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MEMOIRS OF THE HOURGLASS CRUISES

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SEAROBINS (PISCES: TRIGLIDAE)

BY

STEPHEN T. ROSS[1]

ABSTRACT

Eleven species of searobins were collected during Project Hourglass, a series of monthly collections (August 1965-November 1967) in 6 to 73 m depths on the central West Florida Shelf. Two of these species, *Prionotus scitulus* and *P. tribulus*, were also collected during a 15-month study (1972-73) in Tampa Bay, Florida. Three of the 11 species, *Prionotus stearnsi*, *Bellator brachychir* and *B. egretta*, were collected only rarely and were excluded from detailed analyses.

Major searobin prey were small crustaceans (especially pasiphaeid shrimp), polychaetes and lancelets. Fishes, principally *Bregmaceros atlanticus*, were eaten by *P. roseus*, *P. alatus* and *P. salmonicolor*. Feeding activity of *P. roseus*, *P. alatus* and *Bellator militaris* was greatest during daylight hours.

Prionotus scitulus, *P. martis*, *P. roseus*, *P. salmonicolor*, and *P. alatus* reproduced primarily during spring and late summer. *Prionotus tribulus* spawned between fall and early spring. *Bellator militaris* and *P. ophryas* apparently had greatly protracted spawning activity.

The eight species showed distinct differences in bathymetric distribution. *Prionotus scitulus*, a year-round inhabitant of Tampa Bay, was also collected at the 6 m stations of Project Hourglass. *Prionotus tribulus* occurred in the shallow Hourglass Stations (6-18 m), and also in Tampa Bay.

[1] Department of Biology, S.S. Box 5018, University of Southern Mississippi, Hattiesburg, MS 39401.

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Prionotus martis, *P. ophryas* and *P. roseus* were abundant at 18 m; *P. roseus*, *P. salmonicolor*, *P. ophryas*, and *Bellator militaris* were abundant between 37 and 55 m; and *P. alatus* and *B. militaris* were abundant at 73 m.

Searobins were more abundant along the northern Hourglass transect off Tampa Bay than the southern transect off Fort Myers.

INTRODUCTION

Searobins of the genera *Prionotus* and *Bellator* are major components of demersal fish faunas in the Western Hemisphere, ranging from temperate to subtropical and tropical regions. In the Gulf of Mexico, searobins are included in the industrial bottom fish fishery (Roithmayr, 1965; Gutherz et al., 1975) and may also be quite important as forage for many commercially important species (Lewis and Yerger, 1976).

Ecological information on searobins from the Gulf of Mexico is primarily limited to studies on northeastern and eastern species. Lewis and Yerger (1976) examined distribution, food habits and reproduction of five species from the northeastern Gulf of Mexico. In two previous studies, I treated the relationship of body size and food size to resource partitioning of searobins from the West Florida Shelf and Tampa Bay (Ross, 1977) and the trophic development of *P. scitulus* from Tampa Bay (Ross, 1978). The purpose of this paper is to compare distribution, reproduction and feeding of eight species which occur on the West Florida Shelf. The species treated are: *Prionotus scitulus* Jordan and Gilbert, *P. martis* Ginsburg, *P. tribulus* (Cuvier), *P. ophryas* Jordan and Swain, *P. salmonicolor* (Fowler), *P. roseus* Jordan and Evermann, *P. alatus* Goode and Bean, and *Bellator militaris* (Goode and Bean). Three additional species, *P. stearnsi* Jordan and Swain, *B. brachychir* (Regan), and *B. egretta* (Goode and Bean) were collected rarely and are treated only briefly, as is *P. rubio* Jordan which did not occur in the Hourglass collections.

ACKNOWLEDGMENTS

I thank the Florida Department of Natural Resources (FDNR), St. Petersburg, for allowing me to study searobins collected during Project Hourglass. Robert W. Topp and Frank H. Hoff, Jr. (both formerly with FDNR), and George C. Miller, National Marine Fisheries Service (NMFS), kindly made specimens from Project Hourglass available to me. I am especially grateful to James Seagle (formerly with FDNR) for drawings of the searobins. Elmer Gutherz (NMFS), Bennie Rohr (NMFS), Tim Modde (Univ. Southern Miss.), Ron Lukens (Gulf Coast Research Laboratory), and Dr. Stanley Weitzman, United States National Museum (USNM) kindly provided comparative searobin material.

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METHODS AND MATERIALS

Searobins were obtained from two sources: a 28-month series (August 1965 - November 1967) offshore collections (Project Hourglass) in the eastern Gulf of Mexico conducted by FDNR, and monthly collections at three localities in Tampa Bay, Florida (Ross, 1977; 1978).

Locations and depths of the Hourglass stations are presented in Table 1 and Figure 1.

Detailed information on rationale, gear, cruise patterns, as well as all physical data collected during Project Hourglass were given by Joyce and Williams (1969). The fisheries program involved monthly, late afternoon to night collections at Stations A-E and I-M. Stations B, C and D were resampled later each month during daylight hours. A 6.1 m trynet with 5 cm stretched mesh, and a 0.9 m box dredge were used on both day and night collections. Supplementary sampling of all fisheries stations was done at night in July 1966 and January 1967 using a 13.7 m balloon-type otter trawl.

Tampa Bay stations were sampled from April 1972 to June 1973. Locations of these stations, with depths to the nearest meter, were: Station 1, 27°50'N, 82°27'W, 5 m; Station 2, 27°45'N, 82°35'W, 5 m; Station 3, 27°37'N, 82°41'W, 7 m. Fishes were captured by 3.6 m otter trawl with 2.5 cm stretched mesh and a 0.5 cm cod-end liner. All specimens were injected with 10% Formalin immediately upon capture, fixed in 10% Formalin for several weeks, and then washed in water and stored in 40% isopropanol.

I examined stomach contents from all Project Hourglass searobins available, except for several lots accessioned into the FDNR Marine Research Laboratory fish collection (FSBC). Data

TABLE 1. LOCATIONS AND DEPTHS OF HOURGLASS FISHERY STATIONS

Station	Latitude*	Longitude*	Established Depth (meters)	Approximate Nautical Miles Offshore*
A	27°35'N	82°50'W	6.1	4, due W of Egmont Key
B	27°37'N	83°07'W	18.3	19, due W of Egmont Key
C	27°37'N	83°28'W	36.6	38, due W of Egmont Key
D	27°37'N	83°58'W	54.9	65, due W of Egmont Key
E	27°37'N	84°13'W	73.2	78, due W of Egmont Key
I	26°24'N	82°06'W	6.1	4, due W of Sanibel Island Light
J	26°24'N	82°28'W	18.3	24, due W of Sanibel Island Light
K	26°24'N	82°58'W	36.6	51, due W of Sanibel Island Light
L	26°24'N	83°22'W	54.9	73, due W of Sanibel Island Light
M	26°24'N	83°43'W	73.2	92, due W of Sanibel Island Light

*U. S. Coast and Geodetic Chart No. 1003, dated June 1966.

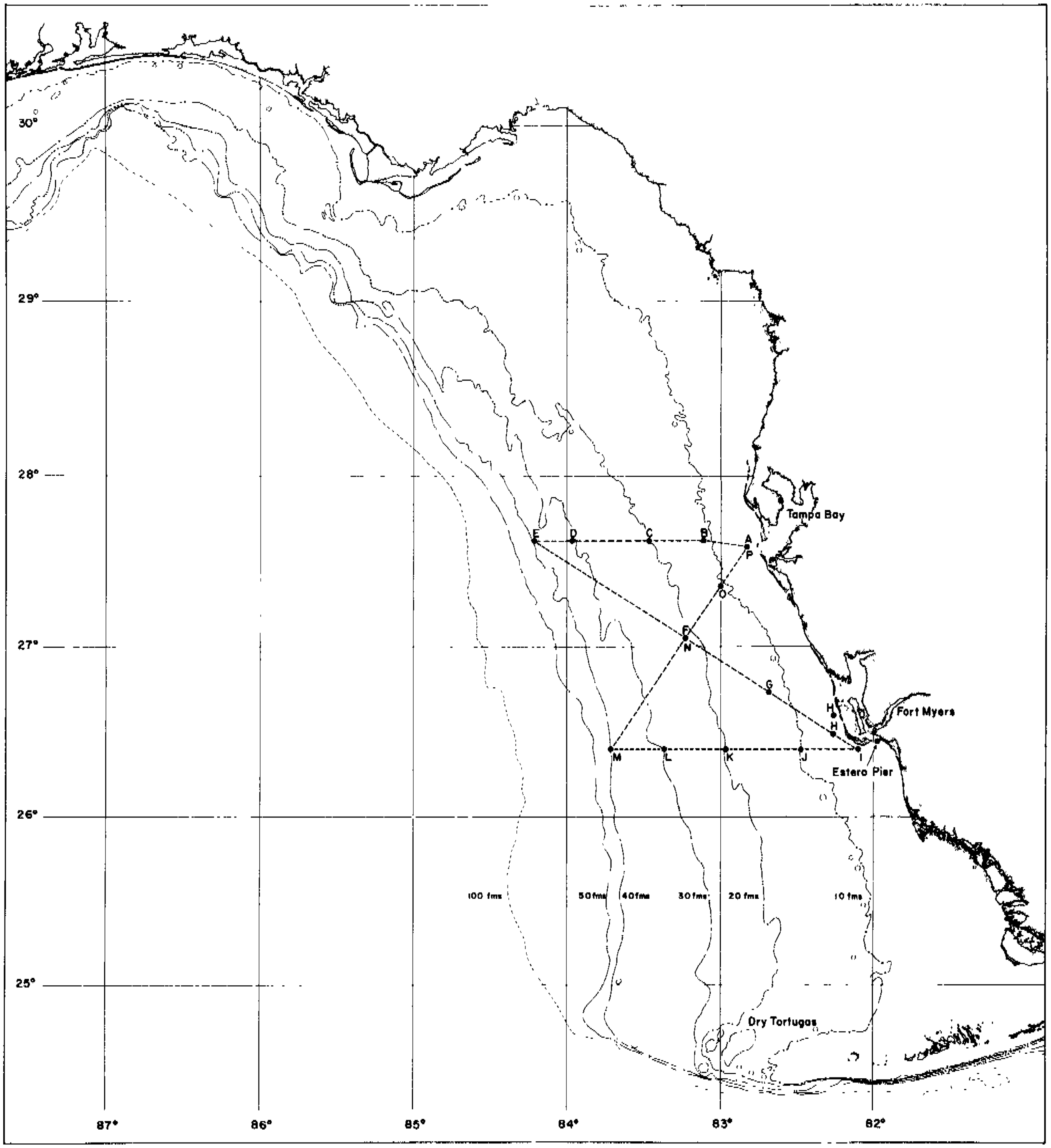

Figure 1. Hourglass cruise pattern and station locations.

recorded were: 1) prey kind, number, volume, and size; and 2) stomach fullness. Stomach fullness was visually estimated as: 1) empty or trace, 2) up to one-half full, or 3) greater than half-full to full. I used a displacement technique to measure volume of food items greater than 0.05 cc, and a squash technique (modified from Hellawell and Abel, 1971) for prey volume less than 0.05 cc (Ross, 1974). Data on prey size were treated by Ross (1977).

Relative importance of each food category was evaluated for each searobin species by using percent stomach occurrence, percent number, and percent volume of that prey category. Problems inherent with each method have been reviewed by Hynes (1950) and Windell (1971). To assess minimum sample size I used the criterion t, obtained by plotting cumulative trophic diversity (H_k) against cumulative stomachs examined (k). The Brillouin information function (H) was used to measure trophic diversity (Pielou, 1966; Hurtubia, 1973). The point of stabilization to a horizontal asymptote defined t, so that examination of stomachs in excess of t would not yield an increase in trophic diversity. All comparisons were based on samples with $k > t$, unless otherwise indicated.

I used UPGMA cluster analysis (Sneath and Sokal, 1973) to classify similarities of Hourglass stations by relative species abundance. The similarity measure used was the Czechanowski coefficient (Bray and Curtis, 1957; Field and McFarlane, 1968).

Most statistical procedures used the SPSS program package (Nie et al., 1970; Nie and Hull, 1973). Differences between means were tested by analysis of variance (Nie et al., 1970), or, if variances were heteroscedastic, by the Kruskal-Wallis statistic H (Sokal and Rohlf, 1969). Use of H is indicated in the text.

Wet weights of searobins (stored in isopropanol) were taken to the nearest 0.1 g after removing stomach contents and blotting the specimens. Ovaries and testes were removed, blotted and weighed to the nearest 0.001 g.

Gonadal development was measured by a gonadosomatic index (GSI) where GSI = [(gonad weight/somatic weight) x 100]. To jointly compare seasonal patterns of male and female GSI values of a species, I recoded GSI values for each sex as a percent of the annual mean value obtained for that sex. This resulted in male and female GSI values based on a comparable scale. Recoding of GSI values did not alter the distributional pattern of the variates (i.e., skewness and kurtosis were unchanged).

Measurements, abbreviations and counts generally followed Hubbs and Lagler (1958), with noted clarifications. Methods of counting gill rakers and vertical scale rows followed Ginsburg (1950). Gill raker counts were for the lower limb and omitted the tubercle-like outgrowths. Vertical scale rows above the lateral line were counted posteriorly from the base of the first dorsal spine to the caudal base. Pectoral fin length was measured from the intersection of the joined and free pectoral rays. Pectoral rays were numbered from dorsal to ventral. The anterior anal support, nonsegmented but flexible, was included in the anal ray count, following Ginsburg (1950). Spine terminology (Figure 2) followed Miller (1965; 1967). All lengths were standard lengths (in mm).

SYSTEMATICS AND BIOLOGY

Prionotus and *Bellator* are both restricted to the Western hemisphere. *Bellator* is represented by four Western Atlantic species (G. Miller, 1965) and one Eastern Pacific species, *B. xenisma*

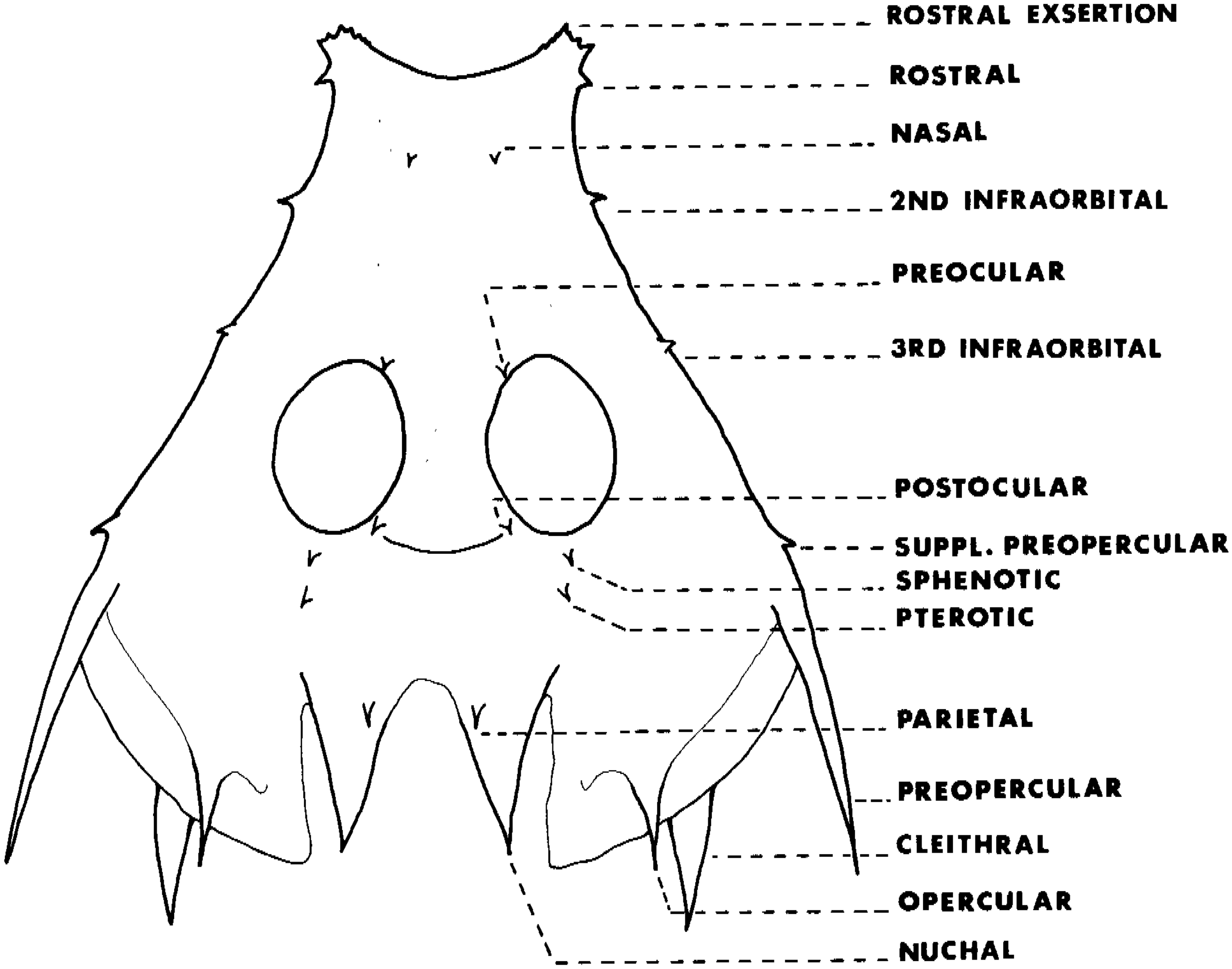

Figure 2. Names and locations of diagnostic spines of searobins (adapted from Miller, 1965; 1967).

(Jordan and Bollman, 1889), (Lee, 1968; Bailey et al., 1970). There are 15 species of *Prionotus* currently recognized from the Western North Atlantic and Gulf of Mexico (Ginsburg, 1950; Teague, 1951, in part; Briggs, 1958; Bailey et al., 1970; Miller and Kent, 1971; Roberts, 1978).

The two most recent searobin revisions (Ginsburg, 1950; Teague, 1951) were contradictory in part and left many questions (Briggs, 1956). Miller (1965) described a new species of *Bellator*; Miller and Kent (1971) clarified relationships within the *P. alatus/P. paralatus/P. beani* species group in the Gulf of Mexico. Miller is currently working on the *P. salmonicolor/P. rubio/P. punctatus* group (Miller and Kent, 1971).

I have followed the nomenclature of Ginsburg (1950), as did Bailey et al. (1970) and Lewis and Yerger (1976). In general, names used by Teague (1951) were excluded from the abbreviated synonymies, pending a much needed revision of the family.

Identification of triglids is confounded by marked ontogenetic changes. Cranial spines are best developed in small specimens. Mouth size in smaller specimens is proportionately greater than in larger specimens. Relative pectoral fin length increases and then decreases with growth.

The abbreviated synonymies and diagnoses were based primarily on Ginsburg (1950), G. Miller (1965), and Miller and Kent (1971). Meristic and morphometric data for the diagnoses were in some instances modified to include variation of specimens from the West Florida Shelf. Upper jaw length data were from Ross (1977). Species included in this study may be identified by the following key.

KEY TO GENERA AND SPECIES OF TRIGLIDAE OCCURRING ON THE WEST FLORIDA SHELF

Adapted from Ginsburg (1950), Teague (1951), G. Miller (1965) for *Bellator*, and Miller and Kent (1971) for *Prionotus alatus*.

1. Dorsal spines usually 10 or fewer (posterior spines reduced); dorsal rays modally 12 or 13 (*Prionotus*) 2

1. Dorsal spines usually 11 (posterior spines reduced); dorsal rays modally 11 (*Bellator*) 10

2. Lower and upper jaws even, or lower jaw projecting; pectoral fins short, narrow, their length considerably less than head length; upper jaw length contained less than 1.5 times in pectoral length. . . . . *Prionotus stearnsi*

2. Mouth subterminal; pectoral fins expanded, approximately equal to or greater than head length; upper jaw length contained 1.5 or more times in pectoral length 3

3. Pectoral fins emarginate (second through sixth, and ninth through eleventh pectoral rays exceeding lengths of intermediate rays); lower several pectoral rays often elongate; nasal spines present; preopercular spine with well developed lateral serrations . . . . . *Prionotus alatus*

3. Pectoral fins not emarginate; nasal spines absent in adults, may be weakly developed in small juveniles; ninth through eleventh pectoral rays not elongate; serrations on preopercular spine present or absent 4

4. Upper jaw length contained 4.8 times in SL (range 4.2-5.6); vertical scale rows 69-84; least bony interorbital width approximately equal to vertical orbit diameter in juveniles, exceeding vertical orbit diameter in adults; in juveniles, postocular spines well developed, with shelf-like bases . . . . *Prionotus tribulus*

4. Upper jaw length contained more than 5.6 times in SL (may be less in very small specimens); vertical scale rows exceeding 80; least bony interorbital width less than vertical orbit diameter (except in very large *P. rubio* and *P. salmonicolor*); in juveniles, postocular spines small, without large shelf-like bases. 5

5. Nasal and supraocular cirri present, well developed; pectoral fins elongate, approaching or exceeding posterior base of anal fin; occipital groove absent. . . . . *Prionotus ophryas*

5. Nasal and supraocular cirri absent; pectoral fins may or may not exceed posterior base of anal fin; occipital groove present or absent. 6

6. Rostral, second infraorbital and third infraorbital spines absent or poorly developed (may be present in juveniles); in adults (>100 mm SL), mouth small, maxillary ending on a vertical midway between orbital rim and anterior nostril or closer to anterior nostril; in juveniles, rostral, second infraorbital and third infraorbital spines may be present; when present spines generally small, only slightly projecting from snout (Figure 3a-c) 7

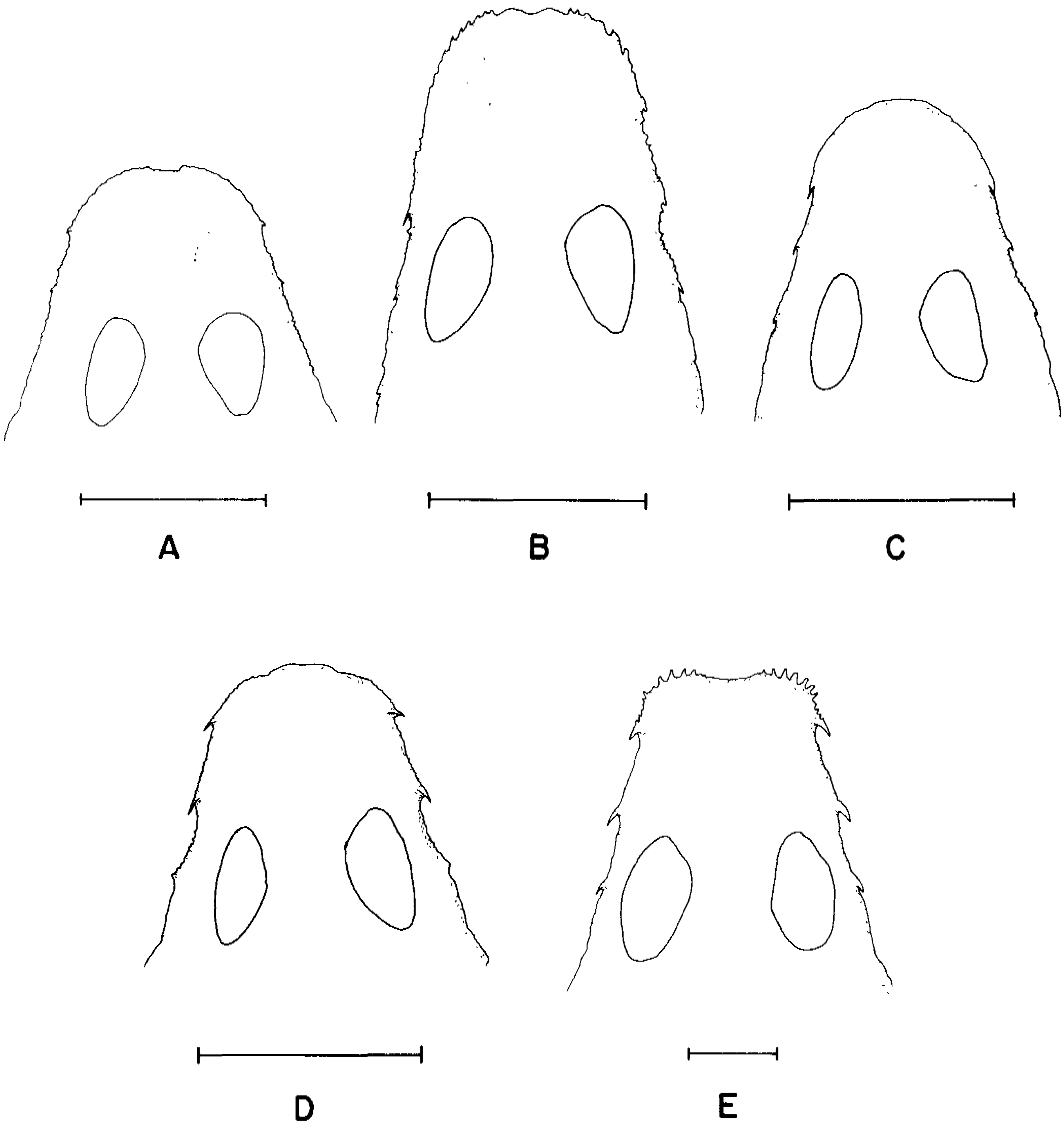

Figure 3. Snout profiles of juvenile *Prionotus roseus*, A(30.5 mm SL); *P. martis*, B(32.8 mm SL); *P. scitulus*, C(29.0 mm SL); *P. salmonicolor*, D(22.7 mm SL); and *P. rubio*, E(71.4 mm SL), showing development and shape of rostral, second and third infraorbital spines. The horizontal bars represent 5 mm.

6. Rostral, second infraorbital and (occasionally) third infraorbital spines well developed in all but very large specimens; in adults (>100 mm SL), mouth large, maxillary ending on a vertical under orbit or closer to orbital rim than to point midway between orbit and anterior nostril; in juveniles, rostral, second infraorbital and third infraorbital spines well developed, strongly projecting from contour of snout (Figure 3d, e) 9

7. Pectoral fins with blue (occasionally brown) ocelli ringed with brown; pectoral fins nearly reaching or exceeding posterior base of anal fin; roof of buccal cavity without dense pigmentation.. *Prionotus roseus*

7. Pectoral fins without ocelli; pectoral fins not exceeding posterior anal fin base; roof of buccal cavity with dense pigmentation (occasionally absent in juvenile *P. martis*) 8

8. Joined pectoral rays 14-15 (modally 15); chest fully scaled in fish larger than 30 mm SL; anal fin with black pigmentation extending to periphery in adults............ *Prionotus martis*

8. Joined pectoral rays 12-14 (modally 13); chest incompletely scaled anterior to point between bases of lower, free pectoral rays; anal fin with narrow black band, but margin of fin immaculate .... *Prionotus scitulus*

9. Black band along anal fin, or at least obvious melanophores on fin membranes; spinous dorsal spot persistent; greatest length of caudal fin lobe contained 3.2 times in SL (range 2.8-3.5) ... . *Prionotus rubio*

9. Anal fin membranes usually without melanophores (melanophores occasionally present on posterior anal fin membranes); spinous dorsal spot present in young fish but usually absent in adults; greatest length of caudal fin lobe contained 3.8 times in SL (range 3.2-4.4) .... *Prionotus salmonicolor*

10. Cleithral spine large, extending posterior to opercular spine; scales on chest anterior to point even with median rays of pelvic fin; first two dorsal spines with elongate filaments in some specimens.. *Bellator militaris*

10. Cleithral spine small, not extending posterior to tip of opercular spine; chest scales absent; first dorsal spine with elongate filament in some specimens 11

11. Tabs or tenacles on posterodorsal portion of eyeball; upper free pectoral ray considerably shorter than pectoral fin .... *Bellator egretta*

11. No tabs or tentacles on eyeball; upper free pectoral ray equal to or exceeding pectoral fin length.. *Bellator brachychir*

Genus *Prionotus* Lacépède, 1802

Prionotus scitulus Jordan and Gilbert, 1882

Figures 3, 4

Prionotus scitulus Jordan and Gilbert, 1882, p. 288 [original description]; Gunter, 1945, p. 80; Ginsburg, 1950, pp. 503-504 [subdivided into *P. s. latifrons* in Gulf of Mexico and *P. s. scitulus* in W. Atlantic]; Hildebrand, 1954, p. 315; Reid, 1954, p. 55; Hildebrand, 1955, p. 215; Joseph and Yerger, 1956, p. 140; Springer and Bullis, 1956, p. 93; Springer and Woodburn, 1960, pp. 83-84; Tabb and Manning, 1961, pp. 635-636; Tabb et al., 1962, p. 61; Gunter and Hall, 1965, p. 45; Moe and Martin, 1965, p. 149; Parker, 1965, p. 215; Burns, 1970, p. 125; Franks, 1970, p. 70; Wang and Raney, 1971, pp. 41-42; Christmas and Waller, 1973, p. 379; Ross, 1974, pp. 27-83; Swingle and Bland, 1974, p. 46; Ogren and Brusher, 1977, p. 90; Naughton and Saloman, 1978, pp. 47-51; Ross, 1978, p. 231; Bass and Guillory, 1979, p. 119; Saloman and Naughton, 1979, p. 90; Ross, 1980, p. 611.

Material examined (identification by sex, rather than as immature, does not necessarily indicate sexual maturity; question mark indicates sex not determined): HOURGLASS STATION A: 2 ♂, 132.7, 140.0; 4 ♀, 141.4-153.3; 3 August 1965; trawl; FSBC uncatalogued. — 26 ?, 129.0-173.0; 30 August 1965; trawl; FSBC 4404. — 2 ♂, 139.3, 143.4; 3 ♀, 132.4-159.0; 4 October 1965; trawl; FSBC uncatalogued. — 1 ♂, 141.3; 8 November 1965; trawl; FSBC uncatalogued. — 2 ♀,136.4, 156.1; 3 December 1965; trawl; FSBC 8832. — 1 ♀, 168.1; 6 January 1966; trawl; FSBC uncatalogued. — 1 ♂, 148.2; 2 ♀, 153.1, 162.0; 8 January 1966; trawl; FSBC uncatalogued. — 18 ♂, 117.5-155.5; 13 ♀, 84.0-161.5; 1 ?, 151.0; 3 March 1966; trawl; FSBC uncatalogued. — 7 ♂, 124.2-146.8; 10 ♀, 120.0-151.2; 6 April 1966; trawl; FSBC 8640. — 1 ♂, 120.4; 1 ♀, 128.0; 6 June 1966; trawl; FSBC 8639. — 1 ♂, 166.7; 31 August 1966; trawl; FSBC uncatalogued. — 1 ♂, 148.0; 2 ♀, 153.0, 162.0; 8 October 1966; trawl; FSBC uncatalogued. — 1 ♀, 168.0; 6 November 1966; trawl; FSBC uncatalogued. — 2 ♂, 136.7, 150.1; 1 December 1966; trawl; FSBC uncatalogued. — 1 ♂, 110.6; 6 January 1967; trawl; FSBC uncatalogued. — 1 ?, 57.5; 25 January 1967; trawl; FSBC uncatalogued. — 1 ♂, 123.5; 1 ♀, 140.8; 3 April 1967; trawl; FSBC 8645. — 1 ♂, 155.5; 2 May 1967; trawl; FSBC 8826. — 1 ♂, 116.0; 2 June 1967; trawl; FSBC 8644. — 2 ♀, 120.0, 123.2; 5 October 1967; trawl; FSBC 8646. — HOURGLASS STATION I: 2 ♂, 145.4, 148.1; 10 October 1965; trawl; FSBC 8659. — 3 ?, 143.8-152.5; 12 November 1965; trawl; FSBC 4577. — 6 ?, 89.2-141.8; 9 March 1966; trawl; FSBC 4798. — 1 ♀, 173.0; 21 March 1966; trawl; FSBC 8823. — 3 ♂, 142.0-164.7; 6 December 1966; trawl; FSBC 8642. — 1 ♂, 100.7; 7 August 1967; trawl; FSBC 8643. — 1 ♀, 75.8; 11 October 1967; trawl; FSBC uncatalogued. —HOURGLASS STATION J: 1 ?, 53.8; 1 ♀, 154.6; 21 March 1966; trawl; FSBC 4986. — TAMPA BAY STATION 1: 25 ?, 26.3-58.2; 19 August 1972; R72-29.

