Progress on Assessment of Recruitment of Postlarval Spiny Lobsters, *Panulirus argus*, to Antigua, West Indies

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ABSTRACT

Thirty-five floating collecting devices, constructed of PVC pipe and air conditioner filter material, were deployed around Antigua, West Indies 20-22 August and sampled weekly for postlarval spiny lobsters from 28 August to 5 November 1987. The samples are the beginning of a one year program designed to document periodicity, magnitude, and distribution of the recruitment of the postlarvae to nearshore waters. Total sample size after 11 weeks is 1,941 individuals. The majority settled on the collectors during the new moon and first quarter. Distribution of arriving pueruli is patchy. Several nearshore sites on the windward (east) coast have experienced the highest weekly settlement rates. Classification of sampled individuals into seven stages according to degree of

INTRODUCTION

A study of settlement rates of postlarval spiny lobsters, *Panulirus argus*, on artificial collecting devices distributed around the nearshore waters of Antigua, West Indies was initiated in August, 1987. The primary objective of the study is to estimate an index of the relative abundance of postlarval lobsters recruited to the island over a period of approximately one year. Secondary objectives are to document time-related arrival patterns, such as lunar periodicity and seasonal peaks, changes in distribution of arrival of the postlarvae over time, and potential interaction of periodicity and spatial distribution of recruitment with physical oceanographic phenomena. The purpose of this report is to describe progress toward these objectives between 28 August and 5 November 1987.

BACKGROUND

The use of floating artificial collecting devices has supported numerous studies on settlement of postlarval palinurid lobsters in the tropical western Atlantic, eastern Indian Ocean, and central Pacific Ocean. Witham et. al. (1968)

and Phillips (1972) pioneered the designs of contemporary collectors. Quantitative estimates of recruitment between and/or within years based on sampling these collectors, or modifications thereof, were subsequently made by Serfling and Ford (1975, *P. interruptus*, southern California), Little (1977, *P. argus*, southeastern Florida), Chittlebourough and Phillips (1975, *P. cygnus*, western Australia), and MacDonald (1986, *P. marginatus*, Hawaiian Islands), among others.

Collector-based studies of *P. argus* settlement in the tropical western Atlantic region have documented year round arrival of postlarvae, with highest settlement rates during the new moon and first quarter (Little, 1977, Little and Milano 1980, Menzies 1981, in southern Florida; Monterrosa 1986 in Puerto Rico).

Prior to the present study, samples of newly settled *P. argus* in the Caribbean region are limited in size and aereal coverage., Monterrosa's work was based on a total sample size of 166 individuals from seven study sites. The sites were located along 6 km of shoreline, and were all 2 km or less from shore. Peacock (1974) collected 86 individuals from a single site located Parham Harbour, Antigua over a period of one year.

METHODS, MATERIALS, AND STUDY SITES

We constructed 35 collectors based on a modification of Witham's design. Each collector consisted of a closed, 1.9 cm (3/4 in) PVC pipe frame, dimensions approximately 38 x 46 cm, comprised of six crossbars connected by eight tee fittings and four 90° elbows. One 41 cm x 64 cm sheet of air conditioning filter materials was folded over each crossbar and fixed with plastic cable ties, resulting in 12 total pages. Air trapped within the sealed PVC frame provided flotation. Collectors were anchored with 1 cm (3/8 in) polyethylene trap line spliced with a rubber hose chafe guard to a single concrete building block, tied to the collector with a bowline followed by a half hitch.

We selected 14 random collector sites located within 50 m of shore around Antigua. An additional 21 nonrandom sites, positioned 1 m to 4.8 km from shore, were selected to increase areal coverage and sample size. Figure 1 shows the locations and designations of the 35 sites. The total of distances between sites is 115 km (71.5 mi).

The 35 collectors were deployed between 20-22 August and each site was sampled weekly between 28 August and 5 November. Turbidity, temperature, and salinity were recorded at each site. A fine mesh (4 mm) net sewn on a 0.8 m x 1,0 m PVC frame was used to dip net collectors before untying and bringing them aboard for examination. Both sides of each page in the collector were searched, in sequence, two times. The exterior of the collector was then examined from all angles, after which the collector was lifted and given several brisk shakes over the net positioned in the bilge of the boat. Postlarvae were

