

Department of Natural and Environmental Resources
Fisheries Research Laboratory

Final report for

Study on the juvenile recruitments of the spiny lobster (*Panulirus argus*)

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2 March 2004

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Introduction

The spiny lobster (*Panulirus argus*) is one of the most important fisheries in Puerto Rico. Because of commercial demand and the consequent excessive fishing, there has been a decline in lobster landing, which could be due to diminishing stock. Very few stock assessments have been done in Puerto Rico.

The spiny lobster life cycle includes a planktonic larval stage, which could last from 6 to 9 months. After this stage it settles down on different environments as juveniles. Understanding and collecting information of these two stages, precursors of the adult lobster stage, is essential for knowing the lobster fishery status, and how management could help to improve it.

Objective

The purpose of this study is to estimate, spatially and temporally, the settlement and recruitment of juvenile stages of the spiny lobster (*Panulirus argus*).

Location

On October 2002 two sets of ten stations were placed at two different sites off the West coast of Puerto Rico. The first set (stations 1-10) was located at El Ron Reef (18°06.344'N 67° 16.046'W) (See figure 1.). The second set (stations 11-20) was located close to the Tourmaline area (18°08.581'N 67° 18.324'W) (See Figure 1.).

The area where the first set is located is a shallow sea grass bed habitat associated with a reef. The depth contour goes from 2 to 3 meters. *Thalassia testudinum* is the predominant sea grass. Visibility varies with water currents. The first station is adjacent to the reef. The next eight stations deviate from the reef, up to approximately 10m from it. The last station lies on a sandy bottom.

The area of the second set is a hard bottom habitat with some hard corals and gorgonians. Average depth on the site is 10 meters. Visibility varies with water currents, which sometimes are quite strong.

Methodology

On each station a lobster artificial shelter was constructed. The shelter was built using 16 cement blocks. Eight of the blocks were placed on the seafloor forming a square shape two cement blocks per side. The other eight blocks were placed in top of the first layer of blocks. The blocks were tied to each other with nylon rope. Identification numbers were

assigned to each shelter. Numbers 1 to 10 were assigned to the shelters in the first set. Numbers 11 to 20 were assigned to the shelters in the second set. Acrylic identification tags were attached to each shelter with their ID number engraved on it. In every other station the shelter was covered with a black canvas. Stations with covered artificial shelters were: 2, 4, 6, 8, 10, 11, 13, 15, 17 and 19. The canvas was held in place by tying it with steel wire to four steel rods that were nailed to the sea floor, one on each corner of the square. A cable was tied from shelter to shelter to ease the location of the stations under water.

Starting on March 2003 the stations were visited once a month to collect data on juvenile lobster recruits present on the shelters. Covered shelters were opened to observe presence of recruits on the inside of the shelter. Recruits quantity and size information was collected. The sizes here reported are from the cephalothorax, measuring from the spines to the end of the thorax. Size classification was: less or equal to 1", from 1.1" to 2", from 2.1" to 3", from 3.1" to 4", from 4.1" to 5", and greater than 5.1". On our last visit, 23 February 2004, the canvases were removed to avoid damage to the adjacent areas by the eventual displacement of these.

Results

Juvenile lobster recruits were reported for only eight of the twenty artificial shelters. These were all from the first set, in the shallow area. Appendix I contain the data tables for each artificial shelter in which any juvenile lobster recruit was found. Station four was the one with greater recruit reports, individually or accumulatively, followed by station three.

On the first set area, octopus and moray eels were observed using the cement block holes. A great variety of fish and invertebrates gathered around the structures. Artificial shelter on station 10 was found partially destroyed, probably by an anchor, on May 23, 2003. We were not able to rearrange completely the cement blocks, but its shape still provided shelter for plenty of fish and invertebrates, although no lobster recruit was observed. Covered artificial shelters of station 6 and 8 were found with their canvas removed in a couple of occasions. The artificial shelter on station 8 was found without the canvas during the July and September visit. Artificial shelter on station 6 has been found without the canvas on every visit since August.

