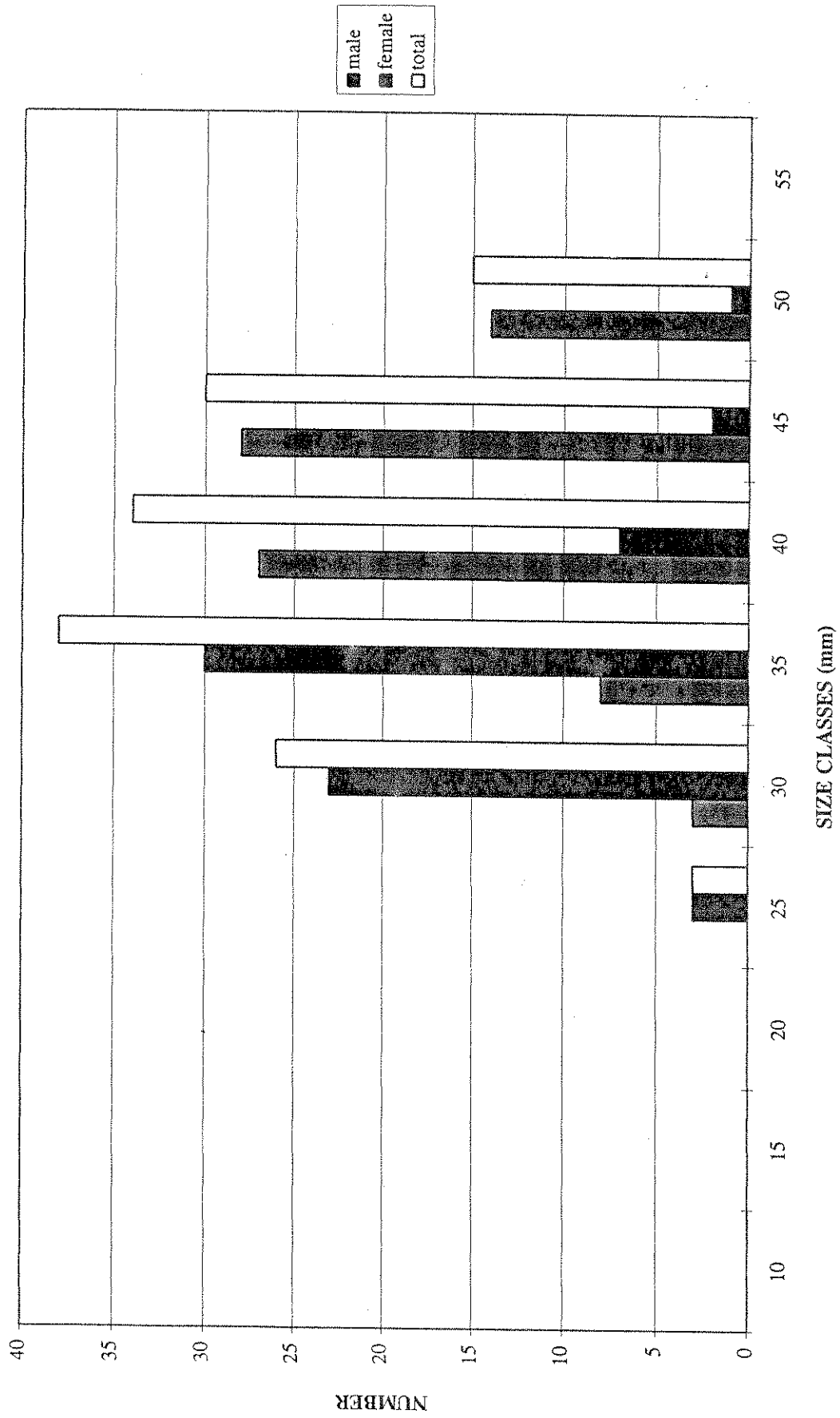


FIGURE 8

Lemiox rimosus SIZE DISTRIBUTION, 1988 (69 SPECIMENS)