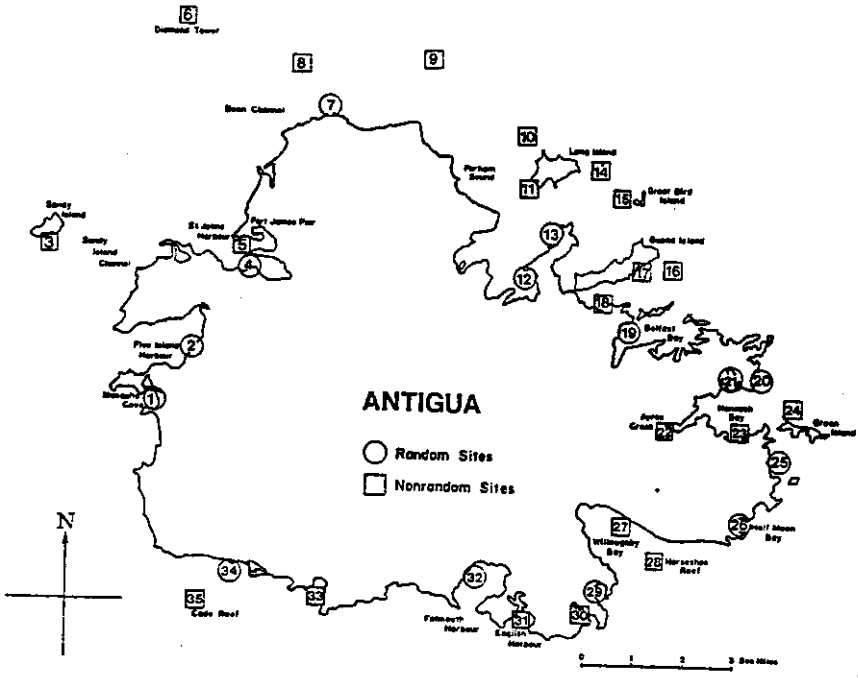

Figure 1. Locations of the 35 collectors maintained for a period of 11 weeks between August 1987 and November 1987 in coastal waters 1 m to 4.8 km from shore around Antigua. Circled numbers indicate random sites. Squares indicate nonrandom sites.

counted and classified according to seven stages based on degree of pigmentation (pueruli) and post-molt appearance. Number and position of any missing and damaged pages were noted prior to repair of the collector., Average wind speed in knots and average degree of cloud cover were estimated ad recorded for each sample day. All data were recorded with pencil on underwater paper in the field and recopied onto standardized forms each week.

RESULTS AND DISCUSSION

Table 1 lists number, name, habitat classification, bottom type, depth, distance offshore, and total number of postlarvae collected at each study site depicted in Figure 1. Highest recruitment for the initial 11 weekly samples was recorded at Belfast Bay, Flat Point, and Indian Creek, all windward (east) coast sites located within 20 m of rick and mangrove shorelines. Settlement rates in mean number of postlarvae per week were 23.5, 22.5, and 20.7 for these sites respectively. The next most productive group of sites was located 1.6 to 4.8 km from shore in the vicinity of coral reefs. Diamond Tower, Cade Reef, and Sandy

Table 1. Number, name, habitat classification, bottom type, depth (m), distance from shore (km, or * denoting less than 50 m) and total number of postlarval lobsters collected for 35 study sites around Antigua over 11 weekly samples between 28 August and 5 November 1988. Habitat classifications are: 1 = mangrove, 2 = rocky shore, 3 = mixed mangrove/rocky shore, 4 = inshore reef, 5 = offshore reef. Bottom types are: 1 = mud, 2 = sand, 3 = *Thalassia*, 4 = rock, 5 = hard ground, 6 = hard ground/*Thalassia*, 7 = sand/*Thalassia*, 8 = coral/coral rubble, 9 = sand/coral rubble.

Collector No.	Name of Site	Habitat Code	Bottom Code	Depth (m)	Dist from Shore	Total No. Indiv.
1	Mosquito Cove	3	3	2.6	*	44
2	Five Islands Harbour	2	3	2.1	*	2
3	Sandy Island	5	8	3.2	3.1	85
4	St. John's Harbour	2	1	2.4	*	6
5	Fort James Pier	2	4	1.1	*	6
6	Diamond Tower	5	8	3.4	4.8	136
7	Boon Point	4	9	0.8	*	60
8	Northwest Reef	5	9	3.4	1.9	42
9	Horseshoe Reef	5	8	3.3	2.4	43
10	Long Island North	5	8	2.6	0.8	42
11	Long Island South	1	3	1.3	*	11
12	Parham Harbour	1	3	1.1	*	12
13	Crabbs Peninsula	1	3	1.2	*	13
14	Little Bird Islet	4	9	3.8	*	16
15	Great Bird Island	4	9	3.0	*	9
16	Guana Reef	5	9	1.6	0.6	59
17	Guana Island	3	7	2.0	*	71
18	Guana Bay	1	3	2.6	*	48
19	Belfast Bay	3	6	2.0	*	258
20	Flat Point	3	6	1.1	*	248
21	Ledcoff Cove	1	3	3.0	*	5
22	Ayres Creek	1	1	1.9	*	5
23	Nanny Island	3	6	1.8	*	67
24	Bird Island Reef	5	2	3.3	*	64
25	Devil's Hole Island	4	9	5.3	*	100
26	Half Moon Bay	4	8	2.9	*	34
27	Willoughby Bay	3	6	1.2	*	38
28	WB Horseshoe Reef	5	8	2.8	0.8	14
29	Mamora Bay	2	7	3.0	*	32
30	Indian Creek	1	1	2.3	*	228
31	English Harbour	3	6	1.8	*	4
32	Falmouth Harbour	2	3	2.3	*	5
33	Carlisle Bay	2	7	3.0	*	9
34	Cade Bay	4	6	1.8	*	25
35	Cade Reef	5	9	2.2	1.6	100

