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Reproductive Status, Sex Ratios and Morphometrics of the Slipper Lobster *Scyllarides nodifer* (Stimpson) (Decapoda: Scyllaridae) in the Northeastern Gulf of Mexico

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REPRODUCTIVE STATUS, SEX RATIOS AND MORPHOMETRICS OF THE SLIPPER LOBSTER *Scyllarides nodifer* (Stimpson) (Decapoda: Scyllaridae) IN THE NORTHEASTERN GULF OF MEXICO

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ABSTRACT: Morphometric data on the slipper lobster, *Scyllarides nodifer*, was determined by assessing the catch of a commercial vessel trawling in the northeast Gulf of Mexico on a 3-day cruise in April, 1985. Over 900 lobsters were captured during 17 trawls in two well-established areas. Reproductive status, male:female ratios and the relationship between carapace length and weight were determined. Forty-six percent of the lobsters captured were determined. Forty-six percent of the lobsters captured were female. A high percentage of these females were ovigerous, extending the previously reported reproductive season of this species. Mean weight of the lobsters was 430.5 g and the carapace length was 95 mm. No juvenile *S. nodifer* were captured. The first reported migratory behavior for *S. nodifer* is presumed from nightly catches in small well-defined trawl areas. In addition, the first description of a new habitat for this species in this area is included.
[Keywords: *reproduction; sex ratios; Scyllarides; slipper lobster*]

The lobster *Scyllarides nodifer* (Stimpson) is one of 12 species of Scyllarid lobsters found in the western Atlantic Ocean and Gulf of Mexico. Verrill (1922) established the synonym *S. americanus* and Williams (1965) provided a detailed morphological description of the species. Common names include slipper, shovelnose, bulldozer, Spanish, and sand lobster. This species has not been studied extensively although selected aspects of its biochemistry (Cline 1980, Cline & Hinton 1983, Cline & Hardwick Jr. 1985, Hardwick Jr. & Cline 1985), physiology (Frutchey & Cline 1986), genetics (Hardwick & Cline 1984), behavior (Ogren 1977, Gilbert 1982), reproduction (Robertson 1969, Cline Chilcutt & Lindsay 1978, Lyons 1980), distribution (Shipp & Hopkins 1978, Gilbert 1982) and life history parameters (Lyons, 1970) have been reported.

Scyllarides nodifer is of marginal economic importance but supports several small seasonal fisheries. Little is known about its reproductive capacity and growth rates or how fishing practices affect abundance or population structure. One population which has not been studied previously supports a spring fishery about 40 km south of Carabelle, Florida. Our objective was to examine lobsters trawled under commercial conditions and record reproductive status, sex ratio and morphometrics. Our primary interest was to assess reproductive status of this population during the lobster season since ovigerous females of unknown origin begin to appear in shoreside markets in late February. We examined over 900 *S. nodifer* as they came up in the trawls and found 28% of the females ovigerous. This documents the reproductive season to be at least 1 month longer (earlier) than previously thought (Lyons 1970). In addition, we report the first evidence that this species buries into the sediment, a behavior which can affect trawl efficiency.

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MATERIALS AND METHODS

The lobsters in this study were collected from 26 to 28 April 1985 aboard a 75 ft. commercial fishing vessel, the MARGARET YVONNE, which pulled four 35-foot modified shrimp trawls at approximately 2.75 knots. Trawls were held open by two pairs of spreaders, each weighing approximately 115 kg and connected by heavy tickler chains. Total effective trawling width was estimated to be 130 ft. (40 meters). All collections were at night in two tracks, A and B, shown in Figure 1. These tracks have been cleared of large rocks and debris over years of trawling and are called "hang-free". Track A was more southerly at approximately 30 meters depth. Track B was approximately 7 km north in about 27 meters of water. Each track was approximately 3.0 km in length and was trawled repetitively on reciprocal headings. Water temperature on the bottom was 20°C and trawl-down periods ranged from 30 minutes to 1 hour.

Carapace length (CL), weight measurements and sex determinations were made on a selection of lobsters trawled during the cruise. CL was determined by using a vernier caliper. A computer program was used to define the exponential regression curves relating CL and weight. Weight was determined using a triple-beam balance. Sex was determined by the presence of chela on the 5th pair of walking legs of females. Over 500 lobsters were sexed and the ovigerous status of the females assessed. Fifteen females not carrying eggs were randomly chosen from this group and dissected to determine the state of ovarian development.

