Biological Considerations in Spiny Lobster Culture

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Abstract

Interest in mariculture is increasing with emphasis on animals of high monetary value. Spiny lobsters, because of their consistently high demand and price, have been attractive to many potential investors.

Spiny lobsters could probably be grown profitably, but pecularities of their life cycle would impose methods and procedures radically different in some respects from traditional cultivation systems. These departures are discussed. Recommendations are made and hazards outlined.

ANY PLAN TO CULTIVATE a marine species must take into account needs of the organism that are rigidly established by its physiological apparatus. Facilities and techniques consonant with its unique life history features must also be provided.

For example, temperature requirements for optimum growth, spawning and survival are programmed in basic biochemistry and if other temperatures are experienced, vital physiological mechanisms may be deleteriously affected. Also, if some peculiar need of a species is not satisfied during a part of its life cycle, optimum development may be interfered with or death may ensue.

In traditional artificial cultivation activities certain individuals are permitted to reproduce or are stimulated to do so. The resulting eggs and immature stages are then protected from pathogenic organisms, food is provided and isolation is provided against predators. All of this is carried out in a milieu of compatible physical and chemical conditions.

In due time the animals are harvested, having reached a desired growth and condition through indulgent care and protection.

Those who would attempt to employ this program with spiny lobsters would quickly encounter enormous difficulties. The distinguishing and in many ways the most dominant feature of spiny lobster biology is its long larval life. Although larval period has not been fixed with exactitude it probably is approximately 6 or 7 months (Sims and Ingle, 1966). During this period the body is effectively structured for the planktonic existence it maintains. It is flat, somewhat transparent, with long slender legs which probably give resistance to the water and thus aid in maintaining suspension.

The larvae were originally thought to be separate species of animals and, as such, were given the name *Phyllosoma* (Leach, 1816). In the early 1900s several workers hatched spiny lobster eggs and discovered the error. The name has persisted, however, and the premetamorphosis stages are still called phyllosomes.

During the floating period of 6 or 7 months, spiny lobster larvae are extremely delicate, physically, and inordinately fastidious, physiologically. Their

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requirements are sufficiently exquisite that, to date, although competent people have repeatedly tried in several parts of the world, no one has been able to rear them through the metamorphosis stage.

The length of time required, the technical difficulties presented, the expense and effort imposed, together with the basic fragility of phyllosome stages provide very little recommendation that traditional hatchery methods will be successful or practical with our spiny lobster.

There may be ways to bypass these difficulties. Recent research by our group in the Florida Board of Conservation has revealed that at about the time of metamorphosis (after the long larval period has been completed) the puerulus, or first-stage postlarva, gains access to sequestered and protected sanctuaries of coastal bays and lagoons. In this shallow water, safe-haven-seeking migration, spiny lobsters follow a behavioral pattern similar to shrimps, other valuable crustaceans and numerous species of salt water fishes. The principal difference lies in the fact that while most other animals showing this tendency have marked euryhaline characteristics, the lobster with which we are most familiar, *Panulirus argus*, does not survive well in salinities below 19 parts per thousand (ppt) (Witham, et al., 1968).

Phyllosomes are rarely found in plankton samples taken from inlet bridges at incoming tides, or in plankton nets towed behind boats in bays and lagoons, but first and later stages of postlarvae are readily obtained in those areas. The drift to protected waters appears to coincide with the metamorphosis from phyllosome to the typical spiny lobster form.

We have found natural habitats to which the postlarvae are attracted after they enter embayments. Along the bay side of the barrier island, just north of St. Lucie Inlet, small unpigmented and pigmented metamorphosed individuals can be dependably found, hiding in algae attached to mangrove roots and to the roots themselves. Slightly older and commensurately larger specimens have also been taken in several locations near St. Lucie Inlet and in some parts of Biscayne Bay.

During our studies we developed an artificial habitat with which we tried to duplicate as nearly as possible the filamentous, convoluted, intricately intertwined algal clumps in which we found small postlarvae so frequently *in situ* (Fig. 1 and Fig. 2). The material we used was manufactured by Minnesota Mining and Materials Corporation of St. Paul, Minnesota. Laminations of this material were attached to small wooden rafts, approximately 1 foot square, from which they were suspended downward in the water. These Witham habitats (named after their originator) were placed in several bays, lagoons, and areas of shallow flats between the St. Lucie estuary and Key West.

Results in some areas were negative and further testing was abandoned. In other locations, collection of postlarvae was erratic. Many weeks might be negative with large numbers of postlarvae obtained only occasionally. A few stations proved to be very dependable, with consistently positive recruitment. Even in the most reliable stations, numbers of postlarvae varied widely from week to week.

We observed the type of habitat occupied by later postlarval stages and attempted to simulate such a structure. We created a small reef, at the end of a dock, in shallow water (4 feet deep) where it could be easily checked. It apparently served the needs of later stages. They were observed sequestered inside and between the drain tiles of which the reef was constructed. Observations over a period of years established the need of these animals to hide

