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ON THE POSSIBLE CARIBBEAN ORIGIN OF FLORIDA'S SPINY LOBSTER POPULATIONS

by

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Maritime Base, Bayboro Harbor
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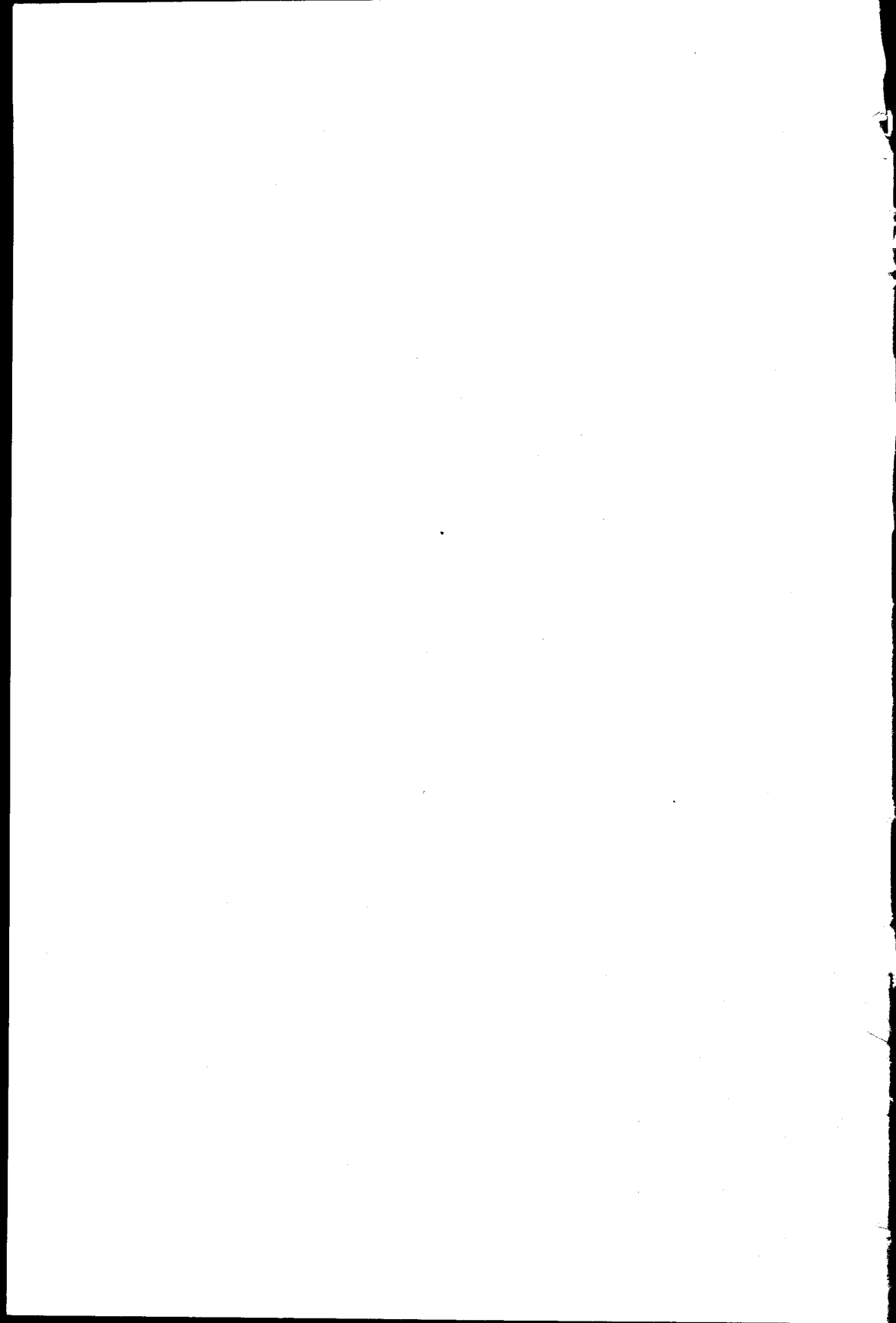
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INTRODUCTION

