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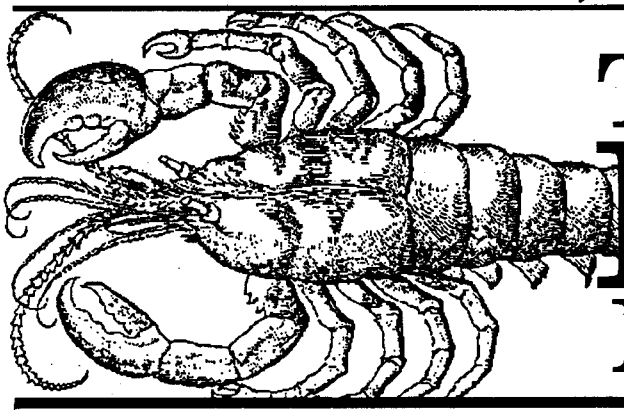

The Lobster NEWSLETTER

RESEARCH NEWS

"Larval" Life in the Egg: An Embryonic Molt Cycle in the American Lobster

FROM: BARBARA BELTZ AND SIMONE HELLUY

Our interest in the development and differentiation of the nervous system in crustaceans has lead us to an examination of the general embryonic development of the lobster *Homarus americanus*. We have established a quantitative staging system that spans the entire period from fertilization to hatching, and have documented more fully a variety of anatomical and behavioral features during embryogenesis (see Figure 1). Various aspects of the perihatching period, as well as larval and postlarval life, have been examined in detail in other labs recently. However, most of the studies concerned with the prehatching period date back to the nineteenth century, and they focus primarily on early embryonic life while largely ignoring middle and late embryonic periods.

The principal features involved in the reproduction and early development of the lobster are well known. After copulation, spermatozoa are stored by the female for several months until oviposition and fertilization occur. Egg development spans about 10 months, from egg extrusion in

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FISHERIES UPDATE

The Cuban Spiny Lobster Fishery

FROM: RAUL CRUZ

The spiny lobster is the most valuable commercial species of Cuba's sea grass and coral reef communities. The fishery began with the establishment of a processing plant at La Coloma, Pinar del Rio in the early 1930s. Recent catches (1984-1988) have averaged 12,500 t per annum, making Cuba's fishery the single most important producer of *Panulirus argus* and one of the largest lobster exporting countries in the world. Export values during this period averaged US $ 100 million per year.

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RECENT EVENTS

Marine Lobsters of the World

The mail in late 1991 brought an extraordinary compilation of the species of lobster. L. B. Holthuis has published an annotated and illustrated catalogue of marine lobster species of interest to fisheries. The families covered (which are a bit wider than we, in this Newsletter, generally talk about as lobsters) are:

Thaumastochelidae
Nephropidae
Polychelidae
Glyphidae
Palinuridae
Synaxidae
Scyllaridae
Thalassinidae
Upogebebiidae
Callianassidae.

The introductory paragraph says: "This catalogue intends to include all those species of marine lobsters that are of interest to fisheries, according to the following three criteria: (i) all species known to be used for food, (ii) species known to be sold for bait and as subproducts, (iii) species not exploited at present but considered by experts to be of potential commercial value. The last category includes deep-sea forms which during exploratory fishing cruises were found to be sufficiently

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RECENT EVENTS

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abundant, large enough in size, and sufficiently accessible to fishing gear so that a fishery for them might be profitable. Edible species found in markets as an admixture to the main catch are included, even if they only make up a negligible percentage of the catch."

The illustrations are superb, and the information is important to all lobster biologists. The book will be reviewed in a later number of The Lobster Newsletter.

New Genus of Lobster

Peter Davie of the Queensland Museum in Brisbane, Australia recently described a new genus and species of lobster. According to his paper (P.J.F. Davie 1990, Invertebrate Taxonomy 4, 685-695)*Palibythus magnificus* is a spiny lobster in the "Stridentes" group of genera in the Palinuridae. The holotype came from deep water off the coast of Savaii, in Western

Palibythus magnificus

Samoa. It differs from all other known genera, except *Palinurellus*, by having a flat and triangular rostrum, and a narrow thoracic sternum. The similarity suggests a close relationship between the two genera. However, *Palinurellus* does not have a stridulating organ. *Palinurellus* was placed in the Synaxidae by George and Main in 1967. Davie says that the close similarity to *Palinurellus* but contradictory presence of a stridulating organ in *Palibythus* suggests that *Palinurellus* should not be placed in the Synaxidae, and that both should be considered primitive palinurids. On the other hand, Holthius (1991, noted above) placed Davie's new *Palibythus* in the Synaxidae, and left both *Palinurellus* species in the Synaxidae.

Cuban Fishing Science and Technology Seminar

The Fisheries Research Center for the Ministry of Fisheries sponsored its "First Seminar on Fishing Science and Technology", held in Havana, Cuba in January, 1992. The seminar covered a wide variety of topics including 15 papers on *Panulirus argus*. Most of the authors belong to Cuba's "Centro de Investigaciones Pesqueras". They are attempting to improve both the management system and their abilities to predict catches. Below is a brief summary of the papers presented on the biology and/or fishery science of spiny lobsters.

"Tendencias de las pesquerias de langosta en el Mar Caribe y regiones adyacentes" by R. Cruz, M. E. de Leon y R. Puga.

The catch statistics were analyzed for the spiny lobster fishery of the west central Atlantic. This area yields the highest catch of Palinuridae in the world; annual landings ranged between 27 000 and 35 000 tons over the last ten years. The main fishery takes place off Cuba, Brazil, the Bahamas, Honduras and Florida. A relationship was found between the catches of the Bahamas and those of Cuba's north central shelf. This may be due to a common larval source.

"Aspectos de la dinamica de poblaciones de la langosta espinosa Panulirus argus en Cuba: Cambios en el coeficiente de capturabilidad" by R. Cruz, R. Puga y M. E de Leon.

