Preliminary Observations On The Distribution Of Phyllosoma Larvae In La Parguera, Puerto Rico

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ABSTRACT

Information on the pelagic distribution of phyllosoma larvae is of relevance for fisheries and recruitment research, specially for palinurids which have an extended planktonic life cycle estimated to last 6 - 12 months. The objective of this study was to examine the taxonomic composition of phyllosoma larvae in the south-west coast of Puerto Rico and to determine their distribution along an inshore-offshore gradient. Lobster phyllosoma larvae were sampled during three cruises in February, August and December, 1995 and May, 1996 to examine temporal, spatial and ontogenetic distribution patterns across an inshore-offshore gradient off La Parguera. Samples were taken at six different distances across the inshore-offshore gradient (6, 10, 13, 16, 29 and 46 km from the coastline) along three parallel transects (67°00', 67°03' and 67°06' W) for a total of 18 stations. Samples were collected in stratified step-oblique tows at three discrete depths (0 -20 m; 21-40 m; 41 - 60 m) using a 1 m^2 Tucker Trawl system fitted with three 0.202 mm mesh. A total of 594 phyllosoma larvae were collected. Fifty eight percent of the total larvae were collected in May, with maximum abundance at the innermost station (6 km). Larvae were identified into three genera (*Panulirus*, *Scyllarides* and *Scyllarus*) of which *Panulirus* was the most abundant (69%) followed by *Scyllarides* (26%) and *Scyllarus* (5%). The horizontal distribution of *Panulirus* showed that early stage larvae (I-III) remained within insular shelf stations, whereas later stage larvae increasesd offshore, thus suggesting an ontogenetic related flux. *Scyllarus* larvae of all developmental stages were found almost exclusively within the insular shelf. Temporal trends of *Panulirus* larval abundance between cruises showed that early stage larvae were present year-round but were most abundant during May. This finding supports previous observations that the peak reproductive season in the Caribbean occurs during spring and early fall, but reproduction is continuous in lower itensity throughout the year. Such data suggests that locally spawned larvae of *Panulirus* and *Scyllarides* are being transported offshore, whereas *Scyllarus* larvae appears to be retained in coastal waters during their shorter planktonic life cycle.

KEY WORDS: Phyllosoma larvae, ontogenetic distribution, *Panulirus argus*

INTRODUCTION

The phyllosoma larvae of spiny lobsters (Palinuridae) have an extended planktonic life estimated to last 6 to 12 months (Lewis, 1951; Kittaka and Kimura, 1989). During this larval period they are capable of long-distance dispersal. For this reason it is believed that larvae spawned in Puerto Rico contribute to larval recruitment at other localities and that local recruits come from islands of the Lesser Antilles (Ingle *et al.*, 1963).

As in the rest of the Caribbean, *Panulirus argus* is the most commercially important among the spiny lobsters. Nevertheless, there are other species of spiny lobsters inhabiting the area which contribute to the phyllosome catch. Phyllosomata of the slipper lobster genera (Scyllaridae) like *Scyllarides* and *Scyllarus* have been reported as abundant in the plankton at other areas of the Caribbean (Baisre, 1976; Robertson, 1968, 1969). Although there has been some work done on the horizontal and vertical distribution of phyllosoma larvae in the Florida Keys (Yeung and McGowan, 1991) and Cuba (Baisre, 1976), such information was not available for Puerto Rican waters.

Spawning by gravid females of *Panulirus argus* occurs year-round with maximum activity in late spring and early fall (Buesa, 1969). During the planktonic larval period, phyllosomes molt through 11 larval stages before metamorphosing into transparent, lobster-like, swimming post-larvae called pueruli. Previous work on the spatial and temporal patterns of recruitment of pueruli reported for La Parguera (Monterrosa, 1986) found that a seasonal peak in recruitment occurred in late summer (July - August) with highest recruitment during new and first quarter moon phases.