Juvenile lobster recruits have been found since the first visit to the stations. The total number of recruits has been increasing with time. Table 1 is a summary of the amount of lobster recruits found throughout the monitoring period. Nevertheless, the quantity of recruits found on each station varied on every visit.

Table 1. Total number of lobster recruits in the shallow artificial shelters from March 2003 to February 2004, by carapace length.

Date	Carapace length						Total
	<1"	1.1-2"	2.1-3"	3.1-4"	4.1-5"	>5.1"	
25-Mar-03	2						2
24-Apr-03	6	2					8
23-May-03	4	2	1				7
27-Jun-03	4	2	1				7
24-Jul-03	5	3					8
29-Aug-03	12	2	2				16
25-Sep-03	16	5	1				22
21-Oct-03	14	7					21
21-Nov-03	22	2					24
19-Dec-03	14	4					18
22-Jan-04	8	4					12
23-Feb-04	5	1					

No juvenile recruits were found on stations 11 to 20. Strong currents and, perhaps, fishing activities, destroyed the square formation of several shelters and moved the black canvas from place. All, but one, were fixed. Station 19 was severely damaged, and we were not able to fix it. The canvas, in all the artificial shelters that had them, were always found out of place or removed. The canvas on station 15 was found wrecked and it was removed permanently. Lots of invertebrates, mainly tunicates, colonized the cement block holes. A great quantity of the long spine urchin, *Diadema antillarum*, was observed in the shelters since July 2003.

Discussion

After a year of monitoring, a peak is observed on number of lobster's recruits on the artificial shelters from August to December (Graph I). There are several things to consider when making this kind of statement, since the study covers only one year. One factor is the structure "stability". A clear process of succession was observed in the shelters. The shelters were colonized by different kinds of organisms, and these have change with time. There is a possibility that at some point during this process the settlement of certain organism in the structure make it a better habitat for spiny lobster juvenile recruits. There was a decrease on number of recruits during January and February. High swells are characteristic of these months because of the cold fronts. These weather systems stir the seafloor considerably, which my account for the reduction on recruits on the artificial shelters. Small recruits might be move from place by strong currents, and the bigger ones might seek protected areas in the reef.

There was no observed benefit associated with the shelters being covered. We had no way to track if the observed recruits were the ones previously observed at the shelter. Assuming that the recruits observed on one visit are directly related to the ones observed on the previous visit, the following conclusion could be dragged. Estimating from the size of the recruits observed, on stations 3 and 4, we could assume that some of the recruits might have stayed on the shelters for a couple of months. Table 1 show that 30% of the observed recruits on the first size category passed to the second size category. From those on the second size category 15 % passed to the third size category. Predation, fishing and migration are possible causes for not observing more of the recruits developing on the shelters for a longer time. We could not concluded from the present study if the fact that we did not observed any lobster recruit larger than three inches was because of a habitat constrain or that they were fished.

On the second set of stations, where no recruits were observed at the artificial shelters, an adult lobster and a three inch juvenile lobster were observed, on different occasions each, on the vicinity of the shelters. Knowing that the lobsters inhabit the area but are not using the shelters we could conclude one of two things, or both: that the amount of recruit settlement is so low in this area that we did not get to see any at the shelters, or that the lobsters are moving to this area once they reach certain size for which it is more likely they will seek a more protected natural shelter. There is also a big difference in habitat type between the two sets. The pueruli might be showing habitat preference towards sea grasses, for which they were observed at the first set of stations. Another peculiarity observed in the artificial shelters of this set was the overgrowth of sessile invertebrates.

We conclude that the project should be done for a longer time to be able to derive more accurate conclusions. We also suggest the addition of pueruli collectors in the vicinity of the second set of stations to assess if the lack of juvenile recruits is because there are none, or if there are but they are settling in other areas.