Diagnosis: Mouth proportionately small, upper jaw length averaging 11.6% SL (s = 0.10); pectoral fin rounded, reaching posteriorly to base of fourth or fifth anal ray; chest naked in front of median free pectoral rays; roof of buccal cavity with dense melanophores; D. X, 12-14 (modally 13); A. 11-13 (modally 12); pectoral 12-14 (modally 13); gill rakers 9-11; vertical scale rows 103-130.

Remarks: There were 129 specimens of *P. scitulus* available from Hourglass collections (Table 2); all were collected at 6 and 18 m stations. Bottom temperatures were 16-33°C, and bottom salinities were 30-36 ‰.

TABLE 2. NUMBERS OF *Prionotus scitulus* EXAMINED FROM PROJECT HOURGLASS, BY STATION AND MONTH.

Prionotus scitulus	1965					1966													1967												
STA	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	TOT
A	32		5	1	2	4		32	17		2			1		3	1	2	1	1			2	1	1				2		110
B_1																															
B_2																															
C_1																															
C_2																															
D_1																															
D_2																															
E																															
I			2	3				7										3									1		1		17
J								2																							2
K																															
L																															
M																															
TOT	32		7	4	2	4		41	17		2			1		3	1	5	1	1			2	1	1		1		3		129

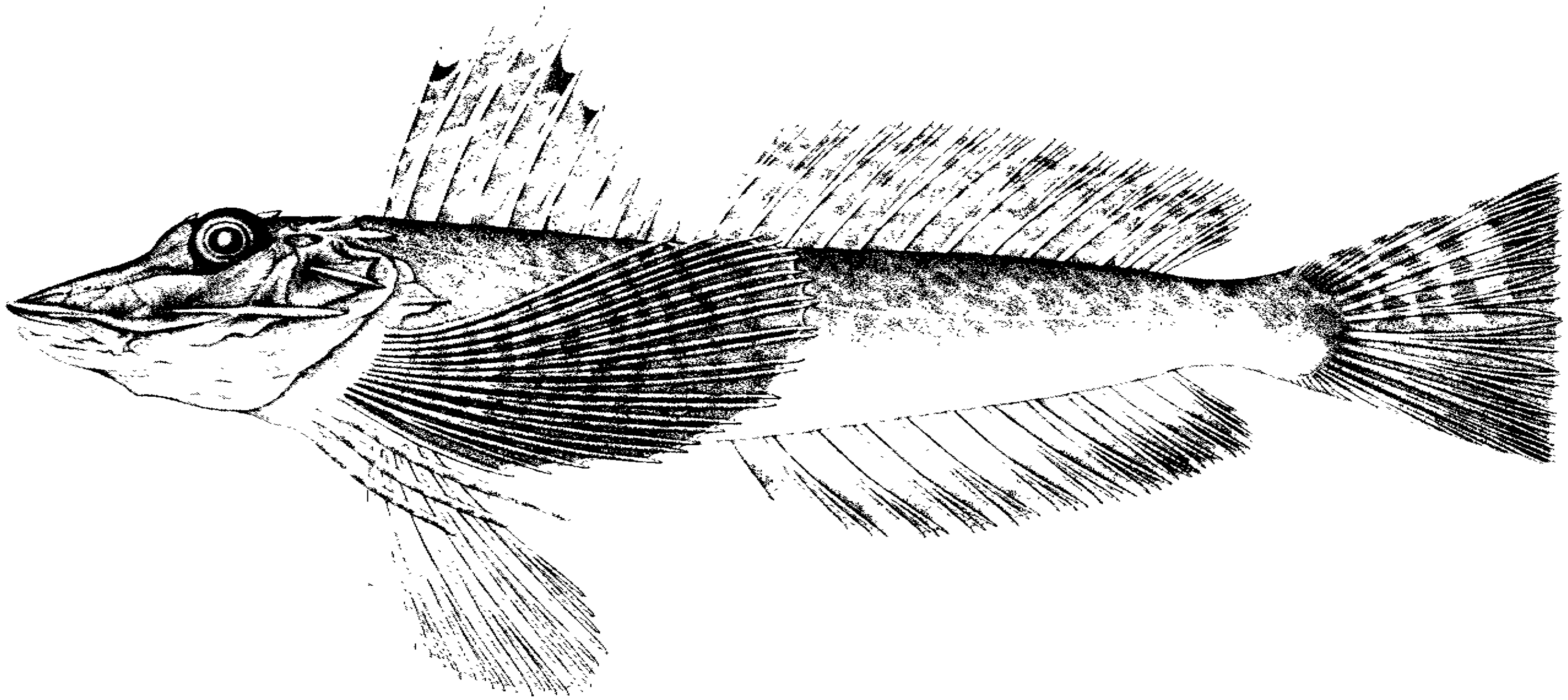

Figure 4. *Prionotus scitulus* Jordan and Gilbert.

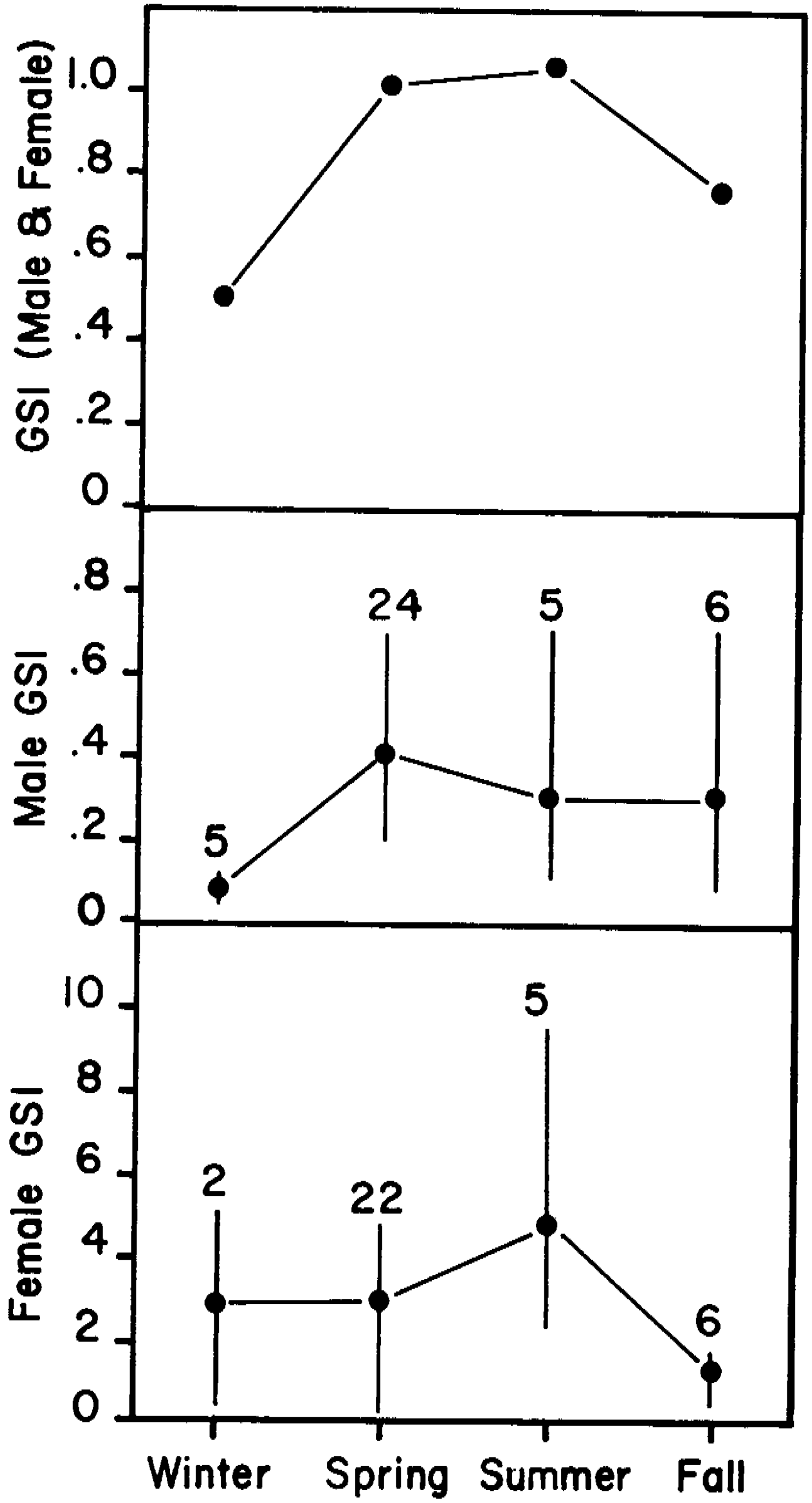

Figure 5. Seasonal changes in the gonadosomatic index (GSI) for separate and combined male and female *Prionotus scitulus* collected at Hourglass Stations A and I. The method used to combine male and female gonadosomatic indices is explained in the text. Vertical lines indicate ranges; number of fish examined is shown above the ranges.

Reproduction: I measured gonadal weights of 79 fish (38 ♀ and 41 ♂). Since only four sexed fish were smaller than 110 mm, I included fish 110 mm or larger in the analysis of seasonal reproductive changes (N = 75). Based on data from Tampa Bay collections (Ross, 1978), these fish were all of reproductive length.

TABLE 3. FOOD ITEMS UTILIZED BY *Prionotus scitulus* (N = 75) FROM HOURGLASS STATIONS A AND I.

Prey Category	Percent Occurrence	Number no.	Number %	Volume cc.	Volume %
Amphioxi					
Branchiostoma floridae	26.0	65	8.03	1.409	20.76
Hemichordata					
Enteropneusta	1.3	1	0.12	*	
Chaetognatha	10.6	24	2.97	0.022	0.32
Echinodermata					
Opiuroidea	8.0	11	1.35	0.078	1.15
Brachyura					
Portunidae	2.7	2	0.25	0.157	2.31
Xanthidae	4.0	14	1.75	0.626	9.21
Pinnotheridae	17.3	23	2.84	0.985	14.53
Leucosiidae	1.3	2	0.25	0.007	0.10
Unidentified crabs	24.0	24	2.97	0.683	10.06
Brachyuran megalops	8.0	20	2.47	0.013	0.19
(all crabs)	(52.0)	(85)	(10.51)	(2.471)	(36.40)
Anomura					
Galatheidae	6.7	5	0.62	0.187	2.76
Natantia					
Pasiphaeidae	12.0	15	1.85	0.373	5.49
Processidae	1.3	6	0.74	0.086	1.30
Hippolytidae	1.3	1	0.12	0.003	0.04
Penaeidae	4.0	6	0.74	0.363	5.35
Sergestidae	2.7	3	0.37	0.003	0.04
Unidentified shrimp	30.7	55	6.80	0.661	9.54
(all shrimp)	(33.3)	(86)	(10.63)	(1.476)	(21.73)
Amphipoda					
Gammaridea	26.7	44	5.44	0.060	0.88
Caprellidea	1.3	1	0.12	0.001	0.01
Cumacea	41.3	252	31.25	0.199	2.93
Mysidacea	6.7	8	0.99	0.011	0.16
Copepoda	2.7	58	7.17	0.007	0.10
Ostracoda	1.3	2	0.25	0.004	0.06
Annelida					
Polychaeta	52.0	**		0.811	11.95
Mollusca					
Pelecypoda	9.33	12	1.48	0.026	0.38
Gastropoda	1.33	2	0.25	*	
Nematoda***	21.33	99	12.24	0.014	0.21
Cnidaria	1.33	54	6.67	0.012	0.18
Totals		809		6.788	

*Trace amount only.
**An accurate count of individuals impossible.
***Possibly includes parasitic forms.

Significant seasonal differences occurred between GSI values for both males and females and combined values ($P < .05$). Combined GSI values indicated that spawning occurred during late summer and fall (Figure 5).

Food habits: Hourglass Stations A and I were usually sampled during late afternoon and evening; but generally not at night on the regular cruises (Joyce and Williams, 1969). Fish ranged from 75-175 mm, with 71% of the specimens between 120 and 150 mm.

Brachyurans, polychaetes, cumaceans, natantians, lancelets, and gammaridean amphipods each occurred in 26% or more of the specimens (Table 3). Numerically, cumaceans were the major prey category, followed in decreasing importance by nematodes, natantians, brachyurans, lancelets, copepods, cnidarians, and gammaridean amphipods. Brachyurans, natantians and lancelets composed 79% of the ration by volume.

Branchiostoma floridae and brachyurans increased in occurrence with increasing fish size, while gammaridean amphipods and cumaceans decreased (Table 4).

Polychaetes,.cumaceans and gammaridean amphipods were the most imporant prey items in the spring, while brachyurans, natantians and *B. floridae* were of greater importance in summer or fall (Figure 6). Although only spring, summer and fall collections of Hourglass *P. scitulus* formed sufficient sample sizes, the seasonal feeding pattern was similar to that of *P. scitulus* from Tampa Bay (Ross, 1974).

TABLE 4. FEEDING CHANGES IN THREE SIZE CLASSES OF *Prionotus scitulus* FROM HOURGLASS STATIONS A AND I, BASED ON PERCENTAGE OCCURRENCE. ONLY MAJOR PREY CATEGORIES ARE PRESENTED.

Prey Category	Size Groups mm		
	71-120 (N=12)	121-140 (N=33)	141-180 (N=30)
Branchiostoma floridae	16.7	18.2	40.0
Chaetognatha	16.7	9.1	10.0
Ophiuroidea	-	6.1	10.0
Brachyura	25.0	55.6	60.0
Natantia	41.7	24.2	40.0
Anomura	-	-	16.7
Gammaridea	41.7	30.3	16.7
Cumacea	83.3	51.5	13.3
Mysidacea	16.7	3.0	6.7
Copepoda	16.7	-	-
Polychaeta	50.0	66.7	36.7
Pelecypoda	-	15.2	6.7
Nematoda	16.7	15.2	30.0
Cnidaria	8.3	-	-

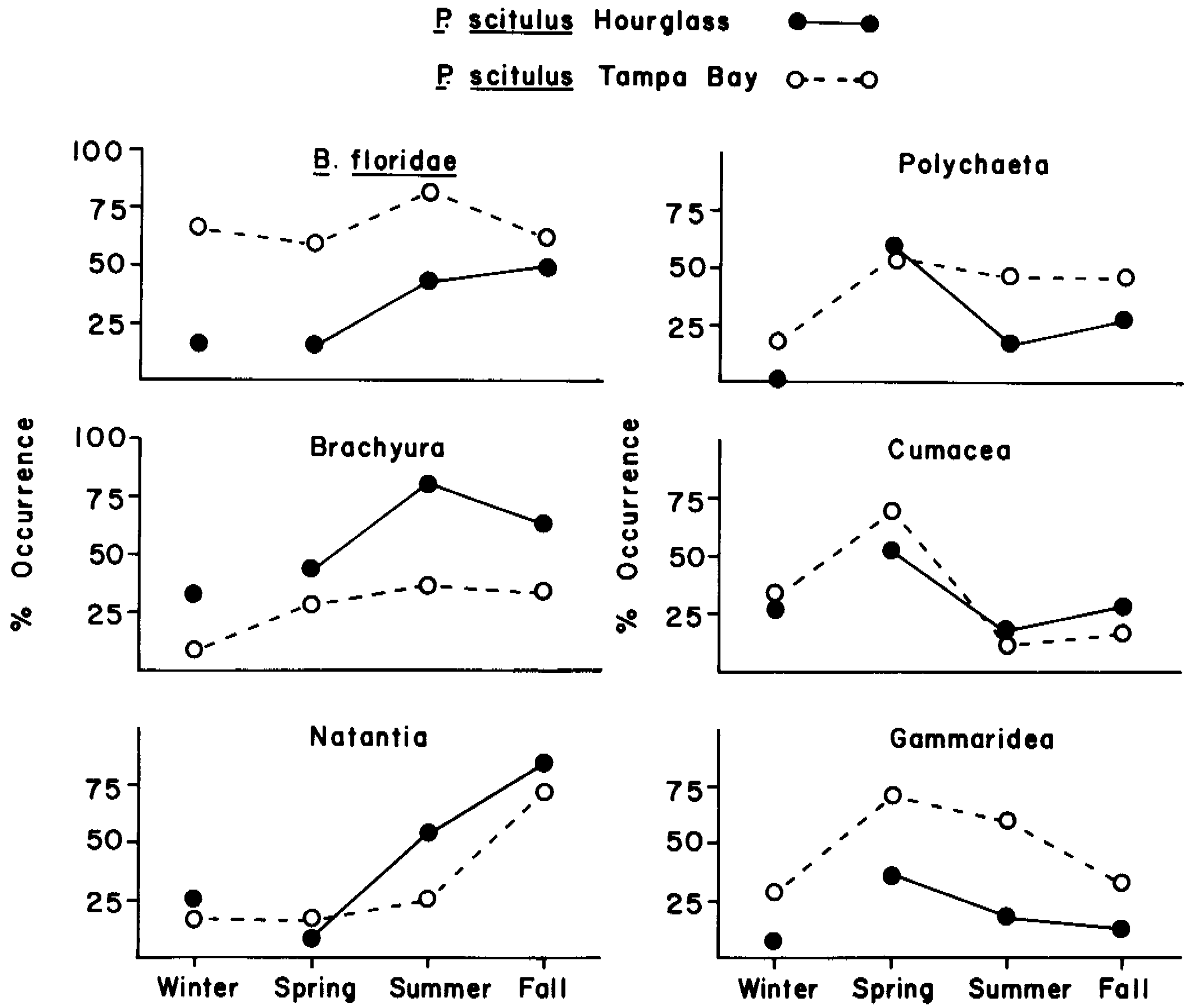

Figure 6. Seasonal changes in percent occurrence of six major prey categories for Tampa Bay (1972-1973; open circles) and Project Hourglass (1965-1967; closed circles) *Prionotus scitulus*. The winter sample from Project Hourglass did not reach a stabilized curve of H_k versus k.

Prionotus tribulus (Cuvier, 1829)

Figure 7

Trigla tribulus Cuvier, 1829 [name only].

Prionotus tribulus: Cuvier and Valenciennes, 1829, p. 98; Gunter, 1945, p. 80; Ginsburg, 1950, pp. 516-518 [subdivided into *P. t. crassiceps* in Gulf of Mexico and *P. t. tribulus* in W. Atlantic]; Hildebrand, 1954, p. 316; Reid, 1954, pp. 55-56; Hildebrand, 1955, p. 215; Kilby, 1955, p. 227; Joseph and Yerger, 1956, p. 140; Springer and Bullis, 1956, p. 93; Springer and Woodburn, 1960, p. 84;Tabb and Manning, 1961, p. 636; Tabb et al., 1962, pp. 50-61; Gunter and Hall, 1965, pp. 44-45; J. Miller, 1965, p. 99; Moe and Martin, 1965, p. 144; Parker, 1965, p. 215; Wang and Raney, 1971, p. 42; Franks et al., 1972, p. 111; Christmas and Waller, 1973, p. 379; Hoese, 1973, p. 86; Perret and Caillouet, 1974, p. 61; Swingle and Bland, 1974, pp. 46-47; Ogren and Brusher, 1977, p. 90; Cooley, 1978, p. 40; Naughton and Saloman, 1978, pp. 47-51; Bass and Guillory, 1979, p. 119; Saloman and Naughton, 1979, p. 90.

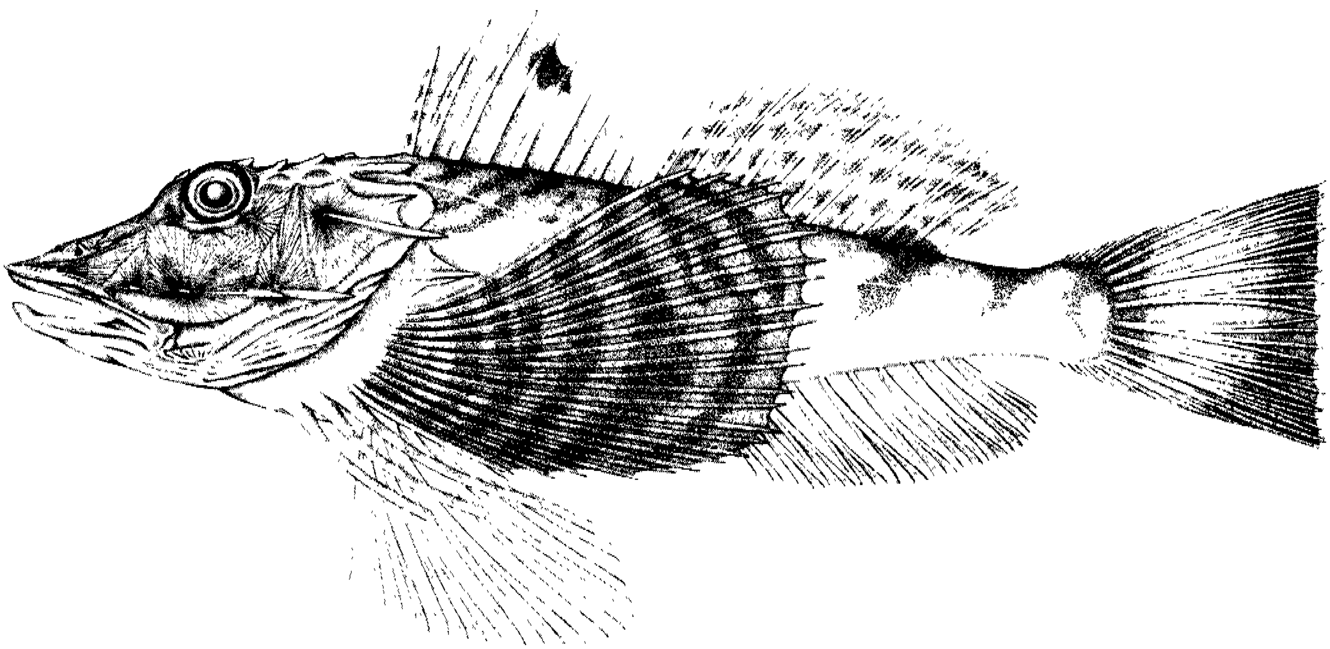

Figure 7. *Prionotus tribulus* (Cuvier).

Material examined: HOURGLASS STATION A: 1 ♀, 66.4; 6 April 1966; trawl; FSBC uncatalogued. — 1 ♂, 211.0; 1 ♀, 204.0; 6 June 1966; trawl; FSBC 8637. — 1 ?, 57.5; 25 January 1967; trawl; FSBC uncatalogued. — HOURGLASS STATION B: 1 ♀, 168.5; 6 November 1966; trawl; FSBC uncatalogued. — 2 ♂, 168.5, 178.0; 1 December 1966; trawl; FSBC 8651. — 1 ♂, 163.0; 1 ♀, 169.5; 6 January 1967; trawl; FSBC 8648. — 1 ♂, 175.5; 25 January 1967; trawl; FSBC uncatalogued. — 1 ♀, 163.5; 5 February 1967; trawl; FSBC uncatalogued. — HOURGLASS STATION I: 1 ♀, 94.3; 9 March 1966; trawl; FSBC uncatalogued. — 1 ♀, 256.0; 11 May 1966; trawl; FSBC 8635. — HOURGLASS STATION J: 1 ♀, 197.0; 21 July 1966; trawl; FSBC 8655. — 1 ♂, 175.0; 14 November 1967; trawl; FSBC 8647. — TAMPA BAY STATION 1: 5 ♂, 49.5-85.3; 21 March 1972; R72-7. — 1 ♂, 94.1; 1 May 1972; R72-11. — 1 ♂, 68.5; 1 May 1972; R72-12. — 1 ♀, 131.9; 11 July 1972; R72-25. — 1 ♂, 55.2; 1 ?, 48.5; 21 November 1972; R72-40. — 1 ♂, 38.9; 2 ?, 31.0, 39.2; 16 December 1972; R72-44. — 2 ♂, 58.7, 72.7; 24 January 1973. — 1 ♂, 70.7; 2 ♀, 58.7, 76.1; 24 January 1973; R73-4. — 1 ♂, 62.4; 4 ♀, 51.1-64.2; 4 ?, 43.2-51.6; 24 February 1973; R73-7. — 1 ♂, 54.9; 3 ♀, 49.6-71.4; 4 ?, 51.2-55.5; 24 February 1973; R73-8. —TAMPA BAY STATION 2: 1 ♂, 125.0; 3 June 1972; R72-21. — 1 ♂, 100.6; 1 ♀, 107.4; 6 July 1972; R72-23. — 2 ♂, 119.5, 121.3; 2 August 1972; R72-27. — 2 ?, 28.4, 29.7; 8 November 1972; R72-38. — 1 ♀, 51.2; 4 ?, 26.8-42.7; 7 December 1972; R72-41. — 1 ♂, 59.2; 14 January 1973; R73-1. — 2 ?, 30.5, 47.1; 6 February 1973; R73-5. — 1 ♀, 64.2; 6 March 1973; R73-9. — 4 ♂, 66.2-70.1; 1 ♀, 87.4; 12 April 1973; R73-12. — TAMPA BAY STATION 3: 2 ♂, 68.9, 76.0; 14 March 1973; R73-10. — 3 ♂, 75.0-81.2; 1 ♀, 98.6; 4 May 1972; R72-13. — OTHER MATERIAL: 1 ?, 74.8; Gulf of Mexico, Tampa Bay, Egmont Key; 18 August 1971; R71-5. — 2 ?, 48.3, 98.6; Gulf of Mexico, Horn Island, Mississippi; 27 November 1974; R74-9-12.

Diagnosis: Mouth proportionately large, upper jaw length averaging 20.7% SL (s = 0.10), may be slightly less in large specimens; cranial spines well formed in juveniles, becoming reduced in large

TABLE 5. NUMBERS OF *Prionotus tribulus* EXAMINED FROM PROJECT HOURGLASS, BY STATION AND MONTH.

Prionotus tribulus

STA	1965 A	S	O	N	D	1966 J	F	M	A	M	J	J	J sp	A	S	O	N	D	1967 J	J sp	F	M	A	M	J	J	A	S	O	N	TOT
A									1		2									1											4
B_1																	1	2	2	1	1										7
B_2																															
C_1																															
C_2																															
D_1																															
D_2																															
E																															
I								1		1																					2
J												1					1														2
K																															
L																															
M																															
TOT								1	1	1	2	1					2		2	2	1										15

specimens; postocular spines with broad shelf-like bases; vertical scale rows 69-84; D. X, 11-12 (modally 12); A. 10-12 (modally 11); pectoral 12-14 (modally 13); gill rakers 8-12.

Remarks: I examined 15 specimens of *P. tribulus* available from Hourglass collections (6-18 m), and 63 specimens of *P. tribulus* from Tampa Bay (Ross, 1974). Monthly Hourglass station occurrence of *P. tribulus* is given in Table 5. Bottom temperatures in Tampa Bay collections were 15-32°C, and salinities were 25-35 ‰. Bottom temperatures for the Hourglass collections of *P. tribulus* were 16-28°C, and bottom salinities were 34-36 ‰.

Reproduction: The relationship of the GSI to length indicated that gonadal development was slight for fish less than 90 mm. Since only 17 specimens exceeded 90 mm, determination of seasonal reproductive pattern is tenuous. Female GSI values increased from summer to winter, suggesting

TABLE 6. SEASONAL CHANGES IN LENGTH-FREQUENCY CLASSES OF *Prionotus tribulus* FROM STATIONS 1, 2 and 3, TAMPA BAY, FLORIDA (1972-1973). THE DIFFERENCES ARE SIGNIFICANT (χ^2 = 46.5, P < .001).

Months		Size Classes mm 21-50	51-80	81-140	Row totals
December to February	count	10	8	0	18
	row%	55.6	44.4	0	28.6%
	column %	58.8	22.9	0	
March to May	count	7	25	2	34
	row %	20.6	73.5	5.9	54.0%
	column %	41.2	71.4	18.2	
June to August	count	0	2	7	9
	row %	0	22.2	77.8	14.3%
	column %	0	5.7	63.6	
September to November	count	0	0	2	2
	row %	0	0	100	3.2%
	column %	0	0	18.2	
Column Totals	(N)	17	35	11	63
	(%)	27.0	55.6	17.5	100

fall to early spring spawning. This is corroborated by seasonal changes in length-frequency for the Tampa Bay collections (Table 6). Small fish (< 50 mm) occurred more frequently in winter, and no small fish were collected from June-November 1972 or June 1973. Eighty-five percent of the specimens larger than 81 mm were taken in the summer and fall. No individuals smaller than 51 mm were obtained from Hourglass collections, possibly reflecting sampling gear selectivity.

A seasonal inshore movement of pelagic eggs or larvae, followed by an offshore movement or longshore dispersal of juveniles or adults, might occur since 83% of the Tampa Bay *P. tribulus* were collected in winter or spring, and 79% of these were 80 mm or smaller. Other habitats within Tampa Bay were occasionally sampled, but larger *P. tribulus* again occurred only during summer.

TABLE 7. FOOD ITEMS UTILIZED BY *Prionotus tribulus* (N = 56) IN TAMPA BAY, FLORIDA, FROM APRIL 1972-MAY 1973 (ROSS, 1974). FOOD ITEMS UTILIZED BY *P. tribulus* (N = 13) FROM PROJECT HOURGLASS (1965-1967) ARE SHOWN BY PERCENT OCCURRENCE ONLY.