The catchability coefficients for the two fishing methods used in the Batabano Gulf were calculated for the period 1979 to 1991. Artificial shelters are now the principal method of capture; traps are only used during October to February, the period of mass migration. Despite the interannual variability in the catchability coefficients, they are considered useful for the catch-forecasting system under development.

"Tendencias del reclutamiento a la pesqueria de la langosta Panulirus argus en el Golfo de Batabano" by R. Puga, R. Cruz y M. E. de Leon.

Recruitment to the fishable stocks of *P. argus* in the Batabano Gulf, an area that yields 60% of the Cuban catch, was assessed for the period 1974 to 1990. The recruitment index was defined as the abundance of two year olds. Three year olds make up the majority of the commercial catch. The authors showed the recruitment index, lagged by one year, explains 50% of the variation in annual landings. Work continues in an attempt to discern the other primary causes for the variance in landings.

The Lobster NEWSLETTER

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Please send change of address to John Pringle.

"Analisis de las capturas de langosta Panulirus argus en la Isla de la Juventud durante el periodo 1985-1990" by P. Sahalange.

Catch and effort data for the Island of Youth enterprise was analyzed.

"Estimacion de parametros de crecimiento de Panulirus argus del Golfo de Batabano, Cuba" by M. I. de Leon, R. Puga y R. Cruz.

The growth parameters for *P. argus* in the Batabano Gulf were updated by taking into account the length frequency compostion of juveniles in nursery areas and the adults of the fishing grounds. The results were: $L\infty$ = 190 mm CL, K = 0.31 for males and $L\infty$ = 175 mm CL and K = 0.24 for females.

"Pueden los ciclones tropicales provocar migraciones masivas de langosta?" by B. Hernandez, C. Garcia y J. Baisre.

The impact of tropical storms on *P. argus* catches in the Batabano Gulf during October to February, the period of mass migration, was assessed. The storms impact migration significantly when atmospheric pressure anomalies are high and negative.

"Estandarizacion de jaulones langosteros en el Golfo de Batabano" by A. Gonzalez, L. Cardenas y R. Fernandez.

The authors designed an inexpensive but durable trap-like net that has been used successfully on traditional fishing grounds.

The remainder of the papers covered such topics as food technology and bacterial and chemical analysis. The participants agreed the seminar was most useful in planning Cuban lobster research.

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New Species of Slipper Lobster

Md. K. Rahman wrote that he has recently described a new species of slipper, or sand, lobster in the genus *Scyllarus*. The new species, *Scyllarus tutiensis*, was found in Tuticorin Bay of the Gulf of Mannar, India. The animal matures at a carapace length of 16mm, judging from berried specimens collected in the region. The maximum size recorded thus far is 58mm total length. A paper describing the new species is now in press in the Journal of the Marine Biological Association of India.

Recent Graduates

We have been informed of two recently completed theses. Congratulations to Dr. D.S. Jayakody, of the National Aquatic Resources Agency in Colombo, Sri Lanka, who completed his Ph.D. at Stirling University in the U.K. in late 1991. His Ph.D. thesis title was "Fishery, population dynamics and reproductive biology of *Panulirus homarus* on the south coast of Sri Lanka." Congratulations also to Chris Ninnes who completed a M. Phil at the University of Newcastle. His thesis was titled "The biology and population dynamics of the lobsters *Panulirus echinatus* S. I. Smith and *Scyllarides herklotsii* (Herklots) at Saint Helena Island, with a study of their fisheries." We hope to hear more from both of them about their research.

FISHERIES UPDATE

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The fishery operates in four distinct zones around the country. Each are separated by areas with a narrow shelf (Fig. 1). The fishing grounds are characterized by sandy to rocky bottom interspersed with sea grass beds (*Thalassia testudinium*) and coral reef. There is little movement of adults among zones, thus each are managed as separate stocks.

Management regulations include a 90 day closed season (usually between March and May), a minimum legal size (210 mm total length -Lt), non-possession of egg-bearing females and a ban on spear fishing. Prior to 1978, 19% of the yearly catch was composed of undersized (shorts) animals. Stricter enforcement of short possession and a doubling of the 45 day closure were introduced in 1978. This initiative may have been in part the reasons landings increased by 3,000t in 1978 and the decrease in the incidence of shorts in the catch by 7%. Increases were also noted in both yield per recruit and average size of animals caught (Cruz et al, 1990a).

The seasonal landing pattern is similar in all zones; a decline in February and March, a minor peak with the reopening of the fishery in June and the major peak

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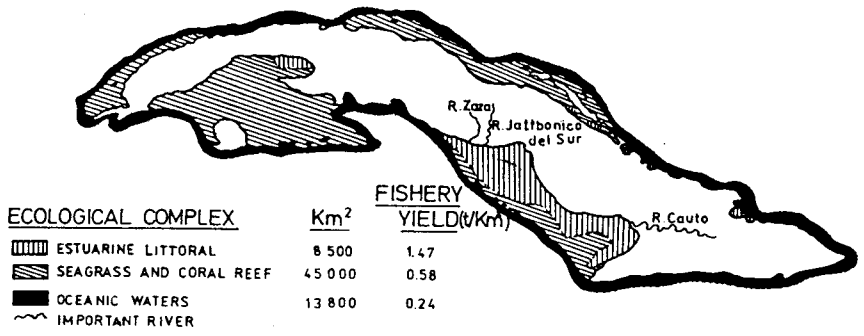

Figure 1. The island of Cuba, showing fishing zones

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occurring with the fishing of the early part of the annual lobster migration in October and November.

The fishery's nine enterprises utilize 286 boats crewed by 1286 fishermen. Each boat is allotted a fishing area with subareas from which statistics are kept on size composition and catch effort. A chief inspector per subarea monitors boat operations and adherence to regulations.