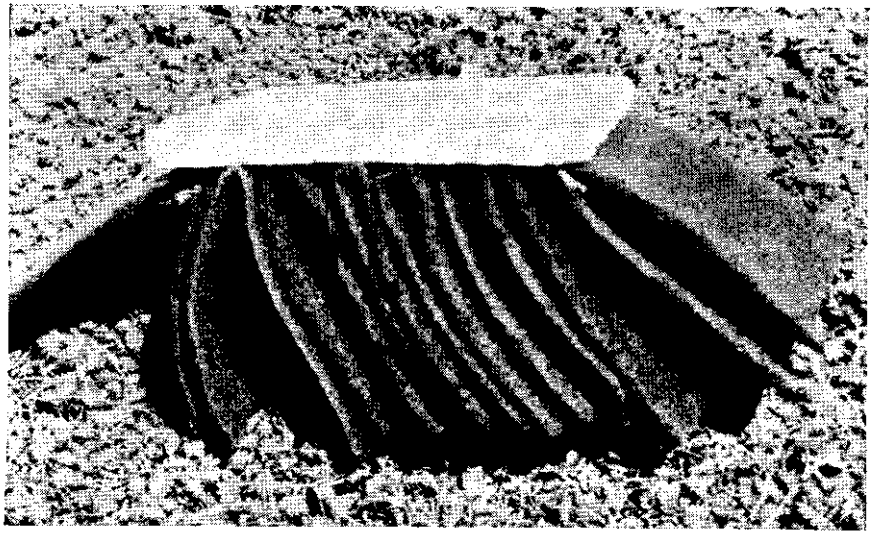

FIG. 1. When floating, laminations of Witham habitat hang from small raft, as shown above.

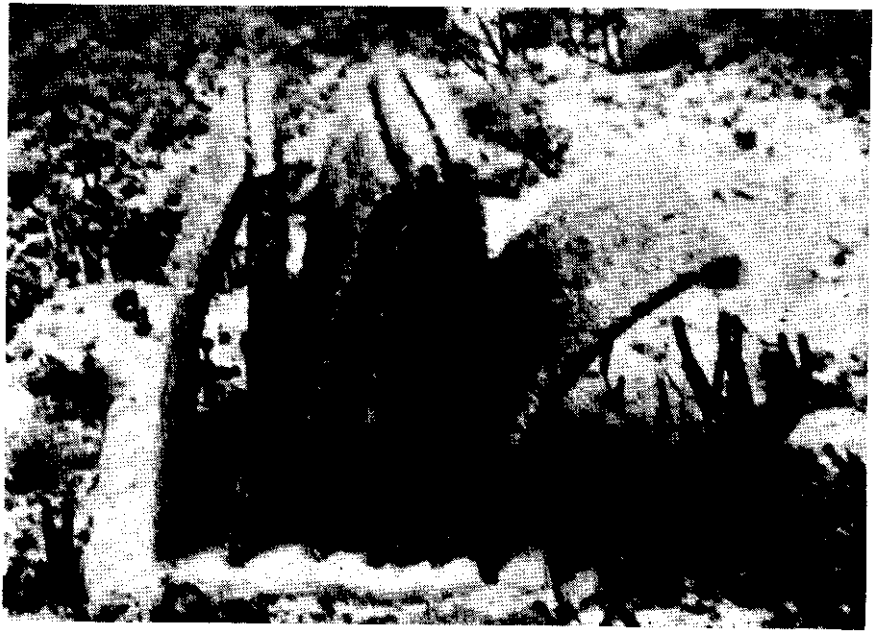

FIG. 2. By inverting the habitat, it can be secured by a heavy base. Laminations then extend upward, as shown here.

themselves in crevices, under rock overhangs and under large wrecks. This led us to check a new artificial reef, constructed of old cars, near Key West. After a period of only a few weeks, medium to large lobsters had already become established.

With the knowledge we have summarized, we can propose a method of artificial cultivation that eliminates any consideration of hatching eggs and rearing phyllosomes. This program, which is consonant with the salient life-history features of the spiny lobster, would involve the following procedures: (1) Locate a protected embayment in which postlarvae can be reliably obtained. (2) Install several habitats of proved ability to attract pueruli and later stages. (3) Check habitats daily. Remove lobsters and transport to holding ponds. All fish must be removed from these ponds before lobsters are introduced. (4) Abundant small articles of a porous texture should be provided for the sanctuary of the growing juveniles. Instinct to recede into protective niches during daylight hours will be satisfied and security will be provided during the molting process. (5) Food should be added regularly. Preferably, the pond would experience tidal ebb and flow. This exchange could reduce the danger of accumulation of decaying organic material resulting from overfeeding. (6) When captive animals have passed through the smallest, most vulnerable stages, the project may proceed in any one of three different ways: a) The animals may be kept in the pond until large enough to harvest. b) Captive lobsters can be released into a larger enclosure in shallow, open areas where they can forage and have supplementary food added. As with earlier stages, abundant rubble is needed. c) If the project is government-funded and the production is to be shared by the public, confinement is not essential, but abundant reef material should be spread out over a wide contiguous area before lobsters are released.

Because of a requirement for tropical and semi-tropical temperature regimes, it appears unlikely that the methods described above would be financially successful north of the Florida-Georgia line on the Atlantic Coast.

No intensive studies have been made on postlarvae recruitment success on Florida's west coast, but such data as are available indicate difficulties for cultivation programs as described in this report. Water temperatures during much of the year also appear to be unfavorable. Currents there probably are not properly oriented for the dissemination of postlarvae. The "big loop" current carrying advanced-stage larvae moves from the Yucatan Straits toward the Florida Keys and east coast. It bypasses all except the southernmost regions of the southwest coast. Evidence now available suggests that water masses moving south along the western continental shelf areas also discourage the transport of larvae to much of Florida's west coast. Plankton samples from the area from Ft. Myers to Apalachicola contain phyllosomes and postlarvae very rarely. But within the principal drift (Yucatan Straits, "big loop current," and Florida Current) advanced-stage larvae are relatively abundant.

Previous studies have shown that postlarvae enter protected areas of Florida throughout the year (Sims and Ingle, 1966; Witham et al., 1968) and the same continuous availability probably exists in embayments of Middle America and the West Indies. Investigations should be undertaken to affirm this. Even if recruitment does not proceed throughout the year, cultivation practices as outlined above would still be feasible in the Caribbean area. All other necessary factors, especially temperatures, appear to be favorable.

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