Short Papers and Notes:

ASPECTS OF THE BIOLOGY OF *Spilocuma salomani* (CUMACEA: BODITRIIDAE)[1]

The order Cumacea consists of numerous species that are distributed throughout the world's oceans. Cumaceans are infaunal burrowers. Although found in all ocean depths, they are most abundant in the littoral zone. Jones (1969) listed 770 species occurring at depths from 0 to 6,000 m.

The cumacean *Spilocuma salomani* was described (Watling, 1977) from the nearshore zone of Panama City Beach, Florida (Figure 1) and has not been reported from any other locality. Previously, I had reported this species as belonging to the genus *Mancocuma* (Saloman, 1976).

Information in this report was obtained by examining 3,460 benthic samples collected in the nearshore zone of Panama City Beach from August 1974 through March 1977. The samples were collected before, during, and after onshore deposition of sand dredged from offshore. Dredging and deposition of sand occurred from July 1 through August 7, 1976.

STUDY AREA

Panama City Beach has a nearly straight shoreline and an average width of 26 m. A sand dune at elevations of 3 to 5 m above mean sea level occurs landward of the beach (Wilson, 1975). Two offshore sand bars occur parallel to the beach. Seaward of the second sand bar, the depth is irregular and increases rapidly. Depths at 1.85 km offshore range from 15.5 to 19.8 m (Saloman, 1976).

Panama City Beach is a popular resort area which is undergoing development for tourism. Natural beach and sand dunes occur at St. Andrews State Park. The majority of the area adjacent to the beach from St. Andrews State Park to the western-most stations (Figure 1) has been developed with private residences, condominiums, and motels.

Fifty-five stations were located in five separate habitats of the nearshore zone of the Gulf of Mexico from St. Andrews State Park (West Pass) to about 7.4 km west of Powell Lake (Figure 1). The habitats were: (1) swash zone, defined as the beach face, or the sloping surface of the beach that is covered by the run up of water brought by waves (Russell, 1969); (2) first sand bar located about 15 m offshore; (3) midway between the first and second sand bar, about 137 m offshore; (4) second sand bar that lies about 244 m offshore; (5) seaward of the second sand bar at 3 m depth (Figure 1).

The hydrology is characterized by water temperatures ranging from 7.8 to 32.1° C over a 32 month period. Average monthly water temperatures varied from 8.8° C in February 1977 to 29.9° C in July 1975. Salinities during the study period fluctuated from 23.7 $^{0}/_{00}$ in August 1975 to 35.7 $^{0}/_{00}$ in July 1976. The lowest monthly average (28.8 $^{0}/_{00}$) occurred in August 1975 and the highest monthly average (35.1 $^{0}/_{00}$) in December 1974.

METHODS

Substrate samples were taken with a stainless steel plug sampler that covered an area 1/64 m^2 and penetrated to a depth of 23 cm (Saloman, 1976). Four samples were taken during each station visit. A total of 3,460 samples was obtained: 2,156 in the swash zone, 872 in the first sand bar, 144 between first and second sand bars. 144 in the second sand bar, and 144 seaward of the second sand bar. Samples from the swash zone and first sand bar were collected after wading out to the appropriate depth, and from the remain-