Eighty-one percent of the fishing fleet is composed of the "Cayo Largo" and "Ferrocemento" style boats which have an overall length of about 18m. Fishing trips on these boats are ten days long with five days off between trips. The "Criollo" type wooden boats range in length from 5m to 11m and make up 17% of the fleet. The remaining 2% are small inshore boats.

Gear types have changed from the traditional "Bully nets" and "Antillean traps" to "pesqueros" (artificial shelters, see figure 1 on page 7) and "chinchorros"(trawl nets), which are tended from the surface or by divers. As well, during the migration, fishery traps of chicken wire with long V-shaped leads are deployed either singularly or in groups in a zig-zag pattern. Pesqueros are used about 84% of the time.

Lobster mating begins in February or March. The incidence of ovigerous females is highest between March and May. Egg production per female ranges from 159,000 to 1,629,000 in all four zones (Cruz and De Leon, 1990). Phyllosome larvae are found in the offshore waters of the Caribbean. The pueruli move back to the shelf, peaking in abundance in September/October (Cruz et al, 1990b). Ten months later juvenile recruitment to the nursery areas peaks. These animals have a mean carapace length of 38 mm (about 17 months old). Juvenile abundance troughs in March/April, coincidental with recruitment of large juveniles (about 25 months old) on the fishing grounds (Leon et al, 1990).

Monthly surveys, to characterize juvenile habitat and assess juvenile settlement on artificial reefs, were conducted from 1982 through 1984. The highest rate of settlement was on concrete blocks. Factors found influencing settling rate included immersion time, shape, overall size, and construction material. The nurseries tend to be in relatively stable areas, and are characterized by shallow water, high temperatures, and a rich and diverse fauna. Mean density of macrobenthos was calculated at 563 organisms per m^2. Predominant groups were molluscs (32%), polychaetes (26%) and gastropods (11.5%) (Lalana et al, 1987). The foregut contents of lobsters from seagrass beds consisted of gastropods, pelecypods and the sea urchin *Lytechinus variegatus*..

The nurse shark *Ginglimostoma cirratum* is an important predator of juvenile lobsters on the commercial grounds. The foregut of 21 specimens captured in the pesqueros consisted mainly of lobsters.

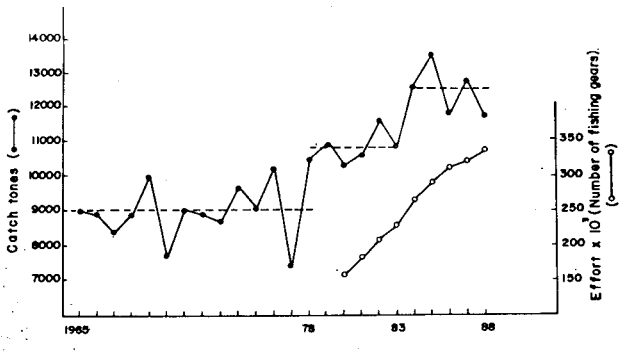

Figure 2. Catch and total fishing gears of spiny lobsters (Panulirus argus) *in Cuba.*

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Spiny Lobster Research in India

FROM: MD. K. RAHMAN

The Fisheries College and Research Institute, Tuticorin has developed a facility for lobster research since 1990. This is one of the major research programs on spiny lobsters in India. A research project titled "Mariculture of spiny lobsters" for Rs. 750,000 was funded by the Department of Ocean Development of the Government of India in January 1991. The program includes studies on nutrition, growth, reproduction, and sea ranching of phyllosoma larvae of *Panulirus ornatus* and *P. homarus*. The landings of the southeast coast of India are dominated by *Panulirus ornatus*. A lobster hatchery has been proposed for development at Tuticorin. There has been some success in the breeding of *P. ornatus* at the institute. Mature *P. ornatus* collected from the Gulf of Mannar, Tuticorin were observed to mate and breed in laboratory conditions. Last November, the Institute experimented with "sea ranching" of phyllosoma larvae of *P. versicolor*.

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ANNUAL FISHERIES YIELD

Listed below are the landings per species, per regional location for the countries from which data were received. We thank the following for their submissions: USA-B. Holgren, P. Briggs, M. Blake, A. Valliere, B. Estrella, J. Nelson, J. Krouse and A.C. Jones; New Zealand-J. Booth; South Africa-R. M. Smith; and Canada-G. Roach, A. Pelletier, P. Hudson, J-P. D'Allaire, A.M. Russel, and E. Gauvin. R. Duggan collated the USA and Canadian data.

The Lobster Newsletter has readers in all lobster producing countries in the world. Our objective is to have annual yields for each of these states. If you have access to your countries fisheries data and your country is not included below, please arrange to have it sent to J. D. Pringle by December of each year. We are now receiving 1991 data. Please write us and ensure your country or region is represented!

Country	Species	Location	Seasons	Landings (t)
USA				
	H. americanus	New Jersey	1990	997
		New York	"	1,272
		Conneticut	"	1,200
		Rhode Island	"	3,241
		Massachusetts	"	7,514
		New Hampshire	"	544
		Maine	"	12,733
		USA Total		**27,501**
Canada				
	H. americanus	Nova Scotia	1990	22,700
		New Brunswick	"	8,850
		Prince Edward Is.	"	10,205
		Quebec	"	3,311
		Newfoundland	"	2,917
		Canadian Total		**47,983**
New Zealand				
	Jasus edwardsii		1990	3,136
	Jasus verreauxii		"	1
South Africa				
	Palinurus delagoae	East coast	1989	14
			1990	13
	P. gilchristi	South coast	1989/90	970
			1990/91	974
	J. lalandii	West coast	1989/90	3,491
			1990/91	2,996
USA				
	P. argus	Florida	1990	2,606
		Puerto Rico	"	77

RESEARCH NEWS

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late summer to hatching the following spring. Following extrusion, the eggs are attached to the pleopods where they are carried for the duration of embryonic life.

