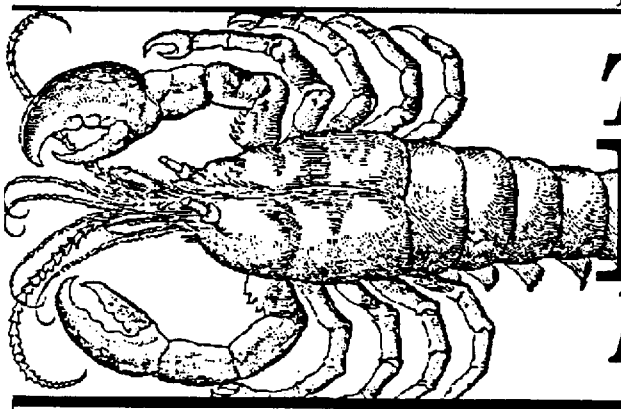
VOLUME EIGHT JULY 1995 NUMBER ONE



The Lobster NEWSLETTER

RESEARCH NEWS

A Trans-Atlantic Perspective on *Homarus* Recruitment

FROM: RICHARD A. WAHLE

For the better part of a decade scientists in New England and the Canadian Maritimes have made important strides in understanding the processes that influencing the benthic recruitment of the American lobster. Published reports have identified cobble and boulder as an important nursery habitat for lobsters (Hudon 1987, Wahle & Steneck 1991, Incze & Wahle 1991), and in many ways this habitat remains one of the last frontiers of descriptive benthic ecology. That is because cobble defies traditional sampling techniques. For example, cores and grabs used in sand and mud tend to break on cobble, and photo-quadrats just do not tell the whole story. For cobble, the suction sampling method has opened a window not only on early benthic phase lobsters, but on the associated fauna as well. This tool has allowed us to begin learning how potentially competing species may influence lobster recruitment. Here I make a trans-Atlantic comparison of cobble habitat fauna that reveals dramatically higher species diversity, but lower numbers of *Homarus* in Europe than in New England. This suggests a multispecies approach to recruitment issues is warranted.

In the autumn of 1994, I worked with John Mercer, of the Shellfish Research Laboratory of University College, Galway, Ireland, who coordinated my dive surveys of sites on the southwest coast where a lobster

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RECENT EVENTS

Taxonomic Changes

Two recent publications bring tidings of a new genus of Nephropid lobster and a new species of the Palinurid genus *Palinustus.*

Kornfield, Williams and Steneck (1995 Fish. Bull. 93: 97-102) report that the Cape lobster of South Africa, *Homarus capensis* (Herbst, 1792) should be transferred to the monotypic new genus *Homarinus*. The species is known from only a few specimens. The known individuals are small

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FISHERIES AND AQUACULTURE UPDATE

LOBSTER FISHERIES OF INDIA

FROM: E.V. RADHAKRISHNAN

Spiny lobsters form one of the most valuable crustacean resources of India. The richness of the lobster fauna is brought about by the range of habitats available - rock and mud through to coral reef. Annual landings increased from 350 t in 1965 to 3,000 t in 1975, but declined sharply to 680 t in 1980. The fishery recovered to 4,100 t in 1985, but has generally declined since then (Fig. 1). Slipper lobsters also are taken commercially.

Distribution

Spiny lobsters are widespread along the 6,100 km coast of India (which includes the Arabian Sea, the Bay of Bengal, and the Lakshadweep and Andaman and Nicobar Islands). The major fisheries are in the northwest (Veravel and Bombay), the southwest (Colachel) and the southeast (Tuticorin, Mandapam, and Madras) (Fig. 2). Among the nine spiny lobsters present, *Panulirus polyphagus, P. homarus, P. ornatus,* and the deep sea lobster, *Puerulus sewelli,* are the most significant commercial species. *P. versicolor*

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stock enhancement program was ending its second year of hatchery-releases (Mercer and Brown, 1994). I also traveled to the Channel Islands, UK, which, dispite their small size, have some of the largest lobster landings in Europe.

Remarkably, there are still no reports of newly settled European lobsters in the wild, providing an added challenge for our efforts. By November's end we had sampled eight sites in three study areas. Here, I compare the diversity, abundance, and diversity of taxa to that noted with equivalent sampling effort in New England cobble beds. I restrict this report to non-hermit crab, shelter-dwelling decapods inhabiting cobbles during part or all of their lives.

