# A Simple Collector for Postlarvae of the Spiny Lobster *Panulirus argus*

DAVID GUTIERREZ-CARBONELL, JORGE SIMONIN-DIAZ, and PATRICIA BRIONES-FOURZAN
*Instituto de Ciencias*
*Mary Limnología Estación Puerto Morelos*
*Universidad Nacional Automome de Mexico*
*P. O. Box 1152*
*Cancun, Q.R. 77500*

ABSTRACT

In order to study the settlement of postlarvae of spiny lobsters, two types of collectors were tested from April to September, 1987, in three sampling stations in Bahía de la Ascensión, Q.R., Mexico. A modified "Witham" habitat (Witham *et al.*, 1968) and a modified "Phillips" Collector (Phillips *et al.*, 1972) were used. The "Phillips" collector was modified by the authors and for practical purposes we call it the GuSi collector.

The GuSi collector is a cylindrical structure covered with tassels of a synthetic fibre ("filostica") of the type used in the construction of the defenses for shrimp trawling nets. The structure is moored to a concrete weight, and polyurethane circular plates are used inside the cylinder to give it buoyancy. In order to imitate the natural marine vegetation found in the Bay (seagrass beds and rhodophyte beds) collectors were constructed in two colors: green and red. The "Witham"-type habitats followed the design proposed by the GCFI in 1987.

Results are presented on the comparisons between types of collector and among colors of collectors. The mean CPUE (number of postlarvae per collector per week) was 0.75 for the GuSi collector, and 0.37 for the "Witham" habitat, which is significantly different ($.01 < p < .05$). There is a gradient in CPUE from red to green to blue collectors. Furthermore, the durability of the GuSi collector is longer and the cost of construction lower. Therefore, the GuSi collector is proposed as an efficient and inexpensive alternative to the "Witham" habitat for *P. argus* postlarval settlement studies.

## INTRODUCTION

The spiny lobster *Panulirus argus* is widely distributed throughout the Caribbean and some areas of the North Atlantic (Phillips and Sastry, 1980). This species, as most of the Palinurids, has a long and complex life cycle, including 11 stages of a pelagic larva, termed phyllosoma (Lewis, 1951; Baisre, 1964). The last phyllosoma stage metamorphoses into a transitional swimming stage called a puerulus (Lewis *et al.*, 1952; Lyons, 1980), which swims to nearshore benthic habitats, where it settles on suitable substrates, such as turtlegrass (Witham *et al.*, 1968; Buesa, 1965) or rhodophyte beds (Marx and Herrnkind, 1985).

The pelagic life of the phyllosoma larvae is usually very long (6 months or more) (Lewis, 1951; Sims and Ingle, 1967), and thus the larvae can be widely dispersed by ocean currents (Gurney, 1936). Their collection by zooplankton

nets usually produces small numbers (Johnson, 1971; 1974; Phillips, 1972; Booth, 1986), which poses difficulties in studying their recruitment to fishable stocks. This is not the case for the puerulus, since their arrival to the nearshore areas can be useful for this purpose.

During the last few years, strong emphasis has been made on the need to determine the recruitment patterns of the pueruli of *P. argus* in different parts of its geographic range (Idyll, 1981). It was hypothesized more than 20 years ago (Ingle *et al.*, 1963; Sims and Ingle, 1967), that areas along this range could be populated by recruits originated elsewhere, and that this could be of major importance to define stock units. The genetic approach has not yielded conclusive evidence for local nor foreign recruitment (Menzies, 1981). Temporal and spatial settlement patterns of the pueruli of *P. argus* could shed some light on this issue. But to do so, there is a need to standardize study methods in order to compare results.

Different kinds of collectors resembling the substrates where pueruli settle have been designed to attract the pueruli during their arrival to the coast. The ones with the more extended use are the "Witham" habitat (Witham *et al.*, 1968; Little, 1977; MacDonald, 1986) and the "Phillips" collector (Phillips, 1972; 1986; Chittleborough and Phillips, 1975; Phillips and Hall, 1978). The former has been traditionally used in Florida and the Caribbean, while the latter has been usually employed in Australia. To our knowledge, no attempt has been made to test the "Phillips" collector in any place of the Caribbean, despite its proved efficiency in pueruli recruitment studies carried out for *P. cygnus* in Australia (Morgan *et al.*, 1982).