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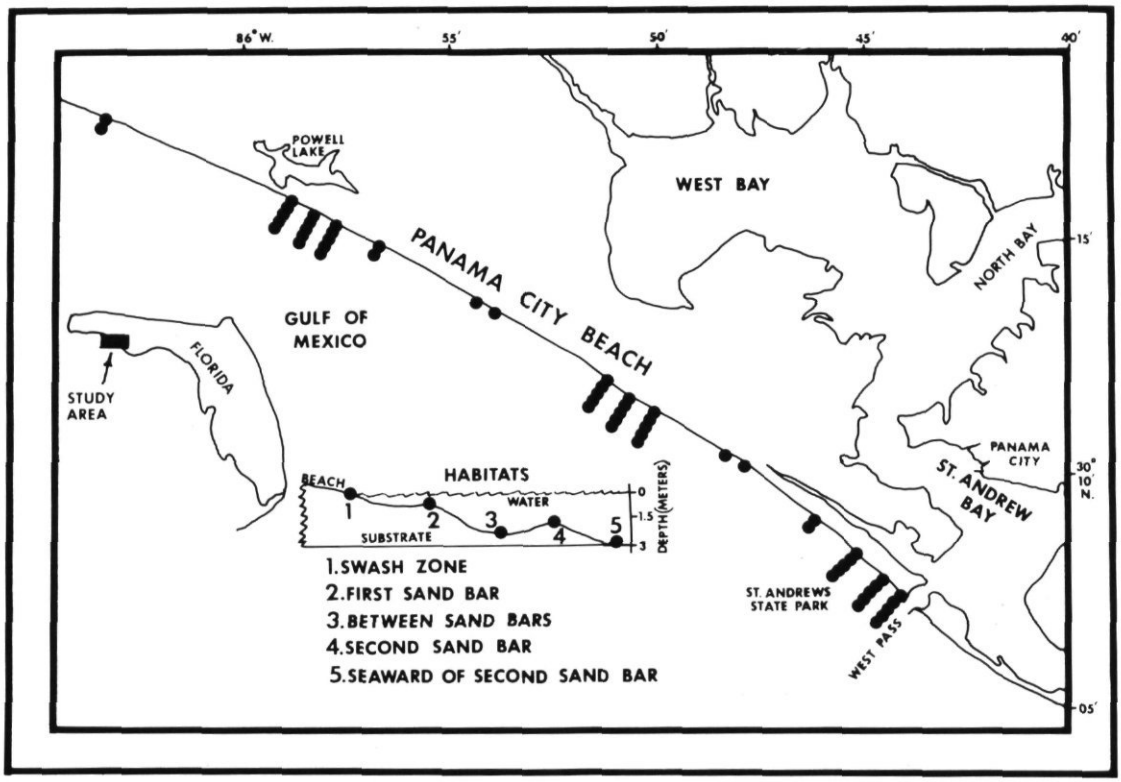

Figure 1 Habitats and station locations in the nearshore zone of Panama City Beach, Florida.

ing seaward stations with the aid of SCUBA gear. Samples were sieved through a screen (0.701 mm² mesh), and the sieved material was preserved in 10% Formalin[2] -seawater solution. Rose Bengal, a protein-staining dye, was added to the sample to help in sorting the organisms. Benthic organisms were separated into major taxa, placed in 70% isopropyl alcohol, and later identified.

Methods of collection and analysis for sediment/particle-size composition, carbon, carbonate, and accompanying statistical factors were described by Saloman (1976)

A surface water sample for temperature and salinity was taken at each station. Water temperatures were measured with a mercury thermometer. Salinities were determined in the laboratory with a Goldberg refractometer.

[2] Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA

SEDIMENTOLOGY

Little variation in the sedimentological factors was found at any station or within the geographical boundaries of the study area (Saloman, 1976). The average percent of total sample weight of gravel was 0.20%, sand 99.75%, and silt 0.05%. The clay-size fraction was absent. The amount of total carbon in the surface sediments was low, averaging 0.21%, and carbonate values ranged from 0 to 1.70% of the sample weight. The average mean grain size was 1.918 phi (0.273 mm), standard deviation was 0.608 phi (moderately well sorted), skewness was -0.085 (nearly symmetrical), and kurtosis was 1.043 (mesokurtic).

DISTRIBUTION AND ABUNDANCE

The first appearance of *Spilocuma salomani* in the samples was in February 1975. It was most abundant during spring and early summer. Density of individuals peaked at 78.5 per m^2 in May 1975 and averaged 16.7 over the sampling period (Table 1).

Individuals of *S. salomani* were most abundant (88.5% of all individuals) on the first sand bar. They were low in abundance between sand bars and at the second sand bar, and were absent in samples seaward of the second sand bar (Table 2).