Prey Category	Percent Occurrence		Number		Volume	
	Tampa	Hourglass	no.	%	cc.	%
Teleostei						
Prionotus	-	7.7	-	-	-	-
Unidentified fishes	10.7	-	6	1.45	0.356	5.04
Amphioxi						
Branchiostoma floridae	12.5	-	10	2.42	0.601	8.50
Brachyura						
Portunidae	14.3	15.4	19	4.60	3.363	47.57
Xanthidae	1.8	-	2	0.48	0.406	5.74
Pinnotheridae	35.7	-	46	11.14	0.584	8.26
Unidentified crabs	26.7	30.8	41	9.93	1.149	16.25
(all crabs)	(66.1)	(46.2)	(108)	(26.15)	(5.502)	(77.82)
Anomura						
Paguridae	1.8	-	1	0.24	0.030	0.42
Natantia						
Pasiphaeidae	-	30.8	-	-	-	-
Processidae	1.8	7.8	1	0.24	0.031	0.44
Ogyrididae	-	15.4	-	-	-	-
Penaeidae	-	23.1	-	-	-	-
Unidentified shrimp	8.9	15.4	8	1.94	0.028	0.40
(all shrimp)	(10.7)	(38.5)	(9)	(2.18)	(0.059)	(0.84)
Amphipoda						
Gammaridea	28.6	-	55	13.32	0.058	0.82
Cumacea	12.5	7.7	29	7.02	0.022	0.31
Mysidacea	42.9	30.8	174	42.13	0.247	3.49
Copepoda	7.1	-	11	2.66	0.005	0.07
Ostracoda	3.6	-	2	0.48	0.004	0.06
Unidentified crustaceans	1.8	7.7	3	0.73	*	
Annelida						
Polychaeta	8.9	-	**		0.168	2.38
Mollusca						
Pelecypoda	5.4	-	3	0.73	0.011	0.16
Gastropoda	1.8	-	1	0.24	0.006	0.09
Nematoda	1.8	7.7	1	0.24	*	
Totals			413		7.069	

*Trace amount only.
**An accurate count was impossible.

Food habits: I identified stomach contents from 56 *P. tribulus* from Tampa Bay. Most fish were smaller than 100 mm. Brachyurans were the dominant food item based upon percent occurrence, followed by mysidaceans, gammaridean amphipods, *B. floridae*, shrimp and fishes (Table 7). Mysidaceans dominated numerically, followed by brachyurans, gammaridean amphipods, cumaceans, and copepods; additional prey categories accounted for another 9%. Brachyurans, principally *Portunus*, were dominant volumetrically, followed by *B. floridae*, fishes, mysidaceans, and polychaetes; additional prey categories contributed less than 3%.

Stomach contents of 13 Hourglass specimens, generally larger than 100 mm, were examined. Due to sample size, I have only presented data on the percent occurrence of prey (Table 7). Brachyurans occurred in 46% of the stomachs, and natantians and mysidaceans also occurred frequently. Brachyurans and mysidaceans were major prey for both Tampa Bay and Hourglass *P. tribulus*, although similarity (Czechanowski coefficient) based on all prey was only 55% between the two collections.

Several feeding trends occurred with increasing fish size (Table 8). Fishes (primarily sciaenids and triglids), gammaridean amphipods, and possibly copepods and lancelets, declined in importance while brachyurans increased. Larger fish might rely heavily on portunids.

Prionotus martis Ginsburg, 1950

Figures 3, 8

Prionotus martis Ginsburg, 1950, p. 502 [original description]; Reid, 1954, p. 55; Springer and Bullis, 1956, p. 92; Bullis and Thompson, 1965, p. 55; Lewis and Yerger, 1976, pp. 98-99; Chittenden and Moore, 1977, pp. 108-111; Ross, 1977, pp. 564-568; Cooley, 1978, p. 40.

Prionotus carolinus Hoese and Moore, 1977, p. 253.

TABLE 8. PERCENT OCCURRENCE OF FOOD CATEGORIES FOR FOUR SIZE CLASSES OF *Prionotus tribulus* FROM TAMPA BAY AND PROJECT HOURGLASS (THE TWO INTERMEDIATE SIZE GROUPS HAD k > t).

Prey Category	Size Groups mm 21-40 (N=9)	41-60 (n=21)	61-80 (N=18)	81-120 (n=9)
Teleostei	22.2	14.3	5.6	-
Branchiostoma floridae	-	19.1	5.6	11.1
Portunidae	-	4.8	5.6	44.4
Xanthidae	-	-	11.1	-
Pinnotheridae	44.4	52.4	27.8	-
(All crabs)	(44.4)	(61.9)	(66.7)	(77.8)
(All shrimp)	(77.8)	(23.8)	(55.6)	(22.2)
Gammaridea	55.6	28.6	22.2	11.1
Cumacea	22.2	9.5	16.7	11.1
Mysidacea	77.8	23.8	55.6	22.2
Copepoda	22.2	4.8	5.6	-
Polychaeta	-	9.5	11.1	11.1
Pelecypoda	-	4.8	11.1	-

Material examined: HOURGLASS STATION B: 1 ♂, 147.1; 2 ♀, 151.7, 158.5; 30 August 1965; trawl; FSBC uncatalogued. — 2 ♂, 152.0, 154.0; 20 October 1965; trawl; FSBC 8512. — 1 ♀, 135.5; 3 January 1966; trawl; FSBC 4651. — 1 ♀, 142.5; 3 March 1966; trawl; FSBC 8518. — 1 ?, 42.9; 10 July 1966; trawl; FSBC 8520. — 1 ♂, 161.5; 1 ♀, 143.0; 18 July 1966; trawl; FSBC 8508. — 2 ♂, 118.4, 121.1; 6 November 1966; trawl; FSBC 8510. — 1 ♂, 119.6; 1 ♀, 153.6; 1 December 1966; trawl; FSBC 8510. — 1 ♀, 168.0; 6 January 1967; trawl; FSBC 8515. — 1 ♂, 137.1; 1 ♀, 153.5; 25 January 1967; trawl; FSBC 8513. — 1 ♂, 146.5; 25 January 1967; trawl; FSBC 8505. — 1 ♂, 149.1; 11 September 1967; trawl; FSBC 8504. — 1 ♂, 163.2; 5 October 1967; trawl; FSBC 8503. — 3 ♂, 87.2-145.2; 5 October 1967; trawl; FSBC uncatalogued. — HOURGLASS STATION J: 2 ♂, 145.4, 150.2; 6 December 1965; trawl; FSBC 8517. — 3 ♂, 115.4-118.3; 2 ♀, 100.6, 115.0; 21 July 1966; trawl; FSBC 5072. — 1 ♂, 131.9; 5 August 1966; trawl; FSBC 8507. — 2 ♀, 70.6, 136.3; 12 January 1967; trawl; FSBC 8509. — 1 ♂, 131.3; 1 ♀, 132.0; 8 March 1967; trawl; FSBC 8514. — HOURGLASS STATION K: 2 ♀, 163.7, 164.0; 4 September 1966; trawl; FSBC 4826. — HOURGLASS STATION L: 1 ?, 50.1; 13 January 1967; trawl; FSBC uncatalogued. — OTHER MATERIAL: 4 ?, 31.3-41.7; Gulf of Mexico, 24°41'N, 82°00'W to 24°52'N, 82°35'W; 27 January 1967; trawl; FSBC 337.

Diagnosis: Mouth proportionately small, upper jaw length averaging 12.2% SL (s = 0.19); chest fully scaled except in very small specimens (<30 mm SL); joined pectoral rays 14-15 (modally 14); pectoral length not exceeding base of anal fin; roof of buccal cavity with dense melanophores, except in small specimens; D. X, 12-13 (modally 13); A. 11-13 (modally 12); gill rakers 8-11; lateral scale rows 99-106.

Remarks: I examined 38 Hourglass specimens of *P. martis*, mostly 90 mm or larger, collected at 18-55 m depths. Numbers of specimens examined from each station for each month are given in Table 9. Bottom temperatures were 18-30°C; bottom salinities were 31-36‰, but 97% of the specimens were captured at 34-36 ‰.

Reproduction: I determined GSI values for 8 female and 17 male *P. martis* which were 100 mm or larger. Macroscopic gonadal analysis showed specimens of these sizes were sexually mature. Seasonal changes in separate male or female GSI values were not significant, but seasonal means

TABLE 9. NUMBERS OF *Prionotus martis* EXAMINED FROM PROJECT HOURGLASS, BY STATION AND MONTH.

Prionotus martis																															
STA	1965					1966													1967												TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1						1		1					2				2	2	1	3									4		16
B_2	3		2									1																1			7
C_1																															
C_2																															
D_1																															
D_2																															
E																															
I																															
J					2								5	1					2			2									12
K															2																2
L																			1												1
M																															
TOT	3		2		2	1		1				1	7	1	2		2	2	4	3		2						1	4		38

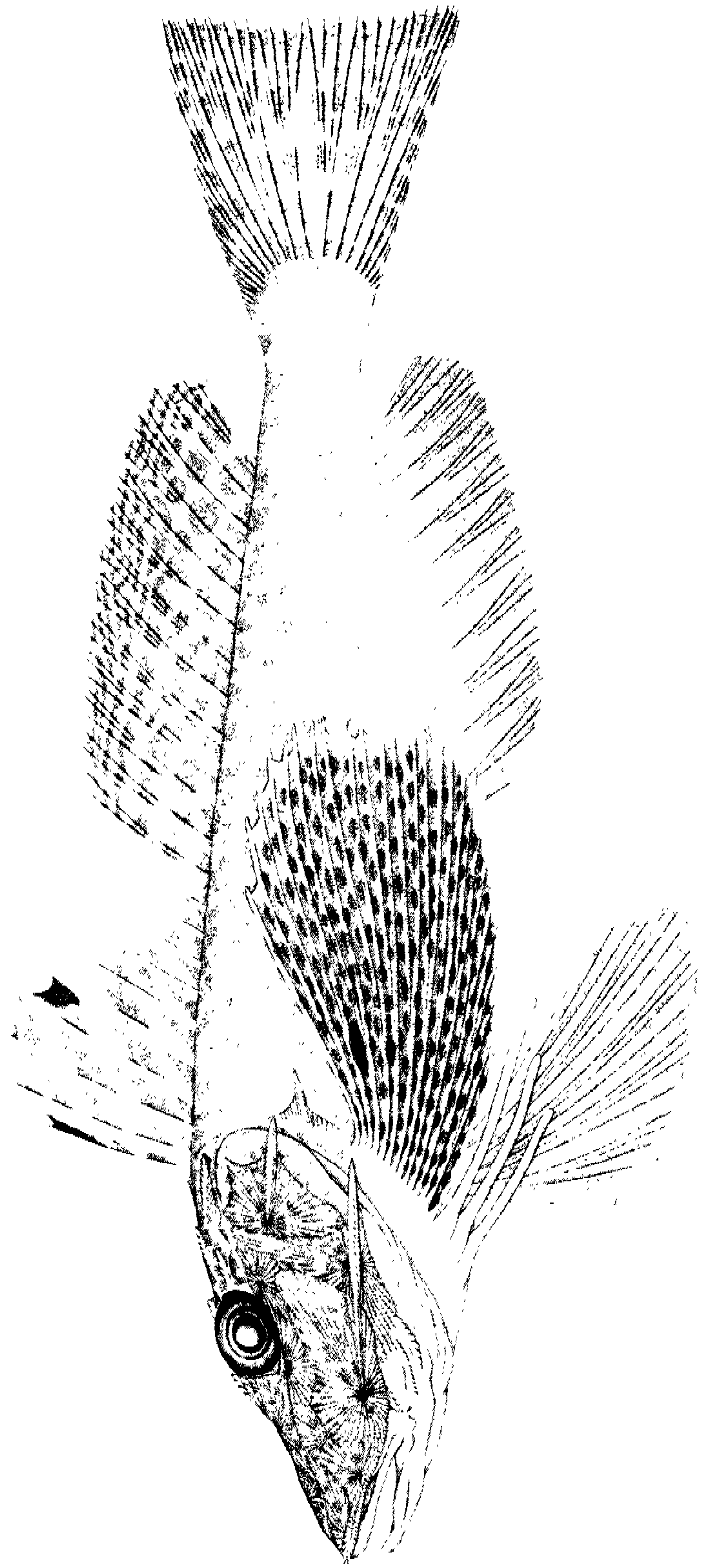

Figure 8. *Prionotus martis* Ginsburg.

of combined GSI values differed significantly ($P < .01$; Figure 9). The greatest inferred spawning activity occurred between early spring and summer for the 28 months of Project Hourglass; however, the small sample size makes the results tenuous.

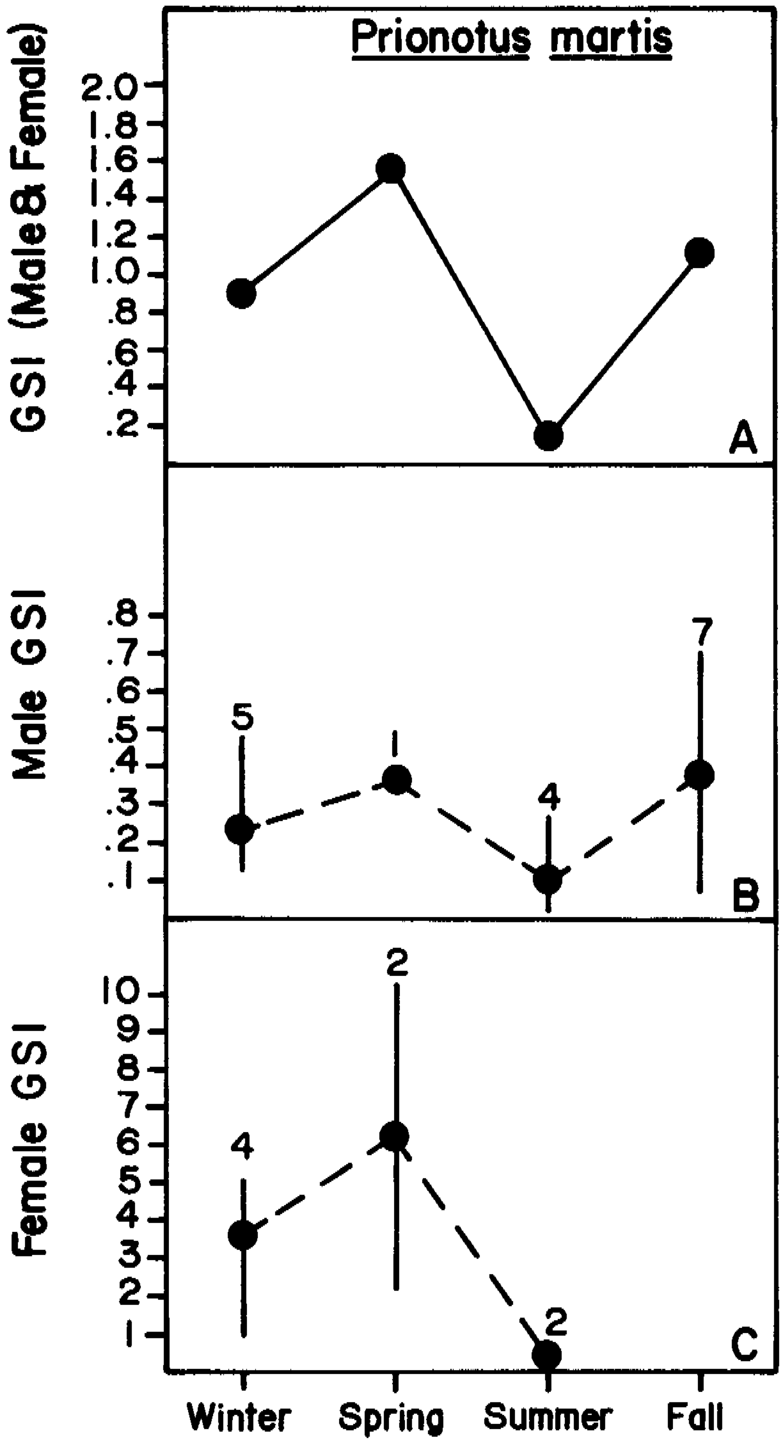

Figure 9. Seasonal changes in gonadosomatic indices of combined and separate male and female *Prionotus martis* collected during Project Hourglass. See Figure 5 for further explanation.

TABLE 10. FOOD ITEMS UTILIZED BY *Prionotus martis* (N = 28) COLLECTED DURING PROJECT HOURGLASS.

Prey Category	Percent Occurrence	Number no.	Number %	Volume cc.	Volume %
Amphioxi					
Branchiostoma floridae	10.7	6	1.49	0.256	4.81
Brachyura					
Unidentified crabs	3.6	1	0.25	0.003	0.06
Natantia					
Pasiphaeidae	60.7	77	19.15	2.724	51.23
Alpheidae	3.6	10	2.49	0.131	2.46
Penaeidae	14.3	4	1.00	0.706	13.28
Unidentified shrimp	60.8	36	8.96	0.567	10.66
(all shrimp)	(82.1)	(127)	(31.59)	(4.128)	(77.64)
Amphipoda					
Gammaridea	60.7	69	17.16	0.235	4.42
Cumacea	10.7	3	0.75	0.030	0.56
Mysidacea	71.4	191	47.51	0.644	12.11
Isopoda	3.6	2	0.50	0.005	0.09
Copepoda	3.6	2	0.50	0.002	0.04
Annelida					
Polychaeta	21.4	**		0.014	0.26
Nematoda	3.6	1	0.25	*	
Totals		402	5.317		

*Trace amount only.
**An accurate count of individuals was impossible.

Food habits: I identified stomach contents from 28 *P. martis*, ranging in size from 45 to 165 mm; 61% were between 110-150 mm. Natantians, primarily Pasiphaeidae, were the dominant prey category on the basis of percent occurrence and volume, and were second in numerical importance (Table 10). Mysidaceans, gammaridean amphipods and lancelets were also important prey categories for *P. martis*.

Prionotus ophryas Jordan and Swain, 1884

Figure 10

Prionotus ophryas Jordan and Swain, 1884, p. 542 [original description]; Ginsburg, 1950, p. 507; Hildebrand, 1954, p. 314; Hildebrand, 1955, pp. 214-215; Springer and Bullis, 1956, p. 92; Bullis and Thompson, 1965, p. 55; Burns, 1970, p. 125; Franks et al., 1972, p. 109, Ogren and Brusher, 1977, p. 90.

Material examined: HOURGLASS STATION B: 1 ♂, 91.0; 2 ♀, 70.1, 110.8; 30 August 1965; trawl; FSBC 4425. — 2 ♂, 99.6, 125.5; 20 October 1965; trawl; FSBC 8522. — 1 ♂, 126.0; 15 April 1966; trawl; FSBC 8532. — 1 ♀, 131.2; 15 April 1966; trawl; FSBC uncatalogued. — 1 ♂, 165.5; 10 July 1966; trawl; FSBC uncatalogued. — 1 ♀, 143.6; 1 December 1966; trawl; FSBC 8526. — 1 ♂, 152.8; 20 November 1967; trawl; FSBC 8528. — HOURGLASS STATION C: 1 ♂, 140.4; 20 October 1965; trawl; FSBC 8529. — 1 ♂, 63.0; 3 March 1966; trawl; FSBC 5098. — 1 ♀, 176.0; 19 May 1966; trawl; FSBC 8530. — 1 ♂, 109.2; 18 July 1966; trawl; FSBC uncatalogued. — 2 ♀, 130.3, 147.2; 18 October 1966; trawl; FSBC 8535. — 1 ♂, 95.3; 1 December 1966; trawl; FSBC 8542. — 1 ♂, 169.0; 25 January 1967; trawl; FSBC 8527. — 3 ♂, 87.4-150.7; 1 ♀, 150.0; 25

January 1967; trawl; FSBC 8533. — 1 ♂, 178.0; 1 ♀, 177.0; 5 February 1967; trawl; FSBC 8544. — 2 ♂, 163.5, 173.5; 1 ♀, 151.7; 3 April 1967; trawl; FSBC 8537. — 1 ♀, 108.7; 20 May 1967; trawl; FSBC 8541. — 1 ♂, 141.7; 11 September 1967; trawl; FSBC uncatalogued. — 1 ♀, 135.0; 25 October 1967; trawl; FSBC 8539. — 1 ♂, 174.5; 1 ♀, 80.5; 21 November 1967; trawl; FSBC 8531. — HOURGLASS STATION D: 1 ♂, 156.2; 11 August 1966; trawl; FSBC 4979. — 1 ♂, 121.3; 9 November 1966; trawl; FSBC 8819. — 1 ♂, 141.5; 1 ♀, 158.0; 20 November 1966; trawl; FSBC 8534. — 1 ?, 122.8; 1 ♂, 120.6; 26 January 1967; trawl; FSBC 8540. — HOURGLASS STATION J: 1 ♀, 128.4; 21 July 1966; trawl; FSBC 8538. — HOURGLASS STATION K: 1 ♀, 159.6; 13 October 1965; trawl; FSBC 8575. — 1 ♀, 181.5; 7 December 1965; trawl; FSBC 4633. — 1 ♂, 135.1; 1 ♀, 155.1; 9 March 1966; trawl; FSBC uncatalogued. — 2 ♂, 112.5, 167.5; 1 ♀, 148.8; 22 July 1966; trawl; FSBC 5250. — 1 ♀, 188.5; 12 January 1967; trawl; FSBC 8536. — HOURGLASS STATION M: 1 ♀, 176.0; 13 November 1966; trawl; FSBC 4874. — 1 ♂, 169.1; 31 January 1967; trawl; FSBC 8521.

Diagnosis: Mouth moderately large, mean percent SL of upper jaw length 14.5 (s = 0.10); nasal cirrus long, tapering, originating posterior to anterior nostril; eyeball with one large, distally fimbriated cirrus, followed posteroventrally by variable number of smaller, fleshy cirri; lacrimal plate smoothly rounded; rostral and second infraorbital spines absent; joined pectoral rays 14, pectoral length usually exceeding base of anal fin; D. IX-X, 11-13 (modally 12); A. 10-11 (modally 11); gill rakers 6-7; lateral scale rows 93-105.

Remarks: *Prionotus ophryas* occurred principally at 18 and 37 m Hourglass stations (range 18-73 m); 49 specimens were available for analysis. Numbers of specimens examined from each station for each month are given in Table 11. Bottom temperatures were 18-28° C; bottom salinities were 32-37 ‰, although 98% of the fish were taken between 35-37 ‰.

Reproduction: I determined GSI values for 20 male and 16 female fish 100 mm or larger; preliminary macroscopic gonadal analysis showed that all fish exceeded minimum reproductive size. Means of combined GSI values differed significantly among seasons ($P < .05$), and the limited data suggested that spawning occurred from late spring to summer. High GSI values in fall collections may indicate protracted spawning.

TABLE 11. NUMBERS OF *Prionotus ophryas* EXAMINED FROM PROJECT HOURGLASS, BY STATION AND MONTH.

Prionotus ophryas

STA	1965					1966													1967												TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1	3								2			1						1												1	8
B_2			2																												2
C_1								1		1		1				2		1	1	4	2		3								16
C_2			1																					1				1	1	2	6
D_1																	1			2											3
D_2														1			2														3
E																															
I																															
J													1																		1
K			1		1			2					3							1											8
L																															
M																	1			1											2
TOT	3		4		1			3	2	1		2	4	1		2	4	2	1	8	2		3	1				1	1	3	49

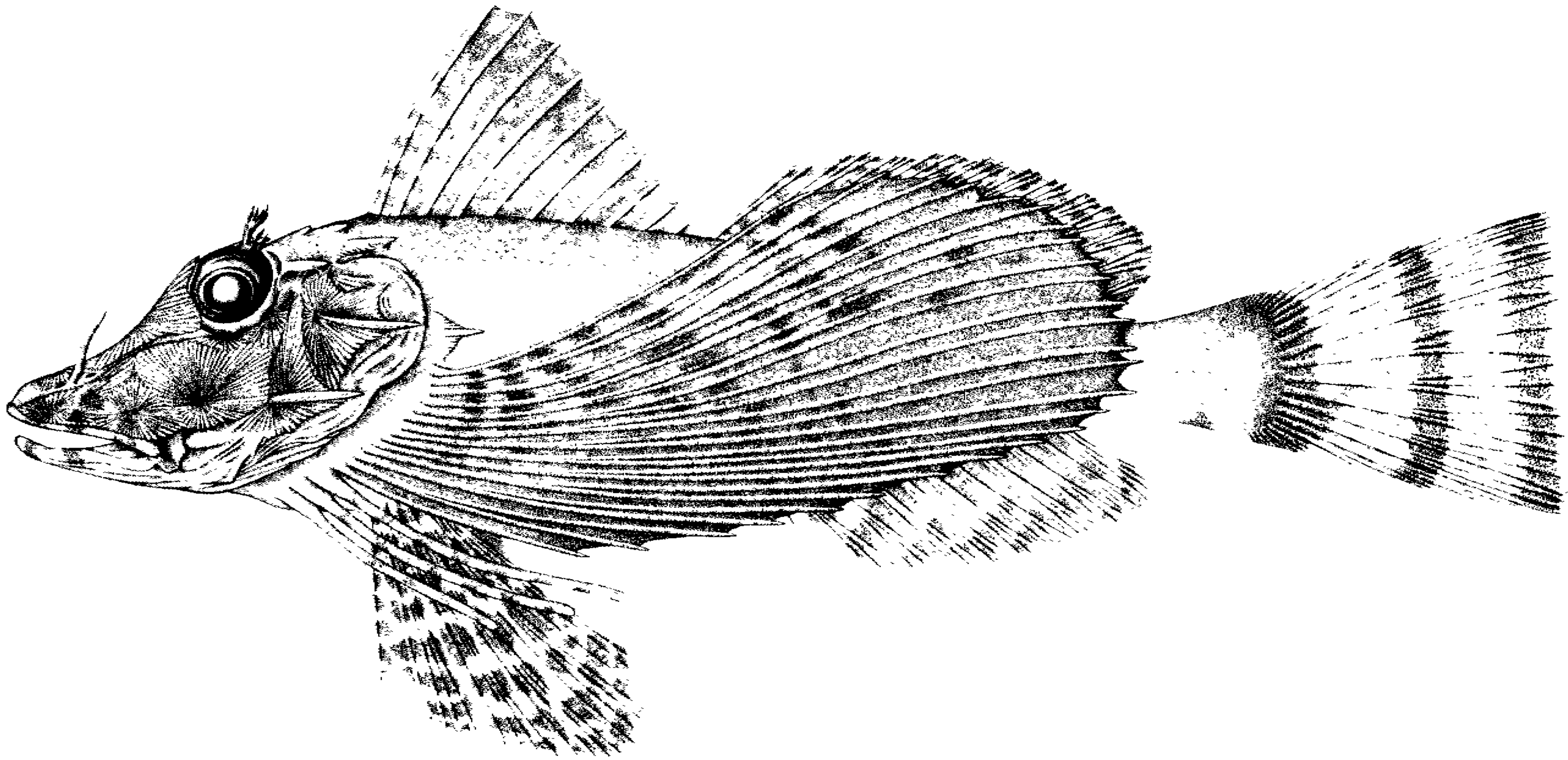

Figure 10. *Prionotus ophryas* Jordan and Swain.

TABLE 12. FOOD ITEMS UTILIZED BY *Prionotus ophryas* (N = 27) COLLECTED DURING PROJECT HOURGLASS.

Prey Category	Percent Occurrence	Number no.	Number %	Volume cc.	Volume %
Brachyura					
Portunidae	3.7	1	0.49	0.006	0.03
Oxyrhyncha	3.7	6	2.91	0.096	0.55
Unidentified crabs	3.7	*		0.023	0.13
(all crabs)	(7.4)	(7)	(3.40)	(0.125)	(0.72)
Natantia					
Pasiphaeidae	59.3	62	30.10	3.071	17.71
Penaeidae	44.4	55	26.70	11.949	68.92
Unidentified shrimp	51.9	26	12.63	2.071	11.95
(all shrimp)	(88.89)	143	(69.42)	(17.091)	(98.58)
Amphipoda					
Gammaridea	3.7	1	0.49	0.008	0.05
Mysidacea	22.2	39	18.93	0.111	0.64
Copepoda	3.7	1	0.49	0.001	0.01
Nematoda	14.8	15	7.28	0.001	0.01
Totals		206		17.337	

*An accurate count of individuals was not possible.

Food habits: Stomachs of 27 of 49 fish (65-185 mm) examined contained food. Most specimens (74%) were greater than 120 mm.

Natantians, primarily Pasiphaeidae and Penaeidae, were dominant prey of *P. ophryas*, accounting for over 98% by volume and occurring in 89% of the fish (Table 12). Mysidaceans were also important numerically and by percent occurrence. Patterns of prey importance based on percent occurrence were similar at both collection depths.

Food habits for two size groups (61-110 and 121-150 mm) indicated that mysidaceans were utilized more by small fish (43%) than larger fish (25%). Agreement in percent occurrence of other prey items was quite similar for the two size groups.

Prionotus roseus Jordan and Evermann, 1886

Figures 3, 11

Prionotus roseus Jordan and Evermann, 1886, p. 470 [original description]; Ginsburg, 1950, p. 505; Hildebrand, 1955, p. 215; Springer and Bullis, 1956, p. 92; Bullis and Thompson, 1965, p. 55; Burns, 1970, p. 125; Wang and Raney, 1971, p. 42; Franks et al., 1972, p. 110; Christmas and Waller, 1973, p. 379; Lewis and Yerger, 1976, pp. 97-98.

Material examined: HOURGLASS STATION B: 1 ♀, 73.5; 26 August 1965; trawl; FSBC 4396. — 1 ?, 60.7; 30 August 1965; trawl; FSBC 4212. — 1 ♂, 107.0; 20 October 1965; trawl; FSBC 8400. — 1 ♀, 66.1; 11 May 1967; trawl; FSBC 8576. — 1 ♀, 72.4; 1 July 1967; trawl; FSBC 8735. — 1 ♀, 132.3; 11 September 1967; trawl; FSBC 8567. — 1 ♂, 133.8; 20 November 1967; trawl; FSBC 8593. — HOURGLASS STATION C: 2 ♂, 89.3, 117.2; 31 August 1965; trawl; FSBC 8585. — 2 ♂, 115.2, 169.5; 2 ♀, 120.8, 160.5; 10 October 1965; FSBC uncatalogued. — 1 ♂, 90.3; 2 ♀, 133.9,

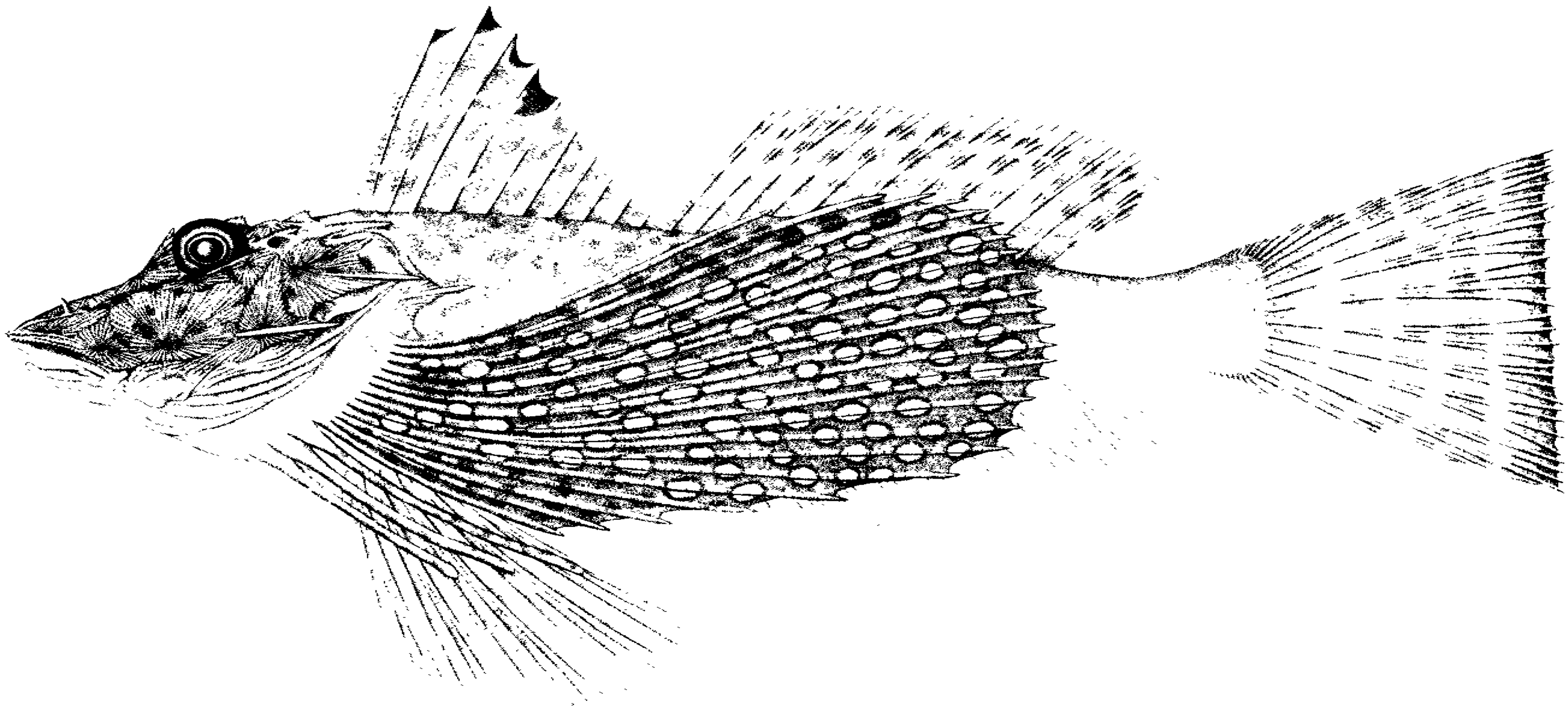

Figure 11. *Prionotus roseus* Jordan and Evermann.