In New England the picture is fairly simple; diversity is relatively low (Fig. 1). In the Gulf of Maine, *Homarus americanus* and *Cancer irroratus* , the rock crab, are by far the two most abundant subtidal species in cobble. (*Carcinus maenas*, the green crab, is more abundant intertidally). *Cancer borealis*, the Jonah crab, common as adults in traps, is extremely rare as juveniles. In the northern Gulf of Maine these decapods were far less abundant than to the south and west, an historic pattern for which the mechanism is still unresolved. In southern New England though, xanthid crabs add to the mix of decapods, and tend to be most abundant where *Cancer* is not.

In Ireland and the Channel Islands, in contrast, species diversity was much higher (Fig. 1), but *Homarus* and *Cancer* were least abundant in Europe despite major fisheries for both groups. Four other decapod families dominated: xanthid crabs, galatheids, porcellanids, alpheids. At least two to three species were found in each family. We were indeed disappointed not to find newly settled *H. gammarus* even at "ground-zero" of the Irish release sites. Despite differences in faunal composition, the collective densities were similar on both sides of the Atlantic, ranging between 20-80 individuals per square meter.

Small individuals dominated the populations (Fig. 2) with size modes between 5 and 15 mm CL or CW which, for a least the porcelain crabs, xanthid crabs, and snapping shrimp approximates the adult size. Only those species that get much bigger (i.e., greater than 30-40 mm), like lobsters and *Cancer* spp., do not maintain lifelong association with cobble.

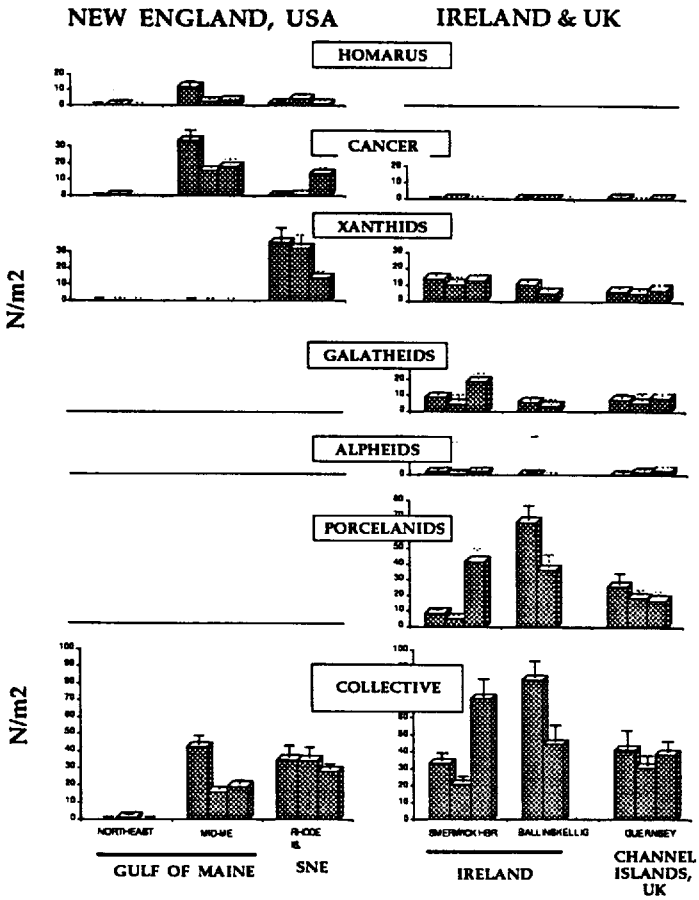

Figure 1. Average population densities (+ 1SE) of decapod fauna in cobble habitats of New England and Ireland/Channel Islands. Each bar represents a study site where twelve 0.5 m² quadrats were suction sampled. SNE = southern New England.

The Lobster NEWSLETTER

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The Lobster Newsletter is cosponsored by Fisheries & Oceans, Canada and the Rhode Island Sea Grant Program. It is published twice yearly.

Please send change of address to John Pringle.

Why didn't we detect young lobsters? If commercial landings are a reasonable index of abundance, it's possible our sampling effort was inadequate to detect *H.gammarus*. Recent landings of *Homarus* throughout Europe have only been about 1/40th of North American landings, about equivalent to the landings of the state of Rhode Island. (Ireland and the UK comprise about 3/4 of Europe's landings). Densities of lobsters of all sizes in central Maine (USA) cobble beds average about 3 - 5/ m^2; and one-fortieth of that would give a density of 0.07 - 0.12 /m^2. At that density, according to Poisson analysis, we would expect our sampling effort of 108 half-square-meter quadrats to produce 102 quadrats with no lobsters and 6 with one lobster. Thus, by this coarse analysis with no correction for fishing effort or coast length, we might have expected very few lobsters. Our less systematic visual searches, totaling five additional dive-hours, did produce two lobsters: a large berried female at 110 mm CL, and a juvenile at 40 mm.