Numbers of individuals were not distributed evenly along the coastline as stations located in the western section of the study area accounted for 63.5% of the total number of individuals (Table 2).

Deposition of sand onshore had no apparent effect on *S. salomani*, as individuals were present in the swash zone and in the first sand bar before and after deposition of the sand.

TABLE 1. Numbers of *Spilocuma salomani* collected from the nearshore zone of Panama City Beach, Florida, from August 1974 to March 1977.

Date	Number of samples	Non-gravid females	Gravid females	Males	Total numbers of individuals	Number individuals per m^2
1974						
Aug.	32	0	0	0	0	0
Sep.	32	0	0	0	0	0
Oct.	32	0	0	0	0	0
Nov.	212	0	0	0	0	0
Dec.	68	0	0	0	0	0
1975						
Jan.	68	0	0	0	0	0
Feb.	212	12	6	2	20	6.0
Mar.	68	0	0	0	0	0
Apr.	68	4	0	0	4	3.8
May	212	128	105	27	260	78.5
Jun.	68	0	1	0	1	0.9
Jul.	68	0	1	0	1	0.9
Aug.	180	8	12	5	25	8.9
Sep.	36	0	0	0	0	0
Oct.	36	0	0	0	0	0
Nov.	36	0	1	0	1	1.8
Dec.	36	2	12	0	14	25.0
1976						
Jan.	36	1	0	1	2	3.6
Feb.	36	0	0	0	0	0
Mar.	36	0	1	0	1	1.8
Apr.	148	24	72	16	112	48.5
May	260	23	66	16	105	25.9
Jun.	316	45	117	25	187	37.8
Jul.	260	24	57	6	87	21.4
Aug.	316	8	24	7	39	7.9
Sep.	148	2	10	4	16	6.9
Oct.	148	2	6	2	10	4.3
Nov.	92	3	4	2	9	6.2
Dec.	92	3	4	0	7	4.9
1977						
Jan.	36	0	1	0	1	1.8
Feb.	36	0	0	0	0	0
Mar.	36	1	0	0	1	1.8
Total	3,460	290	499	113	902	16.7

SEX RATIO AND FECUNDITY

The sex ratio of this cumacean was seven females to one male (Table 1). Males were represented in 12 of 20 months when specimens of *S. salomani* were present and were most abundant during May 1975 and April-June 1976.

Males were considerably smaller than the females, and their scarcity in benthic samples may be attributed to their pelagic terminal instar stage. Males are most likely lost in the plankton through predation and dispersal (E. Bousfield, personal communication).

Most males were attached to the females' abdomen by their second antenna. Gnewuch and Croker (1973) noted in *Mancocuma stellifera* and Jones and Burbanck (1959) in *Almyracuma proximoculi* that the male grasped the female's abdomen with his second antenna. The orientation of the attached male in the opposite direction to the female was also similar to the findings of Gnewuch and Croker.

Gravid females comprised 55.3% of the specimens and were present in 17 of 24 months from February 1975 through January 1977. The highest ratio of gravid females to non-gravid females was during spring and summer (April through August) 1976, when 336 females were observed with eggs compared to 124 females without eggs (Table 1).

In 1976, gravid females comprised between 60 to 66% of the individuals from April through October. In November and December 1976, the percentage of gravid females was 44 and 55% respectively. Most likely, *S. salomani* reproduced throughout the year.

The number of eggs carried by a female varied from 1 to 24; the average was 6.7. Of the gravid females, those carrying four eggs were the most abundant (Figure 2).

DISCUSSION

The abundance of *S. salomani* in the shallow zone of Panama City Beach peaked in May of 1975 with 78.5 individuals per m^2 and again in April - June 1976 with an average of 35.7 individuals per m^2. Densities were low in comparison to some other cumaceans inhabiting shallow water habitats, as Gnewuch and Croker (1973) found *Mancocuma stellifera* with densities as high as 4,000 per 0.1 m^2, Gladfelter (1975) listed densities of 12 species ranging from 25 to 5,225 individuals per m^2, and Barnard and Given (1961) ranked cumaceans third (78 individuals per m^2) in abundance of crustacean fauna in southern California.