The present paper advances the preliminary evidence resulting from an investigation of the possible relationship of Caribbean water currents to recruitment of larval spiny lobsters to Florida. The established long life (Smith, 1948a; Sheard, 1949; Lewis, 1951; Lindberg, 1955; and Johnson, 1960) and suggested wide geographical dispersal (the above authors; Gurney, 1939; Smith, 1948b; and Thorson, 1961) of planktotrophic lobster larvae clearly pointed to this possibility. We consequently searched for published current patterns of the area concerned and began a widespread plankton sampling program south of Florida. We also extended existing larval shrimp studies of the northeastern and central western Florida coasts to help gain further information on phyllosoma larvae dispersal.

Although our work continues, we prefer to reveal data from our first set of samples now in connection with a discussion of some factors of this possible recruitment (geographical distribution, larval duration, and water current patterns) so that we may enlist the cooperation of fellow scientists in obtaining available phyllosoma larvae in widely separated plankton samples. We hope that such work will result in both further knowledge of the Florida spiny lobster populations and better determination of the direction and drift of many current patterns.

GEOGRAPHICAL DISTRIBUTION OF *PANULIRUS ARGUS*

The common spiny lobster, *Panulirus argus*, of southern Florida has a wide geographical range. It is reported as far north as Bermuda (Sutcliffe, 1952 and 1953) and North Carolina (Hay and Shore, 1918). Smith (*op. cit.*) and Chace and Dumont (1949) extend the southern range to the Bahamas, Cuba, West Indies, British

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Honduras, and Rio de Janeiro, Brazil. Moore (1962) recorded *P. argus* from the Louisiana coast and stated that specimens are caught there by shrimp trawlers. Dr. Gordon Gunter (personal communication) noted the presence of this species in Louisiana several years ago.

Although *P. argus* is commercially important in the Bahamas, Cuba, Caribbean, Florida Keys, and the Miami area, it is found along the eastern and western Florida coasts in lesser numbers. Moore (*op. cit.*) collected some specimens north to Hobe Sound on Florida's east coast. According to Lt. Edward Little, Florida Conservation Officer, and Mr. Martin Moe, Biologist, Florida State Marine Laboratory (personal communication), large specimens are occasionally captured off Pensacola and are frequently taken by skindivers off rock jetties at Panama City. Large lobsters are often observed by skindivers on reefs 45 to 50 feet deep off Tampa Bay (Dr. Richard Kirk, personal communication). Once he saw a group of seven lobsters, including a berried female. Dr. Kirk also occasionally found very large specimens on shallow reefs (15 feet) off Aripeka and Bayport; one he estimated at two feet long. Another specimen, seven pounds, was captured in a commercial fishing net off Sarasota County and is now at the Florida State Marine Laboratory, St. Petersburg.

In November 1961, we obtained a postlarva of *P. Argus* in a try-net haul at 50 feet at a shrimp station directly off Anclothe Key. This specimen measured 39.5 mm. total length and 13.5 mm. carapace length and according to Lewis *et al.* (1952) would be the 9th postlarval stage and about 16 months old.

Adult spiny lobsters are known to migrate along coasts and off-shore during the breeding season and in winter months. Although these movements may at times extend the range along a coastal area, as Smith (*op. cit.*) stated, "There is no evidence that adult lobsters are able to cross deep straits and these act at least as a partial barrier to migration." Therefore, the distribution of adult lobsters depends largely on the duration of the larval life and the directional flow and velocities of the currents which transport the larvae (Gurney, *op. cit.*).