Why would the European lobster be rare in cobble if it is ecologically similar to the American lobster? Several untested hypotheses exist. First, fishing has undoubtedly depleted stocks, and although there is a minimum harvestable size, there is no consistent protection for egg-bearing females throughout the species range, so larval production is likely to be quite low. But that explanation seems insufficient to explain the apparent absence of new recruits at the Irish release sites seeded with tens of thousands of hatchery-reared lobsters over two years.

A second hypothesis is that postlarval *H. gammarus* is not as ecologically similar to *H. americanus* as as assumed; perhaps it prefers a nursery habitat other than cobble? That explanation seems unlikely too, however, given the similarity to *H. americanus* in shelter-seeking behavior and habitat preference (Berrill 1974). All the early benthic phase *H. gammarus* in a seawater pond at the hatchery were under rocks, shells, and plastic placed on the bottom for cover. Moreover, with the sampling effort that has gone into other habitats over the years, such as sediment coring, one is hard pressed to think what other habitat they might occupy.

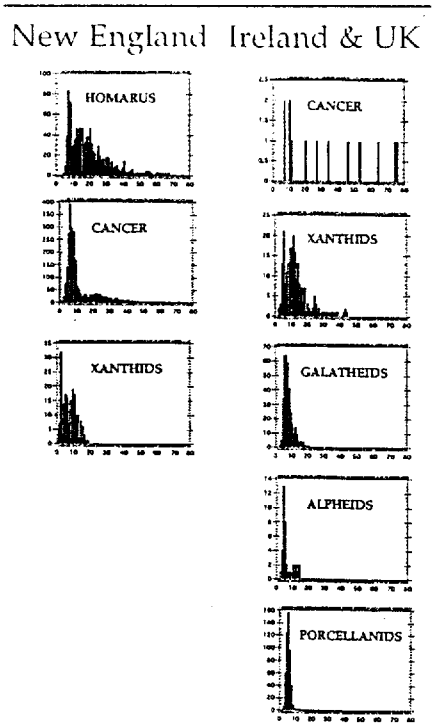

Figure 2. Representative size composition of decapod populations from cobble habitats in New England and Ireland/Channel Islands.

A third hypothesis is that species interactions might inhibit successful recruitment to the benthos. This explanation seems consistent with the data presented here. There are, however, many unknowns when it comes to species interactions. What is the nature of interaction, predatory or competitive? If it is competitive, what is the limiting resource? Shelter is likely to be at least one, but we know very little about the carrying capacity of these habitats for*H. gammarus*. For the American lobster though, we have determined carrying capacity through saturation seeding experiments of standardized cobble plots where quantity of cobble was manipulated (Wahle & Incze in review). From those experiments carrying capacity was estimated to be at the highest benthic recruitment density seen in nature, around 5 - 6/ m^2. This low putative carrying capacity suggests there are space requirements beyond shelter we do not yet understand for the American lobster.

Nonetheless, all these taxa seem to have similar habitat requirements, but we have little knowledge of the nature of the interaction. We clearly need to devise models and experiments to test hypotheses, because the benefit will be a greater insight into the recruitment process as well as the efficacy of stock enhancement. In any case, there seems to be a need to go beyond the single species approach to fully understand the factors that influence recruitment of a target fishery like *Homarus*.

LITERATURE CITED

Berrill, M. 1974. J. Mar. Biol. Ass. UK 54: 797-801.
Hudon, C. 1987. Can. J. Fish. Aquat. Sci. 44: 1855- 1869.
Mercer, J.P. & Brown, R. 1994. Aquaculture in Ireland. (Apr-May): 20-24
Incze, L.S. & R. A. Wahle. 1991. Mar. Ecol. Prog. Ser. 79: 77-87.
Wahle, R.A. & R.S. Steneck. 1991. Mar. Ecol. Prog. Ser. 69: 231-243.