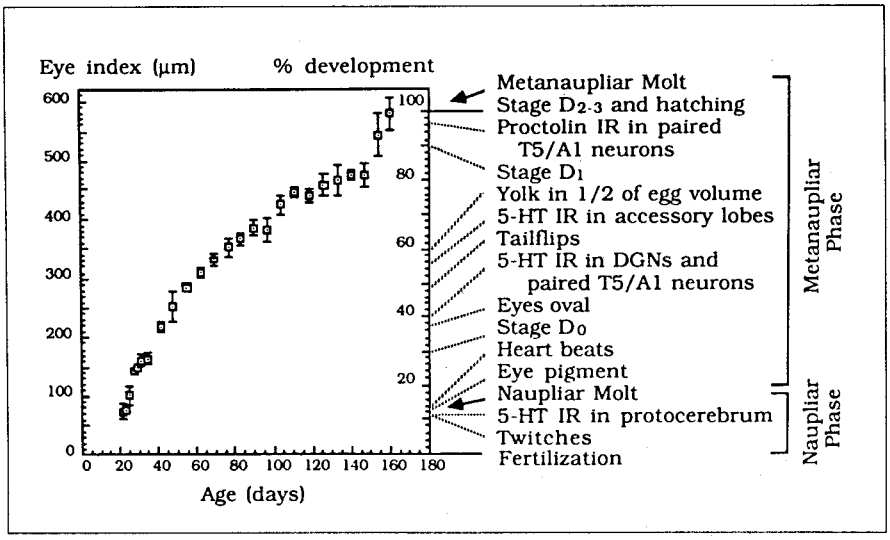

Figure 1. Eye index and percent-scale of embryonic development versus age in a brood of Homarus americanus, *maintained at 18° c.*

In our studies of the embryonic period, behavioral, morphological, anatomical, and morphometric data were gathered from whole eggs and dissected embryos (Helluy and Beltz, 1991). These data were related to a percent-staging scheme based upon the size of the pigmented area in the lateral eyes (the eye index of Perkins [1972]; see Figure 1).

The embryonic period consists of two stages: the naupliar phase and the metanaupliar phase. About 12% of the way through embryonic development (E12%) an envelope enshrouds the telson and is stretched at the tips of the bilaterally paired setae on the telson of the nauplius (Figure 2, top). We think this envelope is the exuvia of the naupliar stage. The metanauplius (which also could be called a prelarva) emerges into the egg at the time this exuvia is lifting from the tegument of the nauplius. From this "naupliar molt" until the appearance of the first larval stage after hatching (the "metanaupliar" or "prelarval" molt), a complete molt cycle is observed in the setal changes in the telson. Tegumentary and setal changes typical of different stages of the molt cycle have been described by Rao et al. (1973) and Sasaki (1984) in larval lobsters, and by Aiken (1980) in older lobsters. We have found that following the naupliar molt, the embryonic lobster undergoes strikingly similar tegumentary and setal changes in the telson. These changes consist of a lifting of the cuticle from the setae (stage D0, starting at about E30%); invagination of the setae and lateral spines and scalloping of the epidermis (stage D1) at about E80-90% when all the spines and setae of the first larval stage telson are already formed. Just prior to hatching (E100%), retraction of spines and setae is maximum. At hatching, the bulging of the epidermis around the setae is pronounced (stage D2-3, Figure 2, middle). Therefore a complete molt cycle spans most of the time spent in the egg, and during that molt cycle the first stage larva is forming under the metanaupliar cuticle. This molt cycle is completed just after hatching, when the metanauplius (or prelarva) molts, shedding the metanaupliar exuvia and releasing the first stage larva.

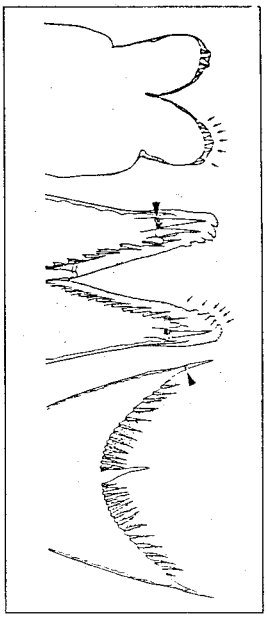

Figure 2. Telsons of Homarus americanus *at the naupliar molt (top), at the metanaupliar (or prelarval) molt after hatching (middle), and in a first larval stage (bottom).*

Embryonic molt cycles have been reported in other crustaceans. However, with the exception of the possibility of early embryonic molts cited by Herrick (1895) and Bumpus (1891), no mention is made of a protracted embryonic molt cycle in lobsters. Besides our intrinsic interest in the mechanisms by which *Homarus* develops, the presence of this embryonic molt cycle raises several fascinating issues related to the hatching process. We propose that the molt and hatch are tightly coupled, and that the molt may precipitate the events of the hatching (Helluy and Beltz, 1991). Following maximum retraction of the setae and spines prior to hatching, the lateral spines of the telson extend from their retracted position. Because these lateral spines are hardened and sharp, it is very possible that their extension could trigger the tearing of the egg envelopes, as the caudal spines do in the embryo of a prawn (Kidd, 1991). By this means, the metanauplius at the end of its molt cycle would precipitate hatching. The beating of the pleopods of the mother would help the larva to slip out of its membrane shroud.

Among friends, we liken this view of the hatching process to that of a bird initiating

hatching using its egg-tooth! Thinking about hatching in this way endows the embryo with an active role in gaining its freedom. Another curious twist to our data is related to theories of nineteenth century carcinologists, who suggested that during the course of evolution early larval stages of some decapods had been relegated to embryonic life. If so, the presence of the embryonic molt cycle in *Homarus* suggests that during much of the relatively long 10-month developmental period, *Homarus* embryos are (technically speaking) really larvae in disguise!