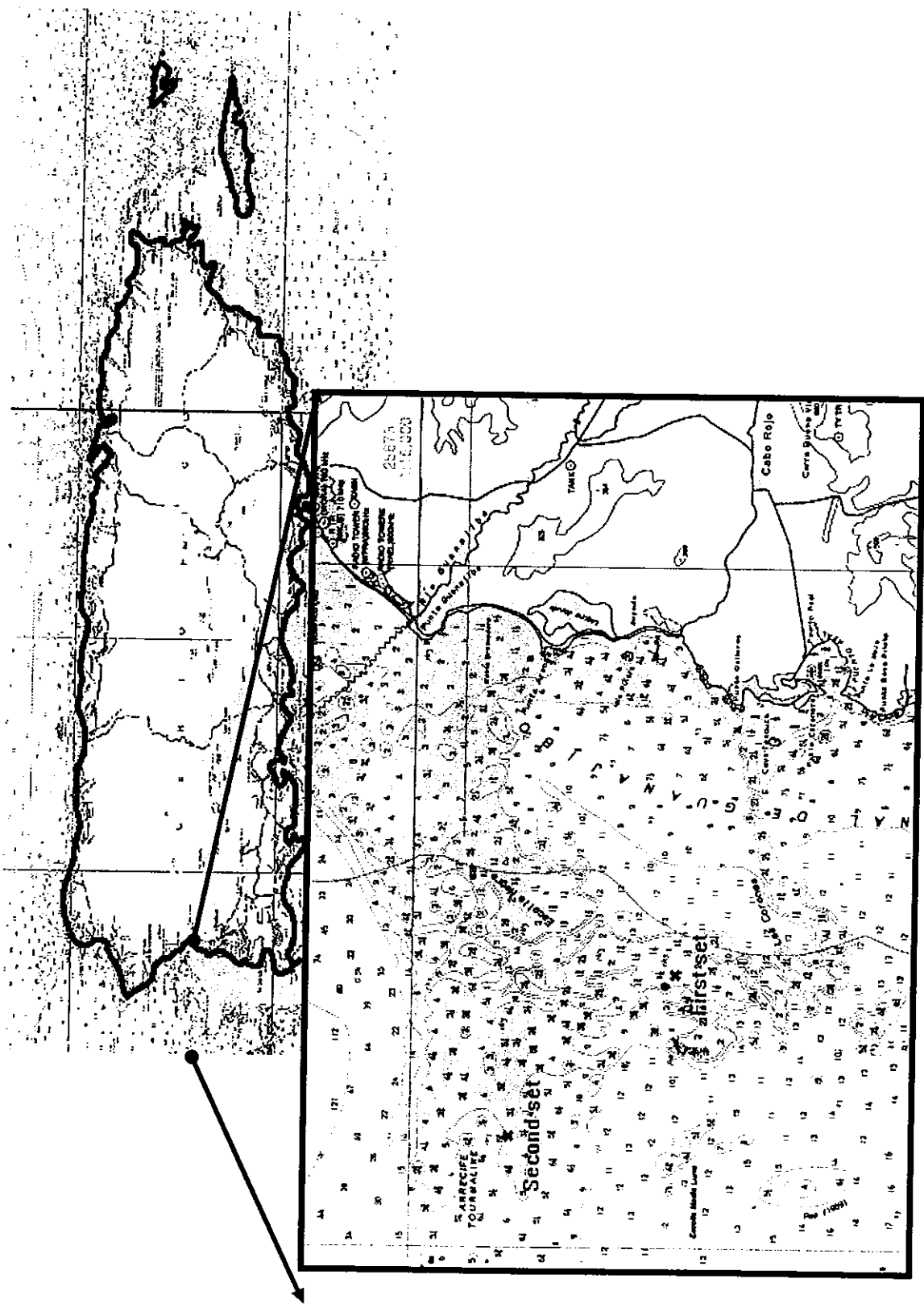


Figure 1. Location of the artificial shelter sets.

Appendix I- Data tables for shallow artificial shelters.

