FINAL REPORT

POPULATION STATUS, DISTRIBUTION, AND BIOLOGY OF THE TAR RIVER SPINY MUSSEL, *ELLIPTIO* (*CANTHYRIA*) *STEINSTANSANA* (JOHNSON AND CLARKE), IN NORTH CAROLINA

BY

NORTH CAROLINA WILDLIFE RESOURCES COMMISSION
RALEIGH, NORTH CAROLINA

FOR

U.S. FISH AND WILDLIFE SERVICE

DECEMBER, 1989

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HOW TO REFERENCE THIS DOCUMENT

Entire Document

North Carolina Wildlife Resources Commission. 1989. Population status, distribution, and biology of the Tar River spiny mussel, Elliptio (Canthyria) steinstansana (Johnson and Clarke), in North Carolina. Final report to the U.S. Fish and Wildlife Service.

Life History of James Spinymussel

Hove, M.C., and R.J. Neves. 1989. Life history of the James spinymussel. in: North Carolina Wildlife Resources Commission. 1989. Population status, distribution, and biology of the Tar River spiny mussel, Elliptio (Canthyria) steinstansana (Johnson and Clarke), in North Carolina. Final report to the U.S. Fish and Wildlife Service.

Job ES6-4: Field Investigations (Tar River Spiny Mussel Survey)

Alderman, J.M. 1989. Status survey of the Tar River spiny mussel. in: North Carolina Wildlife Resources Commission. 1989. Population status, distribution, and biology of the Tar River spiny mussel, Elliptio (Canthyria) steinstansana (Johnson and Clarke), in North Carolina. Final report to the U.S. Fish and Wildlife Service.

FINAL REPORT

STATUS SURVEY OF THE TAR RIVER SPINY MUSSEL

BY

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FOR

U.S. FISH & WILDLIFE SERVICE

DECEMBER, 1989

Elliptio steinstansana Johnson and Clarke, 1983
TAR RIVER SPINY MUSSEL

Type Locality (provided by Johnson and Clarke 1983).
Holotype: MCZ 282677, near Tarboro in Edgecombe County, North Carolina

Description. This small, subrhomboidal mussel grows to approximately 60 mm long. Short spines (up to 5 mm long) are found on most specimens. As many as 12 spines have been found on juveniles; however, adults tend to lose some of their spines as they mature. In general, spines arranged in a radial row slightly anterior of the posterior ridge on one valve are symmetrically positioned with the spines on the opposite valve. (Some individuals may have two rows of spines on each valve.) The smooth, orange-brown to dark brown periostracum may be rayed in younger individuals. The shell is significantly thicker toward the anterior end, and the nacre is usually pink in this area. The posterior end of the shell is thinner with an iridescent bluish white color. Two or more linear ridges, originating within the beak cavity and extending to the ventral margin, can be found on the interior surface of the shell. The distance between these ridges widens toward the ventral margin. Johnson and Clarke (1983) provide additional descriptions.

Range. The Tar River spiny mussel probably ranged throughout most of the Tar River Drainage Basin before the area was settled during the 1700s. By the mid-1960s, its known range had been reduced to the main channel of the Tar River from Spring Hope in Nash County to Falkland in Pitt County (Shelly 1972, Clarke 1983). By the early 1980s, its range in the Tar River was restricted to only 12 miles of the river in Edgecombe County (Clarke 1983), and by 1989 the species could only be found in a one mile section of the river in Edgecombe County downriver from the water intake plant for Tarboro. However, one additional population with successful reproduction has been discovered in Swift Creek - a tributary of the Tar River flowing from Vance County to the Tar River in Edgecombe County. This population appears to be centered in Nash County with some individuals also found in Franklin and Edgecombe counties.

Results - Tar River spiny mussel survey.

Ninety-three stations in the Pamlico Drainage Basin (figure one) were surveyed for Elliptio (Canthyria) steinstansana from September, 1986 through August, 1988. Only seven of nearly 7,000 living mussels found during the survey period were Tar River spiny mussels. Length, height, and width data for each living Tar River spiny mussel are provided in table one. (Additional data for Tar River spiny mussels found since 1988 are also provided in table one.) Table 1A also provides data for Tar River spiny mussel shells found during 1989. The limited data for this species does not allow a valid determination of the age class structure of the population; however, it appears that successful reproduction is occurring in Swift Creek, Nash County.

Although four living Tar River spiny mussels were found at one station in the Tar River during 1987, no living Tar River spiny mussels were found in the river during 1988. (One freshly dead adult was found stranded on a sand bar below the Tarboro water intake plant during the summer of 1989.) Three living Tar River spiny mussels were found in Swift Creek, a tributary of the Tar River, during 1988. Four specimens were found in Swift Creek at one station near SR 1310 in Nash County during 1989. More than two dozen fresh shells were found in muskrat middens along Swift Creek during the summer of 1989. Many of these Tar River spiny mussel shells were from juveniles.

The Tar River provides habitat for up to seventeen mussel species. Site specific data are provided in tables two and three. Future museum work with collected specimens from the Pamlico Drainage Basin will clarify our understanding of the present distribution of Elliptio complanata, Elliptio congaraea, Elliptio icterina and Elliptio roanokensis. These four species are identified as ESP in the tables.

Figures two and three describe the length measurements of Swift Creek mussels during the period May 31 through July 13, 1988. This is cumulative data for all mussels measured from Swift Creek stations during 1988.

Figures four and five describe the length measurements of mussel species from the 1310 bridge station on Swift Creek on July 7, 1988. Two Tar River spiny mussels were collected from this station on that date.

Figures six through nine are from USGS data and describe significant physical and chemical habitat parameters for the SR 1310 station on Swift Creek during recent years.

Figure ten describes relative and cumulative weights of the sediments producing Tar River spiny mussels from Swift Creek during 1988.

TABLE ONE

LENGTH, HEIGHT, WIDTH, AND SPINE NUMBER DATA FOR LIVE TAR RIVER SPINY MUSSELS FOUND DURING THE SURVEY PERIOD SEPTEMBER, 1986 - JULY, 1989
(DO, pH, AND TEMPERATURE DATA ALSO PROVIDED)

STATION: YEAR, MONTH, DAY, STATION NUMBER FOR DAY

COUNTY: E = EDGECOMBE, N = NASH, F = FRANKLIN

CUMULATIVE STATION NUMBER (CSN): LOCATION IDENTIFIED ON SURVEY MAP (FIGURE ONE)

ROAD: HIGHWAY OR SR NUMBER (NOTE TBOR = TARBORO, + OR - INDICATES A SIGNIFICANT DISTANCE DOWNSTREAM (+) OR UPSTREAM (-))

DATE	COUNTY	CSN	ROAD	LENGTH (MM)	HEIGHT (MM)	WIDTH (MM)	NUMBER OF SPINES	pH	DO (PPM)	TEMP. (C)
870708.1	E	9	TBOR	38.9	24.6	16.7	1	6.8	5.8	23
870708.1	E	9	TBOR	33	20	12	2	6.8	5.8	23
870709.1	E	9	TBOR	43.7	27	18.3	1	6.9	6	23
870709.1	E	9	TBOR	43.7	27	17.5	1	6.9	6	23
880601.4	F	87	58+	38.2	24.45	14.1	8	6.8	-	20
880706.1	N	82	1310	21.75	14.6	13.05	5	6.8	7.2	-
880706.1	N	82	1310	41	16.6	26.65	2	6.8	7.2	-
890523.1	N	82	1310	31.65	23.4	15.2	1	6.8	5.2	18
890523.1	N	82	1310	35.7	23.45	14.4	2	6.8	5.2	18
890523.1	N	82	1310	27.1	18	10.4	6	6.8	5.2	18
890523.1	N	82	1310	28.15	18.35	10.75	5	6.8	5.2	18

TABLE 1A

SHELLS TAKEN FROM MIDDENS - SWIFT CREEK FROM SR 1310 BRIDGE TO BELOW US 301, NASH AND EDGECOMBE COUNTIES, 1989

STATION	LENGTH (MM)	HEIGHT (MM)	WIDTH (MM)	SPINES # RIGHT VAL	SPINES # LEFT VALVE	TOTAL SPINES	LENGTH OF LONGEST SPINE RIGHT (MM)	LENGTH OF LONGEST SPINE LEFT (MM)
890725.1	22.15	14.55	8.05	3	5	8	2.8	3.6
890916	23.2	15.65	8.65	4	2	6	2.15	1.35
890725.1	24.9	16.4	9.3	6	6	12	1.9	2.55
890725.1	25.2	16.25	9.85	2	2	4	2.2	2.65
890916	25.45	16.9	10.3	4	4	8	4.2	1.35
890601.1	25.5	17.4	9.4	4	4	8	2.55	2.5
890725.1	25.7	16.7	10.65	3	1	4	1.85	2.3
890725.1	26.15	17.05	10.15	2	3	5	1.3	1.4
890601.2	27.45	18.2	11.15	2	2	4	2.85	2.8
890601.3	28.1	17.7	11.15	2	1	3	1.85	2.35
890725.1	28.1	17.85	10.65	3	3	6	4.2	3.8
890916	29.7	19.3	11.85	1	3	4	1.85	2.15
890725.1	28.75	18.4	11.75	2	2	4	2.35	2.9
890725.1	29.9	19.45	12.05	2	2	4	1.85	2.95
890725.1	30.5	20.15	11.15	3	4	7	3.1	2.95
890725.1	30.95	18.75	11.2	3	3	6	2	2.1
890916	31.05	20.15	11.9	1	1	2	1.15	0.8
890725.1	31.05	19.15	11.85	2	2	4	2.7	2.5
890916	31.5	19.7	12.45	2	2	4	2.65	3.55
890725.1	31.7	19.35	11.55	1	1	2	2.05	0.75
890725.1	32.65	20.15	12.15	1	1	2	0.35	1.3
890725.1	33.4	20.75	13.85	1	1	2	0.85	2.15

STATION	LENGTH (MM)	HEIGHT (MM)	WIDTH (MM)	SPINES # RIGHT VAL	SPINES # LEFT VALVE	TOTAL SPINES	LENGTH OF LONGEST SPINE RIGHT (MM)	LENGTH OF LONGEST SPINE LEFT (MM)
890601.3+	33.9	21.05	14.4	1	1	2	0.7	1.25
890916	34.6	22	13.25	2	3	5	1.35	1.95
890601.3+	35.55	22	13.5	2	3	5	2.3	3.6
890601.1	35.55	23.3	15.1	2	1	3	1.5	2.95
890725.1	35.8	22.8	14.1	1	1	2	1.8	2.05
890725.1	36.2	22.65	15	2	1	3	4.45	1.95
890601.2	36.3	23.05	15.7	2	2	4	3.45	2.85
890916	36.6	23.05	15.25	1	1	2	0.65	1.55
890725.1	36.9	22.75	14.4	1	1	2	2.65	1.1
890725.1	37.25	24.75	15.5	2	2	4	2.25	2.5
890725.1	37.85	23.3	13.05	2	2	4	1.5	2.7
890725.1	39.75	23.9	14.8	5	3	8	4.85	3.8
890725.1	39.9	24.8	15.25	2	2	4	2.6	2.6
890916	43.5	26.85	17.1	0	0	0	0	0
NUMBER	36							
MAXIMUM	43.5	26.85	17.1	6	6	12	4.85	3.8
MINIMUM	22.15	14.55	8.05	0	0	0	0	0
MEAN	31.74	20.17	12.43	2.19	2.17	4.36	2.19	2.27
S. DEV.	5.22	2.98	2.24	1.24	1.30	2.38	1.11	0.91

TABLE TWO

Tar River Spiny Mussel Survey Results
September, 1986 through July, 1988

SPECIES:

AH = Alasmidonta heterodon
AU = Alasmidonta undulata
AC = Anodonta cataracta
AI = Anodonta imbecilis
ECS = Elliptio (Canthyria) steinstansana
EL = Elliptio lanceolata
ESP = Elliptio species
FM = Fusconaia masoni
LC = Lampsilis cariosa
LR = Lampsilis radiata
SU = Strophitus undulatus
VC = Villosa constricta
VD = Villosa delumbis

Station: year, month, day, station number for day

Note: At some stations, measurements were not taken.
At these stations, presence is indicated under Live / Shells.