DURATION OF LARVAE AND ADULT BREEDING SEASON

The phyllosoma larvae of the spiny lobsters (Palinuridae) and the sand lobsters (Scyllaridae) are transparent and leaf-like, and thus well modified for planktonic existence. Thorson (*op. cit.*) considered them, especially the *Panulirus* with a pelagic life of 150 to 180 days, true long-distance larvae with wide and often circum-tropical distribution.

Lewis (*op. cit.*) described the development of the successive larval forms (11 stages) of *P. argus* found in plankton from the western Atlantic, Caribbean, and Florida Current off Miami. He

tentatively concluded from the samples off Miami that the larval development of *P. argus* is completed in about six months. Johnson (*op. cit.*) indicated that the phyllosoma larval period (11 distinct stages) of the California species, *P. interruptus*, covers about seven and three-quarter months.

Although Lewis (*op. cit.*) observed a few larvae in other months, they were found mostly in the summer and early winter months drifting northward in the Florida Current. The later stages were reached in January and February when the larvae then metamorphosed into pueruli (1st postlarval stages) and appeared under rocks and crevices. Lewis *et al.* (*op. cit.*) found the pueruli abundant in January but fewer in February and March, in both 1950 and 1951.

If the adult lobster populations of southern Florida are solely dependent upon results of spawning in the immediate area, Stage I larvae should appear in the plankton at the start and throughout the spawning period; subsequent larval stages should follow definite monthly patterns. In view of the northward flow of the Florida Current along the coast, Lewis (*op. cit.*) suggested that possibly only the early larval stages were results of the immediate spawning population of the Miami area. He further suggested that the later stages from these samplings were perhaps results of spawning in the Gulf of Mexico or farther south in the West Indies.

In southern Florida, sperm-bearing females of *P. argus* were greatest from March through June, but were observed throughout the year (Dawson and Idyll, 1951). These workers report that the spawning season there (indicated by egg masses on females) occurred from March through July, but was concentrated in April.

A few berried females appeared in October and November. Bermuda studies on *P. argus* (Sutcliffe, *op. cit.*) showed that most females were carrying eggs by June. After these eggs were shed, many of these females laid eggs for a second time within a week. Sutcliffe felt that yearly environmental changes, especially temperature, varied the time of mating and spawning from year to year. Caribbean studies by Smith (*op. cit.*) suggested that the mating and spawning of *P. argus* in the warm waters is more prolonged than in the cool northern waters. He found that during October, 1947, at Glover's Reef, British Honduras, sixty per cent of the females examined carried eggs.

SIGNIFICANCE OF WATER CURRENTS ON POPULATION RECRUITMENT

Our studies of published water current patterns have suggested that Caribbean currents may be of importance in seeding spiny lobster beds in the Florida Keys and the mainland peninsula (Sverdrup *et al.*, 1949; Liepper, 1954; Stommel, 1958; and Drum-

mond and Austin, 1958). As Figures 1 and 2 show, Caribbean currents flow out through the Yucatan Straits into the Straits of Florida. These currents in the spring flow with great velocity. Other currents sweep through into the Gulf of Mexico; some later join the Florida Current while others form several large eddies determined by coastal contours and bottom configurations (Sverdrup *et al.*, *op. cit.*)

TABLE I.
Cuban drift bottle data

Place of Origin	Date Released	Location Where Retrieved	Date Retrieved	Time Elapsed (days)
21° 48' 00" N. Lat. 84° 04' 49" W. Long.	24 May 1961	Beach, Vero Beach, Florida	27 October 1961	156
23° 15' 00" N. Lat. 80° 28' 00" W. Long.	13 August 1961	Beach, Ponte Vedra Beach, Florida	23 November 1961	71

Table I presents further current pattern evidence obtained by the recovery of two drift bottles released by the Departamento de Pesca, Centro de Investigaciones Pesqueras, Cuba. These two