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Dynamics of Shelter Selection in the Caribbean Spiny Lobster

FROM: D. B. EGGLESTON
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Shelter use by the Caribbean spiny lobster, *Panulirus argus*, appears to be regulated by predation risk, modified by social condition (solitary individuals versus groups of animals) and scaling, the matching of lobster body size to shelter size. The latter two factors play a role in the protective capacity of the den.

Despite the apparent importance of gregarious sheltering and shelter size to spiny lobster survival (Berrill 1975, Eggleston et al. 1990), no information exists on these factor's influence upon shelter selection. Hence, we recently addressed the following two questions (Eggleston and Lipcius, in press). First, what is the impact of shelter size, social condition and predation risk on den choice? Secondly, does within-shelter lobster size frequency change with time, habitat type and conspecific abundance? We were also interested in developing a conceptual framework which would allow these types of questions to be answered.

To address these questions we designed field enclosure experiments in Bahia de la Ascension, Mexico that examined the effects of a common predator, the nurse shark *Ginglyostoma cirratum* Gmelin, upon den choice by *P. argus* juveniles and adults. To corroborate the findings of the enclosure experiments we investigated *P. argus* seasonal, size-specific abundance patterns in the field by deploying different sized artificial lobster shelters (casitas; Fig. 1) in two habitats: an inner-bay, sand/seagrass flat with high lobster densities; and an outer-bay, coral reef/seagrass bed with low lobster densities.

The experimental and observational field results were strikingly similar - social condition and scaling regulated den choice of adult and juvenile lobsters, particularly under high predation risk. When conspecific density and predation risk were low, lobsters resided primarily in scaled shelters; when conspecific density was high and predation risk low, lobsters were gregarious, opting for voluminous, non-scaled shelters; when conspecific density and predation risk were both high, lobsters shifted to gregarious habitation in smaller shelters; and, when predation risk was high and conspecific density was low, lobsters occupied smaller, scaled shelters. Large shelters offered the highest potential for gregariousness, attracting significantly larger numbers and a broader size range of lobsters than medium or small shelters, particularly at the inner-bay site where lobster densities were high. Medium sized shelters at the outer-bay site concentrated medium-sized, juvenile lobsters only, while small shelters at both sites were only occasionally inhabited, and then by small juvenile lobsters. The frequency of gregariousness was much higher where lobsters were dense (inner-bay), than where lobsters were sparse (outer-bay). Given the relative importance of conspecific density and shelter size to shelter selection (Eggleston and Lipcius, in press), the impact of commercial harvesting of large juvenile and adult lobsters from nursery habitats should be assessed. For example, reduced lobster densities in fished areas might cause small, juvenile lobsters to be less gregarious and to search for a more limited size range of shelters, thereby increasing predation risk.

Den habitation patterns of *P. argus* may be modelled schematically

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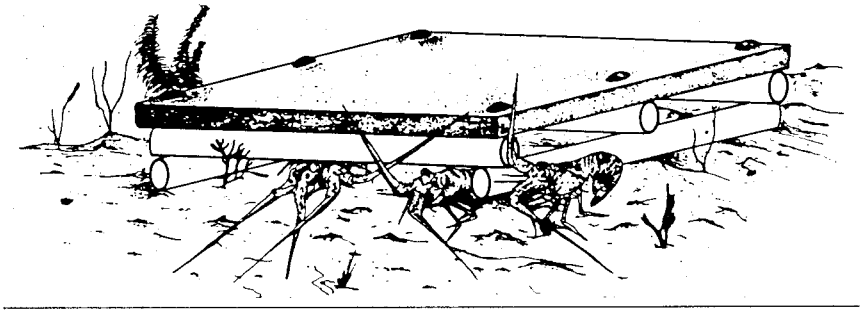

Figure 1

RESEARCH NEWS

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(Fig. 2) based on the following features. Under low predation risk (Fig. 2a), residency pattern in large shelters will increase sigmoidally as lobsters become gregarious above some low lobster density threshold, and reach an asymptote when large shelters reach their maximum carrying capacity, Thereafter, proportional residency in large shelters (or increases in small shelters) declines to an intermediate value because of the unavailability of large shelters. (Note: there is also the possibility that the function between lobster proportional occupancy in small and large shelters and lobster density is linear or hyperbolic rather than sigmoid). Under high predation risk (Fig. 2b), the lobster density above which residency in large shelters increases is higher, compared to that under low predation risk, due to the tendency of lobsters to scale themselves to shelter size in the presence of a predator. Thereafter, lobsters demonstrate the same den use patterns exhibited above (see Fig. 2a). This model reflects the dynamic behavioral flexibility inherent in spiny lobster den selection as a function of varying abundances of predators, conspecifics and suitably scaled shelters.

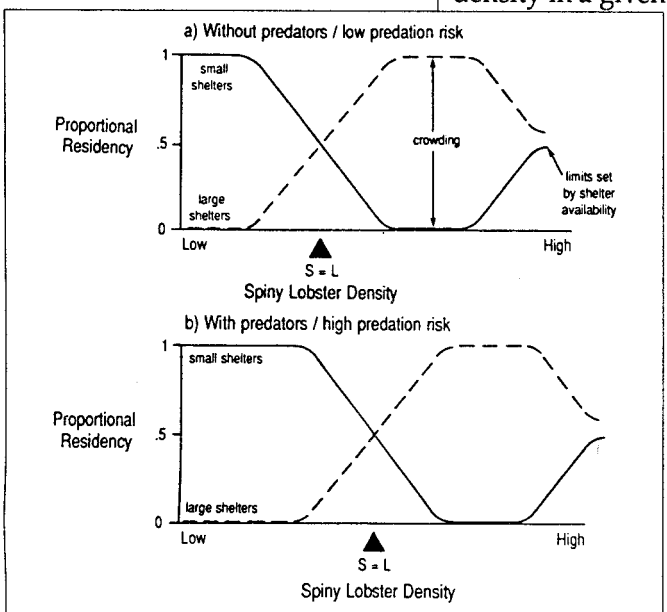

Figure 2. Hypothetical den residency patterns.