158.0; 8 November 1965; trawl; FSBC 8572. — 1 ♂, 113.6; 3 March 1966; trawl; FSBC 8708. — 1 ♂, 88.9; 1 ♀, 96.0; 27 March 1966; trawl; FSBC 8586. — 1 ?, 110.0; 16 April 1966; trawl; FSBC 5106. — 1 ♀, 84.6; 2 July 1966; trawl; FSBC 8587. — 1 ♀, 143.9; 18 July 1966; trawl; FSBC 8562. — 1 ♀, 92.1; 31 August 1966; trawl; FSBC uncatalogued. — 1 ♀, 107.1; 25 January 1967; trawl; FSBC 8606. — 1 ♀, 153.0; 5 February 1967; trawl; FSBC 8598. — 3 ♂, 135.0-172.0; 2 March 1967; trawl; FSBC uncatalogued. — 1 ♀, 129.5; 3 April 1967; trawl; FSBC 8565. — 1 ?, 67.4; 11 September 1967; trawl; FSBC 8399. — 2 ♂, 73.1, 114.8; 5 October 1967; trawl; FSBC 8582. — 1 ♂, 103.7; 6 ♀, 75.8-89.1; 2 ?, 88.0, 90.1; 25 October 1967; trawl; FSBC 8665. — 3 ♀, 123.1-134.7; 2 ♀, 91.9, 103.0; 2 November 1967; trawl; FSBC 8554. — 2 ♀, 130.5, 131.0; 21 November 1967; trawl; FSBC 8555. — HOURGLASS STATION D: 1 ♀, 136.0; 3 August 1965; trawl; FSBC 8580. — 1 ♀, 160.0; 27 August 1965; trawl; FSBC 8568. — 2 ♀, 139.5, 148.5; 1 ♂, 141.6; 29 August 1965; trawl; FSBC 8570. — 1 ♀, 144.2; 5 October 1965; trawl; FSBC 8604. — 6 ♂, 145.7-158.0; 6 ♀, 139.8-154.5; 21 October 1965; trawl; FSBC 8545. — 10 ♂, 135.1-162.5; 10 ♀, 135.1-150.6; 20 November 1965; trawl; FSBC 4600. — 2 ♂, 147.9, 162.5; 4 January 1966; trawl; FSBC 8558. — 4 ♂, 146.1-156.3; 6 ♀, 93.5-149.2; 21 February 1966; trawl; FSBC 8652. — 2 ♂, 150.5, 156.0; 3 ♀, 141.0-148.1; 4 March 1966; trawl; FSBC 8549. — 2 ♂, 146.5, 149.8; 27 March 1966; trawl; FSBC 8569. — 2 ♂, 140.6, 159.0; 1 ♀, 107.8; 7 April 1966; trawl; FSBC 8560. — 5 ♂, 140.0-163.5; 16 April 1966; trawl; FSBC 8594. — 3 ♂, 138.8-161.0; 17 ♀, 130.1-161.0; 18 June 1966; trawl; FSBC 8550. — 1 ♂, 162.0; 1 ♀, 152.3; 3 July 1966; trawl; FSBC 8662. — 8 ♂, 148.7-163.0; 8 ♀, 132.5-156.0; 2 August 1966; trawl; FSBC 8546. — 3 ♂, 128.0-142.6; 2 ♀, 144.8, 150.8; 11 August 1966; trawl; FSBC 8588. — 3 ♀, 141.0-153.0; 1 September 1966; trawl; FSBC 8551. — 2 ♂, 158.5, 160.0; 4 ♀, 137.1-150.0; 9 September 1966; trawl; FSBC 8591. — 2 ♂, 143.5, 148.7; 1 ♀, 147.9; 9 September 1966; trawl; FSBC 8610. — 1 ♂, 165.5; 9 November 1966; trawl; FSBC 8574. — 4 ?, 148.9-155.0; 4 ♂, 145.9-166.0; 2 ♀, 146.6, 149.9; 2 December 1966; trawl; FSBC 8548. — 2 ♂, 130.5, 153.0; 2 ♀, 124.0, 132.6; 14 December 1966; trawl; FSBC 8609. — 2 ♀, 153.1, 153.2; 7 January 1967; trawl; FSBC 8556. — 5 ♂, 153.5-164.2; 5 ♀, 113.9-145.7; 21 January 1967; trawl; FSBC 8547. — 1 ♀, 108.0; 21 January 1967; trawl; FSBC 8583. — 5 ♀, 133.4-150.6; 3 ♂, 145.8-161.6; 26 January 1967; trawl; FSBC 8589. — 1 ♀, 142.8; 6 February 1967; trawl; FSBC 8608. —6 ♂, 148.4-161.5; 3 ♀, 145.1-153.5; 28 February 1967; trawl; FSBC 8653. — 1 ♀, 146.4; 3 March 1967; trawl; FSBC 8564. — 2 ♀, 77.3, 136.4; 15 March 1967; trawl; FSBC 8584. — 1 ♂, 153.0; 4 ♀, 131.3-149.2; 15 March 1967; trawl; FSBC 8590. — 1 ♂, 154.1; 15 March 1967; trawl; FSBC 8607. — 1 ♂, 123.9; 1 ♀, 116.1; 4 April 1967; trawl; FSBC 8403. — 2 ♂, 126.1, 156.0; 2 ♀, 141.5, 147.0; 12 April 1967; trawl; FSBC 8571. — 1 ♂, 89.4; 3 ♀, 120.1-155.5; 21 June 1967; trawl; FSBC 8597. — 1 ♂, 156.2; 2 ♀, 145.5, 146.2; 11 September 1967; trawl; FSBC 8561. — 2 ♂, 138.5, 155.0; 6 October 1967; trawl; FSBC 8595. — 1 ♂, 155.0; 6 October1967; trawl; FSBC 8592. — 1 ♀, 148.8; 22 October 1967; trawl; FSBC 8658. — HOURGLASS STATION E: 1 ♀, 43.1; 4 March 1966; trawl; FSBC 4907. — 1 ♂, 170.1; 9 November 1966; trawl; FSBC 8552. — HOURGLASS STATION J: 1 ?, 107.7; 21 July 1966; trawl; FSBC 5073. — HOURGLASS STATION K: 1 ♂, 117.0; 1 ?, 101.2; 13 October 1965; trawl; FSBC 8581. — 1 ♂, 100.1; 4 ♀, 73.0-106.6; 13 November 1965; trawl; FSBC 4596. — 1 ♀, 157.5; 21 March 1966; trawl; FSBC 8573. — 1 ♂, 165.5; 1 ♀, 150.6; 22 July 1966; trawl; FSBC 8654. — 1 ♂, 151.1; 12 November 1966; trawl; FSBC 8553. — 1 ♂, 171.5; 1 ♀, 153.8; 6 December 1966; FSBC 8578. — 1 ♂, 163.0; 12 January 1967; trawl; FSBC 8660; 1 ♀, 157.0; 15 February 1967; trawl; FSBC 8566. — 2 ♂, 119.6, 135.6; 3 ♀, 108.5-116.9; 2 ?, 101.5, 105.3; 11 October 1967; trawl; FSBC 8559. — 1 ♀, 122.0; 18 November 1967; trawl; FSBC 8404. — HOURGLASS STATION L: 2 ♂, 178.5, 190.0; 1 ♀, 172.2; 13 October 1965; trawl; FSBC 4526. — 1 ♂, 177.5; 2 ♀, 152.4, 152.6; 13 November 1965; trawl; FSBC 8662. — 2 ♂, 170.0, 175.0; 1 ♀, 161.5; 14 December 1965; trawl; FSBC 8601. — 3 ♂, 146.4-174.9; 1 ♀, 139.1; 14 January 1966; trawl; FSBC 8575. — 2 ♂, 162.0, 181.0; 1 ♀, 165.0; 15 February 1966; trawl; FSBC 8603. — 1 ♂, 172.5; 2 ♀, 157.0, 163.2; 12 April 1966; trawl; FSBC 8563. — 1 ♀, 152.6; 12 May 1966; trawl; FSBC 8557. — 1 ♂, 183.0; 13 June 1966; trawl; FSBC

8602. — 1 ♂, 179.2; 22 July 1966; trawl; FSBC 8579. — 1 ♂, 153.4; 13 November 1966; trawl; FSBC 8827. — 3 ♂, 126.8-186.0; 2 ♀, 158.0, 158.2; 13 January 1967; trawl; FSBC 8599. — 1 ♂, 152.1; 1 ♀, 154.1; 31 January 1967; trawl; FSBC 8600. — 1 ♂, 154.0; 16 February 1967; trawl; FSBC 8402. — 1 ♂, 173.0; 8 April 1967; trawl; FSBC uncatalogued. — 1 ♀, 141.3; 16 May 1967; trawl; FSBC 8605. — 1 ♂, 156.5; 15 November 1967; trawl; FSBC 8664. — HOURGLASS STATION M: 1 ♀, 89.7; 13 January 1967; trawl; FSBC 5158. — OTHER MATERIAL: 1 ?, 30.5; Gulf of Mexico, off Sarasota, Florida; FSBC 11981.

Diagnosis: Mouth proportionately small, upper jaw length averaging 10.6% SL (s = 0.10); pectoral fin with blue ocelli ringed in brown, varying to fully brown (ocelli may be absent in very small specimens); pectoral fin long, usually exceeding anal base in adults; rostral, second and third infraorbital and supplementary preopercular spines generally absent except in small specimens; rostral spine may persist in adult specimens; D. X, 11-13 (modally 12); A. 10-12 (modally 11); joined pectoral rays 12-14 (modally 13); gill rakers 7-10; lateral scale rows 89-104.

Remarks: Three hundred and one specimens were available from Project Hourglass and were captured between 18-73 m (Table 13). Bottom temperatures were 16-30°C. Bottom salinities were 32-37 ‰, with 98% of the fish occurring between 34-37 ‰.

Lengths of *P. roseus* were greater from deeper stations; means were 94, 116 and 148 mm at depths of 18, 37 and 55 m (ANOVA, $P < .001$). Fish size also changed with season at the 37 m stations ($P < .001$); smaller fish, 60-90 mm, were more common in fall (September-November) than winter.

Reproduction: *Prionotus roseus* smaller than 90 mm had lower gonadosomatic indices compared to larger fish. Accordingly, I used fish 90 mm or larger in the analysis of seasonal reproductive changes. Mean monthly GSI values for separate, or combined sexes differed significantly ($P < .001$). Gonadal development began in November and the inferred spawning period was April to September (Figure 12).

TABLE 13. NUMBERS OF *Prionotus roseus* EXAMINED FROM PROJECT HOURGLASS, BY STATION AND MONTH.

Prionotus roseus

STA	1965					1966													1967												TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B1	1																							1		1					3
B2	1		1																									1		1	4
C1	2		4	3				1				1		1					1		1	3	1					1	2	5	26
C2								2	1			1																1	9	2	16
D1	1		1			2		5	3			2		16	3		1	10	2	8	10	1	2					3	3		73
D2	4		12	20			10	2	5		20			5	9			4	11			8	4		4				1		119
E								1									1														2
I																															
J													1																		1
K			2	5				1				2					1	2	1	1									7		22
L			3	3	3	4	3		3	1	1	1					1		5	2	1		1	1						1	34
M																					1										1
TOT	9		23	31	3	6	13	12	12	1	21	7	1	22	12		4	16	20	11	13	12	8	2	4	1		6	22	9	301

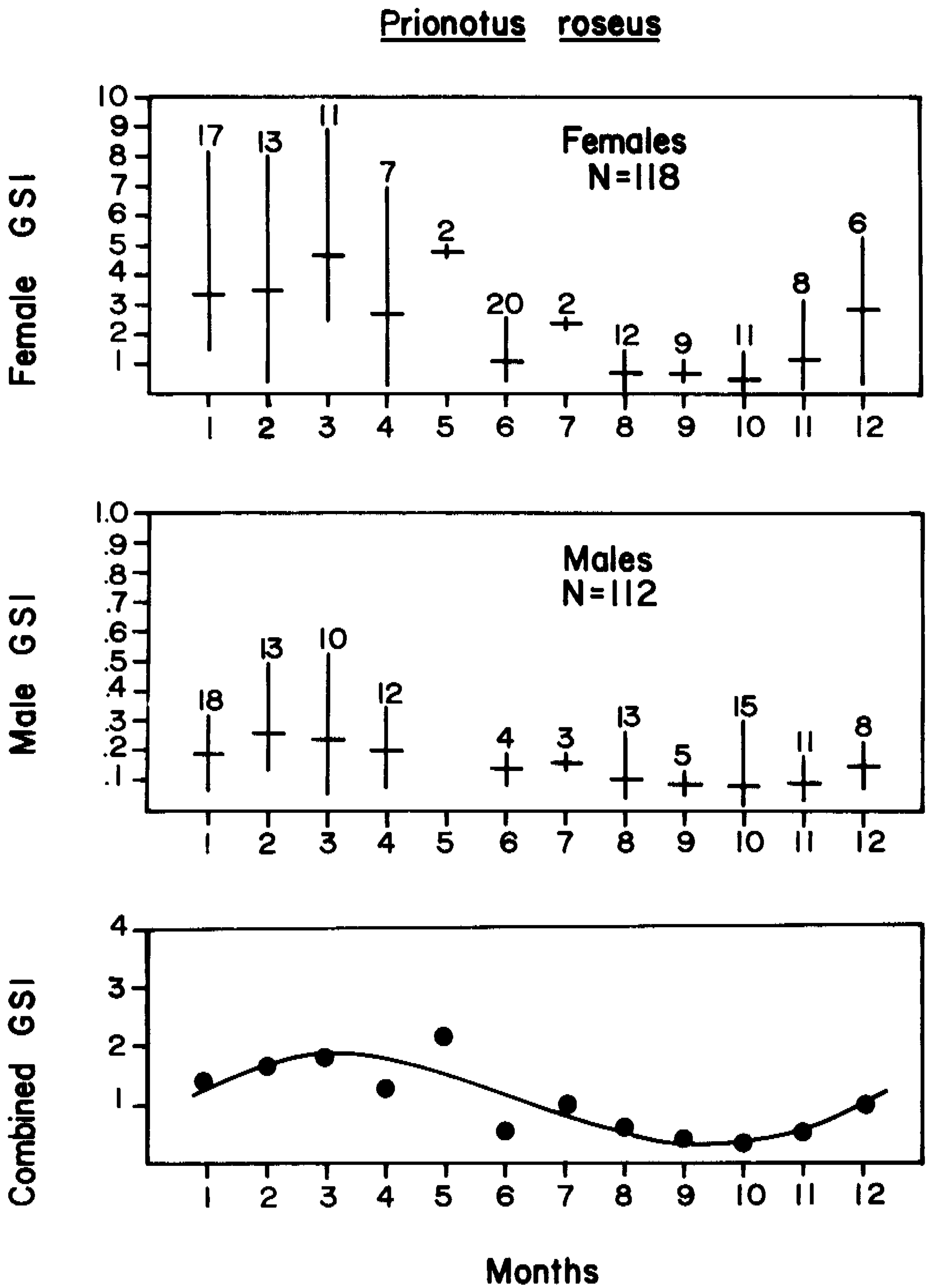

Figure 12. Monthly changes in the gonadosomatic index of male and female *Prionotus roseus* from Project Hourglass. See Figure 5 for further explanation.

Food habits: I identified stomach contents from 141 *P. roseus* ranging from 60-190 mm, with 62% between 130 and 160 mm. Natantians were the dominant prey category, occurring in 90% of the fish and contributing over 60% to the total volume and number of prey items (Table 14). Pasiphaeids, primarily *Leptochela*, were the most common natantians. Mysidaceans, gammaridean amphipods, brachyurans, fishes, polychaetes, and isopods were also important, occurring in over 10% of the stomachs. Mysidaceans and gammarideans had high numerical importance, while fishes, brachyurans, mysidaceans, and polychaetes were important based on volume.

TABLE 14. FOOD ITEMS UTILIZED BY *Prionotus roseus* (N = 141) COLLECTED DURING PROJECT HOURGLASS.

Prey Category	Percent Occurrence	Number		Volume	
		no.	%	cc.	%
Unidentified fishes	16.3	31	2.30	1.839	10.73
Amphioxi					
Branchiostoma floridae	2.8	6	0.44	0.020	0.12
Echinodermata					
Ophiuroidea	1.4	3	0.22	0.014	0.08
Brachyura					
Portunidae	5.0	9	0.67	0.214	1.25
Leucosiidae	2.1	3	0.22	0.248	1.45
Oxyrhyncha	3.6	15	1.11	0.050	0.29
Brachyuran megalops	0.7	1	0.07	0.007	0.04
Unidentified crabs	9.9	17	1.26	0.502	2.93
(all crabs)	(17.9)	(45)	(3.34)	(1.021)	(5.99)
Anomura	7.8	20	1.48	0.131	0.76
Natantia					
Pasiphaeidae	51.8	284	21.05	4.760	27.77
Alpheidae	2.8	48	3.56	0.012	0.07
Processidae	3.6	6	0.44	0.035	0.20
Penaeidae	13.5	22	1.63	1.183	6.90
Unidentified shrimp	75.8	459	34.03	5.527	32.25
(all shrimp)	(90.8)	(819)	(60.71)	(11.517)	(67.58)
Macrura					
Scyllaridea	0.7	2	0.15	0.137	0.80
Amphipoda					
Gammaridea	28.4	87	6.45	0.141	0.82
Isopoda	9.9	19	1.41	0.197	1.15
Cumacea	4.3	6	0.44	0.012	0.07
Mysidacea	33.3	253	18.75	0.504	2.94
Stomatopoda	14.2	29	2.15	1.192	6.96
Copepoda	5.0	8	0.59	0.008	0.05
Ostracoda	1.4	2	0.15	0.003	0.02
Unidentified crustaceans	3.6	8	0.59	0.077	0.45
Annelida					
Polychaeta	15.6	**		0.298	1.74
Mollusca					
Pelecypoda	5.6	9	0.67	0.021	0.12
Nematoda	2.1	4	0.30	*	
Totals		1351		17.132	

*Trace amounts only.

**An accurate count was impossible.

Prionotus roseus fed most actively between morning and noon (Figure 13). Eighty-seven percent of the fish collected during the day had stomach contents of greater than trace amounts, while 68% of the fish collected at night had empty stomachs.

Seasonal feeding differences of *P. roseus* (130-160 mm; Stations D and L) were most pronounced for mysidaceans, which were important only during winter and spring. Percent occurrence of natantians was seasonally constant, although their percent volume dropped during summer, partially in response to the increased volumetric importance of brachyurans. Seasonal patterns were not apparent for other prey categories.

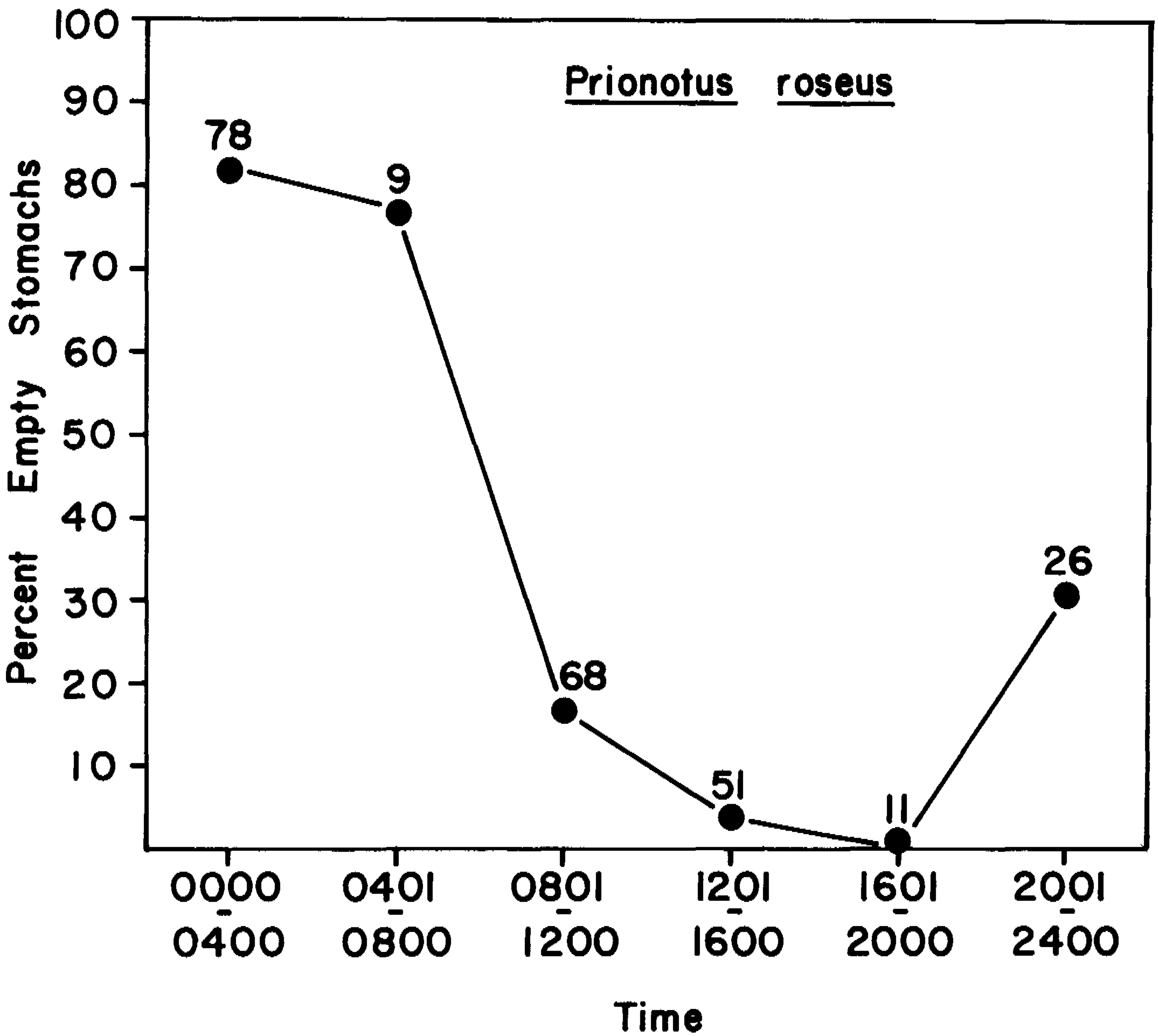

Figure 13. Diel feeding of *Prionotus roseus* from Project Hourglass. Numbers indicate sample sizes.

TABLE 15. PERCENT OCCURRENCE OF MAJOR PREY ITEMS UTILIZED BY FOUR SIZE CLASSES OF *Prionotus roseus* FROM PROJECT HOURGLASS.

Prey Category	Size Groups mm 61-100 (N=19)	101-130 (N=22)	131-160 (N=88)	161-190 (N=10)
Unidentified fishes	10.5	13.6	17.2	30.0
Branchiostoma floridae	-	4.6	2.3	10.0
Portunidae	-	-	4.6	30.0
Leucosiidae	-	-	2.3	10.0
Oxyrhyncha	5.3	-	4.6	-
Brachyuran megalops	5.3	-	-	-
(All crabs)	(10.5)	(9.1)	(20.7)	(30.0)
Anomura	-	-	11.5	10.0
Pasiphaeidae	52.6	36.4	56.3	50.0
Processidae	-	4.6	4.6	10.0
Penaeidae	26.3	4.6	11.5	-
(All shrimp)	(89.5)	(95.5)	(89.7)	(90.0)
Gammaridea	68.4	22.7	24.1	10.0
Isopoda	31.6	4.6	6.9	10.0
Cumacea	15.8	4.6	2.3	-
Mysidacea	57.9	31.8	31.0	20.0
Stomatopoda	5.3	4.6	19.5	10.0
Copepoda	5.3	9.1	3.5	10.0
Polychaeta	10.5		20.7	20.0

Based on four size classes (61-100, 101-130, 131-160, and 161-190 mm), the percent occurrence of fishes in the diet increased with increasing fish size (Table 15). Brachyurans also increased in occurrence, while smaller crustaceans such as mysidaceans, cumaceans and gammarideans decreased in importance to larger *P. roseus*. The dominant prey category, Natantia, remained stable across the size groups. Analyses of numerical and volumetric importance of prey categories showed similar patterns, although fishes decreased in volumetric importance in specimens from 101 to 190 mm. Since many fish prey were represented only by vertebral centra, differential digestion likely resulted in this reverse pattern.

Prionotus salmonicolor (Fowler, 1903)

Figures 3, 14

Merulinus salmonicolor Fowler, 1903, pp. 333-336 [original description].
Prionotus miles pectoralis Nichols and Breder, 1924, p. 22.
Prionotus pectoralis: Gunter, 1945, p. 80; Ginsburg, 1950, pp. 515-516; Teague, 1951, pp. 41-42; Hildebrand, 1954, p. 315; Springer and Bullis, 1956, p. 92; Bullis and Thompson, 1965, p. 55; J. Miller, 1965, pp. 99-100; Franks, 1970, p. 69; Franks et al., 1972, pp. 109-110.
Prionotus vanderbilti Teague, 1951, p. 46.
Prionotus salmonicolor: Teague, 1951, pp. 47-48; Miller and Kent, 1971, p. 240; Chittenden and Moore, 1977, pp. 108-111; Ogren and Brusher, 1977, p. 90.

Material examined: HOURGLASS STATION B: 1 ♀, 181.0; 1 December 1966; trawl; FSBC 4950. — 1 ♂, 192.0; 1 ♀, 166.0; 2 November 1967; trawl; FSBC 8611. — HOURGLASS STATION C: 1 ♀, 176.6; 8 November 1965; trawl; FSBC 4564. — 2 ♂, 171.7, 173.5; 2 November 1967; trawl; FSBC 8675. — HOURGLASS STATION D: 1 ♂, 166.0; 27 August 1965; trawl; FSBC 8633. — 2

♀, 173.0, 221.5; 20 November 1965; trawl; FSBC 8636. — 2 ♀, 163.5, 190.0; 4 December 1965; trawl; FSBC 4622. — 1 ♂, 185.0; 2 February 1966; trawl; FSBC 8634. — 1 ♂, 172.5; 7 April 1966; trawl; FSBC 8614. — 1 ♀, 185.0; 16 April 1966; trawl; FSBC 8623. — 1 ♂, 196.0; 7 June 1966; trawl; FSBC 8621. — 1 ♂, 188.2; 3 July 1966; trawl; FSBC uncatalogued. — 1 ♂, 193.0; 2 August 1966; trawl; FSBC 8615. — 1 ♂, 170.5; 21 January 1967; trawl; FSBC 8617. — 2 ♀, 167.5, 206.5; 1 ♂, 187.5; 26 January 1967; trawl; FSBC 8630. — 1 ♀, 186.1; 28 February 1967; trawl; FSBC 8620. — 2 ♂, 190.2, 208.3; 1 ♀, 185.5; 15 March 1967; trawl; FSBC 8626. — 1 ♂, 175.0; 15 March 1967; trawl; FSBC 8619. — 1 ♀, 180.0; 4 April 1967; trawl; FSBC 8622. — 1 ♀, 191.5; 12 May 1967; trawl; FSBC 8674. — 1 ♀, 151.7; 2 July 1967; trawl; FSBC uncatalogued. — 2 ♂, 162.0, 171.0; 1 ♀, 165.5; 27 October 1967; trawl; FSBC 8612. — HOURGLASS STATION J: 1 ♂, 107.0; 21 March 1966; trawl; FSBC uncatalogued. — 1 ♂, 160.5; 21 July 1966; trawl; FSBC 8618. — HOURGLASS STATION K: 1 ♀, 148.4; 12 October 1966; trawl; FSBC 4940. — 1 ♀, 148.4; 12 October 1966; trawl; FSBC 4940. — 1 ♀, 180.1; 30 January 1967; trawl; FSBC 5527. — HOURGLASS STATION L: 1 ♀, 227.1; 13 October 1965; trawl; FSBC uncatalogued. — 1 ♀, 228.0; 13 October 1965; trawl; FSBC 4525. — 1 ♂, 201.5; 12 April 1966; trawl; FSBC 8632. — 1 ♀, 196.0; 22 July 1966; trawl; FSBC 8631. — 1 ♂, 183.1; 31 January 1967; trawl; FSBC uncatalogued. — 1 ♂, 218.0; 16 February 1967; trawl; FSBC 8624. — 1 ♂, 203.5; 5 September 1967; trawl; FSBC 8629. — OTHER MATERIAL: 3 ?, 22.7-27.0; Gulf of Mexico, West Florida; 1 March 1960; FSBC 1665. — 1 ?, 80.8; Gulf of Mexico, West Florida; 19 March 1960; FSBC 2606. — 7 ?, 44.9-75.2; Gulf of Mexico, Mississippi; 27 November 1974; R74-9-12. — 2 ?, 139.3, 144.5; Gulf of Mexico, 28°51'N, 90°14'W, *Oregon II* Station 16327; 20 November 1974; FSBC uncatalogued. — 2 ?, 121.8, 153.0; Gulf of Mexico, 28°50'N, 90°13'W, *Oregon II* Station 16328; 20 November 1974; FSBC uncatalogued. — 1 ?, 130.7; Gulf of Mexico; 28°44'N, 90°15'W, *Oregon II* Station 16329; 20 November 1974; FSBC uncatalogued.