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RESEARCH NEWS

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Sampling Puerulus and Juvenile Spiny Lobsters from Shallow Rock Reefs using SCUBA

FROM: C. NORMAN AND T. YOSHIMURA

The study of the settlement process of puerulus and juvenile stages of spiny lobsters has been hampered by difficulties in locating and quantitatively sampling specimens in their natural habitat. The habitat of settled puerulus and early stage juveniles appears to vary between species and may also vary within species between localities. Reported habitats of settled puerulus on natural substrates can be split into at least 2 groups:

1) algal/vegetation dwelling, e.g. *Zostera* beds (*Panulirus interruptus*, Serfling & Ford, 1975), *Laurencia* spp. and mangrove roots (*P. argus*, Witham et al., 1964; Marx & Herrnkind, 1985); and

2) rock face/hole dwelling, e.g. holes in limestone reefs (*P. cygnus*, Jernakoff, 1990) and in pholad (bivalve) holes (*Jasus edwardsii*, Booth, 1979).

Pueruli of *P. japonicus* have been sampled from a broad range of artificial habitats as well as from both algal *Gelidium spp.* (Fushimi, 1978) and rock reef face holes (Yoshimura & Yamakawa, 1988). For the past 10 years or so, Professor H. Yamakawa (Tokyo University of Fisheries) and Taku Yoshimura have been examining the settlement behavior of puerulus and ecology of juvenile *P. japonicus*. Our research has concentrated on determining which habitat (algal or hole) is most frequently used by *P. japonicus* and whether habitat use is consistent between localities.

Of the various habitats we examined, only holes in rock faces and *Gelidium spp.* (tengusa in Japanese), a fine leafed red seaweed, were used by puerulus and juvenile *P. japonicus* in the natural environment. The distribution of dense beds of *Gelidium spp.* is restricted in Japan. Even at those localities where *Gelidium* is dense, holes appear to be preferred. At 6 sites along the southern coast of Japan the principal habitat of puerulus stage and early juvenile *P. japonicus* was holes in the rock face of nearshore reefs (Yoshimura et al, 1994; Norman et al., 1994). Holes used by pueruli and early juveniles appear to be of various origins, but those of dead pholads appear to be used where available. Pholads bore into rock and form often spherical, smooth and straight holes that may penetrate deep into a rock face. To capture specimens in this habitat and other hole systems we use a simple technique to remove small crustaceans from holes without damaging them so that they can be tagged and returned to the same hole intact.

The main problem with sampling pueruli from rock reefs is initially locating the specimens to be sampled. Our repeated dives in southern Japan show pueruli to be most abundant in holes on inclined or vertical faces in the proximity to the stem and holdfast of large brown or red algae. At first, locating the pueruli requires some practice, however once you 'get your eye in' then spending a dive puerulus hunting can be quite rewarding. Movement of the 2nd antennae can be very helpful. Pueruli and early juveniles of *P. japonicus* sit at the openings of the holes with their 2nd antennae protruding out. Their 2nd antennae are the first portion of the body to pigment and the color progressively darkens once settled. Pueruli have relatively short, straight 2nd antennae which bear few or no visible hairs. Pueruli characteristically raise these antennae up and down, often in a flicking motion, raising one side while lowering the other. From the first stage onwards, juveniles have highly pigmented 2nd antennae bearing many fine hairs. The 2nd antennae of juveniles are more flexible and move in a less rigid motion than those of the puerulus. The 2nd antennae of juveniles orient towards any intruder and may also beat in shallow up and down movements. Both these movement patterns, once observed, can be useful in the location of pueruli and juveniles. To notice the movement it is often easiest to look obliquely along the rock face. Once your eye is 'in,' if puerulus are present, finding them and juvenile stage lobster may be easier than first anticipated.

Capturing pueruli is very simple. We use a clear plastic bag (approximately 5-10 cm wide by 10-15 cm long - size depending on the size of animal to be taken) and 2 lengths of wire. The plastic bag is made into a net by making a circular loop of wire and attaching it around the mouth of the plastic bag. While diving, on observing a specimen for sampling, the bag is placed over the hole and over the second antennae protruding from it. Then the other piece of wire is pierced through the bag and inserted into the hole. Gently teasing the telson/uropod region incites an escape response and the animal will flee the hole and is caught in the plastic bag. We have used this technique to sample approximately 700 juvenile lobsters and several hundred stomatopods. It requires some practice - particular care should be taken in gently teasing as opposed to macerating and sampling the animal in parts!

One of us (Yoshimura) has found hole dwelling in two other species, *P. longipes* and *P. penicillatus*, as well. Holes are a settlement site for pueruli and preferred habitat

during the early juvenile stages (Yoshimura et al., 1994). We are very interested in determining if this hole dwelling behavior by pueruli is an exception or is the norm for spiny lobsters. We would like to hear of observations of puerulus or juvenile spiny lobsters from reef face holes or other natural substrate. Happy puerulus hunting!