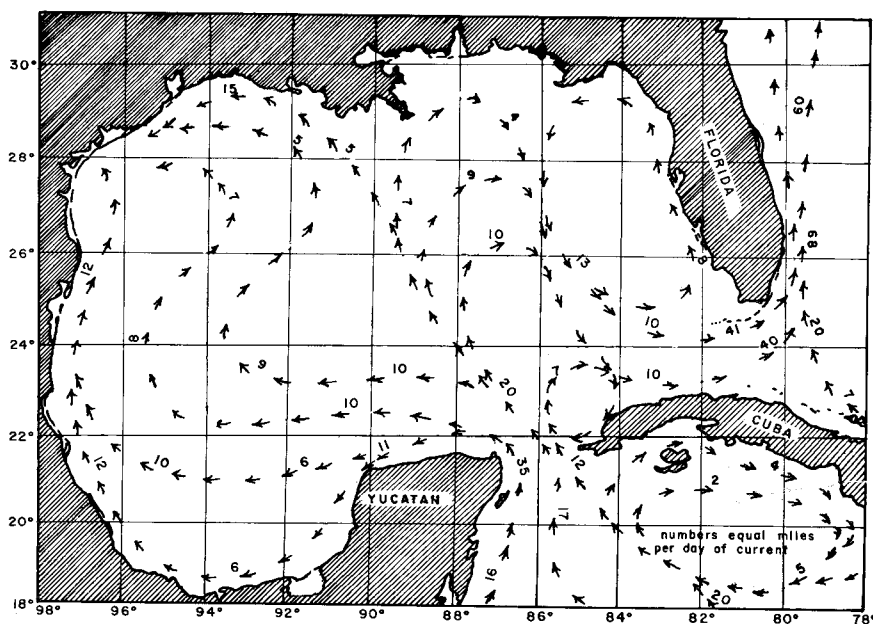


Figure 1. Surface ocean currents in the Gulf of Mexico in June (after Liepper, 1954).

bottles revealed that time elapsed for current drift from Cuba to Florida was in these cases 71 and 156 days. Presumably other bottles which would have helped to indicate the transfer of waters from Cuba to Florida passed northward in the Gulf Stream or even arrived on Florida beaches without our knowledge.

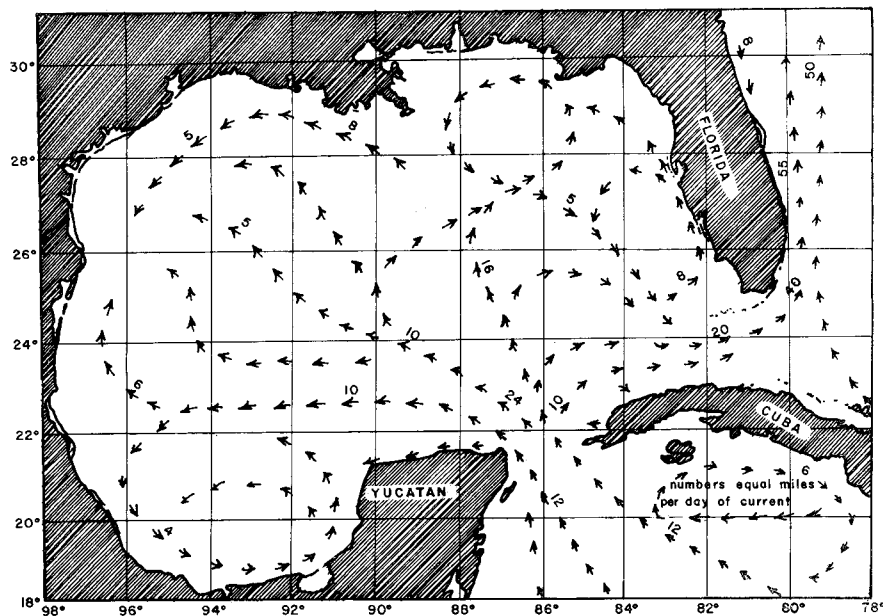


Figure 2. Surface ocean currents in the Gulf of Mexico in December (after, Liepper, 1954).