Station	Species	Live / Shells	Count	Maximum Length (mm)	Minimum Length (mm)	Mean Length	Standard Dev.
860915.1	ESP		40	83	26	54.68	11.83
860916.1	ESP		103	155	35	83.46	26.94
860917.1	ESP		63	108	40	74.17	12.91
860917.1	LC		4	76	55	67.25	9.39
860917.1	EL		5	62	45	53.60	6.43
860917.2	ESP		12	80	40	66.58	12.56
860917.2	EL		1	40	40	40.00	---
860917.2	LC		3	72	35	58.00	20.07
860917.2	VC	6 L	0	---	---	---	---
860917.3	ESP		9	90	58	72.89	10.47
860917.3	LC		1	73	73	73.00	---
860917.3	EL		1	31	31	31.00	---
860917.4	NONE		0	---	---	---	---
860918.1	NONE		0	---	---	---	---
860918.2	NONE		0	---	---	---	---
860918.3	ESP		14	107	45	78.64	17.99
860918.3	EL		1	59	59	59.00	---
860918.4	ESP		20	122	61	82.80	13.25
860918.4	EL		1	48	48	48.00	---
860918.4	FM	S	1	27	27	27.00	---
860918.5	NONE		0	---	---	---	---
860918.6	ESP		15	111	53	85.33	18.13
880918.6	EL		13	67	23	43.85	13.01

STATION	SPECIES	L/S	COUNT	MAX L.	MIN L.	MEAN	S. DEV.
880918.6	LC		4	72	61	67.25	5.62
860922.1	ESP		24	110	45	78.75	18.42
860922.1	SU		2	71	69	70.00	1.41
860922.2	ESP		33	125	63	89.55	15.29
860922.3	ESP		22	110	63	82.68	10.73
860922.3	LC		4	78	52	66.50	12.58
860922.3	VD		1	56	56	56.00	---
860923.1	ESP		61	106	51	79.87	14.48
860923.1	SU		1	45	45	45.00	---
860923.1	LC		1	45	45	45.00	---
860923.2	ESP		17	130	50	98.94	21.25
860923.2	LC		2	87	56	71.50	21.92
860923.2	AC	2S	0	---	---	---	---
860923.2	AU	1S	0	---	---	---	---
860923.2	LS	8S	0	---	---	---	---
860923.3	ESP		17	94	39	79.76	15.80
860923.3	LC		1	45	45	45.00	---
860923.4	ESP		64	110	54	90.50	11.91
860923.4	EL		1	45	45	45.00	---
860923.4	LC		4	80	52	60.25	13.23
860923.5	ESP		20	111	57	82.20	11.99
860923.5	LS	1S	0	---	---	---	---
860923.5	SU	2S	0	---	---	---	---
860923.5	LC	33S	0	---	---	---	---
860923.5	EL	4S	0	---	---	---	---
860923.5	AU	2S	0	---	---	---	---
860923.5	FM	1S	0	---	---	---	---
860924.1	ESP		11	151	44	81.73	37.30
860924.2	LC		1	58	58	58.00	---
860924.2	EL		1	57	57	57.00	---
860924.3	NONE		0	---	---	---	---
860924.4	NONE		0	---	---	---	---
860925.1	ESP		67	116	35	81.45	18.17
860925.1	SU	2L	0	---	---	---	---
860925.1	VC		1	36	36	36.00	---
860925.1	AH		2	29	27	28.00	1.41
860925.2	ESP		27	104	60	86.67	11.81
860925.3	NONE		0	---	---	---	---
860925.4	NONE		0	---	---	---	---
861029.1	ESP		139	156	38	85.18	30.06
861029.1	LC		1	73	73	73.00	---
861029.2	ESP		3	95	63	81.00	16.37
861030.1	LR		1	73	73	73.00	---
861030.1	AU		1	52	52	52.00	---
861030.1	LC		1	77	77	77.00	---
861030.1	ESP		34	71	37	49.56	9.50
861030.2	ESP		92	148	37	76.78	30.47
861030.3	ESP		100	136	35	61.13	18.46
870512.1	ESP		35	101	42	73.03	19.01
870512.1	LC		2	77	53	65.00	16.97
870512.1	EL		28	61	30	45.89	8.23
870512.1	FM		2	36	24	30.00	8.49
870512.2	ESP		9	74	23	44.56	20.30
870526.1	ESP		77	144	38	68.44	21.17
870526.2	ESP		69	152	50	88.52	28.94
870527.1	ESP		71	145	37	72.83	26.50

STATION	SPECIES	L/S	COUNT	MAX L.	MIN L.	MEAN	S. DEV.
870528.1	NONE		0	---	---	---	---
870528.2	NONE		0	---	---	---	---
870528.3	ESP		0	---	---	---	---
870528.4	NONE	L	0	---	---	---	---
870528.5	NONE		0	---	---	---	---
870528.6	NONE		0	---	---	---	---
870528.7	NONE		0	---	---	---	---
870528.8	NONE		0	---	---	---	---
870604.1	NONE		0	---	---	---	---
870604.2	NONE		0	---	---	---	---
870604.3	ESP	MANY	0	---	---	---	---
870604.4	ESP	S	0	---	---	---	---
870604.4	AC	S	0	---	---	---	---
870604.4	VC	S	0	---	---	---	---
870604.5	NONE		0	---	---	---	---
870605.1	ESP	MANY	0	---	---	---	---
870624.1	ESP		5	73	50	58.20	9.12
870624.1	VC	6S	0	---	---	---	---
870624.2	VC	S	0	---	---	---	---
870624.2	ESP		14	94	44	64.14	10.61
870624.3	NONE		0	---	---	---	---
870624.4	ESP		37	91	46	74.73	9.42
870624.5	NONE		0	---	---	---	---
870624.6	NONE		0	---	---	---	---
870624.7	NONE		0	---	---	---	---
870625.1	NONE		0	---	---	---	---
870625.2	ESP	S	0	---	---	---	---
870625.2	FM	3S	0	---	---	---	---
870625.3	ESP	S	0	---	---	---	---
870625.4	NONE		0	---	---	---	---
870625.5	ESP	MANY L	0	---	---	---	---
870626.1	LS	S	0	---	---	---	---
870701.1	LC	S	0	---	---	---	---
870701.2	ESP		2	60	47	53.50	9.19
870701.3	ESP		40	71	30	46.80	9.16
870701.3	LC		1	63	63	63.00	---
870701.3	LR		1	80	80	80.00	---
870707.1	ESP		144	90	35	50.94	9.87
870708.1	ECS		2	39	33	35.95	4.17
870708.1	EL	1L	0	---	---	---	---
870708.1	LC	1L	0	---	---	---	---
870708.1	ESP	MANY L	0	---	---	---	---
870709.1	ECS		2	44	44	43.70	0.00
870709.1	EL	1L	0	---	---	---	---
870709.1	LC	1L	0	---	---	---	---
870709.1	AU	1L	0	---	---	---	---
870709.1	ESP	L	0	---	---	---	---
870804.1	LC	S	0	---	---	---	---
870804.1	ESP	MANY L	0	---	---	---	---
870804.2	ECS	S	1	40	40	40.00	---
870804.2	ESP	L/S	0	---	---	---	---
870804.2	VC	S	0	---	---	---	---
870804.2	FM	3L/S	0	---	---	---	---
870805.1	LC	S	0	---	---	---	---
870805.1	ESP	L/S	0	---	---	---	---
870805.1	VC	S	0	---	---	---	---

STATION	SPECIES	L/S	COUNT	MAX L.	MIN L.	MEAN	S. DEV.
870805.1	EL	S	0	---	---	---	---
870805.1	FM	S	0	---	---	---	---
870805.1	AC	S	0	---	---	---	---
870812.1	ESP		85	87	28	59.41	9.92
870812.1	VC		2	42	20	31.13	15.66
870812.1	AU		1	49	49	49.05	---
870812.1	FM		1	43	43	43.35	---
870812.1	C	S	0	---	---	---	---
870813.1	ESP		82	95	22	66.94	16.91
870922.1	ESP	S	0	---	---	---	---
870922.1	FM	S	0	---	---	---	---
870922.1	SU	S	0	---	---	---	---
870922.1	VC	S	0	---	---	---	---
871008.1	ECS	S	1	44	44	44.35	---
871008.1	ESP	L/S	0	---	---	---	---
871008.1	VC	S	0	---	---	---	---
871008.1	FM	S	0	---	---	---	---
871008.2	LC	S	0	---	---	---	---
871008.2	VC	S	0	---	---	---	---
871008.2	SU	S	0	---	---	---	---
871008.2	ESP	S	0	---	---	---	---
880523.1	ESP	L	0	---	---	---	---
880523.2	ESP	100+ L	0	---	---	---	---
880523.2	EL	L	0	---	---	---	---
880523.2	FM	L	0	---	---	---	---
880523.2	AU	L	0	---	---	---	---
880523.3	ESP	100+ L	0	---	---	---	---
880523.3	FM	1L	0	---	---	---	---
880524.1	ESP	L	0	---	---	---	---
880524.1	AH	40+ L	0	---	---	---	---
880525.1	ESP	100+ L	0	---	---	---	---
880525.1	EL	1 L	0	---	---	---	---
880525.2	ESP	100+ L	0	---	---	---	---
880525.2	AH	L	0	---	---	---	---
880525.3	ESP	75+ L	0	---	---	---	---
880525.4	ESP	100+ L	0	---	---	---	---
880525.5	ESP	L	0	---	---	---	---
880525.5	VC	L	0	---	---	---	---
880525.5	AI	L	0	---	---	---	---
880526.1	FM	L	0	---	---	---	---
880526.1	AU	L	0	---	---	---	---
880526.1	EL	L	0	---	---	---	---
880526.1	ESP	L	0	---	---	---	---
880526.1	SU	L	0	---	---	---	---
880526.1	VC	L	0	---	---	---	---
880526.1	ECS	1S	0	---	---	---	---
880526.1	LC	1L	0	---	---	---	---
880526.2	ESP	16+ L	0	---	---	---	---
880526.3	ESP	15+ L	0	---	---	---	---
880527.1	NONE		0	---	---	---	---
880531.1	FM	L / S	0	---	---	---	---
880531.1	ESP		94	101	27	60.17	13.91
880531.1	VC		1	36	36	36.45	---
880531.1	SU	L	0	---	---	---	---
880531.1	AU	L	0	---	---	---	---
880601.1	FM		6	62	42	47.68	7.69