In 1986, we engaged in a study of postlarval settlement patterns in Bahía de la Ascensión, Q.R., Mexico, a large bay located in the central part of the Mexican Caribbean coast, where large numbers of juveniles of *P. argus* exist (Lozano *et al.*, 1988). This bay is part of the recently decreed Sian Ka'an Biosphere Reserve. We designed a collector following the model of Phillips (1972), but modifying it both to suit our research needs and to reduce its manufacturing cost. The result was a simple and inexpensive collector, which for practical purposes we call the GuSi collector.

In March, 1987, Dr. David L. Miller, of the State University of New York, visited our study area and brought with him three modified "Witham" habitats of the "hog hair" material type. He was interested in finding out the durability of the habitats and left them to us, thus giving us the opportunity to compare the efficiency of the GuSi collector with the new standard Witham habitat.

## MATERIALS AND METHODS

### The Collectors

The GuSi collector is made up of inexpensive materials. The cylindrical structure that supports the collecting area is an inverted strong plastic 19 litre

bucket, 35 cm tall and 30 cm in diameter, of the type in which paint is usually sold. A total of 110 tassels of a synthetic fibre ("Filastica," Industrias Altamar, Guadalajara, Jal., Mexico), commonly used in the construction of defenses for shrimp trawling nets, was attached to the external surface of the bucket, using a rectangular piece of synthetic sack as a base. The "Filastica" fibres are flat and measure 1 cm in width. It was found that shredding the tassels improved the efficiency of the collector. This was done by repeatedly pulling the tassel between two pieces of wood with protruding nails.

A polyurethane circular plate 2.5 cm thick and of the same diameter of the bucket, placed inside of it, was found to be sufficient to keep the collector floating at the surface. Prior to the construction of the collector, the handle of the bucket was removed, and the holes to which it was attached enlarged to allow for a 1 cm diameter polypropylene rope to get through. The rope was then used to moor the collector to a concrete weight (Figure 1).

In order to simulate the macrophytes commonly found in Bahía de la Ascensión (*Thalassia testudinum* and *Laurencia* spp.) and which have been reported as natural habitats for the pueruli of *P. argus* (Witham *et al.*, 1968; Marx and Herrnkind, 1985; Herrnkind and Butler, 1986), some collectors were made of green fibre and others of red fibre.

The modified Witham habitat follows the design by John Hunt (Florida Department of Natural Resources, Bureau of Marine research, 13365 Overseas Highway, Suite 103, Marathon, Fl.), with a PVC-pipe frame and blue "hog hair" filter material.

**Study Area**

Bahía de la Ascensión (between 19°35' and 19°45' N and 87°30' and 87°45' W) is a large bay located within the Sian Ka'an Biosphere Reserve in the central coast of the state of Quintana Roo, Mexico (Figure 2). The only human settlements in the Reserve are two small villages whose inhabitants make their living from spiny lobster fishing.

The depth of the bay ranges from less than 1 to around 6 m. Sand beaches, mangroves, and grass swamps border the bay (Olmsted *et al.*, 1983). The bottom of the bay is composed of several kinds of communities, with turtlegrass (*Thalassia testudinum*) and macroalgal patches as the characteristic vegetation.

**Sampling**

Five GuSi collectors were set during February, 1987 in each of the three sampling stations. In March, one modified Witham habitat was deployed in each of the same stations.

The collectors were examined one to two days after the date of each lunar phase. The GuSi collectors are examined by retrieving them from the water and shaking them vigorously in a large circular tub. The catch so obtained is passed