Biological evidence of summer Caribbean currents flowing through the Yucatan Straits and into the central northern Gulf of Mexico is suggested in the many records of tropical fish fauna in Louisiana and northern Florida (Caldwell and Briggs, 1957; Briggs, 1958; Caldwell, 1959; and Dawson, 1962). It is thought that the pelagic fish larvae were carried there by summer surface currents with drifting seaweed. These same currents could likewise be responsible for the larval recruitment to the spiny lobster population of the northern Gulf, since there is no evidence that this limited population is maintained by spawning females. However, Caldwell, (*op. cit.*) suggested that under certain summer conditions a few of the tropical adult fishes may spawn in the Panama City and Destin areas. Other workers have also indicated that tropical marine animals carried by warm currents northward beyond their usual habitat spawn successfully under favorable conditions (Hutchins, 1947; Radovich, 1961; and Fitch, 1962).

PRELIMINARY RESULTS OF LARVAL SAMPLINGS

Since available evidence on favorable current patterns indicated a strong possibility that spiny lobster larvae emanate from some region south of the Yucatan Straits, we initiated a sampling program to establish confirmation. Samplings are made at regular intervals along a route from Key West, westward to the Straits of Yucatan, thence south approximately 50 miles. To date three

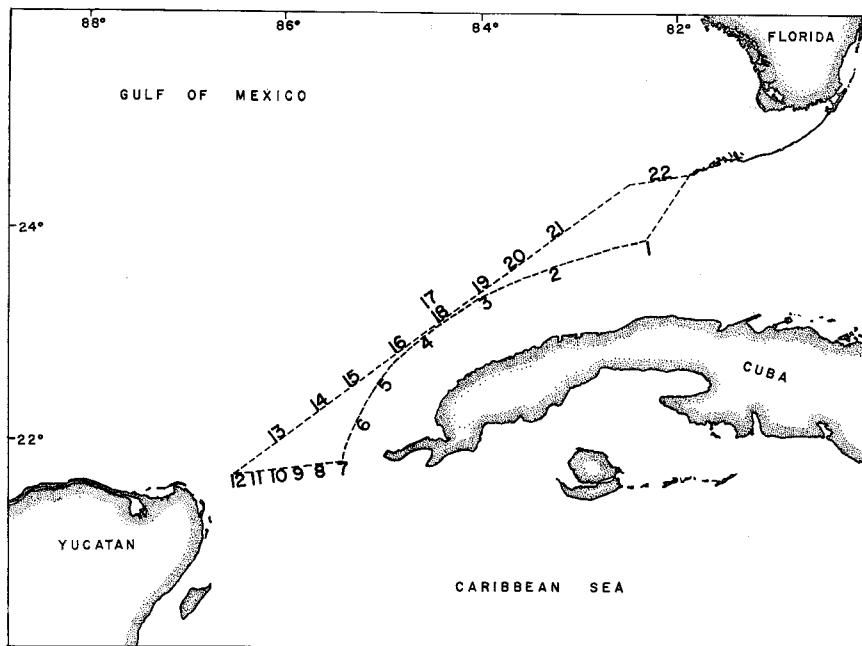


Figure 3. Approximate course of Yucatan Cruise I, showing location of stations one through twenty-two (from U.S.C. and G.S. Chart No. 1007).

sampling cruises were made in this region, but for our purpose, data obtained from Cruise I, during August, 1962, are sufficient to include here. A more exhaustive report on other cruises will be provided later.

As shown in Table II, 848 *Panulirus* phyllosomes were collected on Cruise I. These larvae were measured and identified to stages by following the work on *P. argus* by Lewis (*op. cit.*). Although species of *Panulirus* other than *argus* may be included in the total, we feel that the bulk agree closely with Lewis's identifications of *P. argus*. We also collected 90 additional phyllosomes of genera other than *Panulirus* during Cruise I and preserved them for further studies.