STATION	SPECIES	L/S	COUNT	MAX L.	MIN L.	MEAN	S. DEV.
880601.1	VC		9	39	28	33.11	3.72
880601.1	LC		1	58	58	57.95	---
880601.1	LR		1	81	81	81.15	---
880601.1	EL		3	49	43	45.90	3.15
880601.1	SU		8	72	46	60.59	7.52
880601.1	AU		9	55	49	51.72	1.71
880601.1	LR		1	81	81	81.15	---
880601.1	ESP		182	93	32	67.42	10.75
880601.2	ESP	101 L	0	---	---	---	---
880601.2	LC	1 L	0	---	---	---	---
880601.2	FM	4 L	0	---	---	---	---
880601.2	EL	2 L	0	---	---	---	---
880601.2	VC	4 L	0	---	---	---	---
880601.2	AU	4 L	0	---	---	---	---
880601.2	SU	1 L	0	---	---	---	---
880601.3	FM	1 L	0	---	---	---	---
880601.3	VC	2 L	0	---	---	---	---
880601.3	LC	1L	0	---	---	---	---
880601.3	ESP	13 L	0	---	---	---	---
880601.4	AU	1 L	0	---	---	---	---
880601.4	VC	4 L	0	---	---	---	---
880601.4	ESP	19 L	0	---	---	---	---
880601.4	ECS		1	38	38	38.20	---
880602.1	ESP	100+ L	0	---	---	---	---
880602.1	LR	1 L	0	---	---	---	---
880602.1	AU	1 L	0	---	---	---	---
880602.1	LO	1 L	0	---	---	---	---
880602.2	ESP	30+ L	0	---	---	---	---
880607.1	EL		18	59	24	39.25	9.96
880607.1	VC		3	27	25	26.03	1.00
880607.1	ESP		72	97	42	75.30	11.29
880607.1	FM	1 L	0	---	---	---	---
880608.1	FM		1	53	53	52.70	---
880608.1	ESP		115	115	32	58.06	12.69
880608.1	VC		2	36	25	30.43	7.95
880608.2	ESP	S	0	---	---	---	---
880608.2	EL	S	0	---	---	---	---
880608.3	ESP	89+ L	0	---	---	---	---
880608.3	EL	1 L	0	---	---	---	---
880608.3	VC	1 L	0	---	---	---	---
880609.1	ESP	178 L	0	---	---	---	---
880609.1	EL	28 L	0	---	---	---	---
880609.1	VC	1 L	0	---	---	---	---
880613.1	ESP		58	102	48	74.87	13.37
880613.1	VC		3	44	37	40.50	3.61
880613.1	EL		5	64	56	59.54	3.39
880613.2	ESP		14	101	63	81.81	12.81
880614.1	ESP		6	92	50	68.02	14.71
880614.4	ESP		4	91	65	79.15	12.27
880614.5	ESP		12	86	54	68.46	10.19
880614.6	ESP		115	101	35	68.24	17.25
880614.6	EL		7	85	41	52.63	15.03
880614.6	AU		2	40	24	32.15	11.10
880615.1	ESP		38	95	46	67.58	13.65
880615.2	ESP		10	91	61	73.30	8.73
880615.3	ESP		24	73	39	58.08	7.00

STATION	SPECIES	L/S	COUNT	MAX L.	MIN L.	MEAN	S. DEV.
880615.3	VC		1	26	26	25.80	---
880615.3	FM		2	42	40	41.00	1.84
880615.4	ESP		13	88	49	66.46	10.54
880615.5	ESP		11	82	47	62.52	10.72
880615.6	ESP		65	106	46	81.08	11.39
880621.1	ESP		59	92	39	68.45	11.66
880621.1	AH		1	36	36	35.55	---
880622.1	ESP		75	154	49	89.67	27.60
880622.1	LC		1	72	72	71.70	---
880622.1	LR		1	96	96	96.20	---
880622.2	ESP	2 L	0	---	---	---	---
880622.2	EL	1 L	0	---	---	---	---
880622.2	AI	2 L	0	---	---	---	---
880622.1	LR		1	96	96	96.20	---
880622.3	ESP		73	100	48	75.30	10.25
880622.3	EL		3	80	42	66.58	21.05
880627.1	ESP		81	118	61	90.61	15.46
880627.1	VD		1	55	55	55.10	---
880628.1	ESP		5	91	66	80.07	9.77
880628.1	EL		2	50	49	49.38	0.81
880628.2	ESP		73	89	46	66.81	11.86
880629.1	ESP		7	100	60	85.19	13.57
880629.1	FM	1 S	0	---	---	---	---
880629.1	EL		31	61	40	54.27	4.48
880629.2	ESP		168	104	42	75.16	11.71
880629.2	EL		1	44	44	43.85	---
880629.2	FM		1	40	40	40.25	---
880629.2	LC		5	66	49	56.68	6.19
880701.1	FM		11	60	31	47.80	9.21
880701.1	SU		1	37	37	36.60	---
880701.1	VC		1	39	39	39.10	---
880701.1	LC		1	42	42	42.25	---
880701.1	ESP		253	96	11	59.40	8.23
880705.1	ESP	+ 166 L	140	91	23	57.32	9.76
880705.1	FM		2	43	36	39.45	4.31
880705.1	VC		10	44	31	36.86	4.19
880705.1	LR		2	80	73	76.60	5.09
880705.1	EL		1	41	41	40.95	---
880706.1	FM		12	51	35	41.63	5.11
880706.1	AU		4	51	28	43.13	10.38
880706.1	ECS		2	41	22	31.38	13.61
880706.1	SU		2	55	41	47.93	9.93
880706.1	VC		1	18	18	17.50	---
880706.1	ESP	+147 L	62	85	29	49.40	11.10
880706.1	LC		2	70	59	64.25	8.06
880707.1	ESP	69 L	0	---	---	---	---
880707.2	ESP	791 L	0	---	---	---	---
880707.2	LC	1 L	0	---	---	---	---
880707.2	AU	2 L	0	---	---	---	---
880707.2	FM	1 L	0	---	---	---	---
880707.2	ECS	1 S	0	---	---	---	---
880707.3	ESP	297 L	0	---	---	---	---
880707.3	VC	2 L	0	---	---	---	---
880707.3	FM	1 L	0	---	---	---	---
880707.3	SU	1 L	0	---	---	---	---
880712.1	ESP	L	0	---	---	---	---

STATION	SPECIES	L/S	COUNT	MAX L.	MIN L.	MEAN	S. DEV.
880712.1	AH		18	44	24	31.62	5.30
880712.2	ESP	L	0	---	---	---	---
880712.2	AH		5	42	12	30.93	11.64
880713.1	ESP		146	105	36	62.77	9.79
880713.1	AU		2	45	30	37.40	10.47
880713.1	LC		1	60	60	59.60	---
880713.1	VC		3	34	21	27.87	6.46
880713.1	SU		5	56	36	47.20	7.47
880713.1	FM		6	61	28	42.95	11.23
880713.2	ESP		75	98	12	62.49	17.25
880713.2	VC		4	37	30	33.44	3.70
880713.2	SU		2	54	49	51.63	3.50
880713.2	EL		9	53	38	44.48	4.08

TABLE THREE

SPECIES BY STATION FOR TAR RIVER SPINY MUSSEL SURVEY

STATION: YEAR, MONTH, DAY. STATION NUMBER FOR DAY

COUNTY: E = EDGECOMBE, N = NASH, F = FRANKLIN, G = GRANVILLE
PI = PITT, H = HALIFAX, W = WARREN, P = PERSON, V = VANCE
MA = MARTIN

CUMULATIVE STATION NUMBER (CSN): LOCATION IDENTIFIED ON SURVEY MAP (FIGURE ONE)

ROAD: HIGHWAY OR SR NUMBER (NOTE TBOR = TARBORO, + OR - INDICATES
A SIGNIFICANT DISTANCE DOWNSTREAM (+) OR UPSTREAM (-))

SPECIES: (SEE TABLE TWO FOR SYMBOLS)

SUBSTRATE: SLT = SILT, CLY = CLAY, SND = SAND,
CO = COBBLE, B/B = BOULDERS / BEDROCK

TIME IN HOURS (TOTAL MAN-HOURS FOR 1 - 3 INDIVIDUALS)

STATION	CO	CSN	ROAD	AH	AU	AC	AI	ECS	EL	ESP	FM	LC	LR	LS	SU	VC	VD	SLT	CLY	SND	GRA	COB	B/B	HRS
871007.1	PI	1	33+															X	X	X				4
870701.2	PI	2	222							X								X		X				2
870701.1	PI	3	33+									X												0.5
870528.1	E	4	42															X		X				0.5
860924.1	E	4	42							X								X		X				1
880622.1	E	4	42							X		X	X					X		X				0.7
861030.3	E	5	TBOR							X														0.7
861030.2	E	6	TBOR							X										X				0.7
861030.1	E	7	TBOR		X					X		X	X							X				0.7