Diagnosis: Mouth moderately large, upper jaw length averaging 14.5% SL (s = 0.10); rostral, second infraorbital and supplemental preopercular spines well developed, becoming reduced and occasionally absent in specimens approaching 200 mm; anal fin membranes usually immaculate, occasionally with scattered melanophores, especially on posterior fin membranes; upper free pectoral rays averaging 22.4% SL (s = 1.5; N = 23); longest caudal lobe averaging 26.6% of SL (s = 2.1); pelvic fin averaging 26.9% SL (s = 2.1); pectoral fin elongate, averaging 58.1% SL (s = 5.2), usually exceeding anal fin base; pectoral rays 12-13 (modally 13); spinous dorsal spot absent

TABLE 16. NUMBERS OF *Prionotus salmonicolor* EXAMINED FROM PROJECT HOURGLASS, BY STATION AND MONTH.

Prionotus salmonicolor

STA	1965					1966													1967												TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1																		1												2	3
B_2																															
C_1				3																											3
C_2																															
D_1				2			1		1		1	1		1						3		4		1		1					16
D_2	1				2				1										1		1		1						3		10
E																															
I																															
J								1				1																			2
K																1			1												2
L			2						1				1						1		1							1			7
M																															
TOT	1		2	5	2		1	1	3		1	2	1	1		1		1	3	3	2	4	1	1		1		1	3	2	43

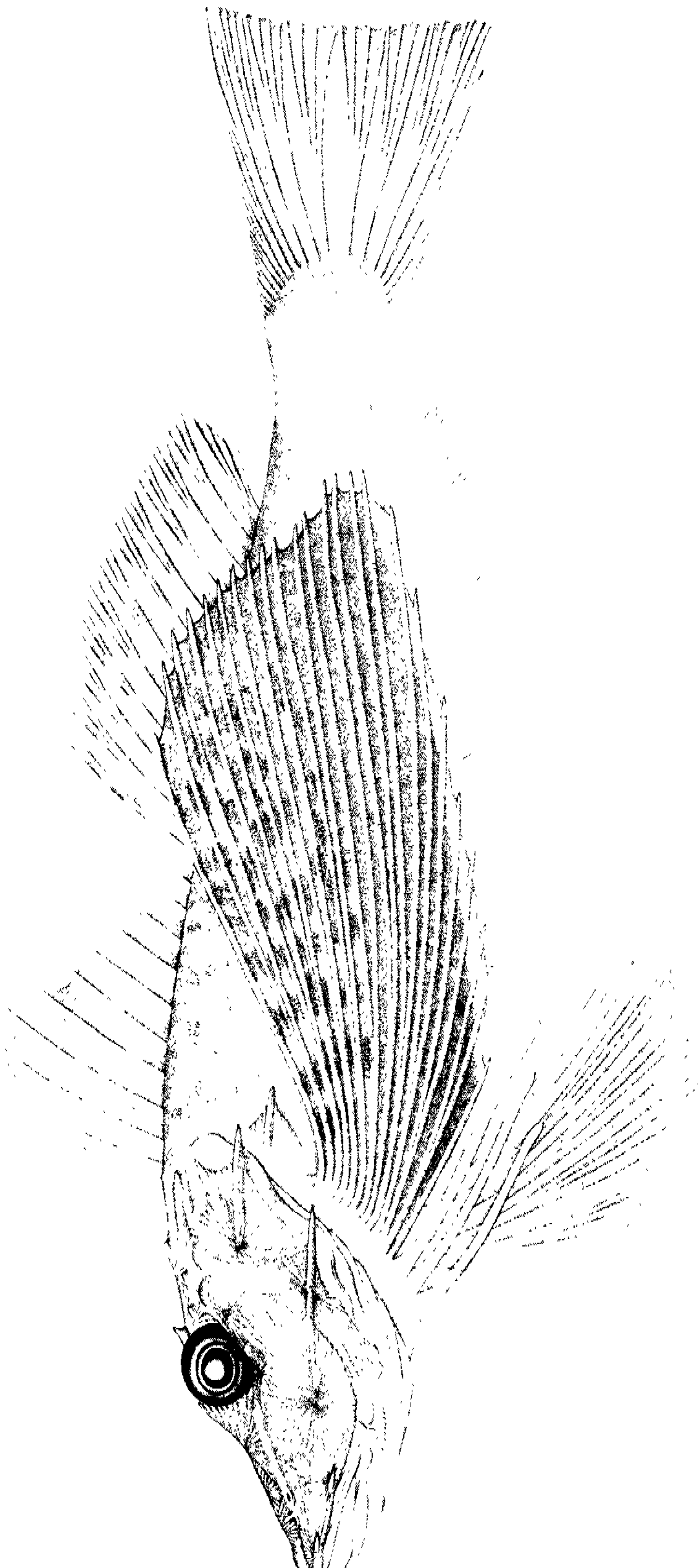

Figure 14. *Prionotus salmonicolor* (Fowler).

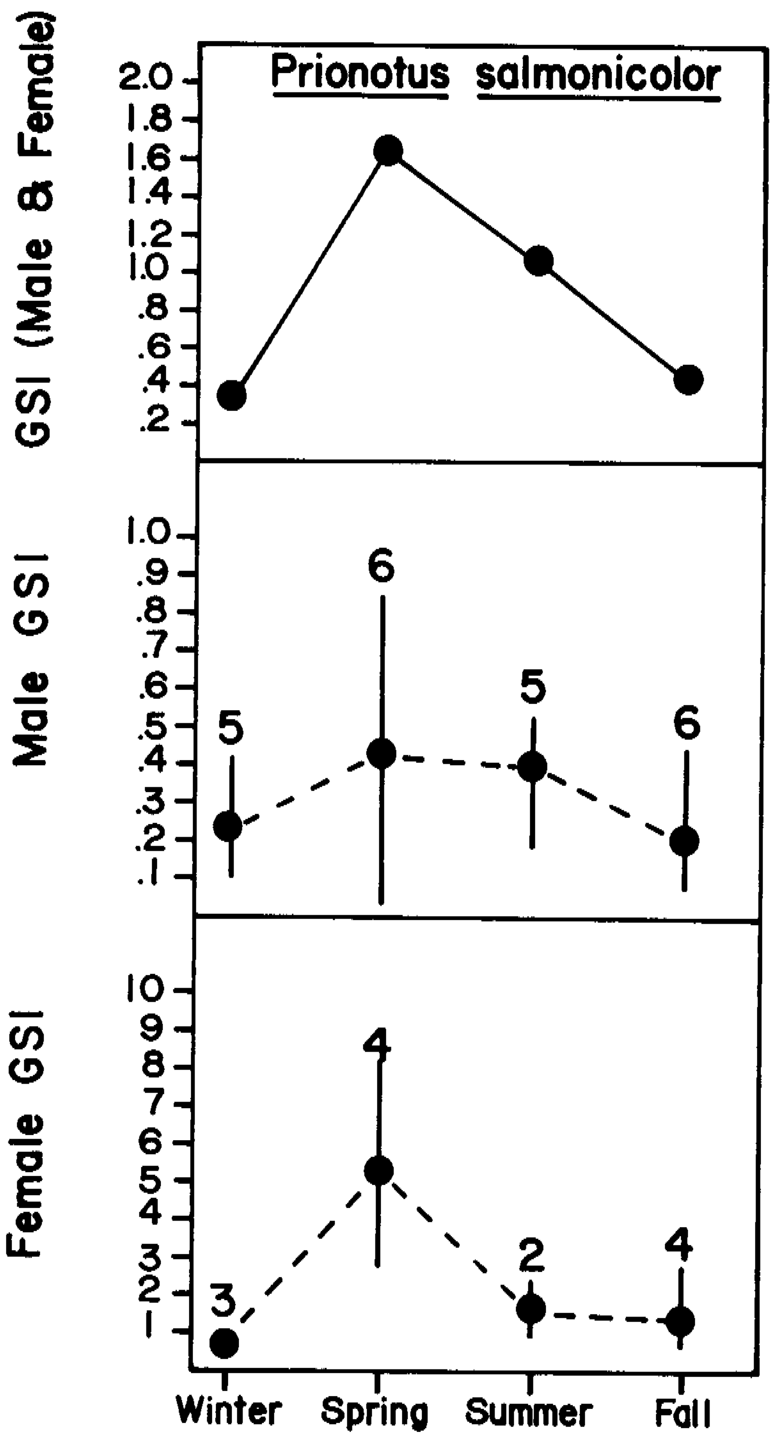

Figure 15. Seasonal changes in gonadosomatic indices of combined and separate male and female *Prionotus salmonicolor* from Project Hourglass. See Figure 5 for further explanation.

in adults, present in young; D.X, 12-13 (modally 12); A.11-12 (modally 11); gill rakers 8-10; lateral scale rows 98-116.

Remarks: Forty-three specimens of *P. salmonicolor* were available from Project Hourglass (18-55 m), and most exceeded 140 mm. Numbers of specimens examined monthly from each station are given in Table 16. Bottom temperatures were 16-28°C; bottom salinities were 34-37 ‰, with 98% of the fish occurring between 35-37 ‰. Mean lengths at 18, 37 and 55 mm were 158, 170 and 187 mm respectively; means were significantly different ($P < .05$) after correcting for heteroscedasticity by using the ln transformation.

Reproduction: I combined GSI values for 35 male and female fish larger than 100 mm. The means of the recorded GSI values differed significantly with season ($P < .001$; Figure 15), indicating that spawning occurred between late spring and fall, with gonadal development occurring through winter and early spring.

Food habits: I identified stomach contents from 22 *P. salmonicolor*; lengths of all specimens except one were 155-195 mm. Natantians were the dominant prey category, of which Penaeidae and Pasiphaeidae had the highest levels of occurrence (Table 17). Fishes also were important prey and 24% were identified as *Bregmaceros atlanticus* (all identifiable fish prey were this species). Mysidaceans, stomatopods and possibly brachyurans were also important prey.

TABLE 17. FOOD ITEMS UTILIZED BY *Prionotus salmonicolor* (N = 22) COLLECTED DURING PROJECT HOURGLASS

Prey Category	Percent Occurrence
Teleostei	50.0
Brachyura	
Leucosiidae	4.6
Oxyrhyncha	9.1
Unidentified crabs	9.1
(All crabs)	(18.2)
Natantia	
Pasiphaeidae	27.3
Processidae	4.6
Penaeidae	36.4
Unidentified shrimp	54.6
(All shrimp)	(72.3)
Amphipoda	
Gammaridea	4.6
Mysidacea	22.7
Stomatopoda	22.7
Annelida	
Polychaeta	4.6
Nematoda	9.1

Prionotus alatus Goode and Bean, 1882

Figure 16

Prionotus alatus Goode and Bean, 1882, p. 210 [original description]; Ginsburg, 1950, pp. 524-525; Springer and Bullis, 1956, p. 92; Bullis and Thompson, 1965, p. 55; Burns, 1970, p. 125; Miller and Kent, 1971, pp. 223-242; Franks et al., 1972, p. 109; Lewis and Yerger, 1976, pp. 96-97.

Material examined: HOURGLASS STATION D: 1 ♂, 104.0; 1 ♀, 138.8; 21 October 1965; trawl; FSBC uncatalogued. — 1 ♀, 142.7; 11 November 1965; trawl; FSBC uncatalogued. — 1 ♀, 137.3; 21 February 1966; FSBC 8497. — 1 ♀, 155.0; 16 April 1966; trawl; FSBC 8474. — 1 ♂, 143.5; 3 July 1966; trawl; FSBC 8483. — 1 ?, 44.0; 11 July 1966; trawl; FSBC uncatalogued. — 1 ♀, 146.6; 9 November 1966; trawl; FSBC 8487. —1 ♂, 120.4; 15 March 1967; trawl; FSBC 8484. — 1 ♀, 148.6; 3 November 1967; trawl; FSBC 8476. — HOURGLASS STATION E: 2 ♂, 105.5, 125.4; 2 ♀, 106.2, 145.1; 5 October 1965; trawl; FSBC 4511. — 1 ♀, 81.3; 9 November 1965; trawl; FSBC 8501. — 2 ♂, 121.4, 135.0; 6 ♀, 112.0-135.0; 4 December 1965; trawl; FSBC 8471. — 1 ♀, 128.7; 8 February 1966; trawl; FSBC 8482. — 3 ♂, 98.1-134.1; 1 ♀, 128.9; 4 March 1966; trawl; FSBC 8464. — 1 ♀, 145.5; 7 June 1966; trawl; FSBC 8666. — 2 ♂, 100.4, 122.3; 3 ♀, 101.4-130.2; 3 July 1966; trawl; FSBC 8468. — 2 ♂, 95.4, 125.5; 2 August 1966; trawl; FSBC 8479. — 1 ♀, 59.5; 2 ?, 40.3, 40.6; 2 August 1966; trawl; FSBC 4992. —1 ♀, 130.2; 9 November 1966; trawl; FSBC 8490. — 3 ♀, 68.5-127.3; 2 ?, 74.0, 77.7; 2 December 1966; trawl; FSBC 8467. — 1 ♂, 127.5; 7 January 1967; trawl; FSBC 8477. — 2 ♂, 47.8, 58.7; 26 January 1967; trawl; FSBC uncatalogued. — 3 ♂, 104.5-126.2; 6 February 1967; trawl; FSBC 8470. — 2 ♀, 88.3, 112.6; 4 April 1967; trawl; FSBC 8495. — 1 ♂, 150.1; 4 April 1967; trawl; FSBC 8466. — 1 ♂, 110.9; 4 April 1967; trawl; FSBC uncatalogued. — 1 ♂, 115.9; 3 June 1967; trawl; FSBC 8669. — 1 ♂, 142.5; 1 ♀, 138.0; 2 July 1967; trawl; FSBC 8499. — 1 ♂, 124.8; 2 August 1967; trawl; FSBC 8668. — 1 ♂, 115.5; 3 ♀, 59.5-121.4; 1 ?, 63.1; 1 September 1967; trawl; FSBC 8500. — 1 ♀, 120.1; 1 September 1967; trawl; FSBC 8491. — 1 ♂, 129.5; 6 October 1967; trawl; FSBC 8491. — 1 ♂, 115.1; 1 ?, 68.5; 3 November 1967; trawl; FSBC uncatalogued. —HOURGLASS STATION L: 1 ♀, 163.0; 7 August 1965; trawl; FSBC 4395. — HOURGLASS STATION M: 2 ♂, 126.8, 140.1; 2 ♀, 107.7, 137.9; 4 September 1965; trawl; FSBC 8493. — 3 ♂, 101.5-137.0; 4 ♀, 109.3-130.6; 13 October 1965; trawl; FSBC 4531. — 2 ♂, 119.2, 156.6; 1 ♀, 158.0; 14 December 1965; trawl; FSBC 8398. — 1 ♂, 117.8; 1 ♀, 134.7; 14 January 1966; trawl; FSBC 8498. — 3 ♀, 129.7-135.4; 22 March 1966; trawl; FSBC 8486. — 1 ♀, 130.0; 12 May 1966; trawl; FSBC 8481. — 1 ♀, 145.0; 22 July 1966; trawl; FSBC 8667. — 1 ♂, 127.2; 2 ♀, 51.2, 126.2; 1 ?, 129.8; 6 August 1966; trawl; FSBC 8485. — 2 ♀, 79.3, 135.0; 13 November 1966; trawl; FSBC 8478. — 2 ♂, 120.6, 122.4; 31 January 1967; trawl; FSBC 8489. — 1 ♀, 142.6; 31 January 1967; trawl; FSBC uncatalogued. — 1 ♂, 135.3; 4 ♀, 116.2-134.3; 16 February 1967; trawl; FSBC 8465. — 1 ♂, 136.5; 2 ♀, 124.8, 131.6; 9 March 1967; trawl; FSBC 8472. — 1 ♀, 122.6; 9 March 1967; trawl; FSBC 8496. — 1 ♀, 129.3; 28 April 1967; trawl; FSBC 8492. — 1 ♂, 156.5; 8 April 1967; trawl; FSBC 8492. — 1 ♂, 142.4; 16 May 1967; trawl; FSBC 8469. — 1 ♂, 130.4; 7 June 1967; trawl; FSBC 8488. — 1 ♀, 134.3; 6 July 1967; trawl; FSBC 8463. — 1 ♂, 131.4; 5 September 1967; trawl; FSBC 8463. — 2 ♀, 120.2, 138.9; 12 October 1967; trawl; FSBC 8475.

Diagnosis: Upper jaw length averaging 12.6% SL (s = 0.09); pectoral fin emarginate, with second through sixth, and ninth through eleventh (usually ninth and tenth) rays longer than intermediate rays; ninth through eleventh pectoral rays often elongate, 53.7-80.7% SL; total joined pectoral rays 12-13 (modally 13); rostral, second infraorbital and third infraorbital spines well developed, generally persistent in adults; nasal spines usually present, although small; chest naked anterior to posterior base of pelvic fin; D. X, 12-13 (modally 12); A. 10-12 (modally 11); gill rakers 7-9; lateral scale rows 92-104.

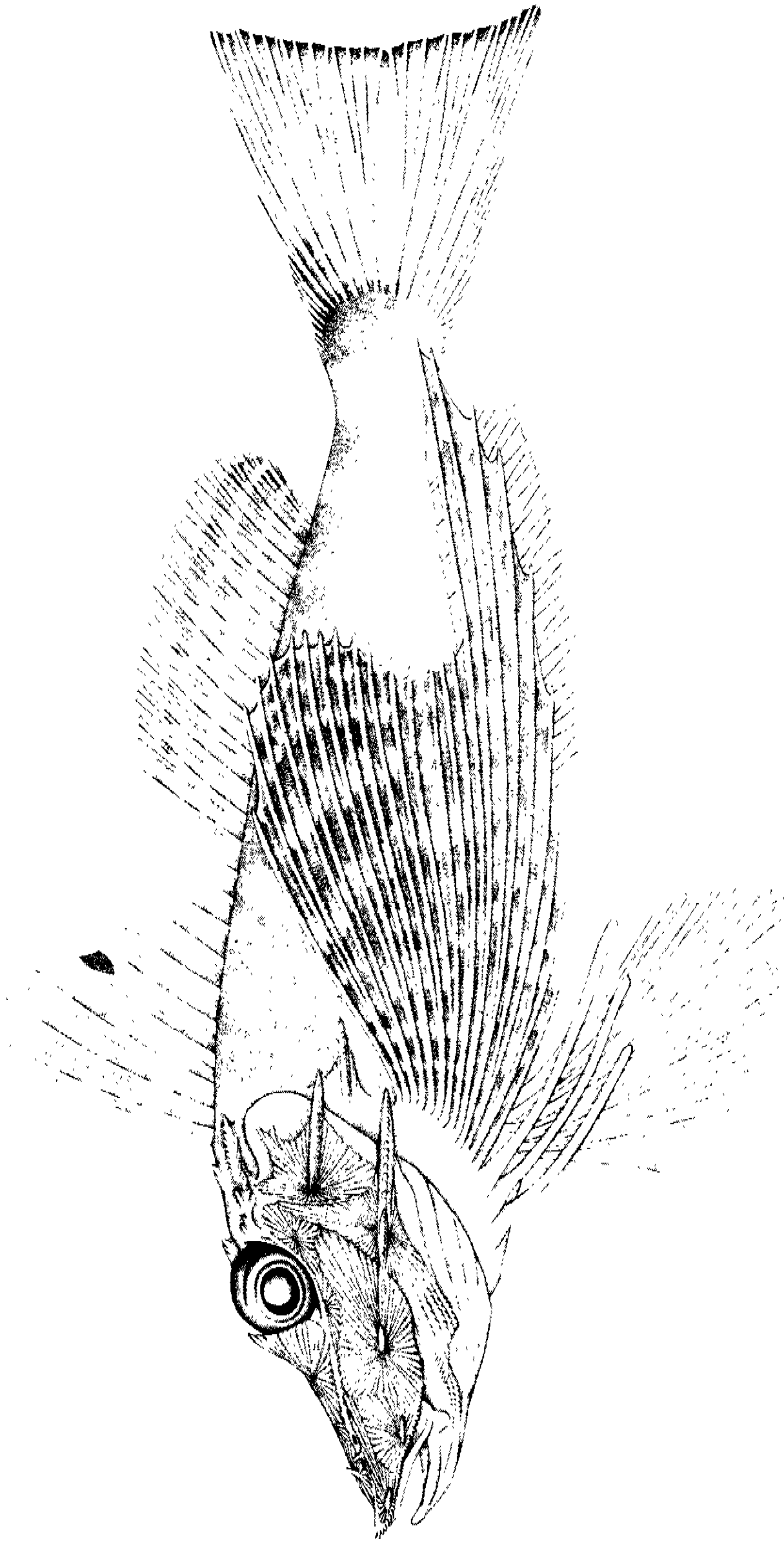

Figure 16. *Prionotus alatus* Goode and Bean.

TABLE 18. NUMBERS OF *Prionotus alatus* EXAMINED FROM PROJECT HOURGLASS, BY STATION AND MONTH.

Prionotus alatus	1965					1966													1967												
STA	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	TOT
A																															
B_1																															
B_2																															
C_1																															
C_2																															
D_1				1								1	1				1													1	5
D_2			2				1		1													1									5
E			4	1	8		1	4			1	5		5			1	5	1	2	3		4		1	2	1	6	1	2	58
I																															
J																															
K																															
L	1																														1
M		4	7		3	2		3		1		1		4			2		2	1	5	4	2	1	1	1		1	2		47
TOT	1	4	13	2	11	2	2	7	1	1	1	7	1	9			4	5	3	3	8	5	6	1	2	3	1	7	3	3	116

Remarks: *Prionotus alatus* was captured only at 55 m (N = 11) and 73 m (N = 105) Hourglass stations and had greater relative abundance at the latter depth. Numbers of specimens examined from each station for each month are given in Table 18. Bottom temperatures were 16-26°C; bottom salinities were 33-37 ‰.

Reproduction: The relationship between GSI and length indicated a minimum reproductive size of 100-110 mm. Mean GSI values for fish larger than 110 mm differed significantly between seasons for each sex ($P < .01$), and both sexes showed a peak in gonadal weight during spring. The inferred spawning season was from March to June, with the greatest decline in combined male and female GSI values from March to April (Figure 17). Gonadal development for the following spawning period began in October.

Food habits: Stomachs of only 20 specimens of *P. alatus*, 5 from 55 m and 15 from 73 m, contained food. Lengths ranged between 45-155 mm, and 60% were between 100-140 mm. Most *P. alatus* were captured at Hourglass Stations E and M (73 m), which were sampled, with few exceptions, between 0300 and 0600 EST (Joyce and Williams, 1969). Eighty-seven percent of the specimens collected during these pre-dawn hours had empty stomachs. Although relatively few fish were

TABLE 19. FOOD ITEMS UTILIZED BY *Prionotus alatus* (N = 20) COLLECTED DURING PROJECT HOURGLASS.

Prey Category	Percent Occurrence
Teleostei	30.0
Anomura	5.0
Natantia	
Pasiphaeidae	40.0
Penaeidae	5.0
Unidentified shrimp	15.0
(All shrimp)	(55.0)
Mysidacea	20.0
Cumacea	10.0
Stomatopoda	15.0

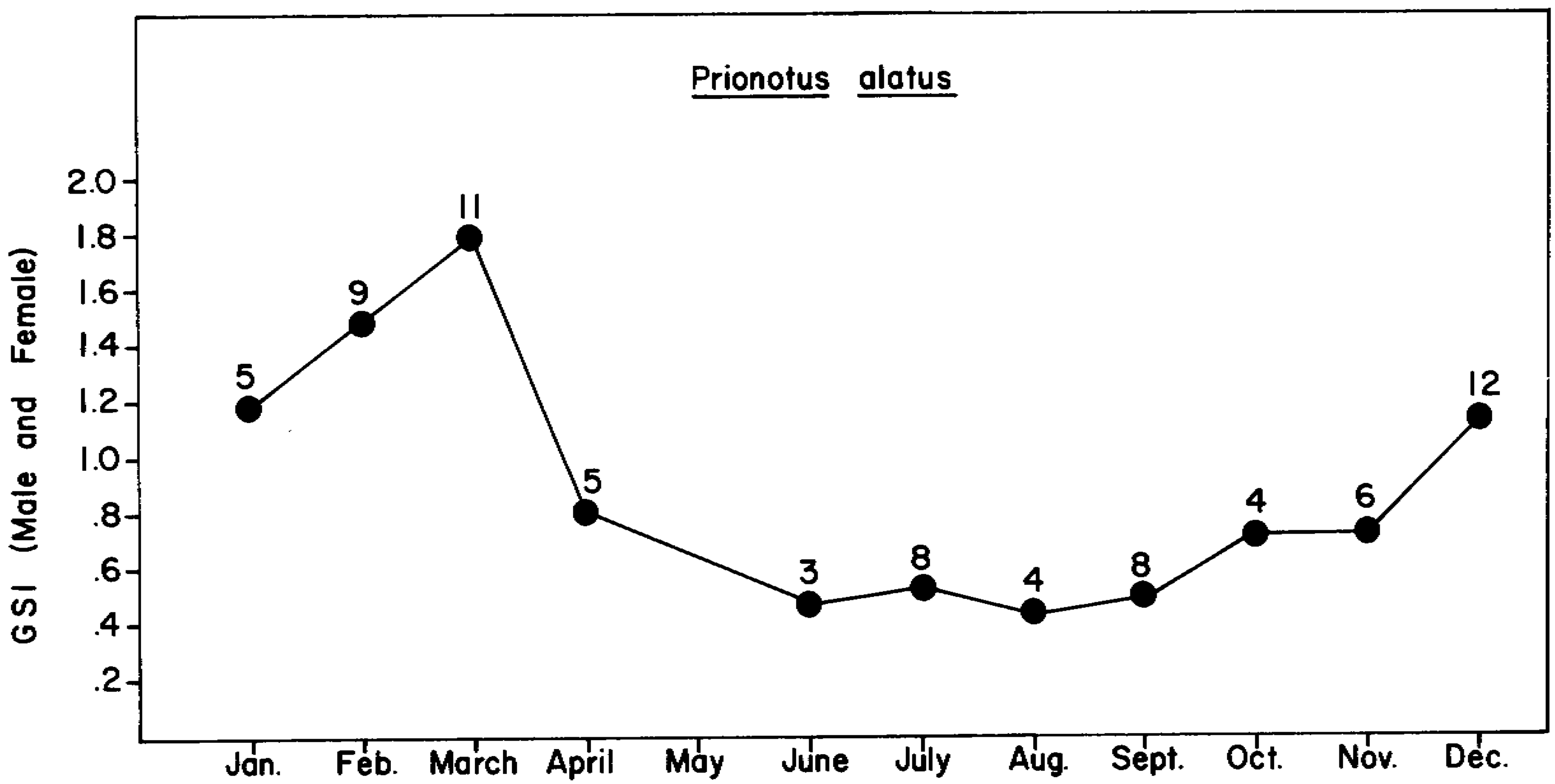

Figure 17. Monthly changes in the combined gonadosomatic index of male and female *Prionotus alatus* from Project Hourglass. The number of specimens is indicated for each month.

available from day collections, fish captured during the day had significantly fuller stomachs than fish collected before dawn ($\chi^2 = 4.9$, $P < .05$). Conclusions on food habits are tentative due to sample size. Natantians, primarily Pasiphaeidae, were an important food category (Table 19). Fishes accounted for 65% of total stomach volume, and 50% of these were *Bregmaceros atlanticus*.

Prionotus stearnsi Jordan and Swain, 1884

Figure 18

Prionotus stearnsi Jordan and Swain, 1884, p. 541 [original description]; Ginsburg, 1950, p. 508; Hildebrand, 1954, p. 315; Springer and Bullis, 1956, p. 93; Bullis and Thompson, 1965, p. 55; Burns, 1970, p. 125; Bullis and Struhsaker, 1970, p. 74; Franks et al., 1972, p. 110; Lewis and Yerger, 1976, pp. 99-100; Chittenden and Moore, 1977, pp. 108-111.
Colotrigla stearnsii: Gill, 1898, p. 339.

Material examined: HOURGLASS STATION D: 1 ?, 32.2; 21 February 1966; trynet; FSBC 5012. — HOURGLASS STATION E: 1 ?, 81.3; 4 January 1966; trynet; FSBC 4664. — 4 ?, 41.3-78.7; 19 July 1966; trynet; FSBC 5028. — 1 ?, 23.5; 3 March 1967; dredge; FSBC 11932. — OTHER MATERIAL: 3 ?, 53.9-85.0; 26°25'N, 83°52'W; 6 June 1965; trawl; FSBC 3610.

Diagnosis: Jaws terminal or lower jaw slightly projecting; pectoral fin short, not exceeding head length; cranial spines absent or weakly developed; eyeball with a cluster of small papillae, sometimes slender filaments, along posterodorsal edge; underside of body silvery, flecked with melanophores; pectoral fins black; pelvic fin rays with scattered melanophores; D. IX-X, 12-13 (modally 12); A. 10-12 (modally 11); pectoral 12-13, gill rakers 9-11, scale rows 78-93.

Remarks: *Prionotus stearnsi*, the shortwing searobin, was only rarely collected from 55 m (Hourglass Station D) and 73 m (Hourglass Station E). However, this species is apparently more common in deeper water (Lewis and Yerger, 1976). Numbers of *P. stearnsi* examined from each station are given in Table 20. Bottom temperatures were 17-22°C; bottom salinities were 34-36 ‰.

TABLE 20. NUMBERS OF *Prionotus stearnsi* EXAMINED FROM PROJECT HOURGLASS, BY STATION AND MONTH.