As in many areas of the Caribbean, Puerto Rico has suffered a substantial decrease in lobster catch during the past decades mostly due to overfishing (Ting, 1973). It is important to study the possibility of establishing fishing regulations which ignore international boundaries. Right now some localities may be benefiting from fisheries controls in upstream areas, and uncontrolled fisheries may be affecting islands downstream. In order to manage such a unique fishery effectively it is necessary to know more about their larval life cycle. Gathering data on the taxonomic composition and distribution of phyllosoma larvae across the Caribbean may be the first step in such an enterprising fisheries management process.

The objective of this study was to determine the taxonomic composition of phyllosoma larvae in the south west coast of Puerto Rico and to determine their horizontal distribution along an inshore-offshore gradient up to 46 km offshore. Preliminary data on temporal variation between the four sampling cruises is presented here.

MATERIALS AND METHODS

Phyllosome data obtained for this study were gathered from samples collected during four cruises (February, August, and December, 1995 and May, 1996). These cruises are part of a larger study aimed to understand the recruitment dynamics of fish and lobsters in La Parguera. Field sampling was conducted on and off the insular shelf, south of La Parguera area, from the R/V Magueyes. Samples were taken at six different distances across the inshore-offshore gradient (6, 10, 13, 16, 29 and 46 km from the coastline) along three parallel transects (67°00', 67°03' and 67°06' W) for a total of 18 stations (Figure 1). A 1 m^2 Tucker Trawl System was employed in sampling. It has three nets of 0.202 mm mesh-size which can be opened and closed sequentially by mechanic messengers. Samples were collected in oblique tows encompassing the entire water column at inshore stations (6 and 10 km). Offshore stations were sampled in stratified step-oblique tows at three discrete depths (0 - 20 m, 21 - 40 m, 41 - 60 m). Each tow filtered approximately 300 m^3 of seawater.

Plankton samples were preserved in a 4% solution of formalin and seawater. Phyllosoma larvae were sorted out of the entire sample and later identified to the genera level. Stages were assigned according to literature references (Lewis, 1951; Robertson, 1968, 1969), 11 stages were assigned for the entire larval development of *Panulirus*, 7 stages to *Scyllarus*, and 11 stages to *Scyllarides*.

The catch of each tow was standardized to individuals per 300 m^3 of seawater . Water column mean abundance was calculated for offshore stations by adding the number of larvae collected at the three depth strata and dividing that number by the total volume filtered. For inshore stations, water column mean abundance represents total number of individuals collected in oblique tows from surface to near bottom divided by the total volume filtered. Horizontal distribution patterns were analyzed using the three water column means as replicates of each distance.

RESULTS

A total of 594 phyllosoma larvae were collected (Table 1). Fifty eight percent of the total larvae were collected in May with a mean cruise abundance of 14 Ind/300 m^3. The total number of larvae caught during each of the other three cruises was around eighty individuals. The larvae were identified into three genera (*Panulirus*, *Scyllarides* and *Scyllarus*) of which *Panulirus* was the most abundant (69%) followed by Scyllarides (26%) and *Scyllarus* (5%).

Panulirus larvae displayed an ontogenetic horizontal distribution pattern in which late stage larvae increased offshore (Figure 2). Early stage larvae were most abundant at inshore and shelf edge stations but present at lower abundances all the way out to 46 km offshore. Sixty four percent of all larvae in stages I-III were collected within the insular shelf or at the shelf edge stations. Scyllarides

larvae were almost exclusively found during May and more than 95% of them belonged to the first three developmental stages (Figure 3). Thus, only early stage larvae of *Scyllarides* are represented in the horizontal distribution data. As for *Panulirus*, early stage Scyllarides larvae were found most abundant at inshore stations, but also present as far as 46 km offshore. *Scyllarus* larvae of all developmental stages were found almost exclusively inside the insular shelf (Figure 4).

Table 1. Summary table representing the number of phyllosoma caught and the mean abundance of larvae for each cruise. The total number of phyllosoma caught during the study and the study mean abundance is also shown.