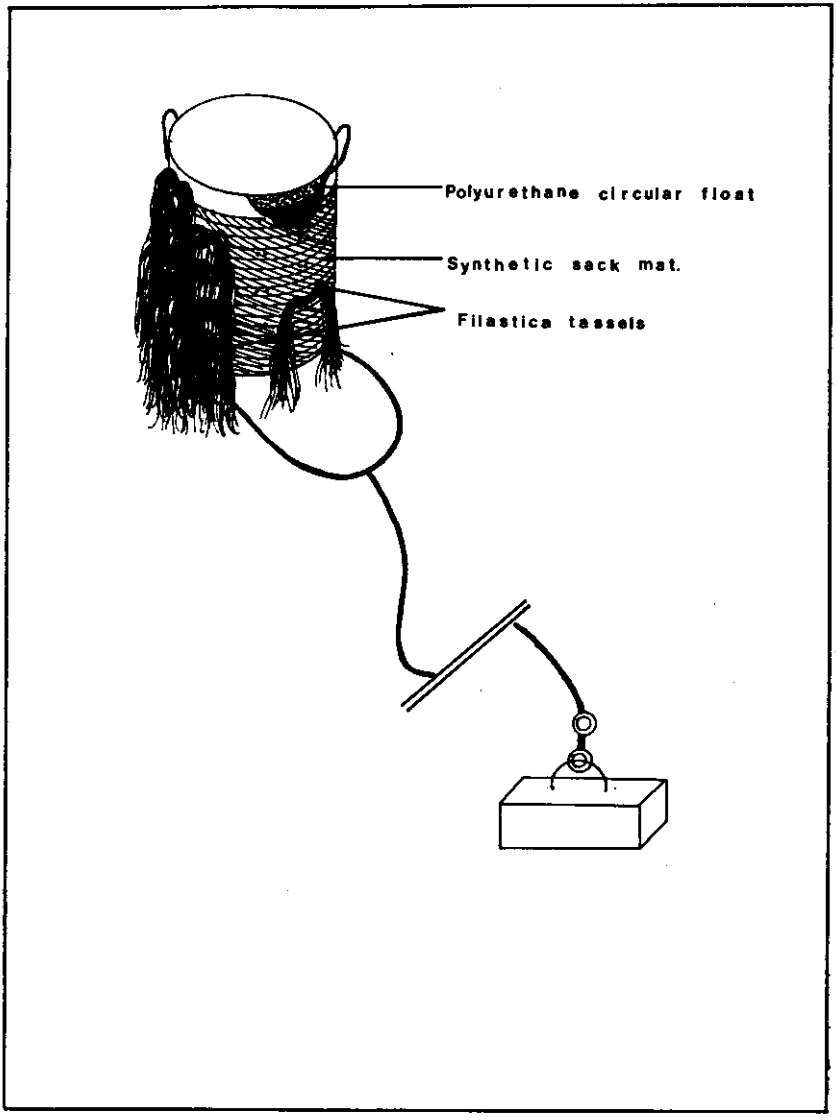


**Figure 1.** Details of the GuSi collector.

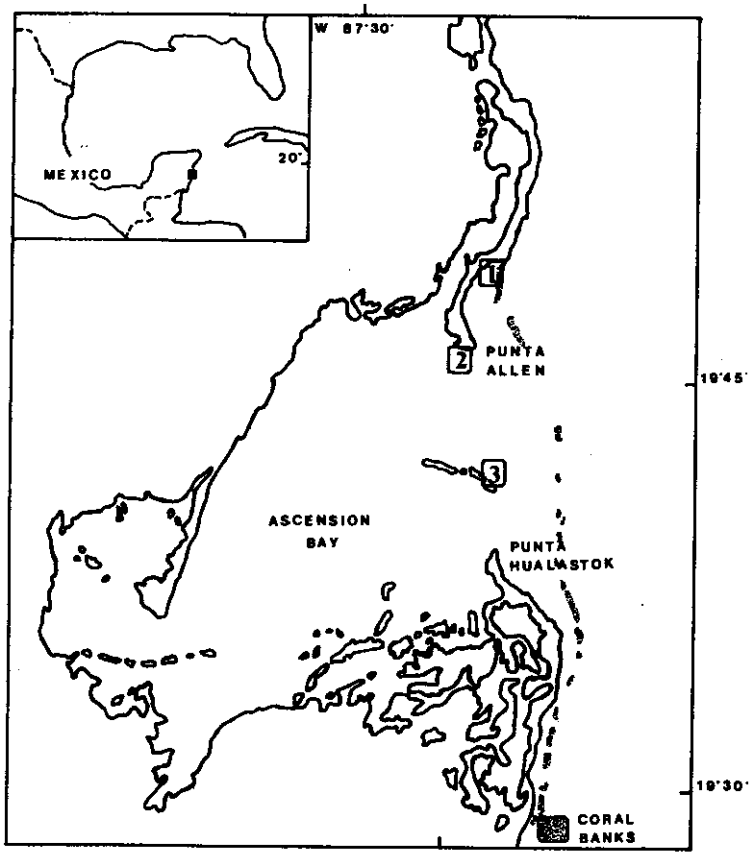


**Figure 2.** Sampling stations in Bahía la Ascensión.

through a mesh sieve, and the pueruli and postpueruli are registered. The Witham habitat, after being retrieved from the water, is examined page by page.