Prionotus stearnsi

STA	1965					1966													1967												TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B1																															
B2																															
C1																															
C2																															
D1																															
D2							1																								1
E						1						4										1									6
I																															
J																															
K																															
L																															
M																															
TOT						1	1					4										1									7

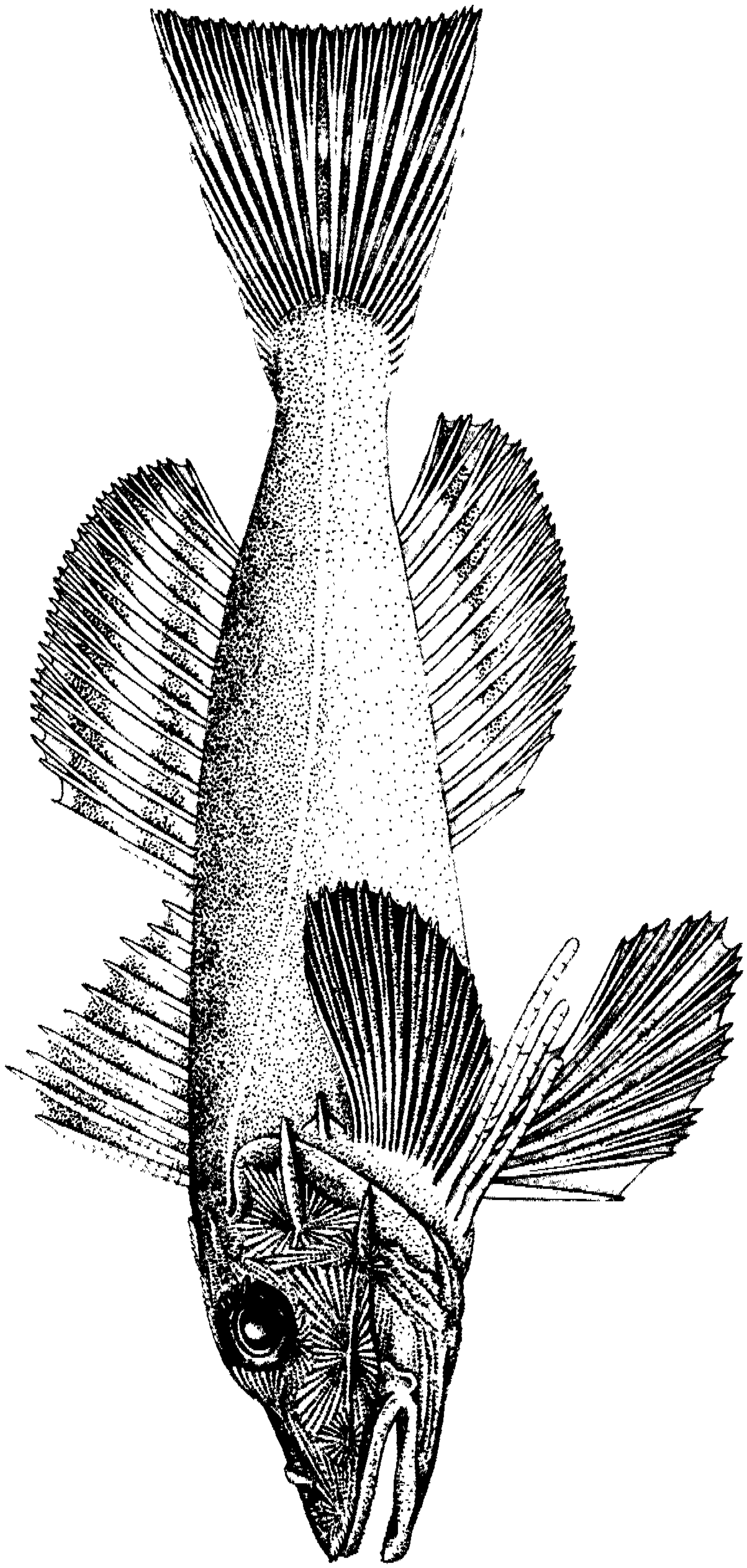

Figure 18. *Prionotus stearnsi* Jordan and Swain.

Prionotus rubio Jordan, 1886

Figures 3, 19

Prionotus rubio Jordan, 1886, p. 50; Ginsburg, 1950, p. 509.

Material examined: 2 ?, 85.5, 111.7; off Horn Island, Mississippi; October 1974; FSBC 11971. — 9 ?, 124.0-252.0; off Alabama and Mississippi; 39 m; 22 November 1974; trawl; FSBC 11980. — 4 ?, 69.0-77.0; 29°58'N, 88°17'W; 31 m; 9 August 1977; trawl; FSBC 11972. — 1 ?, 94.0; 29°12'N, 89°44'W; 13 m; 20 November 1974; trawl; FSBC 11973. — 1 ?, 136.0; 29°12'N, 89°43'W; 13 m; 20 November 1974; trawl; FSBC 11974. — 1 ?, 100.3; 29°11'N, 89°44'W; 14 m; 20 November 1974; trawl; FSBC 11975. — 1 ?, 105.3; 28°56'N, 90°12'W; 18 m; 20 November 1974; trawl; FSBC 11976. —1 ?, 206.0; 28°56'N, 89°48'W; 41 m; 19 November 1974; trawl; FSBC 11977. — 1 ?, 118.4; 28°53'N, 89°22'W; 40 m; 14 November 1974; trawl; FSBC 11978. — 1 ?, 148.0; 28°48'N, 89°47'W; 58 m; 19 November 1974; trawl; FSBC 11979.

Diagnosis: Rostral, second infraorbital and usually third infraorbital spines well developed in all but very large specimens; mouth large, maxillary extending posterior to under orbit, or closer to orbital rim than to point midway between orbit and anterior nostril; anal fin with black band; spinous dorsal with spot on membrane between fourth and fifth spines persistent in larger specimens; length of caudal fin lobe contained 3.2 times in SL (range 2.8-3.5); undersides of body white; pelvics generally without melanophores; D. IX-X, 12-13 (modally 12); A. 10-12 (modally 11); pectoral 12-13; gill rakers 8-11; lateral scale rows 88-106.

Remarks: Although this species was not taken during Project Hourglass sampling, its occurrence on the west Florida shelf prompted its inclusion here.

Genus *Bellator* Jordan and Evermann, 1896

Bellator militaris (Goode and Bean, 1895)

Figure 20

Prionotus militaris Goode and Bean, 1895, p. 464 [original description].
Bellator militaris: Ginsburg, 1950, pp. 526-527; Hildebrand, 1954, p. 316; Hildebrand, 1955, p. 215; Springer and Bullis, 1956, p. 92; Bullis and Thompson, 1965, pp. 54-55; G. Miller, 1965, pp. 259-266 [comparisons with other western Atlantic species]; Burns, 1970, p. 124; Franks et al., 1972, p. 109; Lewis and Yerger, 1976, pp. 95-100; Chittenden and Moore, 1977, pp. 108-111.

Material examined: HOURGLASS STATION C: 1 ?, 33.9; 3 March 1966; trawl; FSBC 8417. — 1 ♀, 67.2; 27 March 1966; trawl; FSBC 8452. — 1 ♂, 43.0; 2 ♀, 82.7, 83.7; 31 August 1966; trawl; FSBC 8415. — 1 ♂, 56.8; 18 October 1966; trawl; FSBC 10801. — 1 ♀, 63.9; 1 December 1966; trawl; FSBC 8454. — 2 ?, 61.9, 62.4; 6 January 1967; trawl; FSBC 10802. — 1 ?, 34.1; 11 July 1967; trawl; FSBC 8435. — 1 ♂, 71.8; 3 ?, 39.7-63.8; 25 October 1967; trawl; FSBC 10803. — 2 ♂, 71.7, 77.6; 3 ♀, 42.8-73.0; 2 ?, 49.5, 64.0; 2 November 1967; trawl; FSBC 8408. — 1 ♀, 58.8; 21 November 1967; trawl; FSBC 8411. — HOURGLASS STATION D: 1 ♂, 105.9; 2 ♀, 80.0, 98.5; 27 August 1965; trawl; FSBC 8405. — 1 ♀, 102.0; 21 October 1965; trawl; FSBC 8437. — 1 ♂, 108.2; 21 February 1966; trawl; FSBC 8418. — 4 ♂, 79.3-104.8; 5 ♀, 54.0-95.5; 6 March 1966; trawl; FSBC 8421. — 2 ♂, 90.0, 118.2; 7 April 1966; trawl; FSBC 8432. — 1 ♀, 91.3; 16 April 1966; dredge; FSBC 8446. — 3 ♂, 103.8-107.4; 18 June 1966; trawl; FSBC 8456. — 5 ♂, 90.5-109.9; 3 ♀, 92.8-95.3; 3 July 1966; trawl; FSBC 8413. — 3 ♂, 112.9-115.1; 1 ♀, 82.3; 2 ?, 32.7, 35.0; 19 July 1966; trawl; FSBC 8425. — 2 ♂, 89.3, 97.8; 11 August 1966; trawl; FSBC 8406. — 1 ♂, 81.9; 1 ♀,

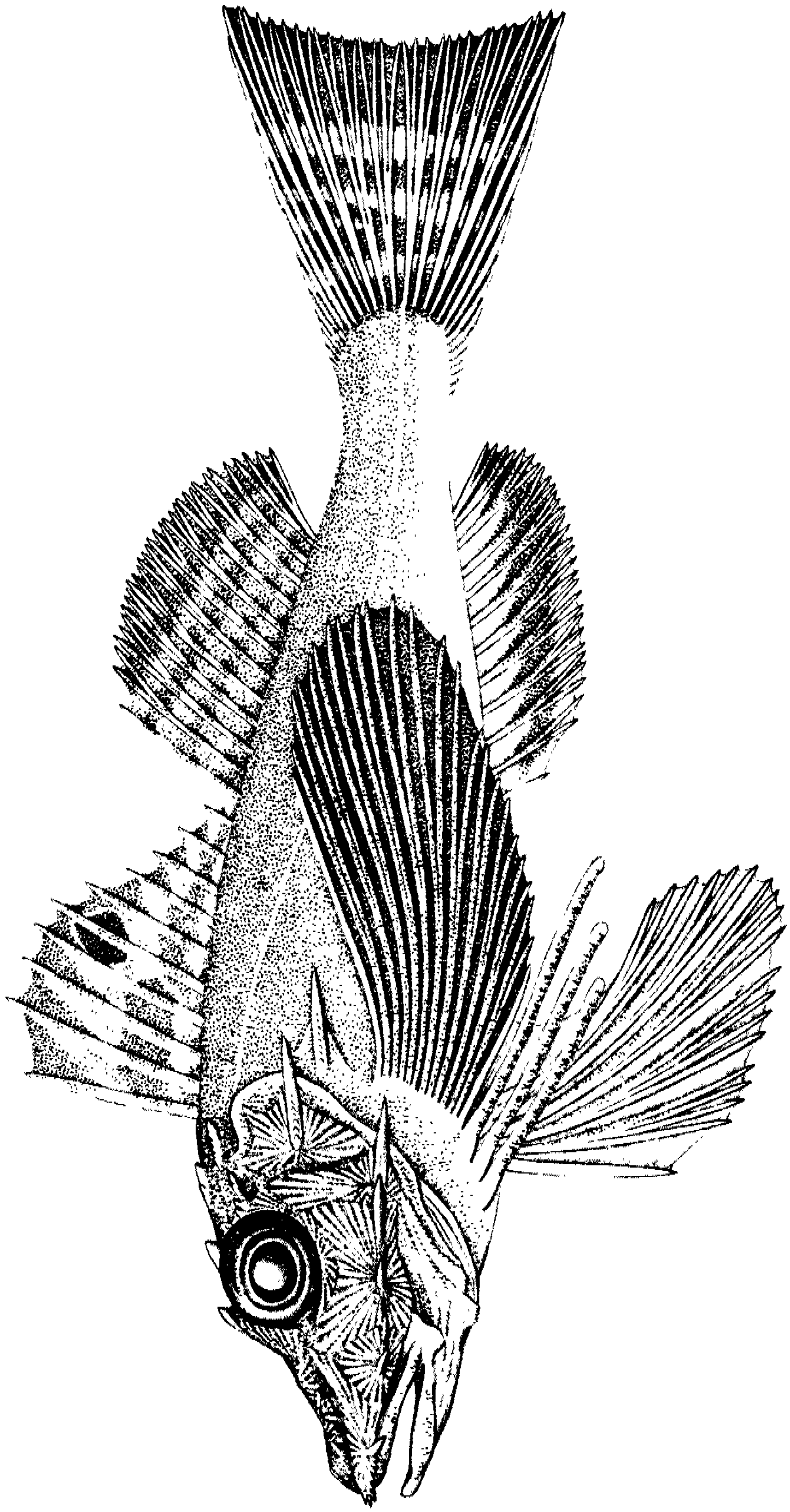

Figure 19. *Prionotus rubio* Jordan.

99.3; 1 September 1966; trawl; FSBC 8431. — 1 ?, 39.0; 19 October 1966; FSBC uncatalogued. — 2 ♀, 92.4, 94.8; 9 November 1966; trawl; FSBC 8831. — 1 ♂, 56.3; 1 ?, 32.8; 20 November 1966; trawl; FSBC 8453. — 1 ♂, 103.0; 2 ♀, 84.7, 99.0; 2 December 1966; trawl; FSBC 10805. — 1 ♂, 96.1; 21 January 1967; trawl; FSBC 8436. — 1 ♂, 36.0; 3 ♀, 58.2-94.0; 26 January 1967; trawl; FSBC uncatalogued. — 1 immature, 39.0; 26 January 1966; trawl; FSBC uncatalogued. — 1 ♂, 84.2; 6 February 1967; trawl; FSBC 8450. — 1 ♂, 105.5; 3 March 1967; trawl; FSBC 8428. — 1 ?, 55.0; 15 March 1967; trawl; FSBC 8439. — 1 ♀, 51.5; 21 June 1967; trawl; FSBC 8451. — 5 ♂, 92.3-105.5; 2 ♀, 89.5, 90.0; 3 November 1967; trawl; FSBC 8457. — 1 ♀, 77.1; 21 November 1967; FSBC 8455. — HOURGLASS STATION E: 1 ♂, 94.6; 5 October 1965; trawl; FSBC 8438. — 1 ♀, 90.3; 9 November 1965; trawl; FSBC 8441. — 3 ♂, 94.9-100.0; 2 ♀, 81.2, 92.6; 8 February 1966; trawl; FSBC 8427. — 3 ♂, 93.5-103.5; 1 ♀, 82.8; 4 March 1966; trawl; FSBC 8440. — 3 ♂, 85.5-104.8; 4 ♀, 47.0-97.0; 2 ?, 45.3, 52.2; 3 July 1966; trawl; FSBC uncatalogued. — 1 ♂, 114.0; 2 ♀, 93.3, 93.6; 3 ?, 42.5-55.3; 2 August 1966; trawl; FSBC 10806. — 1 ?, 30.0; 9 October 1966; trawl; FSBC 8414. — 1 ♂, 87.0; 9 November 1966; trawl; FSBC 8443. — 7 ♂, 80.1-102.7; 3 ♀, 61.8-94.8; 2 December 1966; trawl; FSBC 8461. — 5 ♂, 90.6-98.3; 7 January 1967; trawl; FSBC 10807. — 4 ♂, 91.6-105.5; 5 ♀, 77.0-91.4; 7 January 1967; trawl; FSBC 8420. — 3 ♂, 91.8-98.4; 8 ♀, 78.0-91.3; 6 February 1967; trawl; FSBC 8422. —5 ♂, 67.0-102.4; 2 ♀, 80.7, 89.0; 4 April 1967; trawl; FSBC 10808. — 2 ♂, 92.1, 93.4; 1 ♀, 86.1; 3 June 1967; trawl; FSBC 10809. — 1 ♀, 84.1; 2 July 1967; trawl; FSBC 10810. — 2 ♀, 75.3, 104.0; 2 August 1967; trawl; FSBC 8430. — 3 ♂, 98.5-103.0; 3 ♀, 79.5-84.1; 1 September 1967; trawl; FSBC 8458. — 2 ♂, 92.1, 97.0; 3 ♀, 84.1-91.2; 3 November 1967; trawl; FSBC 8460. —HOURGLASS STATION K: 1 ?, 56.4; 21 March 1966; trawl; FSBC 8407. — 3 ?, 31.8-80.7; 1 ♀, 28.1; 22 July 1966; trawl; FSBC 10811. — 1 ♀, 83.2; 4 September 1966; trawl. — 1 ?, 71.3; 1 ♀, 81.1; 30 January 1967; trawl; FSBC 8444. — 1 ♀, 62.0; 4 September 1967; trawl; FSBC 8477. — 1 ♂, 62.2; 11 October 1967; trawl; FSBC 8410. — 1 ?, 36.7; 11 October 1967; trawl; FSBC 8416. —HOURGLASS STATION L: 2 ?, 29.1, 33.3; 5 September 1966; trawl; FSBC 8448. — 1 ?, 23.5; 5 September 1966; trawl; FSBC 8449. — 1 ?, 33.2; 7 June 1967; trawl; FSBC 8445. —HOURGLASS STATION M: 4 ♂, 95.0-106.4; 2 ♀, 85.6, 93.1; 4 September 1965; trawl; FSBC uncatalogued. — 2 ♀, 87.0, 91.5; 14 December 1965; trawl; FSBC 10812. — 2 ♀, 91.0, 96.2; 22 March 1966; trawl; FSBC 8426. — 1 ♂, 105.8; 22 March 1966; trawl; FSBC uncatalogued. — 1 ♂, 105.2; 1 ♀, 88.2; 22 July 1966; trawl; FSBC 8429. — 2 ♂, 106.9, 109.5; 13 November 1966; trawl; FSBC 10813. — 6 ♂, 102.9-114.7; 5 ♀, 81.3-99.0; 31 January 1967; trawl; FSBC 8412. — 8 ♂, 57.0-105.4; 1 ♀, 54.7; 1 ?, 58.6; 16 February 1967; trawl; FSBC 8459. — 3 ♂, 91.4-93.9; 2 ♀, 87.7, 93.9; 9 March 1967; trawl; FSBC 8433. — 1 ♂, 112.8; 8 April 1967; trawl; FSBC 8419. — 1 ♀, 95.6; 16 May 1967; trawl; FSBC 8434. — 1 ♂, 102.1; 1 ♀, 42.4; 7 June 1967; trawl; FSBC 8442. 2 ♀, 89.2, 92.1; 12 October 1967; trawl; FSBC 8409. — 2 ♂, 102.4, 104.2; 1 ♀, 95.5; 12 October 1967; trawl; FSBC 8423.

Diagnosis: Relatively small mouth, upper jaw length averaging 11.7% SL (s = 0.16); cleithral spine well developed, reaching posteriorly to tip of opercular spine; scales on chest extending anterior to base of median rays of pelvic fin; joined pectoral rays one and two with black and white bands; rostral exsertions usually well developed; supplemental preopercular spines well developed, persistent in large specimens; rostral spines small or absent; second and third infraorbital spines usually absent; first and second dorsal spines often with elongate filaments; D. XI (rarely X), 11-12 (modally 11); A. 9-11 (modally 10); pectoral rays 12-13 (modally 12); gill rakers 7-10; lateral scale rows 55-67.

Remarks: Fifty-eight percent of the available specimens (N = 238) of *B. militaris* were from the 73 m stations, 29% from the 55 m stations and 14% from the 37 m stations of Project Hourglass.

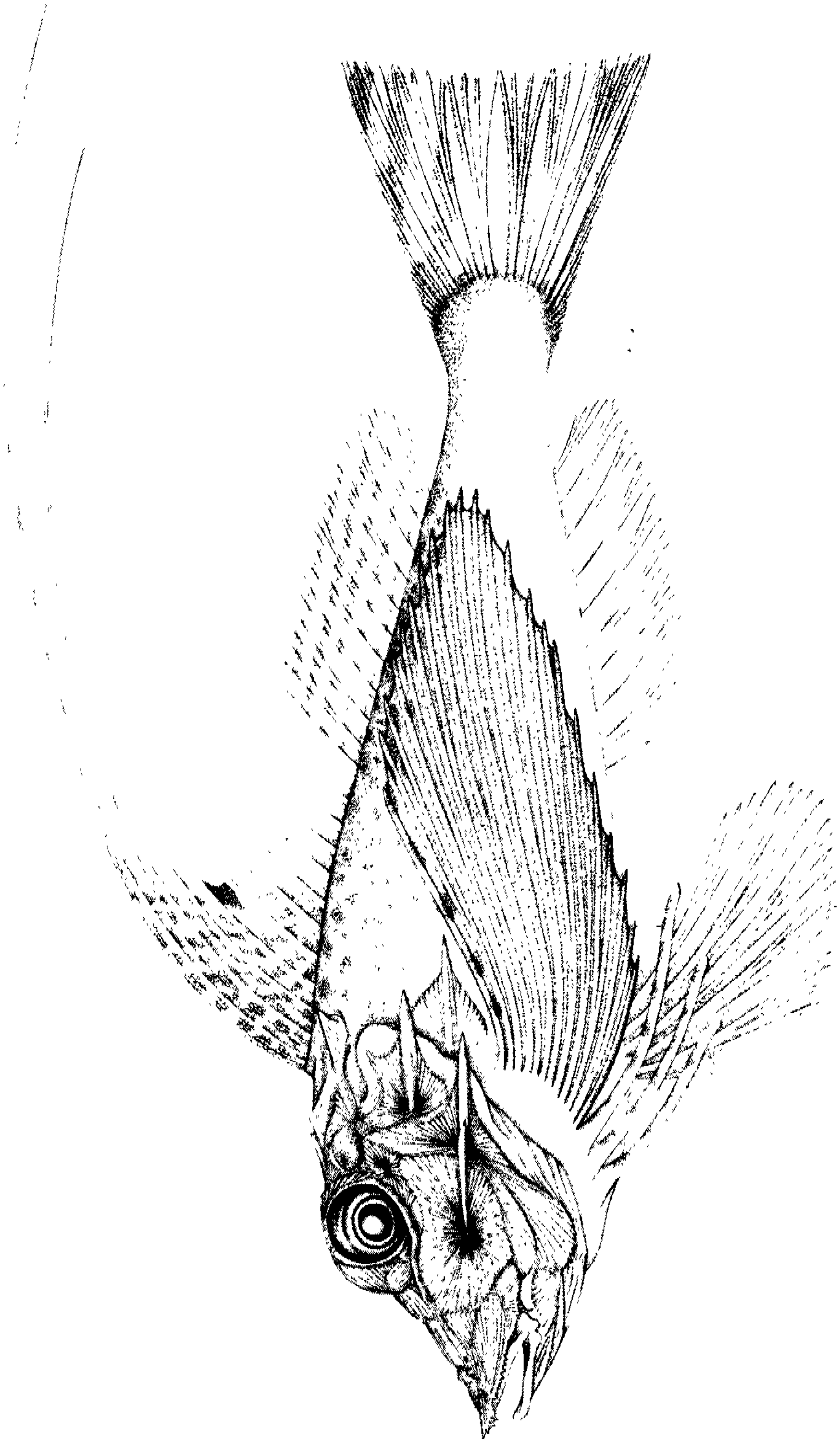

Figure 20. *Bellator militaris* Goode and Bean.

TABLE 21. NUMBERS OF *Bellator militaris* EXAMINED FROM PROJECT HOURGLASS, BY STATION AND MONTH.

Bellator militaris																															
STA	1965					1966													1967												TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1																															
B_2																															
C_1								1						3				1								1				7	13
C_2								1								1			2										4	1	9
D_1								9	2			8	6		2		2	3			1	1								7	41
D_2	3		1				1		1		3			2		1	2		1	5		1			1					1	23
E			1	1			6	4				9		6		1	1	10	14		11		7		3	1	2	6		5	87
I																															
J																															
K								1				4			1				2									1	2		11
L															3										1						4
M		6			2			3				2					2		11		10	5	1	1	2				5		50
TOT	3	6	2	1	2		6	19	3		3	23	6	11	6	3	7	14	30	5	22	7	8	1	7	2	2	7	11	21	237

Numbers of specimens examined from each station for each month are given in Table 21. Bottom temperatures were 18-25°C; bottom salinities were 32-37 ‰.

Lengths of *B. militaris* showed a regular increase with depth; means were 59, 84 and 90 mm for the 37, 55 and 73 m stations, respectively (H = 61, P < .01). Fish size also changed with season (P < .01) at the 73 m stations, but not at shallow stations. Largest fish were captured between March and May at 73 m, and smallest were captured between June and August. Juvenile *B. militaris* (10-30 mm) were not captured at 73 m, but were taken by dredges between July and October at 37 and 55 m. Recruitment to the 73 m depths might not occur until *B. militaris* reach near-adult size.

Reproduction: Analysis of seasonal reproductive trends was based on fish larger than 70 mm. Smaller specimens had low GSI values. Monthly or seasonal differences in means of male, female or combined male and female GSI values were not significant, nor were they significant when fish from each depth were analyzed separately. Ovaries of fish collected in January, February, March, April, July, September, October, November, and December (1965-1967) showed similar macroscopic stages of development. The ovarian condition was gravid, corresponding to the criteria for maturity described by Kesteven (1960, cited by Bagenal and Braum, 1971) as, "Eggs completely round, some already translucent and ripe." In addition, small irregular ova were present and larger translucent ova were interspersed throughout the ovary. Some April and May specimens had larger translucent ova ($\bar{x}$ = 1.1 mm) in the lumen of the ovary, although other individuals showed the same ovarian condition as described above. Differences in macroscopic ovarian condition between stations were not apparent.

Food habits: I identified stomach contents from 54 specimens (25-105 mm) of *B. militaris*. Mysidaceans were the dominant prey, based on both percent number and occurrence, and were second in importance to natantians on a volumetric basis (Table 22). Additional prey categories occurring in 10% or more fish (listed by decreasing occurrence) were copepods, gammaridean amphipods, natantians (primarily Pasiphaeidae), cumaceans, ostracods, caprellidean amphipods, small brachyurans, polychaetes, and pelecypods. Numerical importance of prey categories followed a similar pattern, although the importance of prey categories based on percent volume differed considerably. Natantians, mysidaceans, fishes, and anomurans were most important volumetrically, comprising approximately 71% of the diet.

TABLE 22. FOOD ITEMS UTILIZED BY *Bellator militaris* (N = 54) COLLECTED DURING PROJECT HOURGLASS.

Prey Category	Percent Occurrence	Number no.	Number %	Volume cc.	Volume %
Teleostei	9.2	7	1.19	0.152	10.64
Echinodermata					
Ophiuroidea	1.9	1	0.17	0.009	0.63
Brachyura					
Brachyuran megalops	1.9	1	0.17	0.004	0.28
Unidentified crabs	14.8	13	2.21	0.047	3.29
Anomura	22.2	42	7.13	0.106	7.42
Natantia					
Pasiphaeidae	22.2	41	6.96	0.370	25.91
Penaeidae	1.9	1	0.17	0.008	0.56
Unidentified shrimp	29.6	50	8.48	0.118	8.26
(all shrimp)	(40.7)	(93)	(15.79)	(0.496)	(34.73)
Amphipoda					
Gammaridea	42.6	50	8.48	0.055	3.85
Caprellidea	18.5	19	3.23	0.017	1.19
Isopoda	9.3	7	1.19	0.079	5.53
Cumacea	24.1	48	8.15	0.037	2.59
Mysidacea	50.0	156	26.48	0.191	13.38
Stomatopoda	1.9	1	0.17	0.056	3.92
Copepoda	44.4	108	18.34	0.039	2.73
Ostracoda	22.2	19	3.23	0.023	1.61
Unidentified crustaceans	5.6	8	1.36	0.050	3.50
Insecta					
Corixidae	1.9	1	0.17	0.002	0.14
Pycnogonida	1.9	1	0.17	0.004	0.28
Annelida					
Polychaeta	13.0	**		0.046	3.22
Mollusca					
Pelecypoda	11.1	11	1.87	0.010	0.70
Gastropoda	1.9	2	0.34	0.002	0.14
Nematoda	1.9	1	0.17	*	
Cnidaria	1.9	1	0.17	0.003	0.21
Totals		590		1.428	

*Trace amount only.
**An accurate count was impossible.

Diel feeding activity, examined at four-hour intervals using all available specimens of *B. militaris*, indicated a high percentage of fish with empty stomachs between midnight and 0800 hours EST, and few with empty stomachs from 0801 to 2000 hours EST (Figure 21). Feeding is thus primarily diurnal.

Percent occurrence of fishes, brachyurans, natantians, gammaridean amphipods, and mysidaceans increased with increasing predator size (Table 23). Utilizaton of copepods decreased for fish larger than the 51-80 mm size group.

TABLE 23. PERCENT OCCURRENCE OF MAJOR PREY ITEMS UTILIZED BY THREE SIZE CLASSES OF *Bellator militaris* FROM PROJECT HOURGLASS.

Prey Category	Size Groups mm 21-50 (N=14)	51-80 (N=19)	81-110 (N=21)
Brachyura	7.1	15.8	23.8
Anomura	21.4	10.5	33.3
Natantia	28.6	36.8	52.4
Gammaridea	7.1	47.4	61.9
Caprellidea	21.4	21.1	14.3
Isopoda	7.1	15.8	4.8
Cumacea	14.3	31.6	23.8
Mysidacea	21.4	57.9	61.9
Stomatopoda	-	-	4.8
Copepoda	57.1	57.9	23.8
Ostracoda	21.4	31.6	14.3
Polychaeta	7.1	15.8	14.3
Pelecypoda	7.1	10.5	14.3

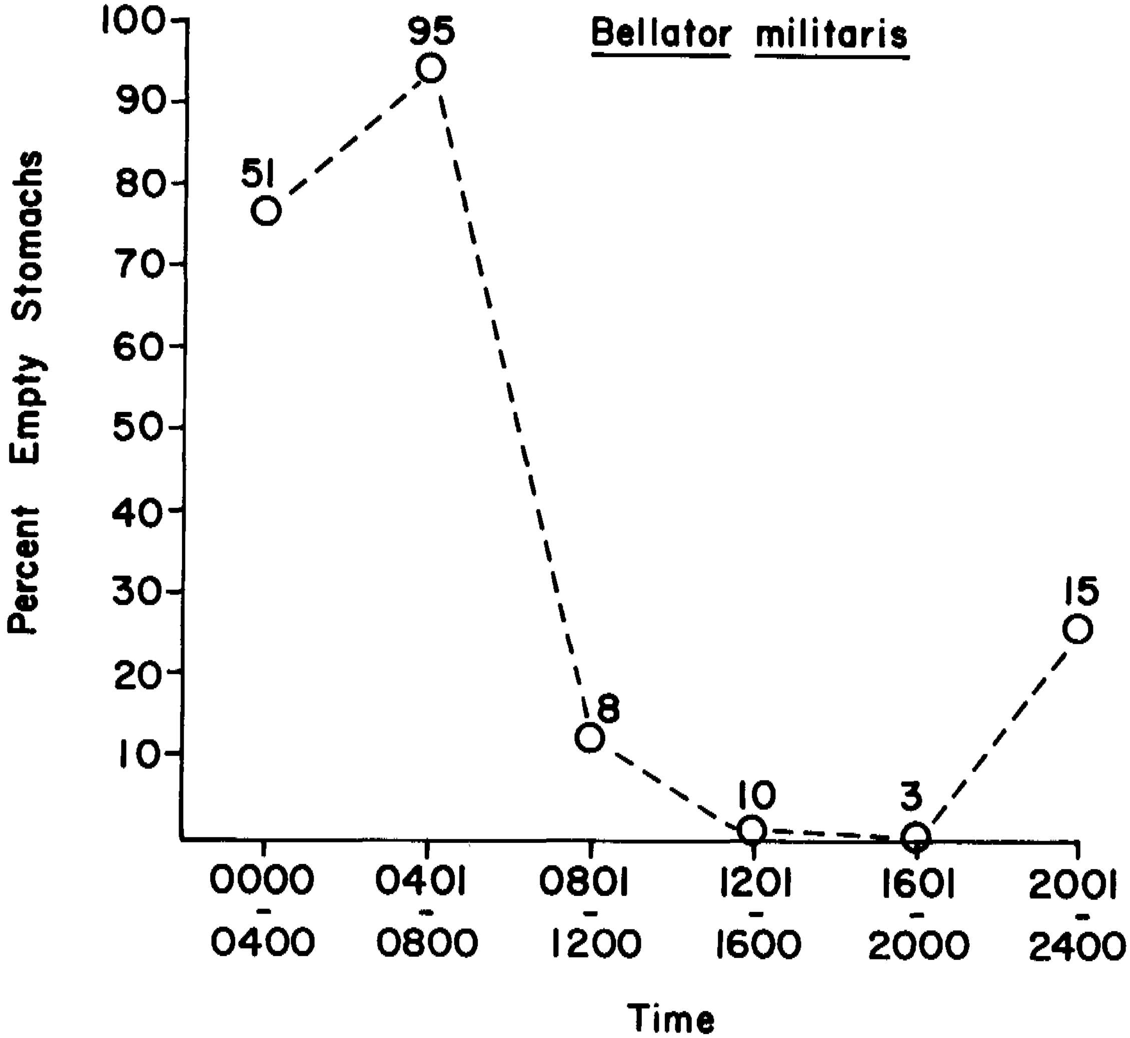

Figure 21. Diel feeding activity of *Bellator militaris* from the 37, 55, and 73 m stations of Project Hourglass. Numbers indicate sample sizes.