The abundance of *S. salomani* on the first sand bar and decreasing abundance seaward is similar to *M. stellifera* where 90% of the population occurred between 0

TABLE 2. Number of samples and percentages of total catch of *Spilocuma salomani* found in the five habitats of the nearshore zone of Panama City Beach, Florida.

	East section			Center section			West section			Total		
Habitat	No. Samples	No. and (%) *S. salomani*		No. Samples	No. and (%) *S. salomani*		No. Samples	No. and (%) *S. salomani*		No. Samples	No. and (%) *S. salomani*	
Swash zone	748	54	(6.0)	652	17	(1.9)	756	26	(2.9)	2,156	97	(10.8)
First sand bar	256	106	(11.8)	256	150	(16.6)	360	542	(60.1)	872	798	(88.5)
Between sand bar	48	1	(0.1)	48	0	(0)	48	2	(0.2)	144	3	(0.3)
Second sand bar	48	0	(0)	48	1	(0.1)	48	3	(0.3)	144	4	(0.4)
Seaward of second sand bar	48	0	(0)	48	0	(0)	48	0	(0)	144	0	(0)
Total	1,148	161	(17.9)	1,052	168	(18.6)	1,260	573	(63.5)	3,460	902	(100.0)

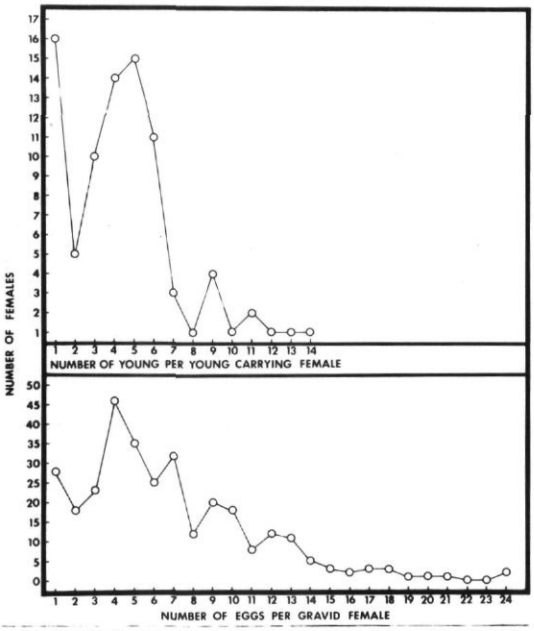

Figure 2. Frequency of young-carrying and gravid *Spilocuma salomani*, as a function of numbers of young and numbers of eggs.

and 4 m, with abundance highest between 1 and 2 m (Gnewuch and Croker, 1973). Similar results on cumacean abundance in Scotland were noted by McIntyre and Eleftheriou (1968) and Corey (1970).

The presence of gravid females throughout the year was similar to the findings of Gnewuch and Croker (1973) for *M. stellifera*, Corey (1969) for *Cumopsis goodsiri* and *Iphinoe trispinosa*, and Corey (1970) for *Diastylis sculpta*. Both *M. stellifera* and *D. sculpta* appeared to produce two generations per year with a peak production in late summer for *D. sculpta* and two production peaks in May and September for *M. stellifera* (Gnewuch and Croker, 1973; Corey, 1969). Evidence of two reproductive peaks was not apparent for *S. salomani*, as the percentage of gravid females was fairly constant from April through October 1976, ranging from 60 to 64%.

Differences in fecundity were also evident between *S. salomani* and other shallow water cumaceans. Fecundity of *S. salomani* was lower than *M. stellifera, D. sculpta, I. trispinosa*, and *C. goodsiri* (Gnewuch and Croker, 1973; Corey, 1969, 1976). The decrease in the number of eggs per egg-carrying female possibly may be attributed to molting, as both Gnewuch and Croker (1973) and Corey (1976) noted a loss during molting.

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