STATION	CO	CSN	ROAD	AH	AU	AC	AI	ECS	EL	ESP	FM	LC	LR	LS	SU	VC	VD	SLT	CLY	SND	GRA	COB	B/B	HRS
870707.1	E	8	TBOR							X								X		X				3
880602.2	E	8	TBOR							X								X	X	X				1.5
870701.3	E	8	TBOR							X		X	X							X				2
870512.2	E	8	TBOR							X														3
870526.1	E	8	TBOR							X										X				1
861029.2	E	8	TBOR-							X										X				0.7
860915.1	E	8	TBOR							X										X				4
870526.2	E	8	TBOR							X										X			B	1
870527.1	E	9	TBOR							X										X				1.3
870708.1	E	9	TBOR+					X	X	X		X								X				1
870709.1	E	9	TBOR+		X			X	X	X		X								X				8
880707.2	E	9	TBOR+		X			S		X	X	X						X		X				1.5
880602.1	E	9	TBOR+		X					X		X	X					X	X	X				2
860916.1	E	9	TBOR							X								X		X				7
861029.1	E	9	TBOR+							X		X								X	X			0.7
870804.1	E	9	TBOR+							X		X						X		X				3
870528.2	E	10	44															X		X				0.5
870626.1	N	11	1544											X				X		X				0.7
860917.4	N	12	1001															X						
860917.3	N	13	581						X	X		X						X		X	X	X		0.7
870805.1	N	14	1145			X			X	X	X	X				X				X	X	X	B	1
860917.2	N	14	1145						X	X		X				X				X				1
860917.1	N	15	64A						X	X		X								X	X	X		0.5
860918.2	F	16	1612															X						
860918.1	F	17	1611															X						
860918.3	F	18	1609						X	X								X		X				1.5
860918.4	F	19	1001						X	X	X							X		X				1
860918.6	F	20	1003						X	X		X								X				1.5

STATION	CO	CSN	ROAD	AH	AU	AC	AI	ECS	EL	ESP	FM	LC	LR	LS	SU	VC	VD	SLT	CLY	SND	GRA	COB	B/B	HRS
870512.1	F	20	1003						X	X	X	X								X	X			3
880629.1	F	20	1003						X	X	X									X	X			1.7
860924.3	V	21	1															X						0
860924.2	V	22	1101									X						X		X				0.5
860923.5	G	23	1622		X				X	X	X	X		X	X					X		X	B/B	1.5
880629.2	G	23	1622						X	X	X	X						X		X	X	X		1.7
860923.4	G	24	96						X	X		X						X		X			B/B	1
860923.3	G	25	15							X		X						X		X				0.5
860925.4	G	26	1133															X		X			B	0.5
860923.2	G	27	1004		X	X				X		X		X										1
860925.2	G	28	1150							X										X	X	X	B	0.7
860923.1	G	30	1138							X		X			X					X	X	X		0.5
860925.1	G	31	1141	X						X					X	X				X	X	X		0.7
880712.1	G	32	158+	X						X								X		X				1.5
880524.1	G	32	158+	X						X							X	X		X				8
860922.1	G	32	158							X					X					X	X	X	B/B	1
880627.1	G	33	1145-							X							X	X		X	X	X	B/B	1.7
860922.2	G	33	1145							X												X		0.7
860922.3	P	34	1567							X		X					X			X	X	X		1
880628.2	PI	35	1538							X										X				1
880628.1	PI	36	1425						X	X								X		X				0.5
880628.3	MA	37	1159															X						0.5
880527.1	E	38	64															X		X				0.7
880525.4	F	39	1613							X								X	X	X				1
880525.1	F	40	98						X	X								X		X				1
880712.2	F	41	1001	X						X								X		X				1.5
880525.2	F	41	1001	X						X								X		X				1
880525.3	F	42	1103							X								X	X	X	X	X	B/B	1
880621.1	F	43	401	X						X								X	X	X				2.5

STATION	CO	CSN	ROAD	AH	AU	AC	AI	ECS	EL	ESP	FM	LC	LR	LS	SU	VC	VD	SLT	CLY	SND	GRA	COB	B/B	HRS
860918.5	F	43	401																	X			/B	0.3
870604.2	F	45	1203																	X				0.2
870604.1	F	46	56																					0.2
860925.3	G	47	1151															X		X	X			0.5
880622.2	E	48	258				X		X	X								X		X				0.3
880622.3	E	49	1505						X	X								X	X	X				1
870528.4	E	50	1500																					0.3
880523.3	E	50	1500							X	X							X		X				1
870528.5	E	51	1429															X						0.3
870528.6	E	52	301															X						0.2
880713.2	H	53	1002						X	X					X	X				X	X			1.3
880608.2	H	54	1322						X	X										X	X	X		1
880608.3	H	55	561						X	X						X				X	X			2
880615.1	H	56	1312							X								X				X		1
880615.2	H	57	1310							X														0.3
880615.6	H	58	1306							X											X			1.5
880615.5	H	59	1304							X								X		X				0.5
880615.4	H	60	1315							X								X			X			0.3
880615.3	H	61	1315							X	X					X				X				1.1
880613.1	W	62	1509						X	X						X					X			1.7
880613.2	W	63	1509							X								X						0.7
880609.1	W	64	1510						X	X						X				X				2
880614.1	W	65	1507							X														0.5
880614.2	W	66	1504																					0.5
880614.3	W	67	1325																	X				0.5
880713.3	W	68	1510															X	X	X	X			0.5
880526.2	N	69	1400							X								X	X	X	X	X	B	1
880614.6	W	70	1640		X				X	X										X	X			1.7
880705.1	W	70	1640						X	X	X		X			X				X	X			2.7
880614.4	W	71	1634							X											X			0.5
880614.5	W	72	1634							X										X	X			0.7

STATION	CO	CSN	ROAD	AH	AU	AC	AI	ECS	EL	ESP	FM	LC	LR	LS	SU	VC	VD	SLT	CLY	SND	GRA	COB	B/B	HRS
870624.6	W	73	1100																	X	X	X	B	0.5
870624.2	W	74	58							X						X		X		X	X			0.7
870624.3	W	75	1620															X		X				0.1
870624.4	W	76	401							X								X	X	X	X			0.7
880707.1	E	77	1253							X								X		X				1.3
870528.3	E	77	1253							X										X				1
870625.5	E	77	1253							X										X				4
880523.2	E	77	1253		X				X	X	X							X		X				1
870528.8	E	78	97							X														0.5
870528.7	E	79	1428																					0.2
880523.1	E	80	1409							X								X		X				1
870625.3	N	81	1003							X								X		X	X	X	B	0.7
870625.2	N	82	1310							X	X							X		X	X	X	B	0.5
870812.1	N	82	1310		X					X	X	X				X				X	X	X	B	2
870804.2	N	82	1310					S		X	X					X		X		X	X	X		3
880706.1	N	82	1310		X			X		X	X	X			X	X		X		X	X			3
880713.1	N	82	1310		X					X	X	X			X	X		X	X	X		X		1
870922.1	N	82	1310							X	X				X	X								2
871008.1	N	82	1310					S		X	X					X		X		X	X	X	B	5
880526.1	N	83	1403+		X			S	X	X	X	X			X	X		X	X	X	X			8
870625.1	N	83	1403															X		X	X	X	B	0.5
880526.3	N	84	1405							X								X	X	X	X	X	B/B	1
871008.2	N	84	1405							X		X			X	X		X		X			/B	
880701.1	F	85	1405+							X	X	X			X	X				X	X			1.5
880531.1	F	85	1449		X					X	X				X	X		X		X				1.3
880707.3	F	86								X	X				X	X		X		X		X		0.7
880608.1	F	86	58+							X	X					X			X	X	X			4
880601.4	F	87	58+		X			X		X						X				X	X			3

STATION	CO	CSN	ROAD	AH	AU	AC	AI	ECS	EL	ESP	FM	LC	LR	LS	SU	VC	VD	SLT	CLY	SND	GRA	COB	B/B	HRS
880601.2	F	87	58+		X				X	X	X	X			X	X				X				0.7
880601.1	F	87	58+		X				X	X	X	X	X		X	X		X		X	X	X		3.5
880601.3	F	87	58+							X	X	X				X				X				0.2
880607.1	F	88	1451-						X	X	X					X		X		X	X			4.7
870624.1	F	89	1433							X						X		X		X				0.5
870604.3	F	91	401							X										X				1
870813.1	F	91	401							X								X	X	X				2
870605.1	F	91	1412+		X					X						X		X	X	X	X	X		12
870604.4	V	92	1523			X				X						X				X	X	X	B	0.5
880525.5	V	92	1523				X			X						X		X	X	X	X	X	B/B	1
870604.5	V	93	1526																					0.2
TOTALS		93		6	17	3	2	8	30	108	27	33	6	4	15	31	3							131