Literature Cited

Booth, J. D. 1979. N.Z. J. Mar. Fresh. Res. 13(3): 395-406.

Fushimi, H. 1978. Benthos Res. 15/16: 60-66. (in Japanese).

Jernakoff, P. 1990. Mar. Ecol. Prog. Ser. 66: 63-74.

Marx, J. M. & W. F. Herrnkind 1985. Bull. Mar. Sci. 36(3): 423-431.

Norman, C. P., H. Yamakawa & T. Yoshimura, 1994. Crustaceana 66(3): 366-383.

Serfling, S. A. & R. F. Ford, 1975. Fish. Bull. (U.S.) 73: 360-377.

Witham, R. R., R. M. Ingle, H. W. Sims, 1964. Quart. J. Florida Acad. Sci. 27: 289-297.

Yoshimura, T. & H. Yamakawa, 1988. J. Crust. Biol. 8(4): 524-531.

Yoshimura, T., H. Yamakawa & C. P. Norman, 1994. Crustaceana 66(3): 357-365.

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Current Research on the Hormonal Control of Crustacean Molting

FROM: E. CHANG

Unlike most other animals lobsters, and all other arthropods, must shed their confining exoskeletons in order to increase in size. Many physiological events precede ecdysis in the course of the molt cycle. The current paradigm of the hormonal control of molting in decapod Crustacea is that a factor from the eyestalk sinus gland, a molt-inhibiting hormone (MIH), inhibits the synthesis and/or secretion of ecdysone, the precursor to the molting hormone, by the molting gland (Y-organ) (reviewed by Chang, 1993). Ecdysone is then hydroxylated by target and other tissues to form the active molting hormone 20-hydroxyecdysone (20E). This paradigm has been developed over the past century. Recent research, however, indicates that other factors, both inhibitory and stimulatory, may regulate molting.

Molting Hormones (Ecdysteroids)

Injections of 20E have been known for many years to shorten the intermolt period when the injections are made prior to premolt. We recently demonstrated, however, that a single injection of exogenous 20E during premolt results in a subsequent delay in ecdysis (Cheng and Chang, 1991). We concluded that both the initial rise in circulating hormone concentration and a coordinated decline are necessary for successful molting.

The primary secretory product of the Y-organ is ecdysone but the situation is more complex than first thought. Other researchers have observed the Y-organs of some crabs to secrete other ecdysteroids, namely 3-dehydroecdysone and 25-deoxyecdysone. More research must be conducted on the determination of the ratios of the different ecdysteroids secreted by the Y-organs of various species at different developmental times.

The response to the molting hormones may be mediated not only by the concentration of the hormone, but by the concentration of specific hormone receptors. With collaborators (El Haj *et al.*, 1994), we identified ecdysteroid receptors (EcR) in walking leg extensor muscle and eyestalk neural tissue of the lobster *Homarus americanus*, using a monoclonal antibody to the EcR of *Drosophila melanogaster*. Protein blots using the EcR antibody hybridized with a 95-110 kiloDalton protein from the lobster tissues examined. Of the tissues examined, muscle, epidermis, and eyestalk neural tissue, only those from premolt lobsters cross-reacted with the antibody as shown by the immunocytochemistry. Intermolt tissues did not cross-react. Sections of eyestalk neural tissue showed cytoplasmic localization of the EcR in the neuroendocrine cells of the X-organ/sinus gland complex. These results indicate that in addition to the rising concentration of ecdysteroids at premolt, the concurrent appearance of cellular receptor molecules may be necessary for successful ecdysis.

Molt-Inhibiting Hormone

The synthesis and/or secretion of ecdysone by the Y-organ appears to be inhibited by the neuropeptide called molt-inhibiting hormone (MIH). MIH is synthesized by the eyestalk X-organ neurons and stored in the sinus gland, a neurohemal organ. We recently reported the complete amino acid sequence of lobster MIH (Chang *et al.*, 1990; Chang, 1995). A closely related neuropeptide from the lobster eyestalk sinus gland is the crustacean hyperglycemic hormone (CHH) which regulates the hemolymph level of glucose. Lobster MIH has high hyperglycemic activity. Lobster CHH, however, has low MIH activity. Our designation of these peptides as MIH and CHH are a consequence of these observed differences in activity. Their actual physiological roles remain to be fully elucidated. CHH may also play a role in osmoregulation in *H. americanus* (Charmantier-Daures *et al.*, 1994). The actual role of the individual members of this family of multifunctional peptides in vivo remains to be determined.