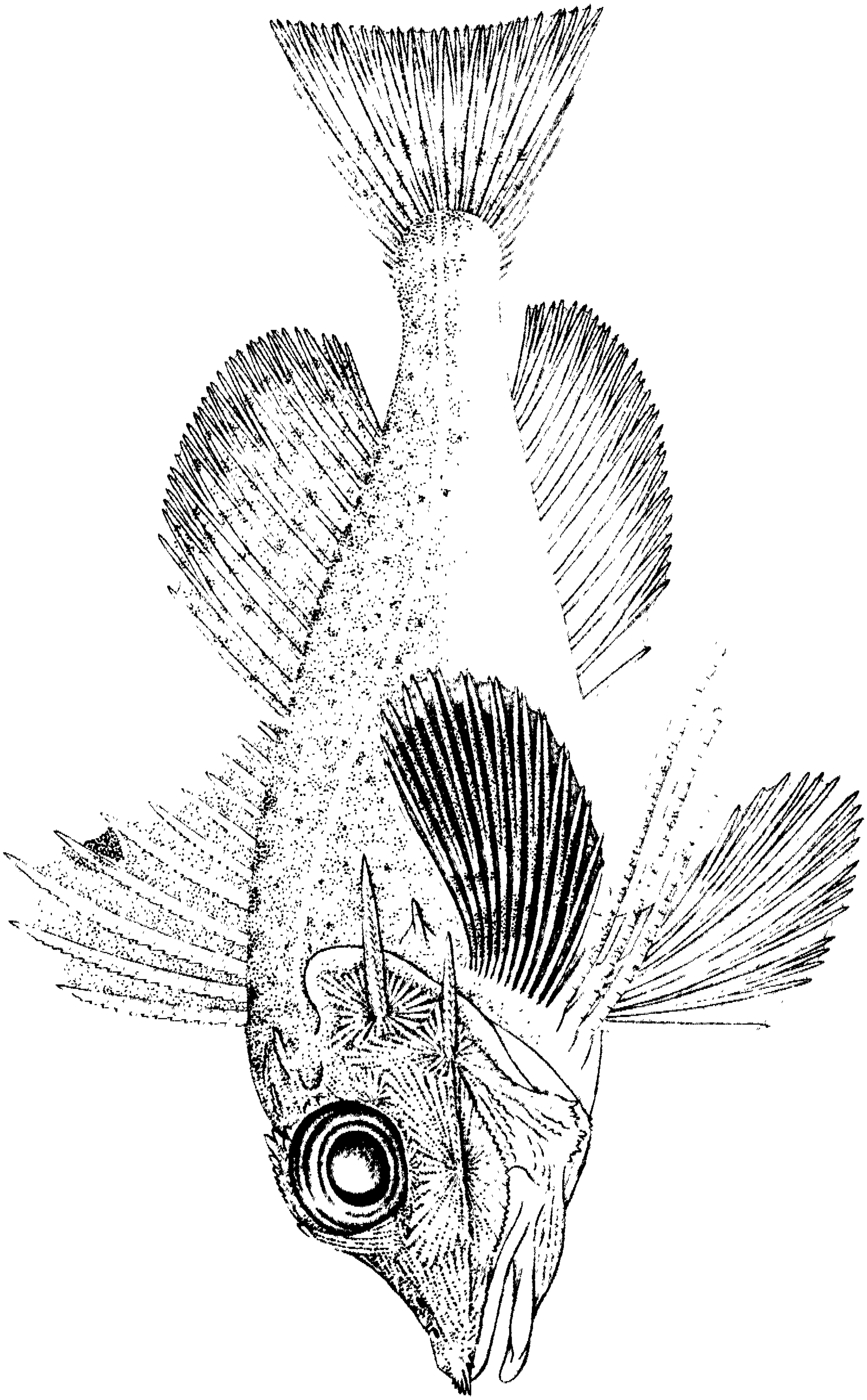

Figure 22. *Bellator brachychir* (Regan).

Bellator brachychir (Regan, 1914)

Figure 22

Prionotus brachychir Regan, 1914, p. 16 [original description].
Bellator brachychir: Ginsburg, 1950, pp. 525-526; Bullis and Struhsaker, 1970, p. 74; Powell et al., 1972, p. 146; Lewis and Yerger, 1976, p. 93.

Material examined: HOURGLASS STATION M: 4 ?, 17.0-22.5; 5 September 1966; dredge; FSBC 11950. — OTHER MATERIAL: 1 ?, 70.0; Caribbean, off Belize; 6 June 1962; USNM 205432. — 8 ♀, 44.5-55.7; Gulf of Mexico, between 26°15'N and 27°00'N, 145 mi. offshore; 24 July 1962; FSBC 3241. — 9 ♀, 45.3-52.5; Gulf of Mexico, between 25°50'N and 26°15'N, 150 mi. offshore; 25 July 1962; FSBC 3242. — 1 ♀, 42.0; Atlantic Ocean, off Indian River, Fla.; 8 August 1962; FSBC 3281. — 1 ?, 26.4; Gulf of Mexico, between 25°35'N and 25°50'N, 150 mi. offshore; 26 July 1962; FSBC 3293.

Diagnosis: Mouth large, maxillary extending posterior to anterior orbit margin; cleithral spine small, not projecting posterior to tip of opercular spine; posterodorsal area of eyeball without well developed tabs or tentacles (very small papillae may be present); chest without scales; rostral exsertions may be moderately projecting; supplemental preopercular, rostal, second infraorbital, and third infraorbital spines absent; first dorsal spine with elongate filament in larger males; no filament on second dorsal spine; upper free pectoral ray equal to or exceeding pectoral fin length; D. XI, 11; A. 11; pectoral rays 12; gill rakers 8-10; lateral scale rows 59-70.

Remarks: *Bellator brachychir*, the shortfin searobin, was poorly represented in Hourglass collections. Four juveniles were captured at Hourglass Station M (73 m). The bottom temperature was 19°C and the salinity 36 ‰. Ginsburg (1950) reported this species from 174 m off South Carolina and Bullis and Struhsaker (1970) captured it at depths exceeding 100 m. Thus, the distribution is primarily deeper than the Hourglass stations.

Bellator brachychir appears to be a small species within the genus. Ginsburg (1950) reported a maximum size of 80 mm, and specimens I examined did not exceed 70 mm. Eleven fish ranging from 42.0 to 55.7 mm had well developed ovaries, indicating that sexual maturity is reached at a small size.

Bellator egretta (Goode and Bean, 1895)

Figure 23

Prionotus egretta Goode and Bean, 1895, p. 465 [original description].
Bellator egretta: Jordan and Evermann, 1898, p. 2174; Ginsburg, 1950, p. 525; Springer and Bullis, 1956, p. 91; Bullis and Thompson, 1965, p. 54; Tabb and Manning, 1961, p. 635; Bullis and Struhsaker, 1970, pp. 53, 70; Lewis and Yerger, 1976, p. 93.

Material examined: HOURGLASS STATION E: 1 ?, 61.6; 4 August 1965; dredge; FSBC 4415. — HOURGLASS STATION L: 1 ?, 69.0; 13 January 1967; FSBC 5148. — OTHER MATERIAL: 1 ♂, 96.6; Gulf of Mexico, between 25°50'N to 26°15'N at 84°54'W; 25 July 1962; FSBC 2224. — 1 ♀, 119.4; Gulf of Mexico, 26°N, depth 61-366 m; 10 September 1963; FSBC 2401. — 1 ?, 98.5; Caribbean, off Belize; 6 June 1962; USNM 205437.

Diagnosis: Maxillary extending posterior to midline between posterior nostril and anterior orbit margin, or closer to orbit; cleithral spine small, not extending posterior to opercular spine; numerous well developed tabs, and usually 1-2 large tentacles, on posterodorsal portion of

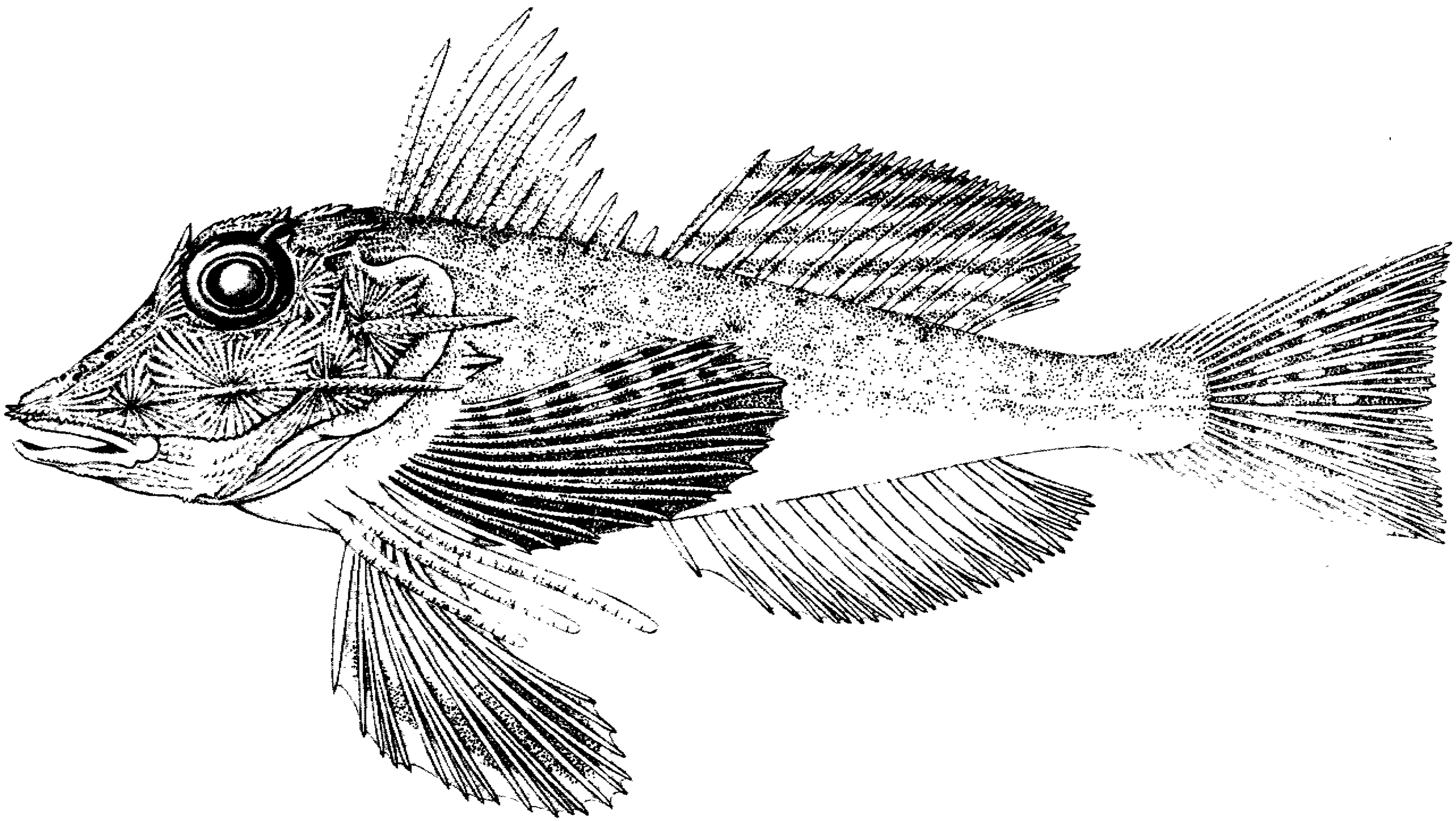

Figure 23. *Bellator egretta* (Goode and Bean).

eyeball; chest without scales; rostral exsertions weakly developed; supplemental preopercular, rostral, second infraorbital, and third infraorbital, spines absent; first dorsal spine with elongate filament in large males; no filament on second dorsal spine; upper free pectoral ray considerably shorter than pectoral fin length; D. XI, 11-12 (modally 12); A. 11, pectoral 11-12; gill rakers 7-10; lateral scale rows 95-112.

Remarks: Ginsburg (1950) reported the bathymetric range for this species as 45-112 fathoms (82-205 m). Hourglass stations were all shallower except during the first cruise when the deepest stations attempted were at depths of 91 m (Joyce and Williams, 1969). One specimen of *B. egretta* was taken at 91 m during that first cruise and another at 55 m. Bottom temperature and salinity were not available for the first cruise. The bottom temperature was 22°C and the salinity 36‰ for the specimen from 55 m.

DISCUSSION

BATHYMETRIC AND TRANSECT DISTRIBUTIONS

The northern Hourglass transect yielded significantly more searobins than did the southern transect during regular (late-afternoon to night) cruises (paired t-test = 2.45, $P < .01$). This pattern occurred for each species.

Numbers of fishes collected during the regular cruises were not significantly different ($P > .05$) from numbers taken during the post-cruises (day) at Hourglass Stations B, C and D. However, all species except *P. roseus* and *P. alatus*, both at Station D, had slightly higher catches during the night trawls. Species used in this comparison were *P. alatus*, *P. roseus*, *P. martis*, *P. ophryas*, *P. salmonicolor*, and *B. militaris*.

Stations at the same depths had the greatest triglid similarity based on relative species abundance (Figure 24). The two shallow stations were distinct from all others; the four mid-depth stations linked at high similarities, while the two deepest stations differed markedly from the intermediate-depth stations in species occurrences.

Patterns of relative abundance (Figure 25) and biomass varied bathymetrically. *Prionotus scitulus* occurred primarily at 6 m, while *P. tribulus* also occurred there at a much lower relative abundance. The relative importance of *P. tribulus* at 6 m was greater when analyzed by biomass. Six species were collected at 18 m; *P. martis* dominated numerically, followed by *P. ophryas*, *P. tribulus* and *P. roseus*. Five species were collected from 37 m; *P. roseus* and *B. militaris* were dominant by number and *P. roseus* and *P. ophryas* by weight. Seven species were collected at 55 m; *P. roseus* dominated in relative abundance, but *P. salmonicolor* and *B. militaris* were also important. Six species were collected at 73 m; however, this depth was dominated by *B. militaris* and *P. alatus*. Four juveniles of *B. brachychir* were collected at 73 m (Station M, September 1966). *Prionotus stearnsi* was also collected infrequently at 55 and 73 m.

Species groups on the West Florida Shelf showed sympatric and allopatric bathymetric patterns. Camp (1973) pointed out that capture of species at the same station, or depth, did not necessarily imply syntopy since collection localities, especially for the deeper stations, could vary as much as a mile for each cruise. A more reliable measure of syntopy would be the occurrence of two or more species in the same trawl. The maximum habitat similarities for the eight species

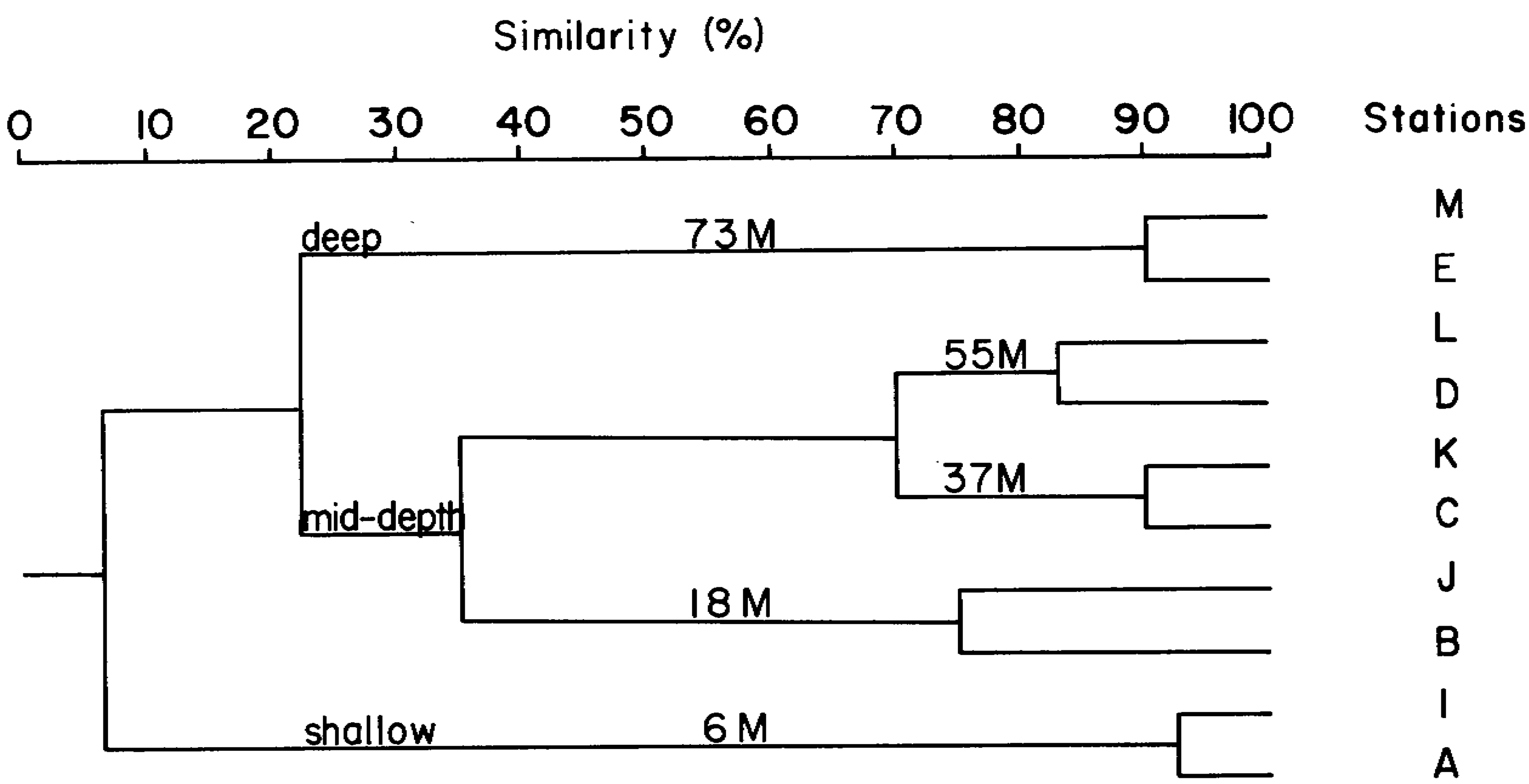

Figure 24. Cluster analysis (UPGMA) based on percent similarity of 10 Hourglass fishery stations using searobin relative abundance.

TABLE 24. PERCENT HABITAT SIMILARITY (CZECHANOWSKI COEFFICIENT) IN SEAROBINS AS DETERMINED FROM THE CO-OCCURRENCE IN INDIVIDUAL TRAWL SAMPLES FROM PROJECT HOURGLASS.

	P. roseus	*P. scitulus*	*P. martis*	*B. militaris*	*P. alatus*	*P. tribulus*	*P. salmonicolor*	*P. ophryas*
P. roseus		0	26.7	52.6	0	25.0	38.1	44.4
P. scitulus			0	0	0	25.0	0	0
P. martis				0	0	26.7	0	22.2
B. militaris					67.0	0	46.2	28.6
P. alatus						0	25.0	18.2
P. tribulus							0	20.0
P. salmonicolor								31.6

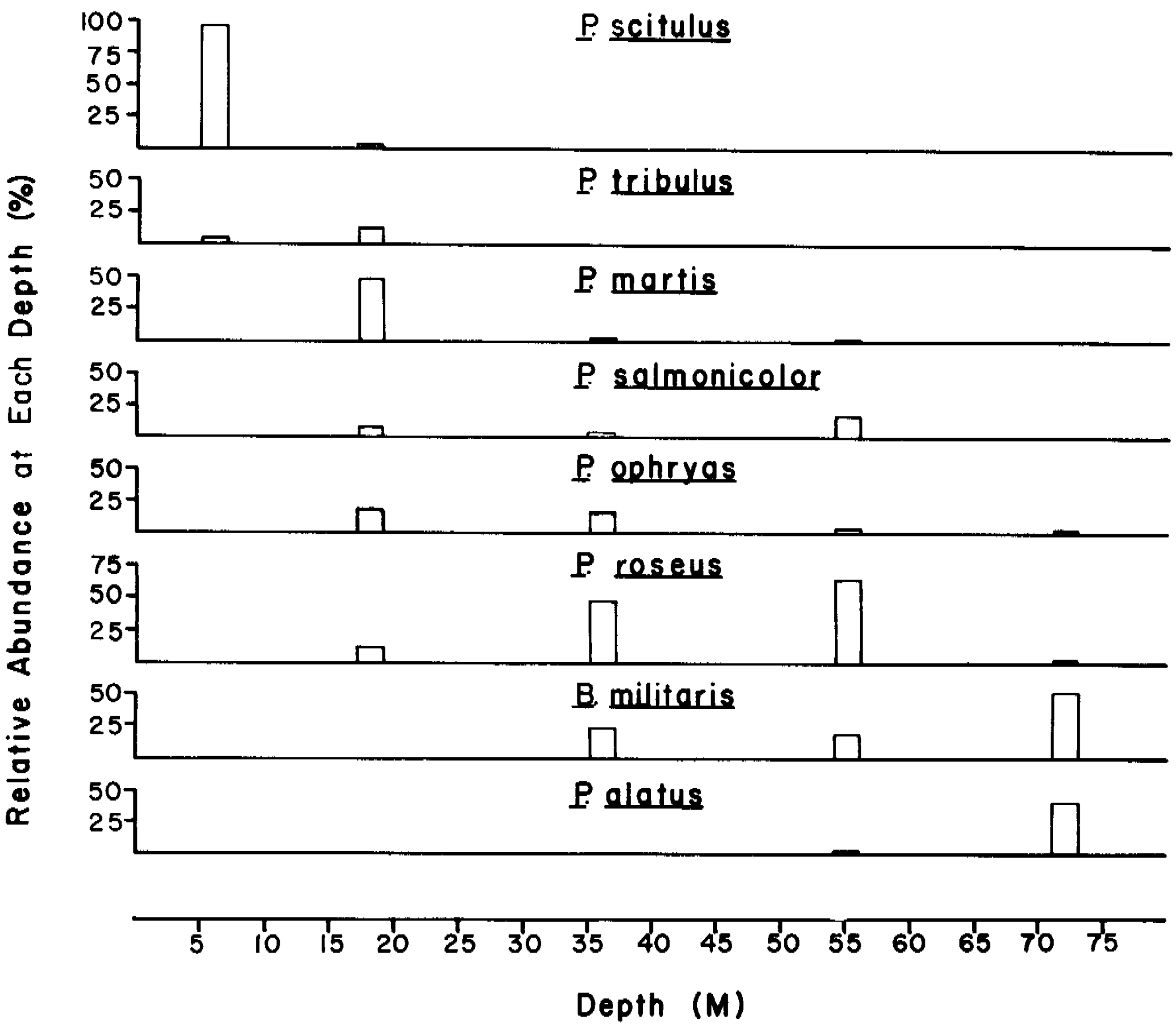

Figure 25. The relative numerical abundance of searobins from each collection depth of Project Hourglass.

(based on their presence or absence in the same net haul) were between *B. militaris* and *P. alatus*, and *P. roseus* and *B. militaris* (Table 24). High similarity also occurred between *P. salmonicolor* and *B. militaris* and between *P. ophryas* and *P. roseus*. *Bellator militaris* and *P. roseus* thus showed the greatest syntopy with other searobin species.

GENERAL DISTRIBUTION

A survey of faunal studies in the Gulf of Mexico (Table 25) indicates general agreement with the bathymetric distribution observed for the Hourglass triglids, especially for species where relative abundances were indicated.

Prionotus scitulus occurs throughout the shallower shelf areas of the Gulf of Mexico. It has been collected at a maximum depth of 73 m, but most studies have reported it from depths less than 33 m (Table 25). It is moderately euryhaline and eurythermal, occurring in salinities from 13 to 37 ‰ and temperatures from 10 to 35°C. Most fish, however, were from salinities above 18 ‰. While Moe and Martin (1965) and Joseph and Yerger (1956) characterized *P. scitulus* as a fish of the open Gulf, its distribution is largely inshore. Perhaps *P. scitulus* is excluded from some inshore marine areas by low salinities (< 13 ‰).

Prionotus scitulus occurred year-round in Tampa Bay, an observation supported by Springer and Woodburn (1960), and indicated for other Gulf coast areas as well. However, Ross (1978) demonstrated consistent size differences of *P. scitulus* between the Tampa Bay stations, immature fish being more common in Old Tampa Bay. Tabb et al. (1962) reported inshore movements of *P. scitulus* into Florida Bay during winter; however, salinities were above 25 ‰.

Prionotus tribulus also occurs at shallow to moderate depths throughout the Gulf of Mexico, being most common at depths of 42 m or less (Table 25). In comparison with *P. scitulus*, it ranges into lower salinity water and is very euryhaline (1-37 ‰), as well as eurythermal (5-35° C).

Tampa Bay specimens of *P. tribulus* were predominantly juveniles; open Gulf specimens were predominantly adults. This pattern may have been exaggerated by sampling bias since mesh size of Hourglass trawls was larger than mesh size of trawls used in Tampa Bay. However, similar patterns in size-depth distribution for *P. tribulus* were observed in other studies, e.g., Hildebrand (1954) for the western Gulf; Kilby (1955) for Cedar Key, Florida; Springer and Woodburn (1960) for Tampa Bay; and Hoese (1973) for the Georgia coast. Christmas and Waller (1973) reported that most small *P. tribulus* (<30 mm) were collected in Mississippi Sound between October and December. *Prionotus tribulus* also occupied shallow water along the Florida Gulf coast primarily in the fall, winter and spring (Reid, 1954; Joseph and Yerger, 1956; Springer and Woodburn, 1960; Tabb et al., 1962; Wang and Raney, 1971). However, Tabb and Manning (1961) reported that *P. tribulus* in southern Florida moved offshore during cold weather.

Prionotus martis is endemic to the Gulf of Mexico (Ginsburg, 1950), although it is closely related to *P. carolinus* of the Atlantic coast. Some authors (e.g., Hoese and Moore, 1977) have considered these forms to be conspecific. *Prionotus martis* occurs on the shallower shelf areas throughout the Gulf of Mexico, ranging from 4 to 366 m (Table 25). The 366 m record in Springer and Bullis (1956) is far deeper than other depth records, and Lewis and Yerger (1976) considered that it was likely an error. More recently, Chittenden and Moore (1977) reported *P. martis* from 110 m, and one Hourglass specimen was taken from 55 m. Thus, *P. martis* may occasionally enter water deeper than the 44 m limit suggested by Lewis and Yerger (1976). *Prionotus martis* occupied

TABLE 25. THE GULF OF MEXICO DISTRIBUTIONAL PATTERNS FOR SEAROBINS COLLECTED DURING PROJECT HOURGLASS. GEOGRAPHIC REGIONS ARE MODIFIED FROM BERRY AND DRUMMOND (1967). DEPTHS FROM LEWIS AND YERGER (1976) WERE TAKEN FROM THEIR FIGURE 3.
(a = ABUNDANT, FREQUENTLY CAPTURED IN LARGE NUMBERS;
c = COMMON, FREQUENTLY CAPTURED AS INDIVIDUALS OR PAIRS;
r = RARE, SELDOM CAPTURED).

SPECIES	LOCATION	ABUNDANCE	DEPTH (m)	SALINITY (‰)	TEMP. (°C)	REFERENCE
Prionotus scitulus						
	Campeche, Mexico	c	11-29			Hildebrand, 1955
	Campeche, Mexico		12-46		24-25	Springer and Bullis, 1956
	W Gulf	c	4-18	25-30	14-30	Gunter, 1945
	W Gulf	r	33			Hildebrand, 1954
	Texas		33		24	Springer and Bullis, 1956
	Texas	r	shallow			Parker, 1965
	Louisiana		14		15	Springer and Bullis, 1956
	Mississippi		15		28	Springer and Bullis, 1956
	Mississippi	r	1-2	18-28	31-33	Franks, 1970
	Mississippi	r	73	37	25	Burns, 1970
	Mississippi	c	shallow	20-35	10-35	Christmas and Waller, 1973
	Alabama	r	shallow	15	24	Swingle and Bland, 1974
	Florida, St. Andrew Bay	a	2-12	13-36	13-31	Ogren and Brusher, 1977
	Florida, St. Andrew Bay	r	1-3			Naughton and Saloman, 1978
	Florida, Apalachicola		11-29		16-22	Springer and Bullis, 1956
	Florida, Alligator Harbor	r	shallow			Joseph and Yerger, 1956
	Florida, Cedar Key	c	shallow	18-32	12-31	Reid, 1954
	Florida, Waccasassa Bay	r	shallow			Bass and Guillory, 1979
	Florida, Tampa Bay	c	shallow	21-33	10-33	Springer and Woodburn, 1960
	Florida, Tampa Bay	a	4-9	28-36	14-32	Ross, 1980
	Florida, off Tampa Bay	c	5-14	31-37	12-28	Moe and Martin, 1965
	Florida, Pinellas Co.	r	1-2			Saloman and Naughton, 1979
	Florida, Tampa - Fort Myers	c	6-18	30-36	16-33	Project Hourglass
	Florida, Charlotte Harbor	c	3-5	27-34	14-31	Wang and Raney, 1971
	Florida, Caloosahatchee Estuary	c	4	18-34	25	Gunter and Hall, 1965
	Florida, Florida Bay	r	3	31-35	17-27	Tabb and Manning, 1961
	Florida Keys		68		24	Springer and Bullis, 1956
Ranges			1-73	13-37	10-35	

TABLE 25. CONTINUED.