There was no replacement material for the hog-hair sheets of the Witham habitats, so the sheets could not be changed when they started to deteriorate. To compare the durability of the collectors, the GuSi ones were also left without replacement of the fibres. By August–October, the Witham habitats were no longer useful, and they were withdrawn. Thus, the comparison study covers the period April–August for stations 1 and 3, and March–October for Station 2.

The postlarvae caught in every date of examination were removed and released in an area far from the sampling stations.

**Data Analysis**

Several characteristics of the collectors were taken into account for their comparison. These were: CPUE (number of postlarvae per collector per week), cost of manufacture, easiness of revision, and durability.

The experiment was unbalanced for the following reasons: a) there were more GuSi collectors than Witham habitats in each station, and b) the colors of the two types of collectors were different, thus masking any possible interaction between type and color of collector. This hindered the utilization of powerful statistical tests. Therefore, to compare the mean CPUE of the different types of collectors and that of the red and green colors of the GuSi collector, we applied an approximate t-Test with a log $(x + 1)$ transformation, both to equalize variances and to partially offset the sampling bias (Sokal and Rohlf, 1981). A one way ANOVA, also with a log $(x + 1)$ transformation, was applied to compare the three colors of the collectors: red and green GuSi, and blue Witham. A Tukey-Kramer test for multiple comparisons among pairs of means based on unequal sample sizes (Sokal and Rohlf, 1981) was used to analyze the results of this ANOVA.

The cost of manufacture of the collectors was estimated by taking into account only the cost of material, without any regard to manpower.

Both the easiness of revision and the durability were qualitatively estimated, taking into account the time invested in examining the collectors and the state of the collecting material in both types of collectors.

## RESULTS

**CPUE**

A total of 206 postlarvae were caught during the study period. Table 1 shows the total catch, the total number of weeks sampled, and the CPUE per collector in each station.

The mean CPUE for each type of collector was 0.75 postlarvae per collector per week for the GuSi collector, and 0.37 for the Witham habitat. The results of the approximate t-Test showed that the differences between the log $(x + 1)$ transformations of these mean CPUE's were significant ($0.01 < p < 0.05$).

The mean CPUE for the different colors were 0.17 for the red GuSi, 0.10 for the green GuSi, and 0.08 for the blue Witham. The ANOVA showed that there were significative differences among these colors ($0.01 < p < 0.05$). The Tukey-Kramer test applied to these results indicate that the red and green colors were not different, and that neither were the green and blue.

**Table 1.** Summary of results.

| | COLLECTOR | TOTAL CAUGHT | NO. OF WEEKS | CPUE |
|---|---|---|---|---|
| | GuSi GREEN | 27 | 17 | 1.6 |
| STATION 1. | GuSi GREEN | 18 | 12 | 1.5 |
| | GuSi RED | 34 | 17 | 2 |
| XOHKEN | GuSi RED | 24 | 17 | 1.4 |
| | WITHAM | 23 | 16 | 1.4 |
| | TOTAL | 126 | 79 | 1.59 |
| | GuSi GREEN | 13 | 28 | 0.5 |
| STATION 2. | GuSi GREEN | 7 | 28 | 0.3 |
| | GuSi GREEN | 5 | 28 | 0.2 |
| EL FARGO | GuSi GREEN | 5 | 6 | 0.8 |
| | GuSi RED | 12 | 28 | 0.4 |
| | WITHAM | 4 | 28 | 0.14 |
| | TOTAL | 46 | 146 | 0.32 |
| | GuSi GREEN | 1 | 19 | 0.05 |
| STATION 3. | GuSi GREEN | 10 | 12 | 0.8 |
| | GuSi GREEN | 1 | 19 | 0.05 |
| VALENCIA | GuSi RED | 12 | 19 | 0.6 |
| | GuSi RED | 9 | 19 | 0.5 |
| | WITHAM | 1 | 19 | 0.05 |
| | TOTAL | 34 | 107 | 0.32 |
| OVERALL | | 206 | 333 | 0.62 |

**Costs**

The total cost of GuSi collector (synthetic fibre, bucket, rope, float, and weight), including the material needed to manufacture the collector, is about $10.00 U.S., in rounded figures. According to Bannerot *et al.* (1991), the cost of a "hog-hair" Witham habitat would be approximately US$30.00.

**Durability**

This study covered six months. During that time, no collectors were given maintenance, *i.e.*, they were all subject to the same deterioration rate. Four GuSi collectors were lost and replaced, but they are not taken into account for this comparison.