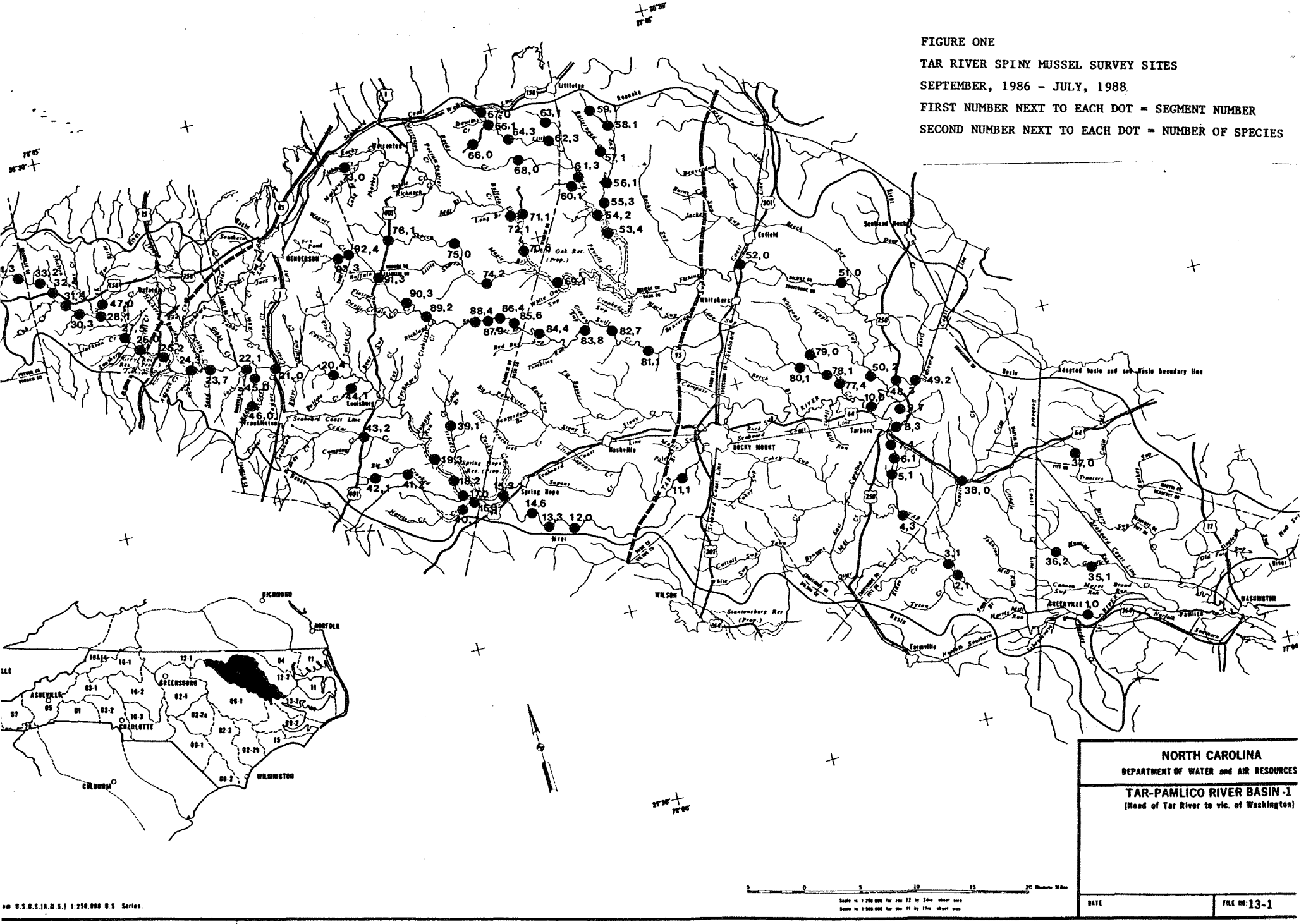
FIGURE ONE

TAR RIVER SPINY MUSSEL SURVEY SITES

SEPTEMBER, 1986 - JULY, 1988

FIRST NUMBER NEXT TO EACH DOT = SEGMENT NUMBER

SECOND NUMBER NEXT TO EACH DOT = NUMBER OF SPECIES



NORTH CAROLINA

DEPARTMENT OF WATER and AIR RESOURCES

TAR-PAMLICO RIVER BASIN -1

(Head of Tar River to vic. of Washington)

DATE

FILE NO: 13-1

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FIGURE TWO

Max. and Min. Shell Lengths for Mussels Measured from Swift Creek

During the Period May 31-July13, 1988

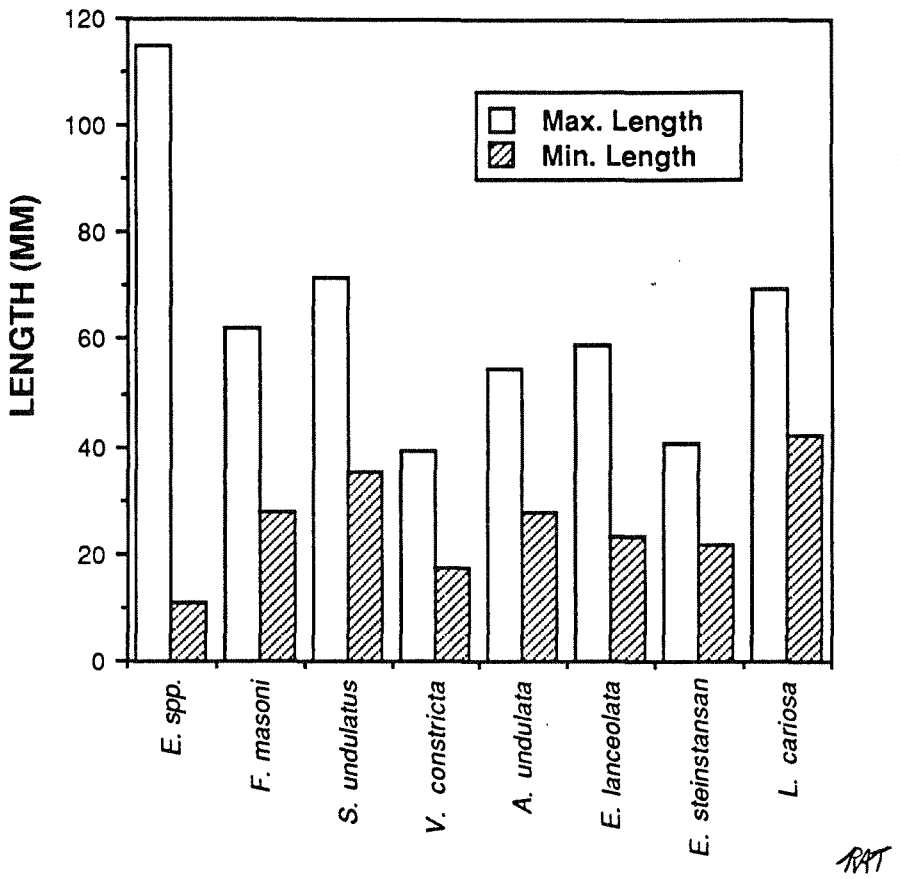


FIGURE THREE

Mean Shell Lengths for Mussels Measured from Swift Creek During the Period May 31-July 13, 1988