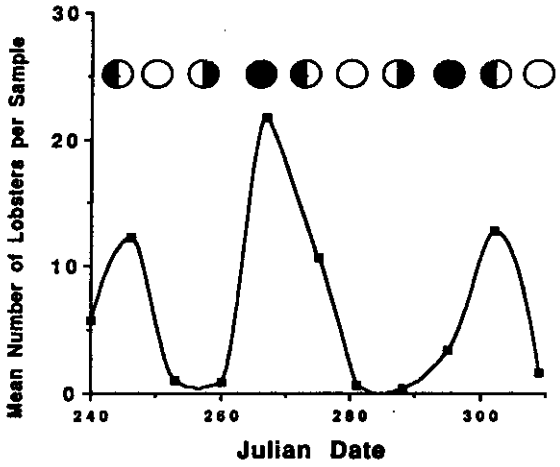

Figure 2. Mean number of postlarval lobsters per weekly sample for all 35 collectors combined. Dates of moon phases are denoted by circles positioned above the horizontal axis; solid circles = new moon, left half dark = first quarter, empty circle = full moon, right half dark = last quarter. The time scale begins 28 August and ends 5 November 1987.

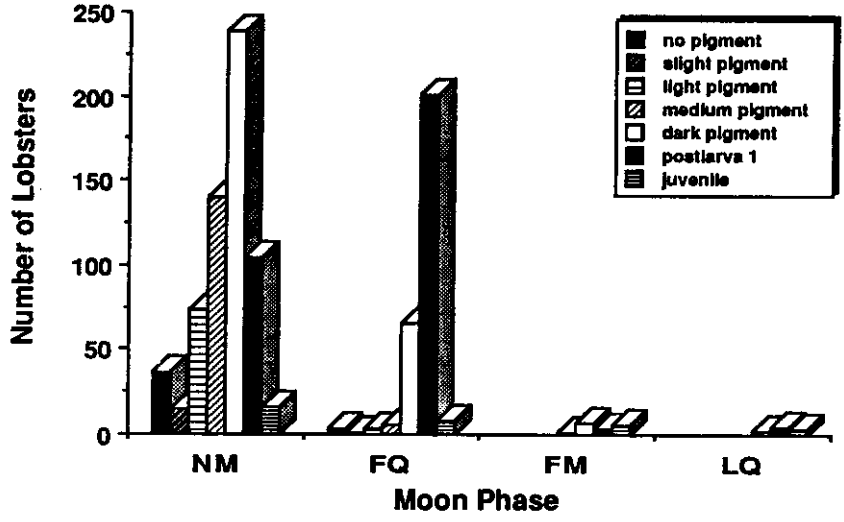

Figure 3. Frequencies of postlarval stages present over a full lunar cycle during September -- October 1987. The samples near the new moon and first quarter were taken after the actual day of the phase change.

Island had respective settlement rates of 13.6, 9.1, and 7.7. A fourth nearshore site on the windward coast was also located near well-developed hermatypic coral aggregations and experienced a settlement rate of 9.1. Thus it would appear, based on preliminary sampling, that (1) spatial distribution of arriving postlarvae is patchy and (2) relative abundance less than 50 m from shore may be greater at certain locations on the windward coast.

Despite the limited timespan of the sampling effort, a clear relationship is evident between the mean number of recruits per weekly sample and lunar phase. Figure 2 shows that the number of arrivals during the new moon and first quarter exceed those during the full moon and last quarter. We combine the results of random and nonrandom collectors in Figure 2 due to lack of a statistical difference between means of the two samples categories (Student's t test, $P[\{|t| > 0.227\} << 0.001]$).

To date, samples near the new moon are characterized by large numbers of clear (Stage I) and lightly pigmented (Stage II and III) pueruli. Samples taken near the first quarter have had comparable numbers of postlarvae predominately belonging to the darker pigment pueruli categories (Stages IV and V) and a considerable proportion of first post-pueruli molt individuals (Stage VI). Number of postlarvae collected drops sharply around the time of the full moon and last quarter, and those present are usually Stage VI or VII post-pueruli.

Figure 3 depicts this general sequence over a full lunar cycle during September-October 1987. We feel that determination of time between the seven stages in our arbitrary classification scheme may allows estimation of the night of arrival of each individual sampled.

Total sample size for the first 11 weekly collections was 1,941 individuals. At this rate, our total sample size at the end of one year could exceed 8,600. A full analysis of the results at that time should reveal any statistically significant lunar and seasonal components in the timing of arrival of postlarvae to Antigua, a detailed picture of the spatial distribution of recruitment over time, and

possibly relationships between temporal-spatial recruitment patterns and physical oceanographic phenomena

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