SPECIES	LOCATION	ABUNDANCE	DEPTH (m)	SALINITY (‰)	TEMP. (°C)	REFERENCE
Prionotus tribulus						
	Campeche, Mexico		22		25	Springer and Bullis, 1956
	Campeche, Mexico	r	15-18			Hildebrand, 1955
	W Gulf	c	11-42			Hildebrand, 1954
	Texas	c	6-27		13-25	J. Miller, 1965
	Texas	c	5-18	10-37	14-30	Gunter, 1945
	Texas	c				Parker, 1965
	Louisiana	r	1-2	4-18	12-28	Perret and Caillouet, 1974
	Louisiana		33		22	Springer and Bullis, 1956
	Mississippi		14-29		15-28	Springer and Bullis, 1956
	Mississippi	c	3-37	29-37	14-29	Franks et al., 1972
	Mississippi	c	shallow	5-36	5-35	Christmas and Waller, 1973
	Alabama		15-16		17-23	Springer and Bullis, 1956
	Alabama	r	shallow	14-26	13-26	Swingle and Bland, 1974
	Florida, Pensacola	r	2-4	20-27	17-18	Cooley, 1978
	Florida, St. Andrew Bay	c	2-12	13-36	13-31	Ogren and Brusher, 1977
	Florida, St. Andrew Bay	r	1-3			Naughton and Saloman, 1978
	Florida, Apalachicola		11-64		16-22	Springer and Bullis, 1956
	Florida, Alligator Harbor	c				Joseph and Yerger, 1956
	Florida, Cedar Key	c	1-2	21-28	17-31	Kilby, 1955
	Florida, Cedar Key	c	shallow			Reid, 1954
	Florida, Waccasassa Bay	r	shallow			Bass and Guillory, 1979
	Florida, Tampa Bay	c	shallow	11-33	11-27	Springer and Woodburn, 1960
	Florida, Tampa Bay	r	5-32	31-37	12-28	Moe and Martin, 1965
	Florida, Pinellas Co.	r	1-2			Saloman and Naughton, 1979
	Florida, Tampa - Fort Myers	r	6-18	25-35	15-32	Project Hourglass
	Florida, Charlotte Harbor	c	3-5	16-34	14-35	Wang and Raney, 1971
	Florida, Caloosahatchee Estuary	c	2-4	1-33		Gunter and Hall, 1965
	Florida, Florida Bay	r	shallow	18-32		Tabb et al., 1962
	Florida, Florida Bay	c	shallow	11-32	16-29	Tabb and Manning, 1961
	Florida Keys		71		19	Springer and Bullis, 1956
Ranges			1-71	1-37	5-35	

TABLE 25. CONTINUED.

SPECIES	LOCATION	ABUNDANCE	DEPTH (m)	SALINITY (‰)	TEMP. (°C)	REFERENCE
Prionotus martis						
	Campeche, Mexico		22		24-25	Springer and Bullis, 1956
	Tabasco, Mexico		46		23	Springer and Bullis, 1956
	Texas		33			Ginsburg, 1950
	Texas - Louisiana	r	110			Chittenden and Moore, 1977
	Louisiana		18		20	Springer and Bullis, 1956
	Mississippi		366		10	Springer and Bullis, 1956
	Alabama - Florida	c	25-45		17-28	Lewis and Yerger, 1976
	Florida, Pensacola	r	13	30-31	19-23	Cooley, 1978
	Florida, Apalachicola		37		20	Springer and Bullis, 1956
	Florida, Apalachicola		24			Bullis and Thompson, 1965
	Florida, Cedar Key	r	4-5	25	10	Reid, 1954
	Florida, Cedar Key		22		16	Springer and Bullis, 1956
	Florida, off Tampa Bay		6			Bullis and Thompson, 1965
	Florida, Tampa - Fort Myers	c	18-55	31-36	18-30	Project Hourglass
Ranges			4-366	25-36	10-30	
Prionotus ophryas						
	Yucatan, Mexico		46		24	Springer and Bullis, 1956
	Campeche, Mexico		22-49		24-27	Springer and Bullis, 1956
	Campeche, Mexico		55			Bullis and Thompson, 1965
	Campeche, Mexico	c	11-29			Hildebrand, 1955
	Tabasco, Mexico		40		24	Springer and Bullis, 1956
	SW Gulf	c	22-73			Hildebrand, 1954
	Texas		27-174		15-24	Springer and Bullis, 1956
	Louisiana		18		22	Springer and Bullis, 1956
	Mississippi	r	91	38	20	Franks et al., 1972
	Mississippi	r	91	34	20	Burns, 1970
	Alabama		68		18	Springer and Bullis, 1956
	Florida, Pensacola		42		20	Springer and Bullis, 1956
	Florida, St. Andrew Bay	r	8-9	31-36	13-20	Ogren and Brusher, 1977
	Florida, Tampa - Fort Myers	c	18-73	32-37	18-28	Project Hourglass
	Florida Keys		51		21	Springer and Bullis, 1956
	Florida, Dry Tortugas		33			Bullis and Thompson, 1965
Ranges			8-174	31-38	13-28	

TABLE 25. CONTINUED.

SPECIES	LOCATION	ABUNDANCE	DEPTH (m)	SALINITY (‰)	TEMP. (°C)	REFERENCE
Prionotus roseus						
	Yucatan, Mexico		46-53		23-24	Springer and Bullis, 1956
	Campeche, Mexico		22-26		24-27	Springer and Bullis, 1956
	Campeche, Mexico		47-53			Bullis and Thompson, 1965
	Campeche, Mexico	r	24-29			Hildebrand, 1955
	Texas		49			Bullis and Thompson, 1965
	Mississippi	r	55	37	22	Burns, 1970
	Mississippi		100	23-37	15-22	Franks et al., 1972
	Mississippi	c	shallow	15-35	10-35	Christmas and Waller, 1973
	Alabama - Florida	a	65		16-28	Lewis and Yerger, 1976
	Alabama - Florida	c	25-45		16-28	Lewis and Yerger, 1976
	Alabama - Florida	r	85		16-28	Lewis and Yerger, 1976
	Florida, Pensacola		42		20	Springer and Bullis, 1956
	Florida, Apalachicola		29-55		19-21	Springer and Bullis, 1956
	Florida, St. Petersburg		46		19	Springer and Bullis, 1956
	Florida, St. Petersburg		38-117		16-18	Springer and Bullis, 1956
	Florida, Tampa - Fort Myers	a	18-73	32-37	16-30	Project Hourglass
	Florida, Bradenton		183		17	Springer and Bullis, 1956
	Florida, Charlotte Harbor	r	3-5	26-34	16-31	Wang and Raney, 1971
	Florida Keys		51		21	Springer and Bullis, 1956
Ranges			3-183	15-37	10-35	
Prionotus salmonicolor						
	Campeche, Mexico		124			Bullis and Thompson, 1965
	Campeche, Mexico		22-37		24-26	Springer and Bullis, 1956
	SW Gulf	c	22-66			Hildebrand, 1954
	Texas		33-73		22-24	Springer and Bullis, 1956
	Texas	r	18	35	17	Gunter, 1945
	Texas	r	27		21	J. Miller, 1965
	Louisiana - Texas	c	110			Chittenden and Moore, 1977
	Louisiana		33		21	Springer and Bullis, 1956
	Louisiana		82			Bullis and Thompson, 1965
	Mississippi		38		27	Springer and Bullis, 1956
	Mississippi	r	1-2	7-18	21-33	Franks, 1970
	Mississippi	r	55	37-39	20	Franks et al., 1972

TABLE 25. CONTINUED.

SPECIES	LOCATION	ABUNDANCE	DEPTH (m)	SALINITY (‰)	TEMP. (°C)	REFERENCE
	Alabama	r	26-68		18-21	Springer and Bullis, 1956
	Florida, St. Andrews Bay	c	3-12	21-36	13-30	Ogren and Brusher, 1977
	Florida, Pensacola		42		20	Springer and Bullis, 1956
	Florida, Tampa - Fort Myers	c	18-55	34-37	16-28	Project Hourglass
Ranges			1-124	7-39	13-33	
Prionotus alatus						
	Campeche, Mexico		124			Bullis and Thompson, 1965
	Louisiana		49		22	Springer and Bullis, 1956
	Mississippi	r	91	38	20	Franks et al., 1972
	Mississippi	r	91	34	22	Burns, 1970
	Alabama		55		18-19	Springer and Bullis, 1956
	Alabama - Florida	a	85		14-28	Lewis and Yerger, 1976
	Alabama - Florida	c	65;105-125		14-28	Lewis and Yerger, 1976
	Alabama - Florida	r	45;145-185		14-28	Lewis and Yerger, 1976
	Florida, Apalachicola		29-192		13-17	Springer and Bullis, 1956
	Louisiana - Florida		55-457		11-19	Miller and Kent, 1971
	Florida, Tampa - Fort Myers	c	55-73	33-37	16-26	Project Hourglass
Ranges			29-457	33-38	11-28	
Prionotus stearnsi						
	Yucatan, Mexico		139		17	Springer and Bullis, 1956
	Yucatan, Mexico		77-124			Bullis and Thompson, 1965
	Campeche, Mexico		44-91		17-24	Springer and Bullis, 1956
	Tabasco, Mexico		64		21	Springer and Bullis, 1956
	Tamaulipas, Mexico		73		23	Springer and Bullis, 1956
	Texas		33-82		21-24	Springer and Bullis, 1956
	W. Gulf, Texas	c	22-73			Hildebrand, 1954
	Texas		183-238		12-16	Bullis and Thompson, 1965
	Louisiana - Texas	c	110			Chittenden and Moore, 1977
	Louisiana		18-223		13-28	Springer and Bullis, 1956
	Louisiana		91-143			Bullis and Thompson, 1965
	Mississippi	r	37-91	36-37	16-21	Burns, 1970
	Mississippi	r		34-37	16-21	Franks et al., 1972
	Alabama		10-205		14-17	Springer and Bullis, 1956

TABLE 25. CONTINUED.

SPECIES	LOCATION	ABUNDANCE	DEPTH (m)	SALINITY (‰)	TEMP. (°C)	REFERENCE
	Alabama - Florida	c	65-105		14-21	Lewis and Yerger, 1976
	Alabama - Florida	r	125-185		14-21	Lewis and Yerger, 1976
	Florida, Pensacola		29-150		13-18	Springer and Bullis, 1956
	Florida, Pensacola		183		14	Bullis and Thompson, 1965
	Florida, Panama City		110-146		14-17	Springer and Bullis, 1956
	Florida, Panama City		29			Bullis and Thompson, 1965
	Florida, Apalachicola		88-123		16-17	Springer and Bullis, 1956
	Florida, Tampa - Fort Myers	r	55-73	34-36	17-22	Project Hourglass
	Florida, Fort Myers		113		16	Springer and Bullis, 1956
	Florida, Dry Tortugas		51			Bullis and Thompson, 1965
	Cuba		411-457		17	Springer and Bullis, 1956
Ranges			10-457	34-37	12-28	
Bellator militaris						
	Campeche, Mexico	r	24-29			Hildebrand, 1955
	Campeche, Mexico		37-64		19-26	Springer and Bullis, 1956
	Tabasco, Mexico		64		21	Springer and Bullis, 1956
	SW Gulf	c	24-73			Hildebrand, 1954
	Texas		51-73		21-24	Springer and Bullis, 1956
	Texas - Louisiana	c	110			Chittenden and Moore, 1977
	Louisiana		35		17	Springer and Bullis, 1956
	Mississippi	r	73-91	37	15-19	Burns, 1970
	Mississippi		55	17-34	14-25	Franks et al., 1972
	Mississippi - Florida	a	85		15-28	Lewis and Yerger, 1976
	Mississippi - Florida	c	45-65;105		15-28	Lewis and Yerger, 1976
	Mississippi - Florida	r	25		15-28	Lewis and Yerger, 1976
	Alabama		68		18	Springer and Bullis, 1956
	Florida, Panama City		77-102		17	Springer and Bullis, 1956
	Florida, Apalachicola		29-73		19-21	Springer and Bullis, 1956
	Florida, Apalachicola		46-55			Bullis and Thompson, 1965
	Florida, central shelf		53-110		16-19	Springer and Bullis, 1956
	Florida, St. Petersburg		46		19	Springer and Bullis, 1956
	Florida, Tampa - Fort Myers	a	37-73	32-37	18-25	Project Hourglass
	Florida Keys		51-55			Bullis and Thompson, 1965
	Florida, Dry Tortugas		51-137		18-21	Springer and Bullis, 1956
Ranges			24-137	17-37	14-28	

TABLE 25. CONTINUED.

SPECIES	LOCATION	ABUNDANCE	DEPTH (m)	SALINITY (‰)	TEMP. (°C)	REFERENCE
Bellator brachychir						
	NE - Florida Gulf					Lewis and Yerger, 1976
	Florida, Tampa - Fort Myers	r	73	36	19	Project Hourglass
	Florida, southern shelf					Powell et al., 1972
Bellator egretta						
	Campeche, Mexico		37-64		19-24	Springer and Bullis, 1956
	NE Florida Gulf					Lewis and Yerger, 1976
	Alabama		55		19	Springer and Bullis, 1956
	Florida, Apalachicola		104		17	Springer and Bullis, 1956
	Florida, central shelf		64-113		16-21	Springer and Bullis, 1956
	Florida, Tampa - Fort Myers	r	55-91	36	22	Project Hourglass
	Florida, southern shelf		119-137		18-20	Springer and Bullis, 1956
	Florida, Florida Bay	r	2	36	26	Tabb and Manning, 1961
	Florida Keys		51-55			Bullis and Thompson, 1965
Ranges			2-137	36	16-26	

deeper water than *P. scitulus* on the West Florida Shelf so that these morphologically similar species appear to be spatially segregated (see also Ross, 1977). In contrast to *P. scitulus* and *P. tribulus*, *P. martis* occupied narrower salinity and temperature ranges (Table 25), although data for salinity were limited.

Prionotus scitulus, *P. tribulus* and *P. martis* primarily occurred in the shoreward zone (0-10 m) and shallow shelf regions (10-30 m) described by Lyons and Collard (1974). Lyons and Collard, and also Joyce and Williams (1969), characterized the shoreward zone as a region of fluctuating temperature and salinity, with high nutrient levels. Substrates are primarily quartz sand and shell fragments with a fine layer of silt; however, within Old Tampa Bay (Station 1) the sand and shell is covered with silt, clay and organic sludge (Brooks, 1973). The shallow shelf region, occupied more by *P. martis* and *P. tribulus*, has some rocky substrates with quartz and some calcareous sand (Brooks, 1973; Lyons and Collard, 1974). Areas between the limestone outcroppings often support the alga, *Caulerpa* and the seagrass, *Halophila* (Joyce and Williams, 1969). *Prionotus ophryas*, *P. salmonicolor* and *P. roseus* ranged from the shallow shelf region out to middle shelf I (30-60 m) of Lyons and Collard (1974). Lewis and Yerger (1976) considered *P. roseus* to be a shallow to midshelf species, and other sources (Table 25) corroborate the rather broad bathymetric distributions of these forms. The middle shelf I area is characterized by widespread carbonate sediments and coral formations overlain by blue, offshore water (Lyons and Collard, 1974). Joyce and Williams (1969) described Hourglass Stations C and K of this area as having low limestone outcroppings, an abundant brown alga, *Sporochnus*, and a calcareous alga, *Lithothamnion*. Hourglass Stations D and L, also included in middle shelf I, had a smooth bottom with abundant bryozoans. The carbonate sediments were covered by brown silt (Joyce and Williams, 1969).

Prionotus ophryas, *P. roseus* and *P. salmonicolor* range throughout the Gulf of Mexico; however, *P. salmonicolor* is less common off southern Florida (Table 25). Of these three species, *P. salmonicolor* also occupies a wider salinity range.

Bellator militaris also showed a broad bathymetric range, but Hourglass specimens had their greatest relative abundance in deeper water than *P. ophryas*, *P. salmonicolor* and *P. roseus*, thus occupying both the middle shelf I and the middle shelf II (60-140 m) regions of Lyons and Collard (1974). Results of other studies in the northern Gulf of Mexico agree with the Hourglass distributional pattern. Lewis and Yerger (1976) reported the greatest abundance of *B. militaris* at 80-90 m, closely matching the pattern shown in this study, where its relative abundance increased from 35 m to the 73 m stations. *Bellator militaris* is broadly distributed in the deeper shelf areas of the Gulf of Mexico (Table 25).

The Gulf of Mexico distribution of *Prionotus alatus* is from Louisiana to Florida, and also off Campeche (Table 25; Miller and Kent, 1971; Lewis and Yerger, 1976). This species was most common in the deepest Hourglass stations (73 m), and had an overall depth range of 29-457 m.

Prionotus alatus occurred within the middle shelf II region of Lyons and Collard (1974). This area is characterized by carbonate sediments of primarily algal origin (Brooks, 1973; Lyons and Collard, 1974) and crushed shell and bryozoan fragments (Joyce and Williams, 1969). Bathymetric overlap between *B. militaris* and *P. alatus*, as observed in Project Hourglass, also appears to exist in the northern Gulf, since Lewis and Yerger (1976) reported a maximum density of *P. alatus* between 80-90 m.

Three additional species, *P. stearnsi*, *B. brachychir* and *B. egretta*, were poorly represented in the Hourglass collections. *Prionotus stearnsi* is broadly distributed in deep shelf areas throughout the Gulf of Mexico, ranging from 10-457 m. Bullis and Struhsaker (1970) reported *P. stearnsi* from 185-366 m in the western Caribbean off Yucatan, and Lewis and Yerger (1976) considered the species to be one of the, "deepest dwelling western North Atlantic triglids."

The Gulf of Mexico distribution of *Bellator egretta* and *B. brachychir* is limited primarily to the Florida shelf, and also (for *B. egretta*) the area off Campeche, Mexico (Table 25). *Bellator brachychir* is poorly represented from Gulf of Mexico collections; however, Bullis and Struhsaker (1970) found it to be common from 137-274 m (ranging to 366 m) in the western Caribbean. *Bellator egretta* is better represented in Gulf of Mexico collections, ranging from 2-137 m. With the exception of the 2 m depth reported by Tabb and Manning (1961), all other records are from depths greater than 30 m. Bullis and Struhsaker (1970) found *B. egretta* to be abundant between 185-274 m in the western Caribbean.

Lewis and Yerger (1976) concluded that bottom type was of little importance in understanding the distribution of *P. martis*, *P. roseus*, *P. alatus*, *P. stearnsi*, and *B. militaris*. *Bellator militaris* was the only species studied by Lewis and Yerger (1976) in which abundance was significantly correlated with bottom type, namely fine, sandy mud, silt or clay. However, West Florida Shelf *B. militaris* occurred over quartz sand, again suggesting that substrate may be of minor importance in habitat selection.

The Hourglass stations showed a general pattern of increasing salinity ($r = .78$; $P < .01$) and decreasing temperature ($r = -.95$; $P < .01$) with increasing station depth. Annual variability of temperature and salinity was greatest for inshore locations (Table 26), and this is reflected in the greater temperature and salinity ranges for *P. scitulus* and *P. tribulus*.

Juvenile *P. tribulus* were especially tolerant of low salinities. *Prionotus martis*, while dominant at 18 m, was captured within a comparatively narrow temperature and salinity range. Other studies (Table 25) also indicate broad temperature and salinity tolerances for *P. scitulus*, *P. tribulus* and *P. salmonicolor*, while *P. ophryas* was captured within a comparatively narrow range of temperature and salinity.

TABLE 26. MEANS AND STANDARD DEVIATIONS FOR BOTTOM TEMPERATURE AND SALINITY FROM THE HOURGLASS STATIONS; RAW DATA WERE FROM JOYCE AND WILLIAMS (1969).

Stations	Depth (m)	Temperature (°C) $\bar{X}$	s	N	Salinity (‰) $\bar{X}$	s	N
A	6	24.04	5.55	28	34.03	1.44	27
I	6	24.59	4.88	29	34.79	1.39	27
B	18	23.38	4.44	54	35.59	0.87	53
J	18	23.56	4.00	29	35.71	0.64	27
C	37	21.50	2.54	53	35.96	0.77	53
K	37	22.15	2.43	28	36.07	0.52	27
D	55	20.89	1.91	51	36.06	0.71	52
I	55	21.53	2.00	28	36.15	0.51	27
E	73	20.54	1.89	26	36.01	0.85	26
M	73	21.00	2.19	28	36.21	0.49	27

Mean lengths of *P. roseus*, *P. salmonicolor* and *B. militaris* increased with increasing water depth, while mean lengths of *P. roseus* and *B. militaris* showed slight negative correlations with bottom temperature. Topp and Hoff (1972) described similar patterns of size changes with depth in several pleuronectiform fishes from Project Hourglass, and Moe and Martin (1965) and Moe (1972) listed the phenomenon for other fishes in the Florida Gulf. Lewis and Yerger (1976) found significant positive correlations between size and water depth for *P. martis*, *P. roseus*, *P. alatus*, and *B. militaris*.

Gunter (1950) discussed general relationships of increasing fish size with colder water temperatures; however, Garside (1970) reviewed many cases where the relationship did not occur. Gunter (1945; 1961a, b) also presented evidence for a positive relationship between fish size and salinity, primarily for estuarine systems. The relationship was initiated by offshore spawning followed by shoreward movement of young into low salinity waters, the actual positive correlation between size and salinity occurring as the developing juvenile fishes moved offshore into more saline water (Gunter, 1961a). This logic should also explain the relationship between fish size and water depth, and the negative relationship between fish size and temperature.

Salinity differences were less between stations in Project Hourglass than were temperature differences (Table 26), which might account for the absence of a correlation of fish size with salinity. Species in which size did not increase with increasing depth or lowered water temperature were either inshore forms so that the total depth range inhabited was small (e.g., *P. scitulus*), or primarily deep water species, so that most of the Hourglass stations were inshore of their distribution (e.g., *P. alatus*).

FOOD HABITS

All searobins studied, except *P. scitulus*, fed principally on crustaceans. *Prionotus scitulus*, while utilizing crustaceans, also consumed lancelets and polychaetes. Shrimp, primarily Pasiphaeidae, were a major prey of most offshore searobins, including *P. martis*, *P. ophryas*, *P. roseus*, *P. salmonicolor*, and *P. alatus*. *Prionotus roseus*, *P. salmonicolor* and *P. alatus* also fed on fishes, of which *Bregmaceros atlanticus* was most common. *Prionotus tribulus* was distinct in its high utilization of brachyurans.

Springer and Woodburn (1960) identified polychaetes and small crustaceans from stomachs of *P. scitulus* from Tampa Bay, and Reid (1954) listed mysidaceans, copepods, amphipods, penaeid shrimp, and polychaetes from *P. scitulus* from Cedar Key, Florida. Reid (1954) reported crabs, amphipods and a gastropod from *P. tribulus* from Cedar Key. Studies on food habits of *P. evolans* and *P. carolinus* from the Atlantic coast also showed high utilization of primarily benthic or epibenthic crustaceans, especially mysidaceans and gammarideans (Marshall, 1946; Bigelow and Schroeder, 1953).

Food habits of four species (*P. alatus*, *P. roseus*, *P. martis*, and *B. militaris*) analyzed in my study were also treated by Lewis and Yerger (1976). All except *P. alatus* could be compared by total dietary arrays of percent number of prey using Spearman's rank correlation, r_s, as outlined by Fritz (1974).

Prionotus alatus from both the northern and southern Gulf fed predominantly on natantians. However, *P. alatus* from south Florida also consumed fishes to a significant extent, while brachyurans and mysidaceans were important to northern Gulf fish. These differences might result from bias in comparing percent occurrence (this study) with percent number of prey, the latter tending to overestimate the importance of small prey items.

Total diet comparisons of *Prionotus roseus* from both areas were significantly correlated (r_s = .75; $P < .01$), and the top four prey groups (shrimp, amphipods, mysidaceans, and crabs) were the same. *Prionotus martis* from south Florida and northern Florida were significantly different (non-correlated) in total diet comparisons (r_s = .43, ns), but overlapped in three of four top-ranked prey categories: shrimp, amphipods and lancelets. Total diet comparisons of *Bellator militaris* from the two regions were correlated (r_s = .67; $P < .01$) and three of four top-ranked prey categories were shared (shrimp, amphipods and mysidaceans). Consequently, at the levels of classification employed in my study and Lewis and Yerger's (1976) study, the four species have very similar food habits, with the possible exception of *P. martis*, which differed in minor prey taxa.

A primarily diurnal feeding cycle may be common to species of *Prionotus* and *Bellator*. Three species which were obtained during both day and night collections (*P. roseus, P. alatus* and *B. militaris*) showed the greatest feeding activity during afternoon hours and the least during late night and early morning. Ross (1977) demonstrated a general diurnal activity pattern for all of the eight triglids commonly taken in Project Hourglass.

The importance of fishes in the diets of *P. roseus* and *B. militaris* increased with increasing searobin size, while fishes decreased in importance to larger *P. tribulus*. Generally, larger invertebrates such as natantians and brachyurans increased in importance in larger individuals of *P. roseus, P. tribulus* and *B. militaris*. Larger *P. scitulus* (>100 mm SL) utilized progressively more lancelets (see also Ross, 1978). Smaller invertebrates (e.g., copepods, gammaridean amphipods, cumaceans, and mysidaceans) generally decreased in importance in larger individuals of *P. scitulus, P. tribulus, P. ophryas*, and *P. roseus*, although larger *B. militaris* utilized more gammarideans and mysidaceans than did smaller individuals.

REPRODUCTION

The eight species of triglids all had rather protracted spawning periods, which were often difficult to discern due to small sample sizes. However, there were three general categories (Figure 26): 1) spring to late summer spawners, 2) fall to early spring spawners, and 3) extreme protracted spawners showing mature gonads in all seasons.

Prionotus scitulus and *P. martis*, which showed little bathymetric overlap, both had major spawning peaks from spring to late summer, although *P. martis* might precede *P. scitulus* in spawning activity. Gunter (1945) and Moe and Martin (1965) also presented evidence supporting a spring to late summer spawning peak for *P. scitulus*. Ross (1974) demonstrated a mid-summer spawning peak in *P. scitulus*, based on gonadal analyses of 546 specimens. However, some individuals apparently remained reproductively active well into winter. Reid (1954) collected a male *P. scitulus* in November which was "near breeding condition." Lewis and Yerger (1976) suggested a late fall to late winter or early spring spawning pattern for *P. martis*, quite opposite the pattern shown in this study. However, sample sizes in both studies were limited, making determinations of spawning periodicity difficult.

Prionotus tribulus, which overlapped bathymetrically with *P. scitulus* and *P. martis*, appeared to spawn from fall to early spring, an observation corroborated by the appearance of most juveniles in winter. This pattern is supported by other observations on gonadal condition and time

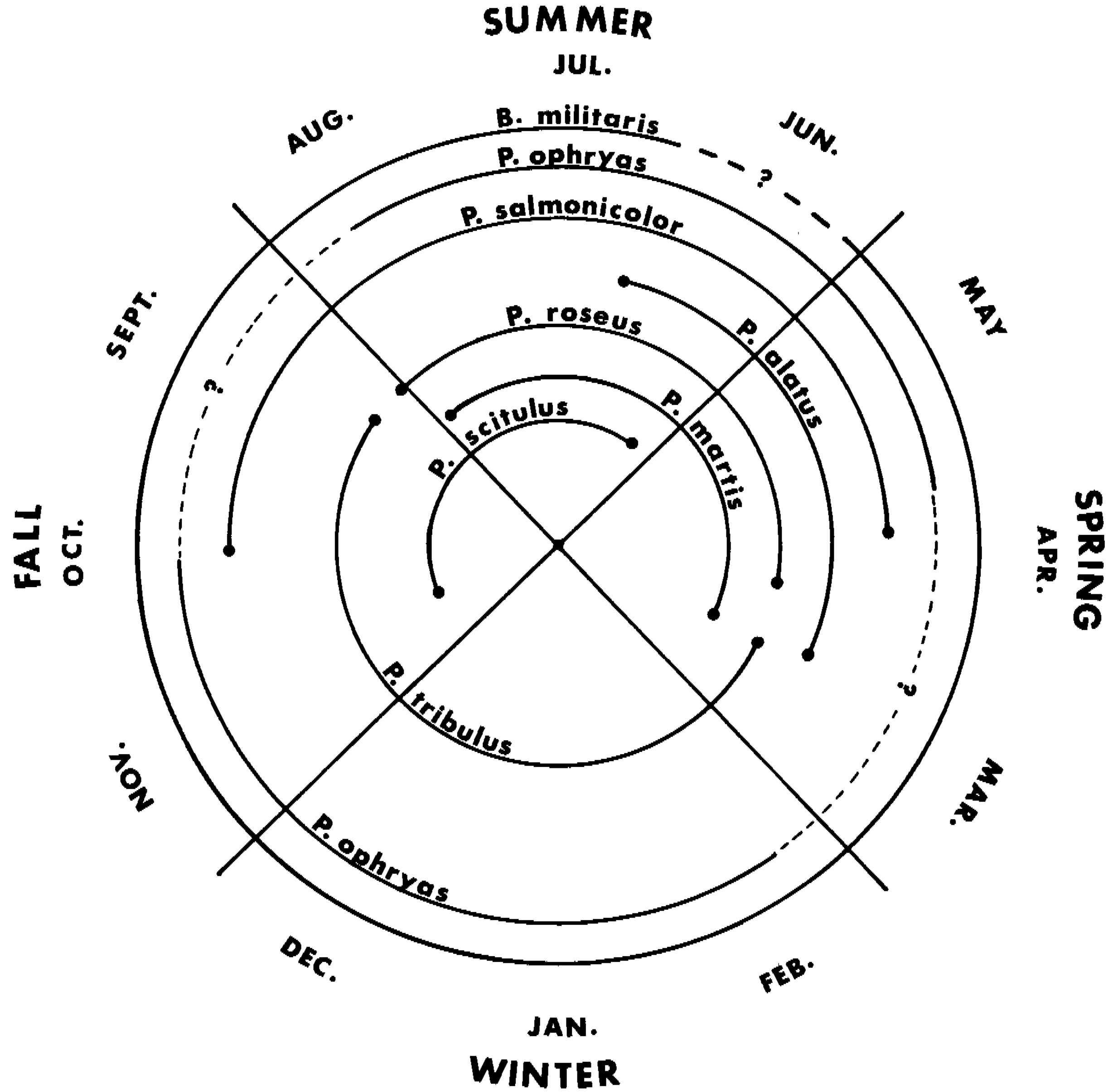

Figure 26. Tentative seasonal patterns of reproductive activity for searobins from the West Florida Shelf.

of occurrence of juveniles (Hildebrand, 1954; Kilby, 1955; Joseph and Yerger, 1956; J. Miller, 1965; Christmas and Waller, 1973). Consequently, partial temporal spacing of reproductive activity was occurring for these inshore species.

Prionotus alatus and *P. roseus* showed definite spawning peaks between early spring and summer on the West Florida Shelf, with reproductive activity of *P. roseus* extending to late summer. Lewis and Yerger (1976) described coincident spawning periods for these species also, but suggested a spawning period from late fall to early spring. Both regions are influenced by the eastern Gulf water mass, although winter bottom temperatures are somewhat lower in the northern Gulf and summer bottom temperatures are higher off Tampa and Fort Myers (Jones et al., 1973). Perhaps the later spawning season of the northern Gulf fishes is related to lower water temperatures.

Prionotus salmonicolor showed a spring to fall spawning pattern, while both *P. ophryas* and *B. militaris* apparently had extremely protracted spawning periods. *Bellator militaris* appeared to spawn between mid-summer and late spring. Lewis and Yerger (1976) also concluded that *B. militaris* had protracted spawning from fall to early summer. The great protraction complicates understanding the spawning pattern; possibly *B. militaris* is capable of breeding in all months.

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