Our study showed that conspecific density in a given habitat can enhance gregariousness in spiny lobsters, which in turn influences the relative impact of lobster size, shelter size, and predation risk upon den choice. In defining the critical determinants of den choice for *P. argus* we also provide an empirical and conceptual framework for identifying how variation in the availability of resources, such as conspecifics and appropriately scaled refuges, influence the distribution and abundance of social, shelter-dwelling species.

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Why do Shovel-Nosed (Slipper) Lobsters Have "Shovels"?

FROM: EHUD SPANIER
AND DANIEL WEIHS

One of the most typical and obvious features of the morphology of slipper lobsters , family Scyllaridae , is their extremely flattened antennae and especially the antennal flagellum which is reduced to a single plate. The latter forms the sixth and the final segment of the antenna (Holthuis,1991). This flat appearance of the frontal part of the body is responsible for the common names "shovel - nosed lobsters" and "bulldozer lobsters" used for many species in this family. But do these lobsters really use their flat antennae the way mechanical bulldozers use their shovels? Do they dig or move soft sediments with these appendages? Slipper lobsters which dwell in rocky habitats like the Mediterranean slipper lobster *Scyllarides latus*

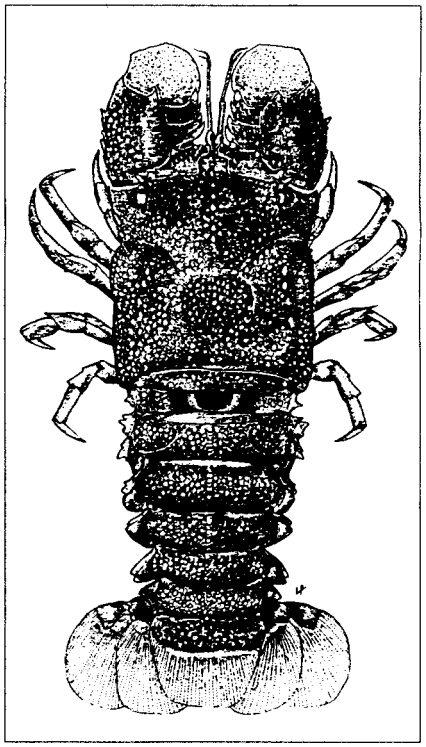

Figure 1. The Mediterranean slipper lobster Scyllarides latus.

(Fig.1) cannot use their antennae to manipulate the hard substrate. Even when held in laboratory aquaria with soft sediments they have not been observed to bury or dig. Species of slipper lobsters which naturally inhabit soft substrates, such as sand or mud, i.e., the flat- head or Australian bay lobster,*Thenus orientalis* , do bury in the soft sediment for concealment (Jones,1988). Yet,the telson and uropods are involved in this process, and not the large plate - like antennae as George and Griffin (1972) speculated. So, if they do not function in moving sediments, why had these features evolved?

the fast backwards escape swimming or tail flip (Fig. 2). Spanier *et al.* (1991) demonstrated that this was a "burst and coast " type of swimming where large amplitude movement of the telson propelled the lobster quickly backwards, alternating periods of acceleration with powerless gliding.

This fast (0.5 - 3.6 body lengths/ second) intermittent swimming may bring the fleeing lobster to a safe shelter within a very short time. The movement includes a vertical component or lift as shown also in the swimming of two species of scyllarid lobsters in Australia (Jacklyn and Ritz,1986). The

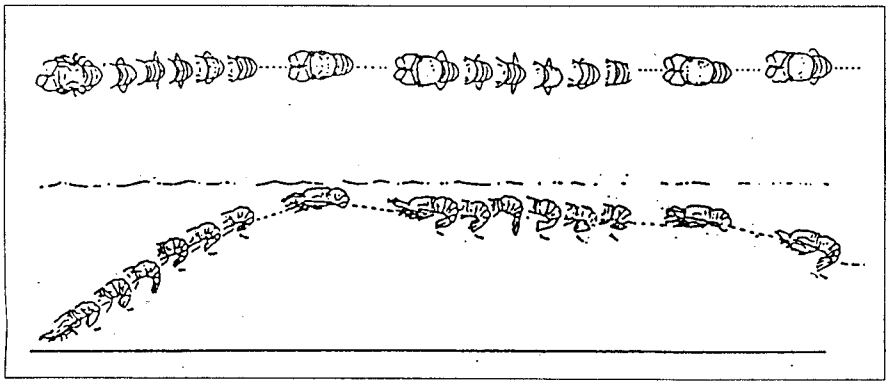

Figure 2. Schematic representations of a swimming sequence of the Mediterranean slipper lobster.

Our recent studies of the Mediterranean slipper lobster suggest that these shovel - like antennae are involved in at least two anti-predator defense behaviors. Diurnal fish, such as the grey triggerfish, *Balistes carolinensis* , may attack this lobster when it is in an exposed area. Barshaw and Spanier have observed recently two types of strategies in response to this attack - clinging to the rough substrate or escape swimming. In both cases the predator initiated its attack on the vulnerable antennulae and mouth parts of the lobster. The lobster may use the movable segments of its armored flat antennae to cover and protect these fragile and essential organs. The alternative defense strategy of this, and many other species of slipper lobsters, is

flattened antennae with their various movable parts and articulations play an important hydrodynamic role in controlling this movement. While "taking off" the antennae are pointing downwards producing a vertical lift which results in a pitching moment around the center of mass. This compensates for forces that tend to tilt the frontal edge of the animal upwards.While accelerating they serve as stabilizers and rudders. In the gliding phase they are kept in a funnel-shape posture to increase stability, prevent rolling and reduce drag. Their proper positioning while performing turns reduces the risk of the animal turning over.