Cruise	Phyllosoma Caught	Mean Abundance (Ind/300 m^3)
2/6/95	81	1.23
8/23/95	84	4.03
12/21/95	85	3.59
5/29/96	344	14.35
Total/Mean	594	5.8

Temporal trends on the stage frequency distribution of *Panulirus* larvae showed that early stage larvae were present during all four cruises but in higher abundance during May. In February and May, more than eighty percent of the larvae belonged to the first three developmental stages (Figures 5a, 5b). The stage frequency distribution for August and December displayed a somewhat bimodal pattern associated with a maximal modal abundance of early stage larvae (I-III) and a lower modal abundance of stage VII larvae (Figure 5c, 5d).

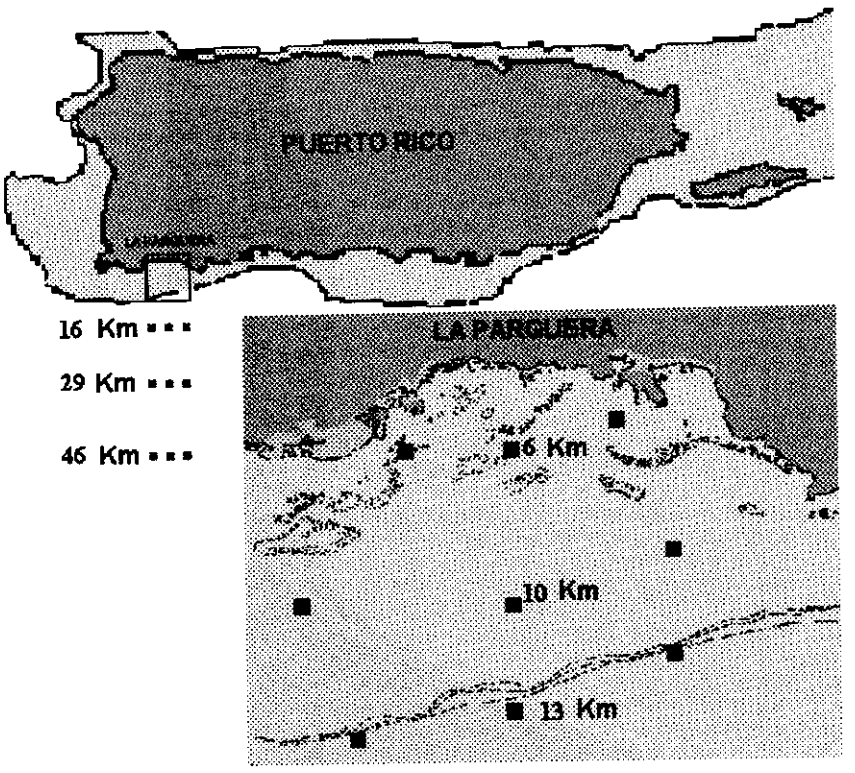

Figure 1. Map of study area showing location of sample stations along three parallel transects.