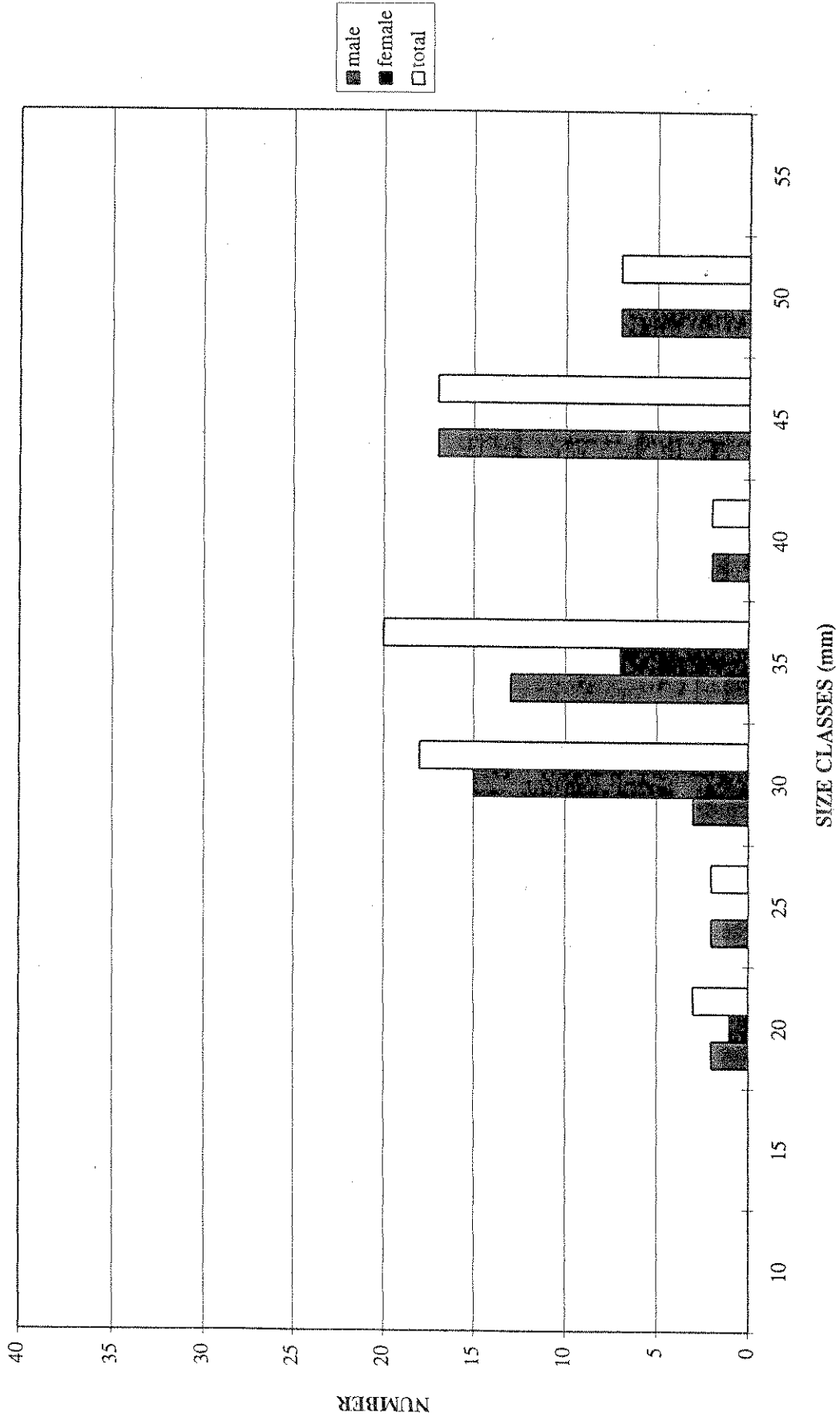
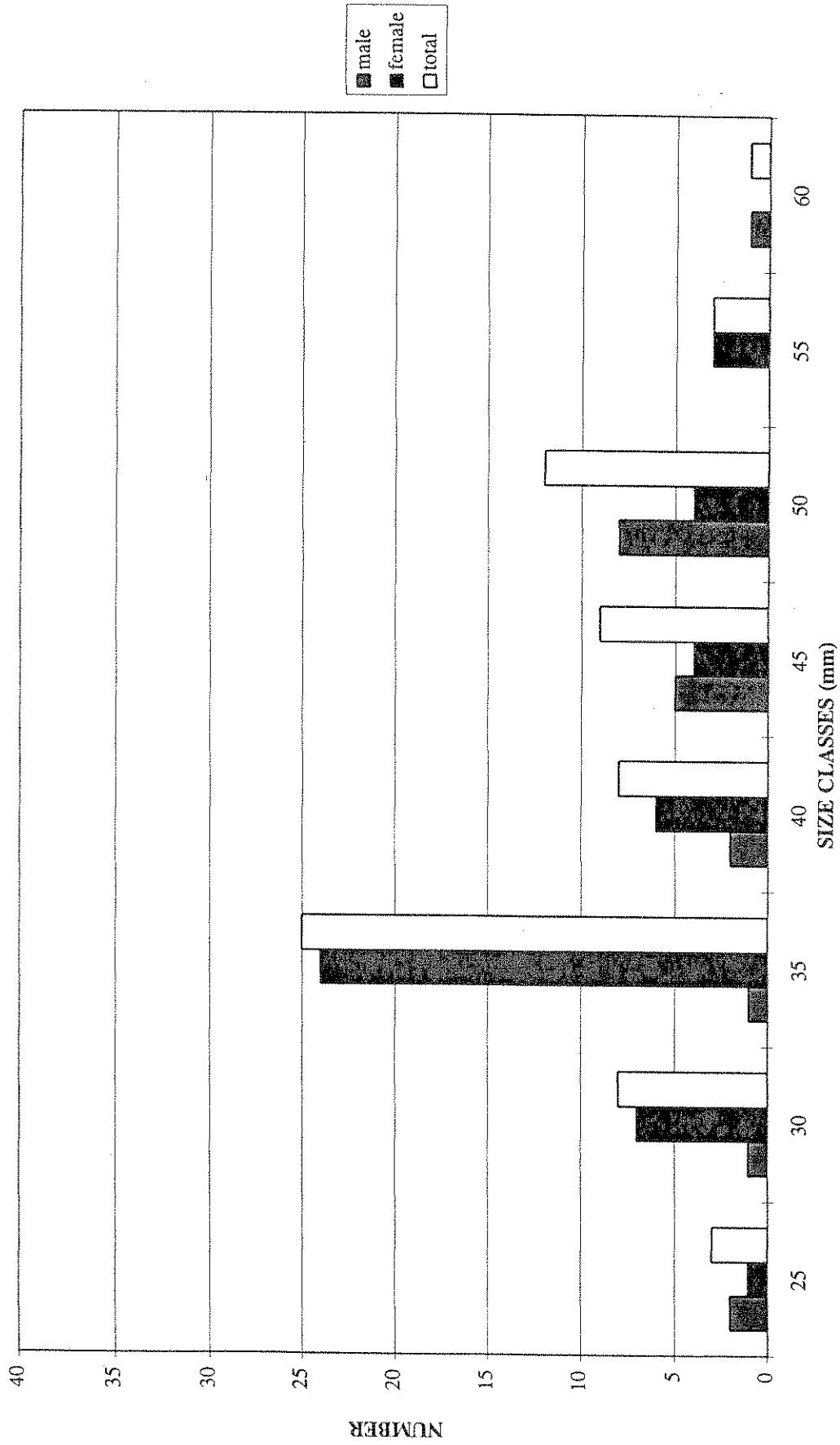


FIGURE 9

Lemiox rimosus SIZE DISTRIBUTION, 1993 (70 specimens)



One of 70 total specimens was a juvenile and not included in this figure.