Finally while landing the antennae are spread to slow the lobster before it touches down.

In view of these versatile hydrodynamic functions of the flattened antennae of these lobsters ,would not it be more proper to call them "rudder-nosed" lobsters?

REFERENCES

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Jacklyn, P.M. and D.A. Ritz (1986). J.Exp.Mar.Biol.Ecol. 101: 85-99.

Jones, C.M. (1988) Ph.D. Dissertation, University of Queensland.

Spanier, E.,D. Weihs and G. Almog-Shtayer (1991). J. Exp. Mar. Biol. Ecol. 145: 15-31.

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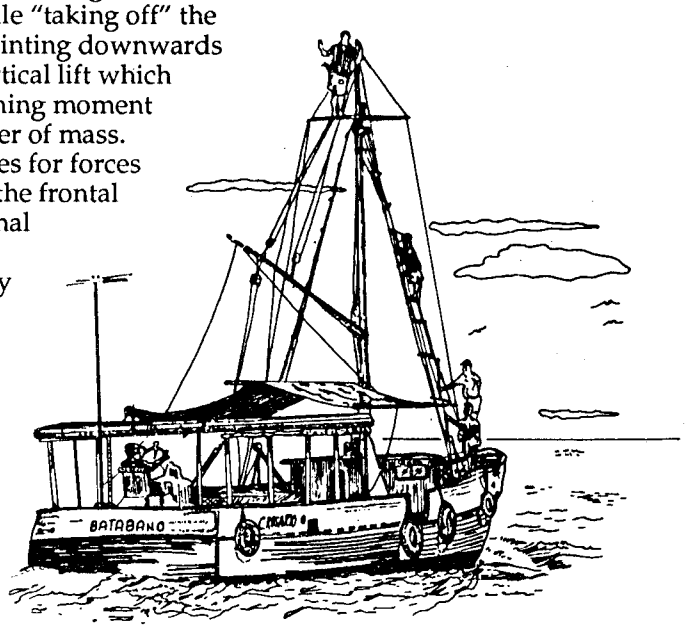

LETTERS

I am starting to prepare a comprehensive review of the family Scyllaridae (some common names: slipper lobster, shovel nosed lobster, spanish lobster, bug, bulldozer, fan lobster), and would appreciate the assistance of your readers. Any information regarding geographical and ecological distributions, general biology, physiology, reproduction, natural history, ecology, behavior, and fisheries is needed. I would be pleased if you could send me publications, list of references, names of scientists, photographs and illustrations as well as any other material you think might be relevant. Thank you very much!

Ehud Spanier
Center for Maritime Studies
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Haifa, ISRAEL, 31999

Actuellement, je suis à Montpellier pour préparer une thèse sur la bioécologie, la dynamique de population, l'évaluation et la gestion de stock de langostes côtières exploitées dans le Sud de Madagascar (24 et 2540' de latitude Sud puis 43 30' et 47 25' de longitude Est) dont je suis originaire. A ce fin, je suis intéressé per les rapports de l'atelier international a la Havane, et aussi dans la mesure du possible des revues ou publications que vous jugez me rendre utiles.

Recevez, avec mes remerciements anticipés pour votre compréhension, l'expression de mes sentiments les meilleurs.

Edouard Mara
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Case Courrier 093
34095 Montpellier, Cedex, 5
FRANCE

I have been receiving The Lobster Newsletter for some time now and would finally like to take the opportunity to introduce my company, "Bioenrichment Technologies." I will be producing cultured *Artemia* biomass (adults) for enrichment using primarily emulsified fish oils (omega-3s). I would be interested to know if there might be any interest among researchers and aquaculturists in a frozen, HUFA (highly unsaturated fatty acids) enriched, adult Artemia as a high-quality food source. I will try to keep you more informed as this project develops. Keep up the good work!

David K. Kawahigashi
5241 Keakealani St.
Honolulu, HI 96821 USA

The following was seen on the OMNET OCEANS Bulletin Board:

Searching for Lobster Specialists

Mr. Bruno Bautil, working in the Seychelles Fishing Authority in Victoria, Mahe, on the sunny Island of Seychelles in the Indian Ocean is currently working on "The development of the Lobster Fishery in the Seychelles." He has produced a report with the same name: a copy can be obtained upon request.

Mr. Bautil is looking for other scientists who are working on lobsters, preferably in tropical areas. If you fit this description then please contact him! He can be reached via OMNET at RECOSCIX.MOMBASA, or via fax at (248) 24508.

Ed. note: a mail address was not given, but we presume it to be:

Bruno Bautil
Seychelles Fishing Authority,
Victoria, Mahe Island,
SEYCHELLES.

ANNOUNCEMENTS

Next International Lobster Workshop:

Sanriku, Japan
July 25 - 31, 1993

Jiro Kittaka chairs the organizing committee of the next International Workshop on Lobster Biology and Management, to be held at Kitasato University, School of Fisheries Science, Sanriku, Japan. Dr. Kittaka and the workshop committee announced that the subjects covered in the workshop will be:

Early Life History: Distribution and Ecology; stages of development
Recruitment: Settlement
Physiology: Sensory systems, Feeding, Reproduction
Biochemistry: Nutrition, Composition, Color
Aquaculture: Larval Culture, Grow-out, Water Quality, Feeds
Restocking: Present Situation and Prospects

The workshop will address both basic and applied research on spiny, rock and clawed lobsters.

The organizing committee is working to keep expenses low. They expect that US$100 per day (excluding travel) will suffice.

A post conference tour of the Sanriku coast and to inland hot springs will be organized.

For further information, contact:

Dr. Jiro Kittaka
School of Fisheries Science
Kitasato University
Sanriku, Iwate 022-01
JAPAN
Phone: 81-192-44-2121
Fax: 81-192-44-2125

Cuba Workshop Proceedings Available Soon

Julio Baisre, convenor of the Third International Workshop on Lobster Ecology and Fisheries (Havana, June 12-16, 1990) recently wrote to say that despite some initial difficulties, the Proceedings of the Workshop soon will be printed. All the participants will receive a copy free of charge. A limited number of copies will be available to libraries and research institutions. The price has not yet been announced.