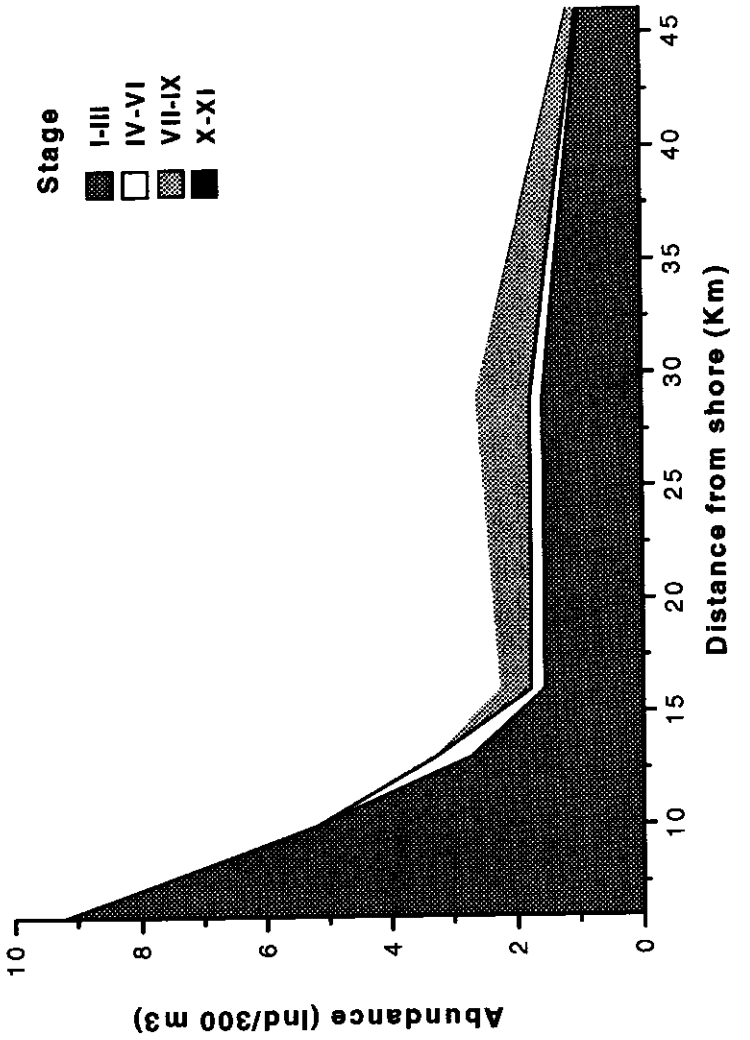

Figure 2. Area chart showing the ontogenetic distribution of *Panulirus* sp. along an inshore - offshore gradient.

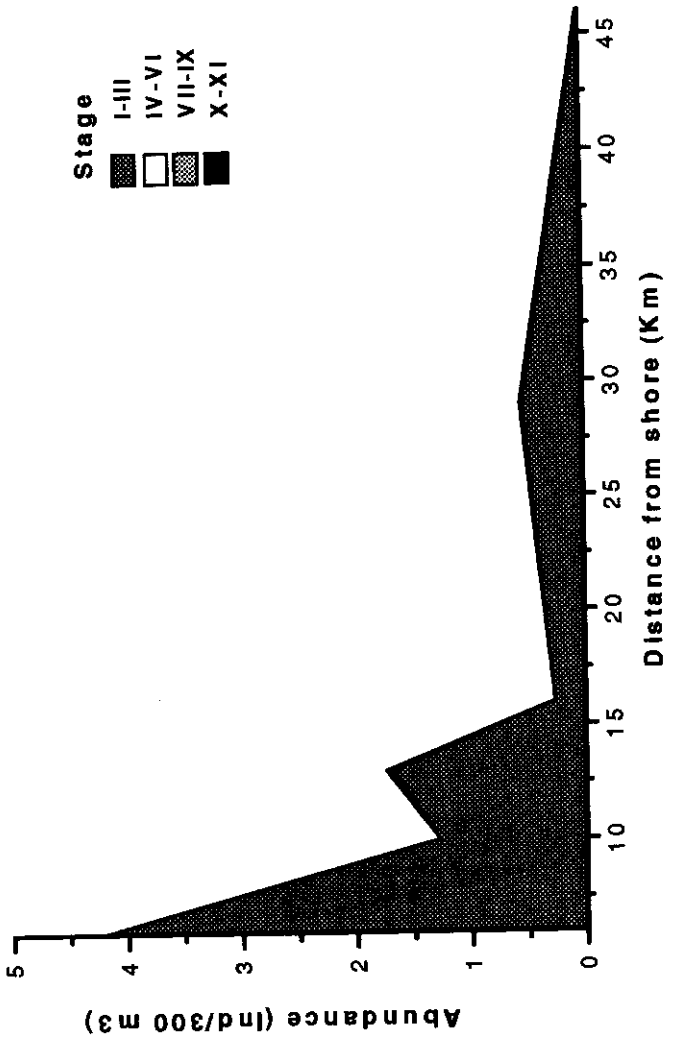

Figure 3. Area chart showing the ontogenetic distribution of *Scyllarides* sp. along an inshore - offshore gradient.