Artificial shelter ID: 1

Date	Lobster recruit carapace length					
	<1"	1.1-2"	2.1-3"	3.1-4"	4.1-5"	>5.1"
25-Mar-03						
24-Apr-03						
23-May-03						
27-Jun-03	1					
24-Jul-03						
29-Aug-03						
25-Sep-03						
21-Oct-03						
21-Nov-03						
19-Dec-03						
22-Jan-04						
23-Feb-04						

Artificial shelter ID: 2

Date	Lobster recruit carapace length					
	<1"	1.1-2"	2.1-3"	3.1-4"	4.1-5"	>5.1"
25-Mar-03						
24-Apr-03						
23-May-03						
27-Jun-03						
24-Jul-03	1					
29-Aug-03	2	1				
25-Sep-03	1					
21-Oct-03						
21-Nov-03						
19-Dec-03						
22-Jan-04						
23-Feb-04						

Artificial shelter ID: 3

Date	Lobster recruit carapace length					
	<1"	1.1-2"	2.1-3"	3.1-4"	4.1-5"	>5.1"
25-Mar-03						
24-Apr-03	2	1				
23-May-03	2					
27-Jun-03						
24-Jul-03	1	1				
29-Aug-03	2	1				
25-Sep-03	6	1				
21-Oct-03	5					
21-Nov-03	4					
19-Dec-03	4					
22-Jan-04	2					
23-Feb-04						

Artificial shelter ID: 4

Date	Lobster recruit carapace length					
	<1"	1.1-2"	2.1-3"	3.1-4"	4.1-5"	>5.1"
25-Mar-03	2					
24-Apr-03	2	1				
23-May-03	2	2	1			
27-Jun-03	1	2	1			
24-Jul-03	3	2				
29-Aug-03	6		2			
25-Sep-03	8	4	1			
21-Oct-03	7	7				
21-Nov-03	10					
19-Dec-03	6	4				
22-Jan-04	4	3				
23-Feb-04	3	1				

Artificial shelter ID: 5

Date	Lobster recruit carapace length					
	<1"	1.1-2"	2.1-3"	3.1-4"	4.1-5"	>5.1"
25-Mar-03						
24-Apr-03						
23-May-03						
27-Jun-03						
24-Jul-03						
29-Aug-03	1					
25-Sep-03						
21-Oct-03	1					
21-Nov-03	4	2				
19-Dec-03	3	1				
22-Jan-04	1					
23-Feb-04	2					

Artificial shelter ID: 6

Date	Lobster recruit carapace length					
	<1"	1.1-2"	2.1-3"	3.1-4"	4.1-5"	>5.1"
25-Mar-03						
24-Apr-03	2					
23-May-03						
27-Jun-03						
24-Jul-03						
29-Aug-03						
25-Sep-03						
21-Oct-03	1					
21-Nov-03						
19-Dec-03						
22-Jan-04						
23-Feb-04						

Artificial shelter ID: 7

Date	Lobster recruit carapace length					
	<1"	1.1-2"	2.1-3"	3.1-4"	4.1-5"	>5.1"
25-Mar-03						
24-Apr-03						
23-May-03						
27-Jun-03						
24-Jul-03						
29-Aug-03						
25-Sep-03						
21-Oct-03						
21-Nov-03						
19-Dec-03						
22-Jan-04	1					
23-Feb-04						