For further information, write to:

Dr. Julio Baisre, Director,
Ciencia y Tecnica
Ministerio de la Industria Pesquera
Barlovento, Santa Fe, 19100
Cuidad Habana, CUBA

...MORE ANNOUNCEMENTS ON BACK PAGE

BOOK REVIEW

Lobsters: Florida, Bahamas, the Caribbean

REVIEWED BY: D. PEZZACK

Martin A. Moe, Jr., Green Turtle Publications, P.O. Box 17925, Plantation, FL 33318. ISBN 0-939960-06-0. 510 pp. Numerous black and white drawings, and photographs.

"Lola's new exoskeleton was fully formed under the old, and she was making final preparations for the molt during her quiet days. Some calcium from the old shell was reabsorbed into her system, especially from a thin line along the bottom of the carapace just above the legs.

On the day of the molt, Lola began to take water into her tissues. She held the water against an osmotic gradient and exerted pressure against her old rigid shell."

Scientific writing? No. An effective way of explaining the molting process to the non scientist? Yes.

In this book, Martin Moe Jr., undertook the challenge of presenting the complexities of the Florida lobsters biology and its management, to a non scientific audience in a form that is informative, readable, but not patronizing. He has succeeded. He has produced a fact filled-book that should be of interest to students, fishermen, divers etc., those wanting a general introduction to the subject.

He introduces the reader to the life history of the lobster through a dramatic narrative that follows the life of a single animal, "Lola," from hatching to her ultimate capture in the fishery. He emphasizes the important events in her life such as larval settlement, molting, and migration. He even includes a scene in which she was captured as a short and nearly died because of improper handling. The approach may not appeal to a scientist, but the targeted audience should find it a readable and interesting account.

But, he does more then just tell a story. He follows it up with an addendum that gives a scientific and technical explanation of the account. He even helps the reader along. Topics described in detail are numbered in the narrative to allow the reader easy reference to them. The technique is effective.

The book consist of six chapters: 1) *Natural History*, which includes the narrative; 2) *Taxonomy and morphology*; 3) *Identification and species accounts*, which includes a basic key, line drawings and a short description of 20 taxa; 4) *Lobster care and culture*, on methods of holding lobsters in aquarium, culturing larval stages and the potential for lobster farming; and 5) *The recreational fishery*; and 6) *The commercial fishery*, which describe the the histories of the fisheries, as well as the theories behind, and methods of, fisheries management. The book ends with a reference section and Appendices of Florida, Federal Regulations and important phone numbers for fishermen in Florida. He has left little out.

The author has recognized that there are many fishermen, and divers interested in the natural history of lobsters and biology. This same keen interest occurs in Canadian lobster fishermen as well. They always have, observations, questions and ideas. They want to know more about the beast from which they make their living, but find the scientific literature difficult and are confused by the scientific jargon we use so freely. This book interprets the science in a way most could understand, while not shying away from technical terms or concepts; explaining ideas such as growth and recruitment over fishing, yield and eggs per recruit and M, F and Z in a clear fashion.

This book will be a useful guide and reference book to anyone interested in a general introduction to the biology and fisheries of Florida, Bahamas and Caribbean lobster.

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ANNOUNCEMENTS

New Newsletter

A new newsletter devoted to the molecular biology of crustaceans has just commenced publication. In its first number, the editors (Alice Brown, Ann Bucklin, and Lisa Kann) write: "This newsletter is intended for ecologists and evolutionary biologists working primarily at the population level, who are applying molecular techniques. The idea is to help us get over the technical hurdles in order to answer interesting questions. In aggregate, we have invested 5 years exploring various molecular approaches. We now are eager to share our findings and exchange ideas, successes, and failures. We hope this will help us as a group to reduce each individual's time (and money) spent on technical problems. ... We welcome your input and critiques and encourage your participation in future issues. This is intended to be an informal sharing of ideas. ... Please send your ideas, articles and addresses to us."

For more information, write:

Alice Brown
Box G-W, Brown University
Providence, RI 02912 USA

European Aquaculture Society Publications

Two new special publications have been issued recently by the European Aquaculture Society:

Larvi '91 covers the short communications and abstracts presented at the "Symposium on Fish and Crustacean Larviculture", Gent, Belgium, August 27-30, 1991. Price: BF2200.

Aquaculture and the Environment covers short communications and abstracts presented at the conference "Aquaculture Europe "91", Dublin, Ireland, June 10-12, 1991. Price: BF1975

For information:

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B-9000 Gent, BELGIUM
Telephone 32-91-23 77 22
Fax: 32-91-23 76 04

Next International Lobster Workshop:

Sanriku, Japan
July 25 - 31, 1993

European Crustacean Conference

The First European Crustacean Conference will be held in Paris, France, from 31 August to 5 September 1992. This conference will welcome anyone having an interest in Crustacea. The program will focus on: (1) systematics and phylogeny; (2) aquaculture and fisheries; (3) ecology and ecotoxicology; (4) nutrition and metabolism; and (5) endocrinology and neurobiology. It will include lectures by invited speakers, selected oral communications, poster presentations, and free communications. The conference is being organized by: the Muséum National d'Histoire Naturelle, the Ecole Normale Supérieure, and the Université Pierre et Marie Curie (Paris VI).

For more information, contact:

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Européene sur les Crustacés
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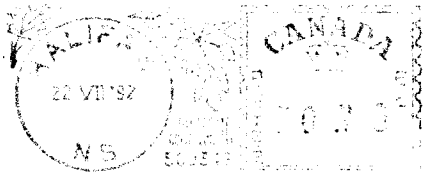

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