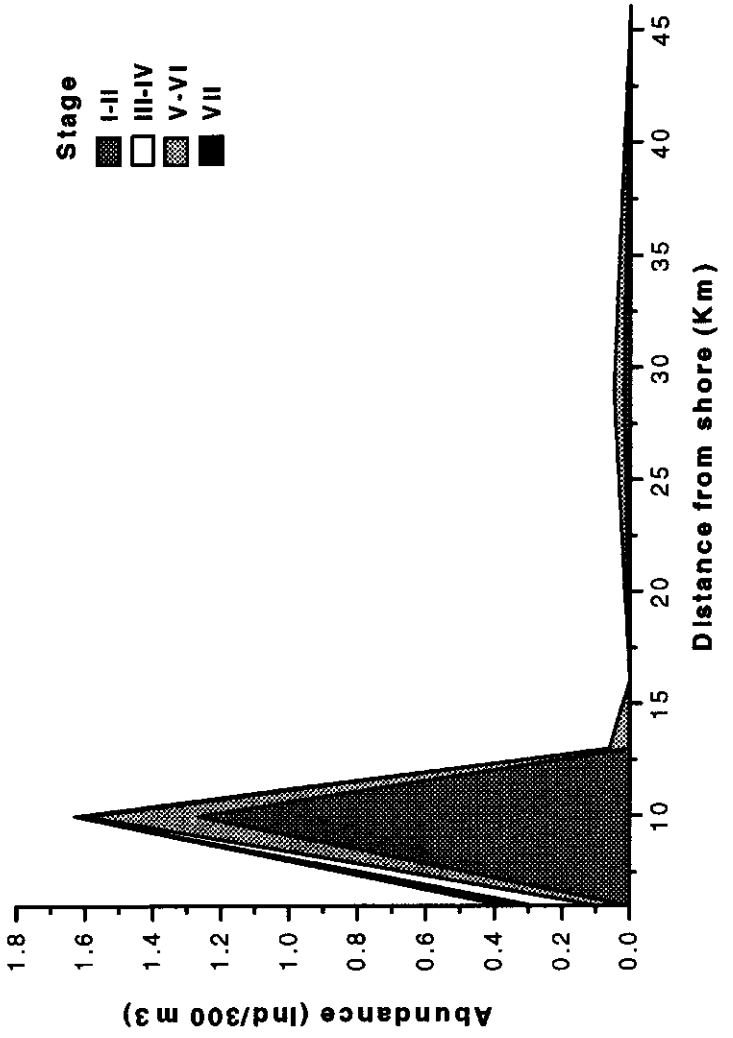

Figure 4. Area chart showing the ontogenetic distribution of *Scyllarus* sp. along an inshore - offshore gradient.