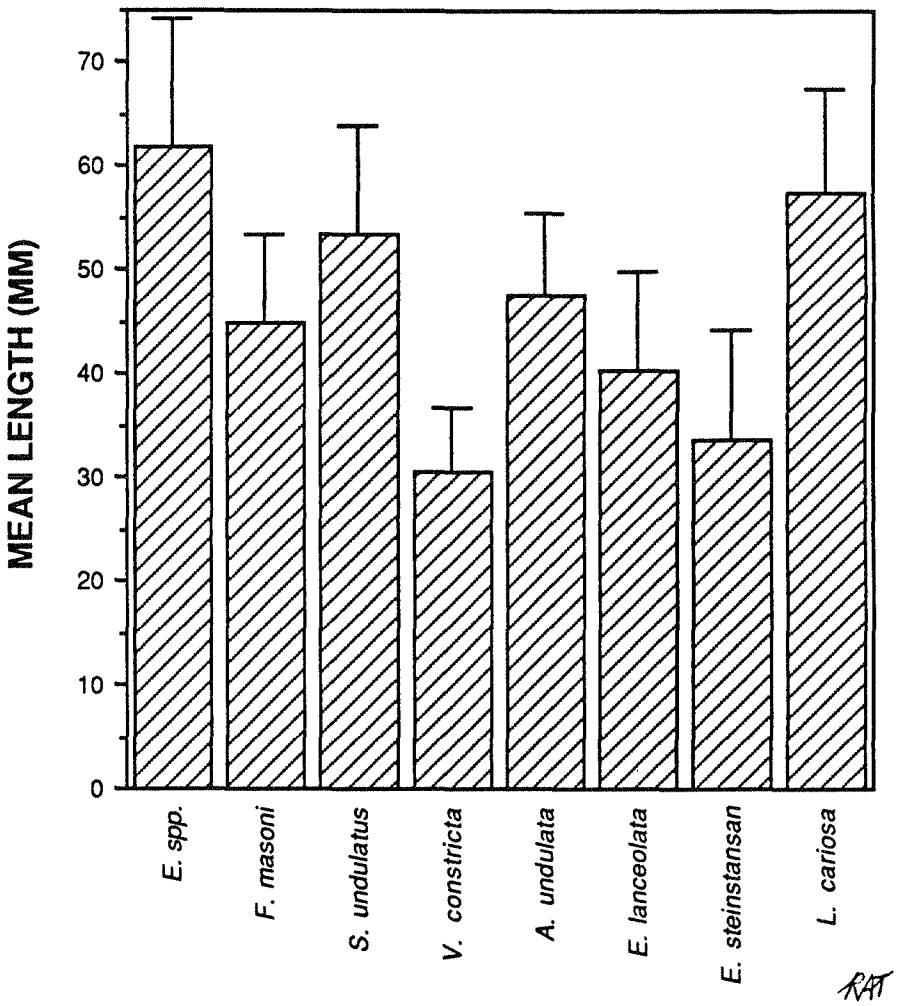


FIGURE FOUR

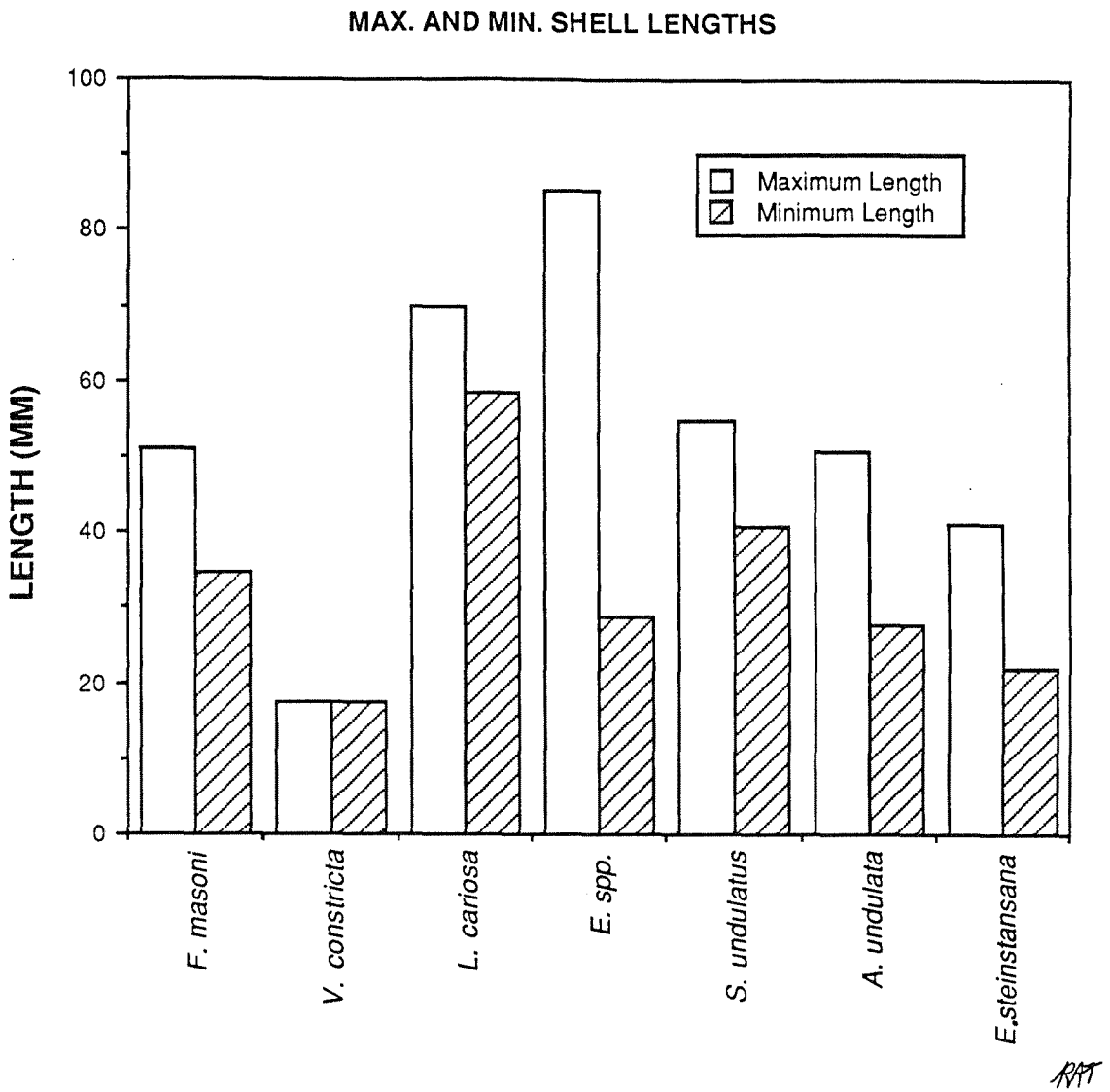
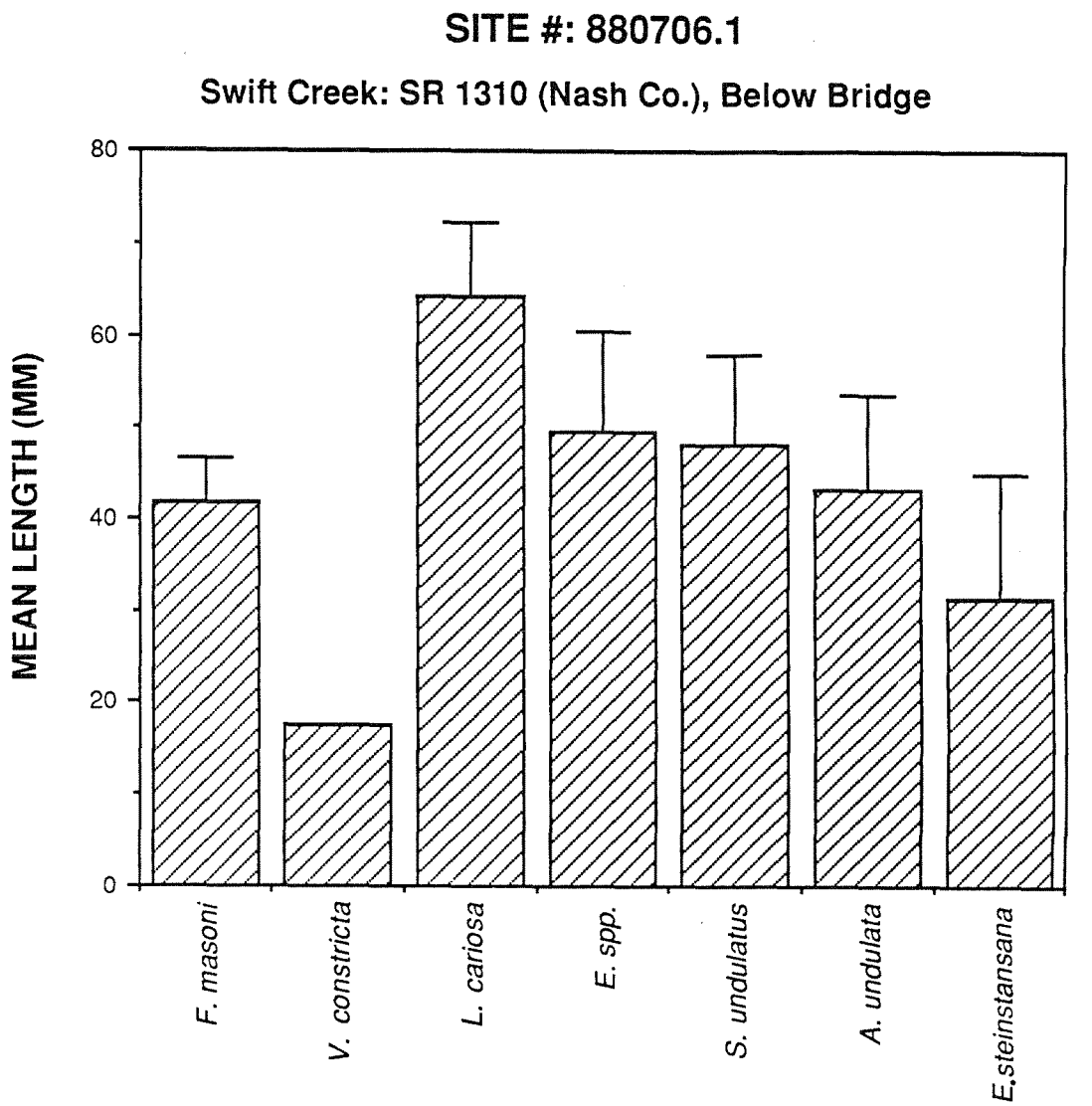

SITE #: 880706.1
Swift Creek: SR 1310 (Nash Co.), Below Bridge
MAX. AND MIN. SHELL LENGTHS
LENGTH (MM)
100
80
60
40
20
0
Maximum Length
Minimum Length
F. masoni
V. constricta
L. cariosa
E. spp.
S. undulatus
A. undulata
E.steinstansana
RAT

FIGURE FIVE



RAT

FIGURE SIX

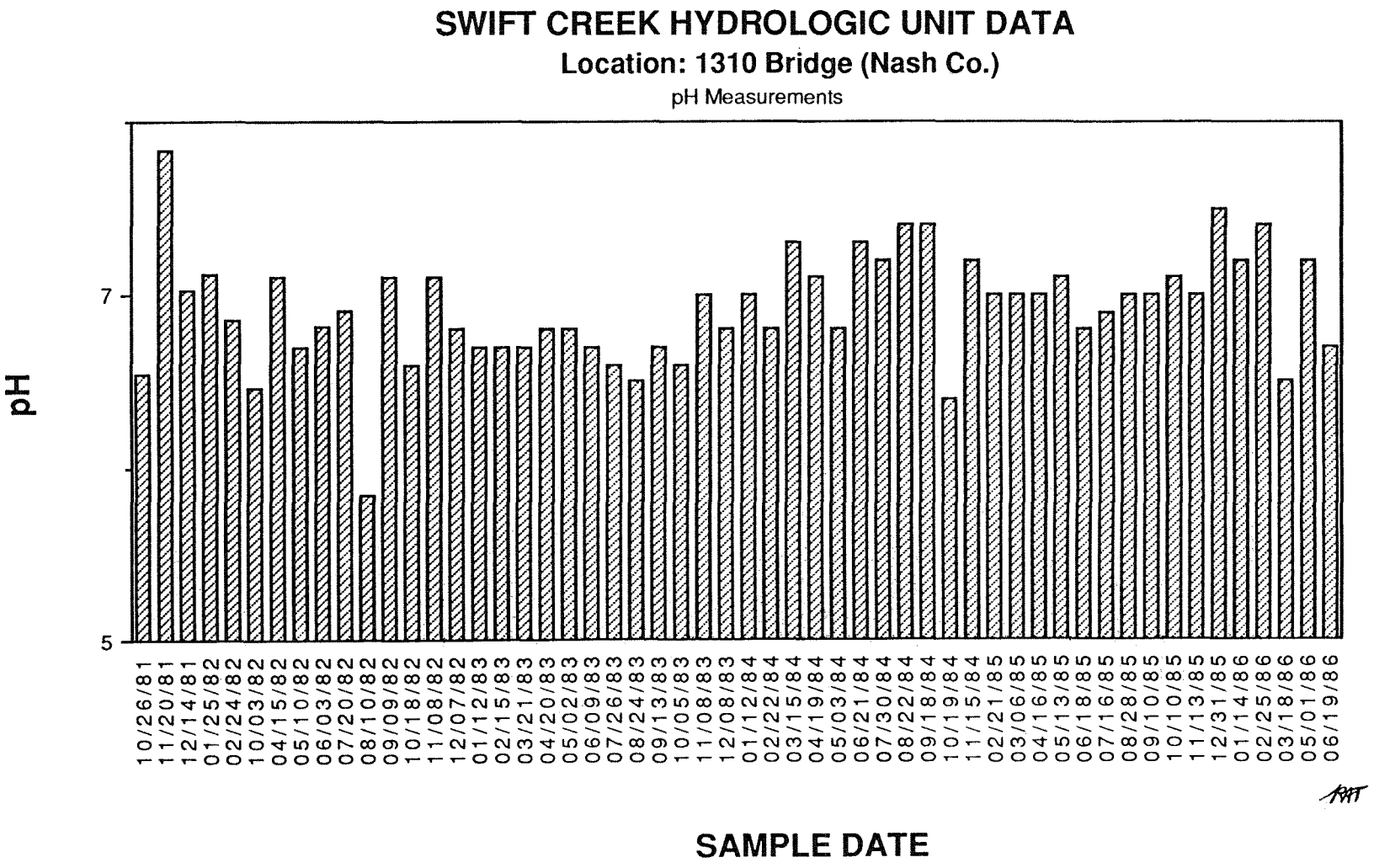

SWIFT CREEK HYDROLOGIC UNIT DATA
Location: 1310 Bridge (Nash Co.)
pH Measurements
pH
7
5
10/26/81
11/20/81
12/14/81
01/25/82
02/24/82
10/03/82
04/15/82
05/10/82
06/03/82
07/20/82
08/10/82
09/09/82
10/18/82
11/08/82
12/07/82
01/12/83
02/15/83
03/21/83
04/20/83
05/02/83
06/09/83
07/26/83
08/24/83
09/13/83
10/05/83
11/08/83
12/08/83
01/12/84
02/22/84
03/15/84
04/19/84
05/03/84
06/21/84
07/30/84
08/22/84
09/18/84
10/19/84
11/15/84
02/21/85
03/06/85
04/16/85
05/13/85
06/18/85
07/16/85
08/28/85
09/10/85
10/10/85
11/13/85
12/31/85
01/14/86
02/25/86
03/18/86
05/01/86
06/19/86
SAMPLE DATE