RESULTS

Table 1 shows the summary of lobsters caught in tracks A and B for 3 nights of trawling. Data were not collected for each trawl on night 1 but were collected

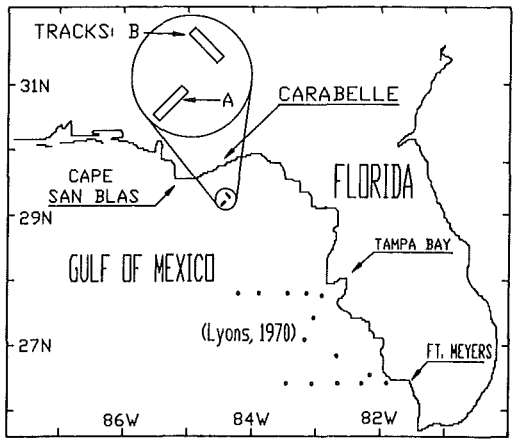

Figure 1. Eastern Gulf of Mexico showing the location of tracks A and B used for trawling *Scyllarides nodifer*. The approximate locations of fourteen of Lyons (1970) Hourglass collection sites about 200 km south are indicated by small circles.

for individual trawls for the next two nights. Fifteen trawls were made in the south track (A) and two in the north track (B). Male:female ratios varied from trawl to trawl but gave an overall average of 54:46 for the 957 lobsters surveyed. Gravid females ranged from 0% in two trawls to 74% in trawl 3 of the second night. Overall, twenty-eight percent of the females caught were bearing eggs. Fig. 2 shows a graphic presentation of individual trawl data from nights 2 and 3.

Carapace length and body weight were determined on a sample of lobster captured during the cruise. The ranges

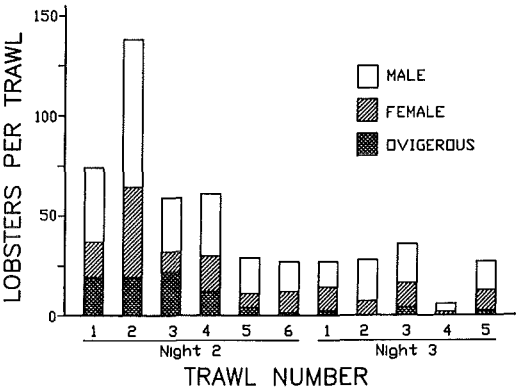

Figure 2. Comparative catch per unit effort for *Scyllarides nodifer* for 11 separate trawls. The proportions of males, females and ovigerous females are shown.

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Table 1. Catch rate, sex distribution and ovigerous females in April, 195 for *S. nodifer* in trawled tracks of 40 meters × 3 km.

				Track A				
	Trawl #	Males	(%)	Females	(%)	Ovigerous	(%)	Total
Night 1	6 comb.	244	(54)	211	(46)	36	(17)	455
	1	36	(49)	38	(51)	21	(55)	74
	2	74	(54)	64	(46)	21	(33)	138
Night 2	3	28	(47)	31	(53)	23	(74)	59
	4	33	(54)	28	(46)	12	(43)	61
	5	16	(62)	11	(38)	4	(36)	29
	6	15	(56)	12	(44)	1	(8)	27
	1	13	(48)	14	(52)	2	(14)	27
	2	21	(75)	7	(25)	0	(0)	28
Night 3	3	19	(53)	17	(47)	4	(24)	36
				Track B				
	4	4	(67)	2	(33)	0	(0)	6
	5	8	(47)	9	(53)	2	(22)	17
Totals:	17	513	(54)	444	(46)	126	(28)	957

and means of CL and weight are presented in Table 2. The empirical equations expressing the relationship between CL and weight for males and females is also presented in Table 2. The graphic relationships are shown in Figure 3.

Over 50% of the lobsters (including ovigerous females) were caked with a sticky mud of high organic content on both dorsal and ventral surfaces. The vast majority of both those with and without caked mud had a layer of green algae on their dorsal surfaces. The smallest lobsters weighed approximately 260 grams and were of reproductive age. All lobsters were kept for sale, including ovigerous females.

Table 2. Morphometrics and empirical equations of *Scyllarides nodifer* from the northeastern Gulf of Mexico.

	Range	Mean
Male (n = 20)		
CL (mm)	84 - 108	93.4
WT (grams)	257.5 - 453	355.3
Female (n = 26)		
CL (mm)	80 - 108	107.7
WT (grams)	216.0 - 658.1	452.5
Male empirical equation:	$WT = 20.07\ e^{(0.031\ CL)}$	
Correlation Coefficient:	0.9045	
Standard Error of the Mean:	0.085	
Female empirical equation:	$WT = 35.27\ e^{(0.025\ CL)}$	
Correlation Coefficient:	0.9042	
Standard error of the Mean:	0.128	

DISCUSSION

The slipper lobster *Scyllarides nodifer* is generally fished in the "off season" by shrimpers in several areas of the Gulf of Mexico. One fishery has focused on a population of lobsters which appears in early spring in an area about 40 km south of Carabelle, Florida. Fishermen re-rig their shrimp trawls with heavier chains and bag chafing gear to withstand working in areas where lobsters are found.

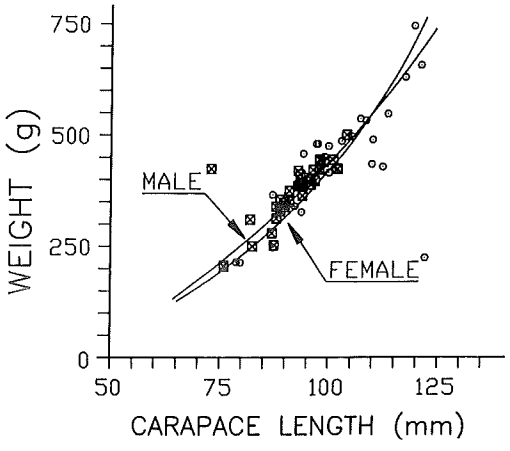

Figure 3. The carapace length (CL) vs weight data for 20 male and 26 females *Scyllarides nodifer* from the collection. See MATERIALS AND METHODS for the empirical equations describing the curves.