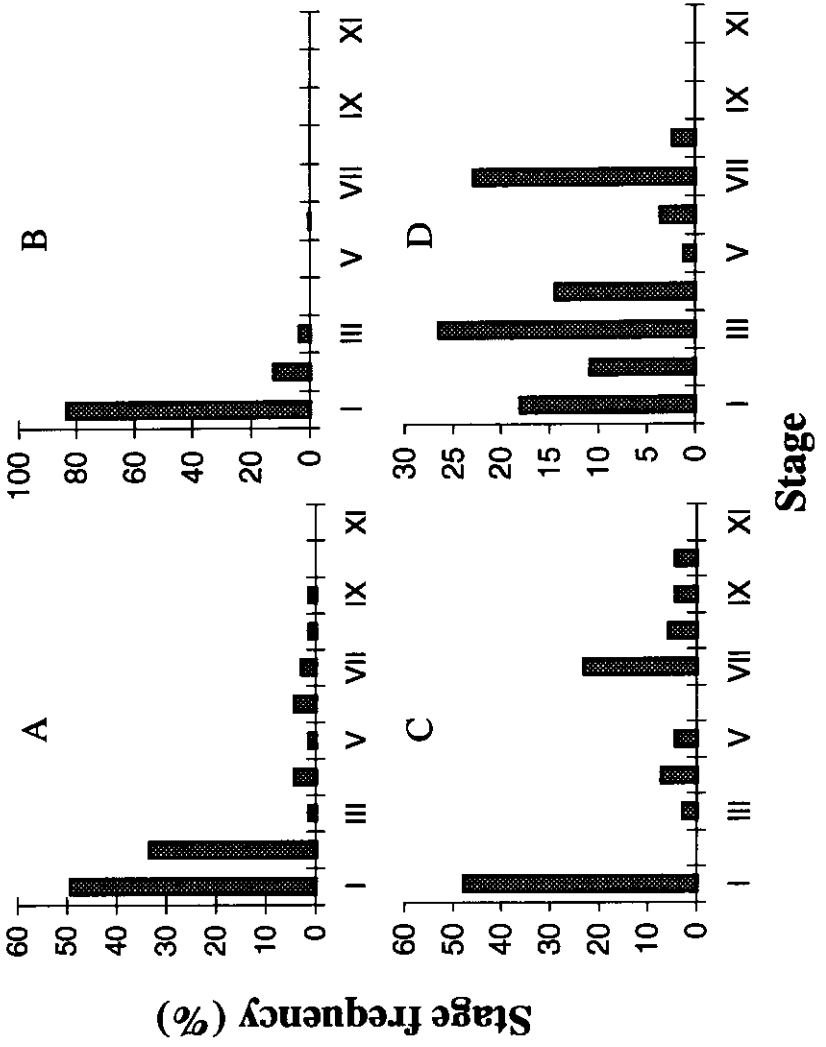

Figure 5. Stage frequency distribution for *Panulirus* sp. larvae. A, February; B, May; C, August; D, December.

DISCUSSION

The high number of early stage phyllosoma larvae of both *Panulirus* and *Scyllarides* during May suggest that adults have one peak reproductive event around this season. Early stage larvae of both species were present on samples from the other three cruises suggesting continuous reproduction, but in a lower intensity. This data coincides with the reproductive pattern reported by Buesa (1969) in which he stated that *Panulirus* sp. reproduce year-round with maximum activity in late spring and early fall. It is important to consider that latitudinal differences have been reported to affect the reproductive behavior for *Panulirus* sp. Lobsters from the Florida Keys concentrate their reproductive effort more into one main event, where as lobsters from areas closer to the equator, like in Puerto Rico reproduce year-round more frequently.

The larval duration of *Scyllarides* has been estimated at eight to nine months, almost as long as palinurids (Robertson, 1969). The data from Figures 1 and 2 suggest that these larvae are being dispersed for a pelagic development. It is unlikely that these could be retained for their entire presettlement period in coastal waters as may be the case for *Scyllarus*. *Scyllarus* larvae of all developmental stages were found year-round almost exclusively within the insular shelf (Figure 4). The larval duration for *Scyllarus* is believed to be one to two months. Such a period of time may be short enough for the organisms to take advantage of retention mechanisms that could permit them to recruit locally. Studies in the Florida Keys have found that the formation of a cold cyclonic gyre from an offshore meander of the Florida Current provides a mechanism for larval retention and local recruitment of fish and slipper lobster larvae (Lee *et al.*, 1992). Such a retention mechanism has not been demonstrated to be acting in the Parguera area. Nevertheless, ongoing water current studies in La Parguera have found that tidal currents cause short pulses of inshore transport in opposite direction to the mean vector (Capella *et al.*, unpublished).

Larval distribution data along with the long planktonic duration of *Panulirus* and *Scyllarides* larvae make it unlikely for the species to be self recruiting. Such findings coincide with the general belief that locally spawned larvae are transported offshore to an unknown fate. It is thus important for fisheries management to establish international regulations which could effectively maintain the caribbean stock. Nevertheless, the study also suggest that there may well be retention mechanisms available for slipper lobster species like Scyllarus and fishes with short planktonic life cycles to be maintained during their entire presettlement period in coastal waters.

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