Artificial shelter ID: 8

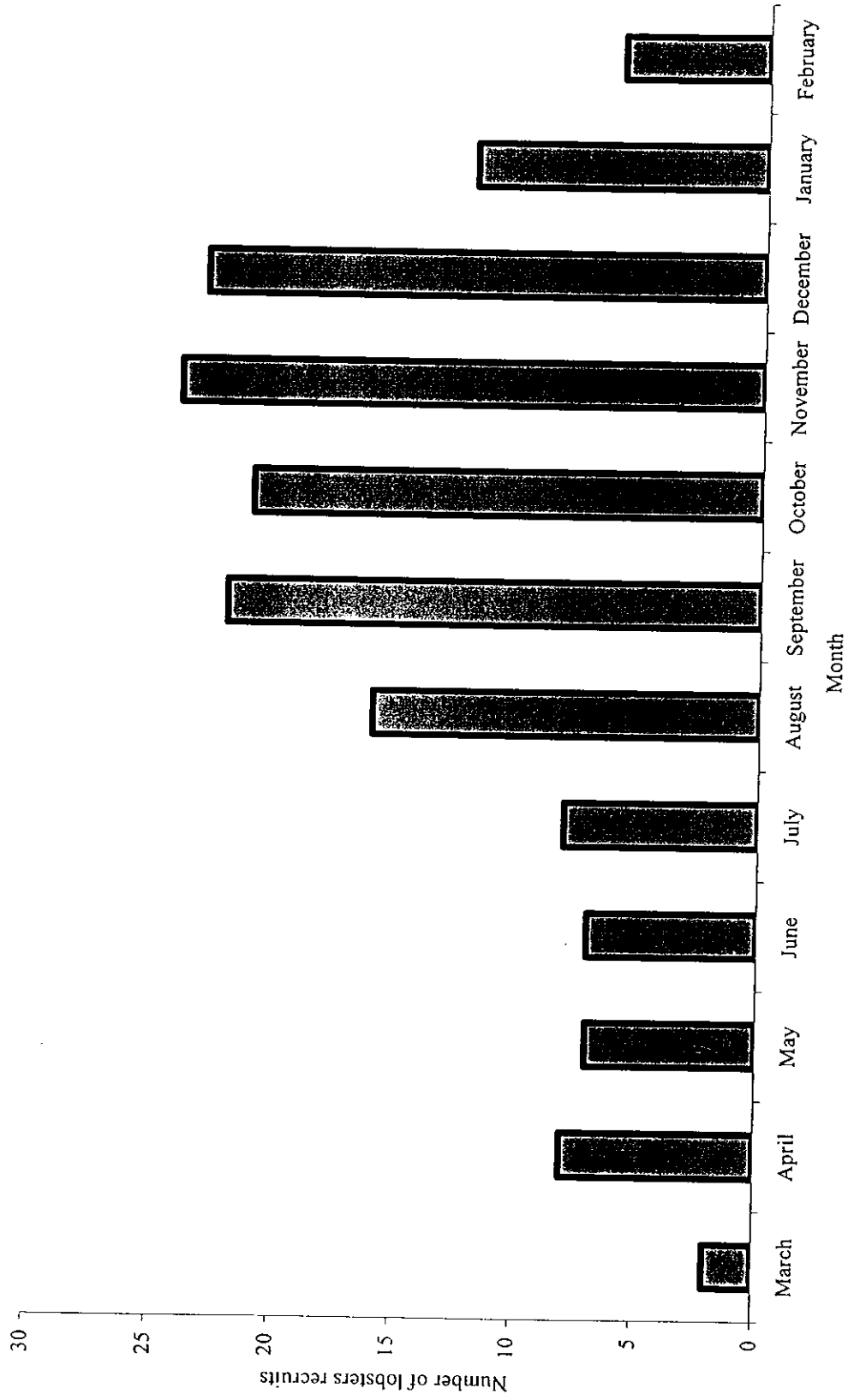
Date	Lobster recruit carapace length					
	<1"	1.1-2"	2.1-3"	3.1-4"	4.1-5"	>5.1"
25-Mar-03						
24-Apr-03						
23-May-03						
27-Jun-03	2					
24-Jul-03						
29-Aug-03	1					
25-Sep-03	1					
21-Oct-03						
21-Nov-03	3					
19-Dec-03		4				
22-Jan-04	1					
23-Feb-04						

Artificial shelter ID: 9

Date	Lobster recruit carapace length					
	<1"	1.1-2"	2.1-3"	3.1-4"	4.1-5"	>5.1"
25-Mar-03						
24-Apr-03						
23-May-03						
27-Jun-03						
24-Jul-03						
29-Aug-03						
25-Sep-03						
21-Oct-03						
21-Nov-03	1					
19-Dec-03						
22-Jan-04						
23-Feb-04						

Artificial shelter ID: 10

Date	Lobster recruit carapace length					
	<1"	1.1-2"	2.1-3"	3.1-4"	4.1-5"	>5.1"
25-Mar-03						
24-Apr-03						
23-May-03						
27-Jun-03						
24-Jul-03						
29-Aug-03						
25-Sep-03						
21-Oct-03						
21-Nov-03						
19-Dec-03		1				
22-Jan-04						
23-Feb-04						



Graph 1. Total number of lobsters recruits at the shallow artificial shelter.