One of our objectives was to determine the percent of ovigerous females brought aboard a lobster trawler during the fishing season since many female lobsters typically arrive in shore-side markets with pleopods cut off (*i.e.*, eggs removed). Sexing lobsters as they come aboard and evaluating the color of the egg mass of berried females provides the best assessment of seasonal reproductive status. Counting the number of lobsters per trawl area gives a measure of catch per unit effort and a reflection of population size and structure.

Catch data in Table 1 demonstrate that sex ratios vary from trawl-to-trawl and from night-to-night. Lyons (1970) does not report male:female ratios but reexamination of his data shows 108 males and 69 females of all size classes caught in both traps and trawls in one year for a ratio of 61:39. Our data of 513 males and 444 females from trawls gives a ratio of 54:46. This approximate 1:1 sex ratio should reflect the natural standing ratio if the trawls were equally effective for both sexes.

Lyons (1970) reports the egg carrying period for *Scyllarides nodifer* to extend from the second half of May through the first half of August. Our data extend the reproductive season at least a month earlier based upon a sample of 444 females. Twenty-eight percent (126) were carrying eggs in late April but the beginning of the season is unknown. The season probably starts considerably earlier since females with clipped pleopods begin arriving in markets by late February. The fishery operates during the first third of the reproductive season and all females are usually kept for market. Long term effects of this practice on this population are unknown at this time.

The extension of the reproductive season to include April in this area of the Gulf of Mexico is further supported by the presence of internal egg masses in late developmental stages. In addition, several of the specimens selected for broodstock mated soon after being brought aboard and up to a week later in laboratory aquaria. Eggs were extruded 24 to 48 hours after spermatophores were deposited. All of the females of this group removed their egg masses before the eggs reached the final stages development.

Egg color on ovigerous females varied from a yellow-orange for newer eggs to a deeper orange on older eggs. Due to logistical constraints on the vessel, no attempt was made to correlate egg color or fecundity with female size (CL or weight). No information is available on the egg bearing period for this species in nature although females in aquaria at 22°C carry eggs for at least 30 days (Cline, unreported data). Since the reproductive season is now documented to extend at least from April through August, this 5 month period is more than sufficient time for two spawns per female, as reported by Lyons, 1970.

Most slipper lobsters in this fishery are captured in tracks cleared by modified shrimp trawls (Bemis, personal communication). Caked mud on 50% of the lobsters indicates a previously unreported habitat. Ogren (1977) suggests that these lobsters are nocturnal foragers, retreating to rocky outcroppings during the day. However, due to lack of nearby structure for our population, some lobsters may bury for concealment during daylight hours. Numerous day time SCUBA dives within and near to the trawl tracks revealed only a thin layer of sand and shell hash over a level, solid rock substrate. No structure, mud bottom areas or lobster were seen.

The carapace length-total body weight relationships for males and females were not statistically different and were virtually identical to curves derived by Lyons (1970). Other data, including the similarity of muscle tissue isozyme data

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for 2 additional populations of *S. nodifer*, would support the hypothesis of a single stock of slipper lobsters in the eastern Gulf of Mexico. (Hardwick, Jr. & Cline 1986, Harwick, Jr. 1987).

The lack of juveniles in our April sample is puzzling. Lyons (1970) collected juveniles with adults in his population but reported no seasonal information. Our trawls did catch numerous specimens of other small Scyllarids so juvenile *Scyllarides nodifer* were either not present or present in very low density. A possible reason for this could be a faster migration rate of adults into warmer and shallower water for the reproductive season. Seasonal migration has been documented for *Scyllarides latus* in the Azores Islands (Martins, 1985), a species virtually identical to *S. nodifer*.

Scyllarides nodifer has not been reported to bury although other small Scyllarid lobsters bury quickly and frequently in aquaria in sand or cracked oyster shells (Cline, unreported observations). Mud-caked on *S. nodifer* brought up in the trawls indicates they had been in the sediment long enough for the sediment to compact on both dorsal and ventral surfaces. It is not possible to determine if they carried the mud from previous burying or had been buried when the trawls came upon them. However, they apparently do not stay buried for extended periods because virtually all lobsters caught had green algae growing on their dorsal surfaces, even under the mud.

The green algae growth in April (and other times) on adults of this population of *Scyllarides nodifer* suggests several reproductive and behavioral parameters. First, the females do not need to molt prior to fertilization and egg extrusion. Second, they must not stay buried for extended periods and probably do not move about in the sediment. Finally, they must have resided for some period at water depths where light intensity was sufficient to support green algae growth. Seasonal studies are continuing to define the reproductive season more precisely, assess fecundity and determine whether this species migrates seasonally in the northeastern Gulf of Mexico.

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