FIGURE SEVEN

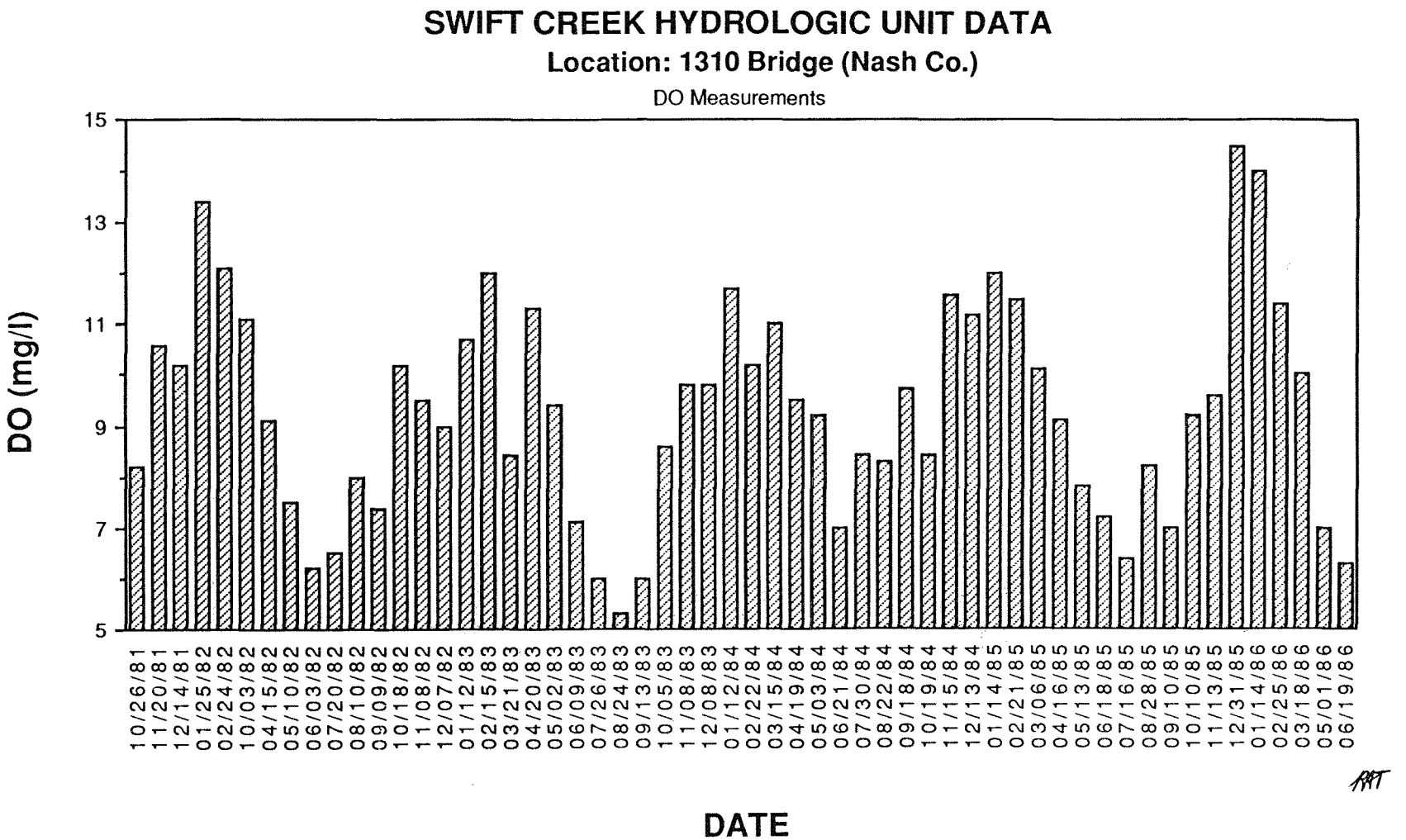
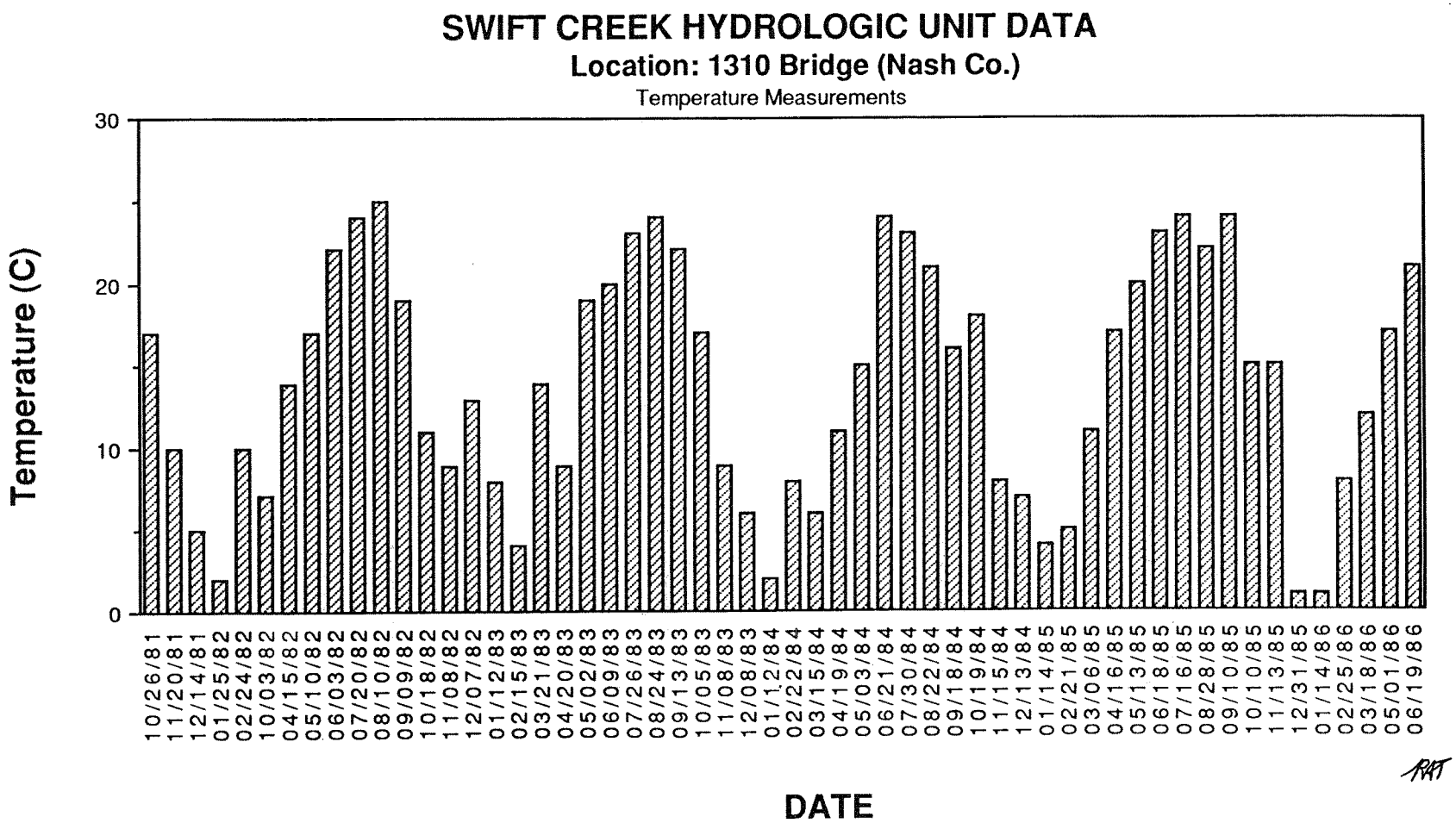


FIGURE EIGHT

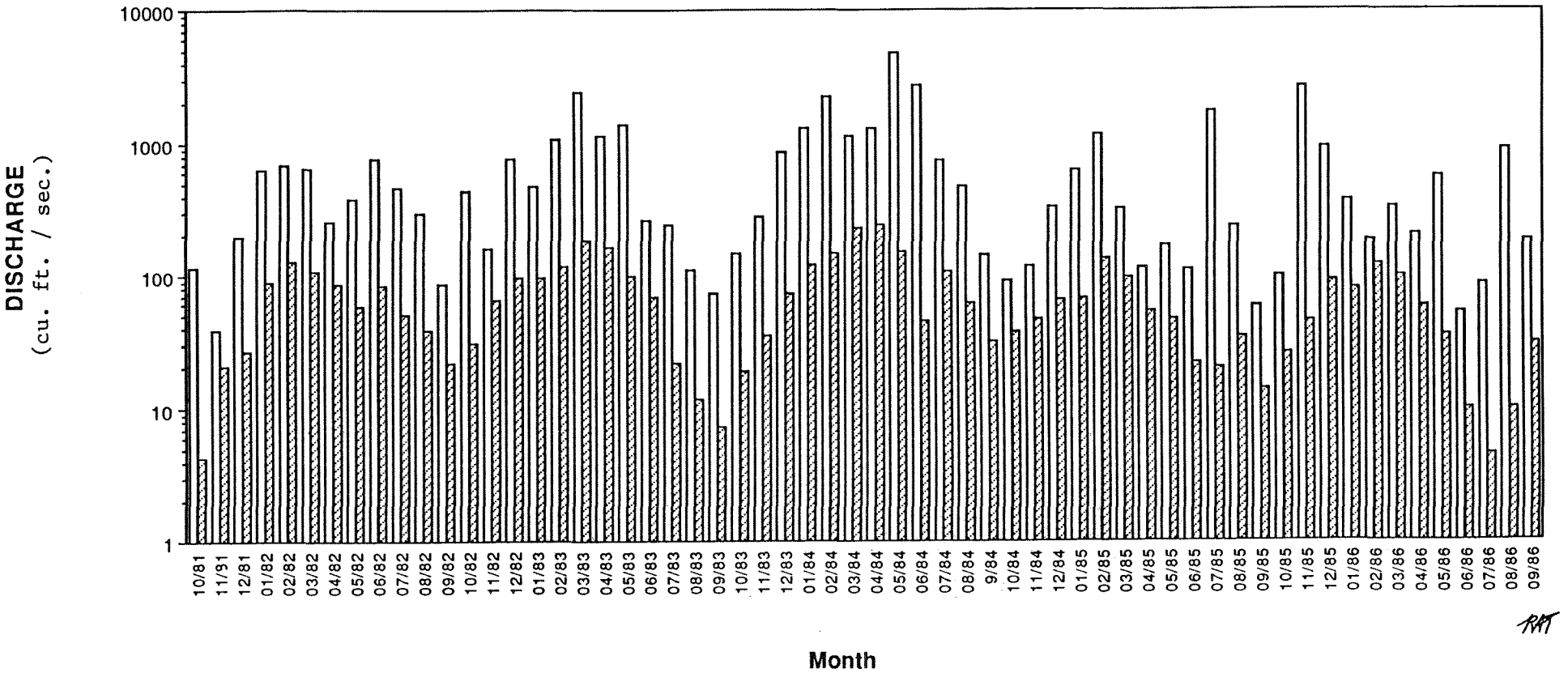


RAT

FIGURE NINE

SWIFT CREEK HYDROLOGIC UNIT DATA

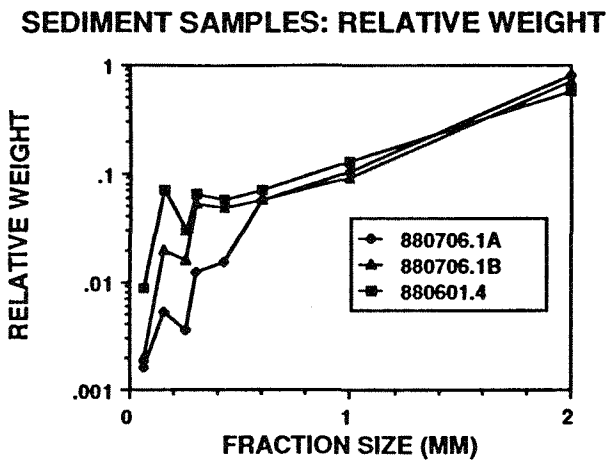
Location: 1310 Bridge (Nash Co.)
Max. and Min. Monthly Discharge