TABLE II.
PANULIRUS larvae collected in the Yucatan and Florida Straits
(Cruise I—2-5 August 1962)

Larval Stages	STATIONS																						Total Number of Stages
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
I											1												1
II	1										2	1* 1*											4 1*
III	5		1				2	1			1*	1								1			11 1*
IV	30	1	1					9		19	45 8*	12	1							3			121 8*
V	9	1	1				1	5		29	81 16*	188 12*	33	17 3*	1				1	1			368 31*
VI			1					3		4	19 3*	77 2*	33 1*	12 3*	1								150 9*
VII					2					4	10	21	23	9 1*		2							71 1*
VIII								1	1	3	4 2*	14	8 1*	4 1*			1	1					37 4*
IX									1	1	1	4	3	1*									10 1*
X										1	1	2	1 1*	1									6 1*
XI							1					3	1										5
Puerulus											1	1											2
Totals	45	5**	4	—	2	—	4	19	2	61	195	339	106	54**	2	2	1	1	1	5	—	—	848

* These larvae collected with a one foot diameter Turtox net (0 mesh).
All other larvae were taken with a one meter net (30 XXX, 56 cod).

** These totals include five badly mutilated specimens that could not be measured or identified to stages.

Although a few early *Panulirus* larvae appeared in the Florida Straits samples (Stations 1 and 2, Table II), and others were retrieved from the open waters northwest of Cuba, most larvae, and two pueruli, were collected in the vicinity of the Yucatan Straits (Stations 7 through 14, Table II). The combined range of larval stages (Stages I to XI) and the two pueruli found at Stations 11 and 12 indicate that spawning took place to the south over at least six months. However, the great numbers of Stages IV, V, and VI in these samples suggest that a spawning peak occurred a few months before August.

In contrast to the notable absence of *Scyllarus* larvae in the samples of Cruise I, plankton samples taken along the central western coast of Florida since the fall of 1961 revealed mostly larvae of *Scyllarus*. These phyllosomes were obtained from shallow water stations adjacent to the coast of the Tampa Bay area and out to 70 miles at depths of 192 feet. During July, 1962, a series of incidental surface plankton samples were taken off Naples, Florida, near the 200 fathom curve. One overnight drift sample (near lat. $26^{\circ} 00' N.$, long. $84^{\circ} 40' W.$) disclosed one larva of *Thenus?* and one Stage VIII phyllosome of *Panulirus argus*; another (near lat. $25^{\circ} 17' N.$, long. $84^{\circ} 23' W.$) contained one puerulus stage of *P. argus*.

We began monthly plankton samplings along the northeastern coast of Florida in the spring of 1962. Only a few cursory examinations of these samples were made, but these revealed the presence of phyllosoma larvae. A more detailed appraisal of the lobster larvae of this area will be made later.

DISCUSSION

The present findings are reported here in advance of the final treatment to acquaint marine biologists and other scientists concerned with plankton samples from the Gulf of Mexico and Caribbean Sea with the need for additional work in this field.

We need to have available numbers of plankton samples, and we must insure that those taken in the course of shrimp studies, fish eggs and fish larvae investigations, and other similar projects will be saved. We should mention here that plankton hauls taken in the Tortugas and Florida Bay areas for larval shrimp studies are providing data on larval lobsters (Iverson and Idyll, 1962). This multiple use of plankton samples has previously been discussed (Ingle, 1962), but in a survey of this scope required for spiny lobster larvae dispersal studies, wide geographical distribution of sources is extremely important.

We also wish to call attention to the usefulness of additional studies in widely separated areas on the presence (or absence) of various phyllosoma stages in particular waters. A possible benefit

of such work might be the elucidation or identification of current patterns. The long life and planktonic existence made up of well delineated larval stages could provide a very good natural device for establishing the direction of flow and rate of movement of water masses (Grice and Hart, 1962).

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