All the collectors, regardless of their type, became fouled in 2–4 weeks. When fouling became very dense, they were slightly cleaned at the time of

examination. After two months, the sheets of the Witham habitats, particularly the most exterior ones, started to shred and loose material. Between August and September, it became very difficult to examine the Witham habitats, since whole pieces of the "hog-hair" material would detach when turning the sheets.

On the other hand, the GuSi collectors retained their original fibre tassels throughout the study period, in spite of getting densely fouled. The cleaning operation was easily carried out in this type of collector, whereas it had to be carefully done to the Witham habitat in case the "hog-hair" material would shred. When the experiment was ended, the GuSi collectors were kept deployed for an additional six months and remained in good conditions.

**Easiness of Revision**

The GuSi collectors need to be shaken in order to get the postlarvae and associated fauna out of the collecting fibres, and the catch passed through a mesh sieve to detect the postlarvae. When the collector is very fouled, or has trapped suspended sediment, this operation is more time-consuming. During some weeks, the operation was performed twice to see if any postlarvae had resisted the first shake. No additional postlarvae were found in the second examination, so it was discontinued.

The Witham habitat sheets need to be carefully observed for the postlarvae. When they are densely fouled, it becomes difficult to examine. However, the total operation requires less effort and is quicker.

## DISCUSSION

Although the statistical analysis for the comparison of CPUE between types of collector gives significant differences in favour of the GuSi collector, it cannot be regarded as conclusive due to the small number of Witham habitats employed. However, several arguments could be exerted to support this evidence. Herrnkind and Butler (1986) found out that postlarvae of *P. argus,* when given a choice between the red alga *Laurencia spp.* and the turtlegrass *Thalassia testudinum* to settle, prefer the former. These authors concluded that the reason for this preference is that the pueruli use the complex algal architecture as a cue for settlement and that later on, after metamorphosis into juveniles takes place, it may be of value to protect them from predators. The fibre tassels of the GuSi collector are far more intricate than the sheets of "hog-hair" of the Witham habitat, which may be more attractive to the pueruli.

On the other hand, the Witham habitat is polygonal in shape, whereas the GuSi collector has its collecting surface more evenly distributed in a 360° area. This could also account for the better performance of the GuSi collector, but is difficult to prove.

There is no evidence in the literature examined that the color of the collecting material may be of some importance for the efficiency of a collector.

The fibre tassels of the original "Phillips" collector are white, but after three months they become dark with fouling (Phillips, 1972). The original "Witham" habitat was made of black sheets of material, while the "hog-hair" material now in use is bright blue. We decided to test red and green material to imitate the color of the rhodophytes and the turtlegrass abundant in Bahía de la Ascensión, although there is no conclusive evidence that *P. argus* can detect red as a color (Wald, 1968 in Ache and MacMillan, 1980). Our results may be indicative that, although no significant differences exist among colors, there is a gradient from red to green to blue. Nevertheless, the experiment should be carried out with only one type of collector of different colors. In addition, the possibility of interactions between color, type of collector and sampling site cannot be excluded.

The cost of a collector and its durability are important factors if long-term recruitment studies are to be developed, particularly in countries where financial support for research is difficult to get. The "Phillips" collectors now being employed in Western Australia, have a cost of approximately $150.00 U.S. (S. Braine, CSIRO Marine Lab, P. O. Box 20, North Beach, W.A.) including aluminum frame, synthetic fibre, floats, and stainless steel chains to anchor the frames. However, these collectors remain operational for very long periods, and only the fibres need to be changed approximately every 3–4 months. The "hog-hair" Witham habitat costs $30.00, but in the case of this study, the sheets would have to be changed every 2–6 months, depending on their position within the frame. In addition, the "hog-hair" material is manufactured in the U.S.A. and difficult to get in other countries. This would rise the cost of the collector in such countries, unless an alternative material is found.

The GuSi collector costs US$10.00 and has a proved mean durability of 8 to 10 months without need to change the collecting material. In fact, this material can last for longer periods if a thorough cleaning is performed. This cleaning would include taking the collector ashore and leaving it outdoors for one week. This makes the removing of the fouling organisms by "shaving" the tassels with a knife easier. Once cleaned, the collectors can be deployed again.

The method employed to examine the collectors for pueruli is different, and the Witham habitat requires less effort.

In conclusion, the GuSi collector has demonstrated its usefulness and efficiency for studies of postlarval settlement of the spiny lobster *P. argus*. Its CPUE, cost, and durability make it an alternative device to the Witham habitat, particularly in countries where little funding for this kind of research limits the utilization of more expensive collectors.

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