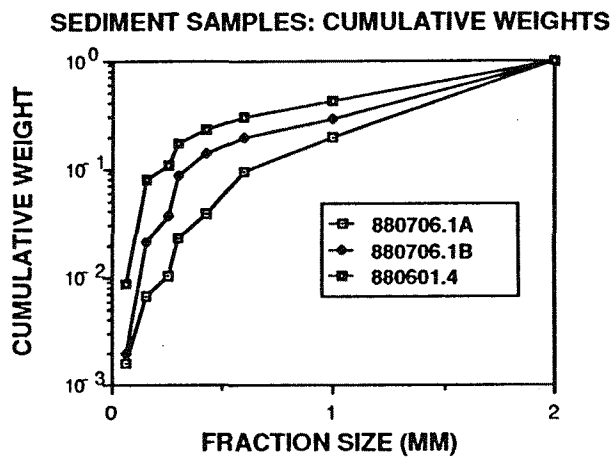


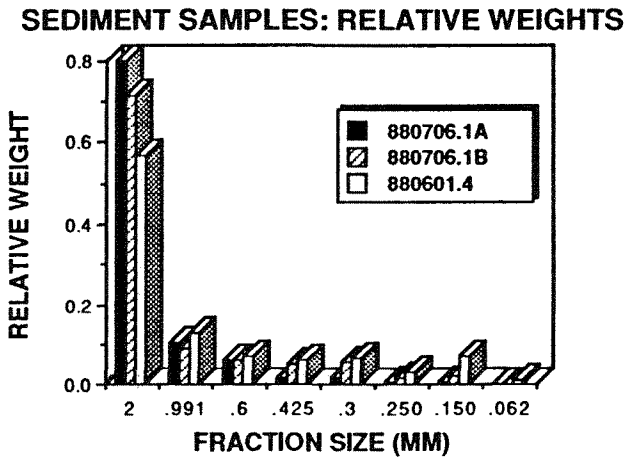
RAT

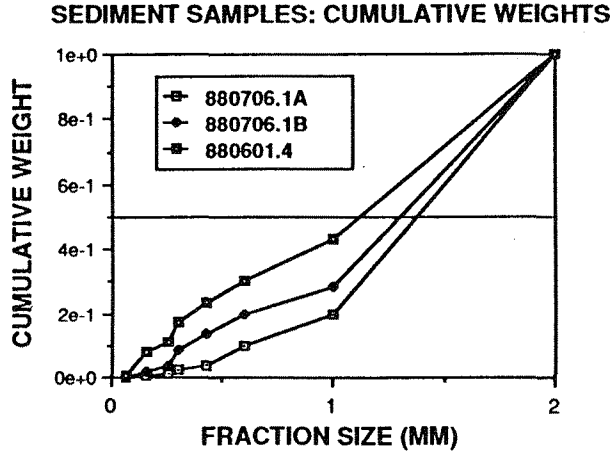
FIGURE TEN

TAR RIVER SPINY MUSSEL PROJECT
SEDIMENT SAMPLE DATA









PREPARED BY R. TANKERSLEY

Habitat. It appears that the Tar River spiny mussel's preferred habitat includes the following:

1. relatively fast flowing, well oxygenated, circumneutral pH water
2. relatively silt-free, uncompacted, gravel / coarse sand substrate
3. sites prone to significant swings in water velocity

Presently, this preferred habitat exists only in Swift Creek and in limited other areas of the Tar River Drainage Basin. This habitat is usually found in shallow water areas. However, muskrat middens along Swift Creek associated with deeper waters have produced Tar River spiny mussel shells. Their presence in these deep water habitats can be explained once the substrate is explored. In virtually every instance, there is gravel / coarse sand substrate toward the middle of the creek channel.

Habitat diversity is relatively low in the Tar River in Edgecombe County because of sedimentation problems; however, live spiny mussels found in the Tar River during 1987 were in habitat which most closely approximated the above preferred habitat.

Life History and Ecology.

It is likely that the James spinymussel and the Tar River spiny mussel are closely related. They probably shared a common ancestor which was carried into the Atlantic Drainages when the Roanoke River captured a major tributary of the New River. Johnson (1970), Ross (1969), and Fuller (1973) give biological evidence for the stream capture event between the New and Roanoke rivers. Subsequent stream capture events between the Roanoke and nearby drainages probably dispersed this ancestral species into the Tar, James, and possibly other rivers farther south. The ancestral species may have been lost from the Roanoke through natural causes or because of man's land-use activities.

If the two spiny mussel species from North Carolina and Virginia are closely related, there is a high probability that they share fish hosts. In their field studies, Hove and Neves observed James spinymussel glochidia on common shiners, rosyside dace, bluehead chubs, pumpkinseeds, and fantail darters. Hove and Neves found the highest frequency of glochidial infestation on bluehead chubs, common shiners, and rosyside dace. Rosyside dace, bluehead chub, and pumpkinseed are part of the Tar River and Swift Creek fish fauna. In their laboratory studies, Hove and Neves identified other species which may be host fish for the James spinymussel. Two of these species - satinfin and rosefin shiners - are also part of the Tar River and Swift

Creek fish fauna. If the assumption is correct that these five, relatively common, fish species may serve as glochidial fish hosts for the Tar River spiny mussel, then it is unlikely that the availability of fish hosts is causing a decline in this species.

Johnson (1970) is probably correct in his belief that the spines on Elliptio spinosa help to stabilize the mussels in the substrate. Similarly, I believe the spines also serve the same function for the Tar River spiny mussel found in the coarse sands and gravels in relatively pristine areas of the Tar River Drainage Basin. The spines and anchoring by the foot probably help to maintain the mussels in their preferred position in the substrate and, most importantly, help to prevent the spiny mussels from being pulled from the substrate while they are feeding in the relatively fast flowing water. Support for this argument comes from the observation that E. spinosa, E. steinstansana, and some young P. collina shells have linear ridges below the spines on the inside of the shells. These ridges probably offer support for the shell when environmental stresses are applied to the spines.

When working in coarse sand / gravel substrates, species associates which are good indicators for the presence of the Tar River spiny mussel include (in decreasing order of association) Fusconaia masoni, Elliptio lanceolata, Lampsilis cariosa, Villosa constricta, Alasmidonta undulata, Strophitus undulatus, and Lampsilis ochracea.

Johnson (1970) stated that Fusconaia masoni appeared to be closely associated with Pleurobema collina in the James River Drainage Basin. This same close association is true for the Tar River spiny mussel and Fusconaia masoni. In habitats which have not been significantly degraded in the Tar River Drainage Basin, the presence of Fusconaia masoni is the best indicator of the potential presence of Elliptio steinstansana.

Note: During a recent visit to the Smithsonian Institution, J. M. Alderman and A. G. Gerberich (unpubl. information) found a specimen in the type collection which looks exactly like an unspined Tar River spiny mussel. This species, Unio castus, was described by I. Lea (1860) using this single specimen from South Carolina (location in the state unknown). T. A. Conrad (1838) stated that a spined Unio could be found abundantly near Columbia, South Carolina in the 1800s. Further research may show that the appropriate name for the spined species from the Tar River should be Elliptio castus, and its range may extend into South Carolina.

Recommendations. Improved land use practices are essential in the Tar River Drainage Basin. Of the 17 drainages in North Carolina, erosion rates are greatest in the Tar River Drainage Basin. Forestry and agricultural Best Management Practices need to be implemented by all landowners, and NPDES permit limits should be enforced. Local zoning is greatly needed to protect water resources, and individual citizens need to be educated about their responsibilities to protect the environment.

It is also important that we determine whether this species ranges into South Carolina. If it does, these populations should be protected.

Remarks. The Tar River spiny mussel has always been a rare species. Probably the major reason for its historic rarity is that its preferred habitat in the riffle areas with a gravel / coarse sand substrate is often lost when sedimentation problems develop. Sedimentation of aquatic habitats has been a major problem in the Tar River Drainage Basin since the early 1800s.

B.F. Baldwin (1816) surveyed the Tar River from Louisburg to Washington for impediments to navigation. He documented immense numbers of roots, logs and trees, sand shoals, and obstructions increased by the cutting of trees into the river by the proprietors of the banks. Baldwin stated that the "obstructions divert the usual course of the current, to the great injury of the banks, which are now so much washed and undermined . . ." Local residents who had observed the river for many years informed Baldwin that the sandy shoals had gradually increased. Hamilton Fulton (1819) corroborated Baldwin's findings. In a report to the Board for the Internal Improvements of the State of North Carolina, Fulton gave a clear description of navigation conditions in the Tar River. He also found numerous sand shoals, sunken logs, and floating logs. At times trees were so numerous in the river channel that he had to cut a passage through the trees for his canoe's passage.

In recognition of the seriousness of the obstructions found in the Tar River, the United States Senate passed S. Bill 83 (1820) consenting to the N.C. general assembly's act passed in 1816 to remove "logs, shoals, and other impediments, in the Tar River, below the town of Washington, ..."

Clearly, sedimentation has been a contributing factor in the decline of the Tar River spiny mussel for almost 200 years. The Tar River spiny mussel populations in Swift Creek and the Tar River can only remain viable if erosion and other forms of environmental degradation are controlled.

Acknowledgements. Significant contributions to the Tar River mussel survey were provided by Bill Adams, Eric Alderman, Joseph Alderman, Richard Biggins, Jack Donnelly, Debbie Scruggs, Jim Spangler, Richard Tankersley, and Jim Widlak. Sediment sample analysis and all graphic figure preparations were completed by Richard Tankersley.

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Nongame & Endangered Wildlife Program
North Carolina Wildlife Resources Commission

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B. Target Dates for Achievement and Accomplishments

Jobs ES6-1 through ES6-4:

All activities were accomplished on schedule. (A one year extension for completion of laboratory activities was scheduled for this project.)

C. Significant Deviations

Jobs ES6-1 through ES6-4: No significant deviations

D. Remarks: None

E. Recommendations:

It should be noted that the state of North Carolina has recently initiated significant efforts to improve water quality in the Pamlico Drainage Basin. However, without expanded monitoring, management, and protection of Tar River spiny mussel habitat in Swift Creek and the Tar River, *Elliptio* (*Canthyria*) *steinstansana* may become extinct in the very near future.

F. Cost: $72,534