Another member of this peptide hormone family is the vitellogenesis-inhibiting hormone of *H. americanus* (Soyez *et al.*, 1991). As far as I know, the activity of this peptide has not yet been reported in either CHH or MIH assays.

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Thus the CHH/MIH/VIH peptide family appears to be a novel group of crustacean neuropeptides that include representatives from the major decapod groups.

Stimulation of Molting by Methyl Farnesoate

It has recently been reported that crustaceans have a terpenoid hormone that is homologous to the insect juvenile hormone (JH; Borst *et al.*, 1987; Laufer *et al.*, 1987). This hormone is methyl farnesoate (MF), an unepoxidated precursor of JH III. The glandular source of MF is the mandibular organ. We previously demonstrated that exogenously added MF has a small, yet significant effect on larval lobsters (Borst *et al.*, 1987).

Many years ago, we observed that implantation of crab mandibular organs into shrimp resulted in more frequent molting resulting in shortened molt cycles (Yudin *et al.*, 1980). The molt stimulation was not due to ecdysteroid secretion by the mandibular organ. Stimulated by these earlier observations, we examined the effects of MF on crustacean ecdysteroid production both in vitro and in vivo. Crab (*Cancer magister*) molting glands were cocultured with or without a crab mandibular organ. The culture medium was assayed for ecdysteroids using radioimmunoassay. Those molting glands cocultured with a mandibular organ had significantly higher levels of ecdysteroids in culture after 12 hr (Tamone and Chang, 1993). We have not yet repeated this experiment with lobsters due to the difficulty in culturing lobster Y-organs. In another experiment, exogenous MF was added to the culture water containing first stage larval lobsters. At various times, these larvae were extracted for ecdysteroids and assayed using radioimmunoassay. After 48 hr, the larvae incubated with exogenous MF had significantly higher levels of ecdysteroids compared to control larvae cultured with water only (Chang *et al.*, 1993).

With the increasing interest in the aquaculture and fisheries of lobsters and other decapod crustaceans, there will be an increased requirement for knowledge about the basic biology of these animals. As more research is conducted in the area of crustacean endocrinology, I think will further modifications to the paradigm of the hormonal control of molting will have to be made.

Literature Cited

Borst, D. W., H. Laufer, M. Landau, E. S. Chang, W. A. Hertz, F. C. Baker, and D. A. Schooley. 1987. Insect Biochem. 17:1123-1127.

Chang, E. S. 1993. Ann. Rev. Entomol. 38:161-180.

Chang, E. S. 1995. J. Exp. Mar. Biol. Ecol. Submitted.

Chang, E. S., M. J. Bruce, and S. L. Tamone. 1993. Amer. Zool. 33:324-329.

Chang, E. S., G. D. Prestwich, and M. J. Bruce. 1990. Biochem. Biophys. Res. Commun. 171:818-826.

Charmantier-Daures, M., G. Charmantier, K. P. C. Janssen, D. E. Aiken, and F. Van Herp. 1994. Gen. Comp. Endocrinol. 94:281-293.

Cheng, J.-H. and E. S. Chang. 1991. Biol. Bull. 181:169-174.

El Haj, A. J., P. Harrison, and E. S. Chang. 1994. J. Exp. Zool. 270:343-349.

Laufer, H., D. Borst, F. C. Baker, C. Carrasco, M. Sinkus, C. C. Reuter, L. W. Tsai, and D. A. Schooley. 1987. Science 235:202-205.

Soyez, D., J. P. Le Caer, P. Y. Noel, and J. Rossier. 1991. Neuropeptides 20:25-32.

Tamone, S. L., and E. S. Chang. 1993. Gen. Comp. Endocrinol. 89:425-432.

Yudin, A. I., R. A. Diener, W. H. Clark, Jr., and E. S. Chang. 1980. Biol. Bull. 159:760-772.

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Phyllosoma Larvae in the South-east Atlantic: A Case for Long-Distance Dispersal

FROM: D.E. POLLOCK, G. BAILEY, AND P. VAN DER BYL

Some intriguing results have emerged from two large-scale oceanographic survey cruises in the S.E. Atlantic, one conducted in March 1989 (cf. Pollock 1991), the other in June 1992. During both surveys, which had multi-disciplinary physical/chemical oceanographic objectives, standard one-hour tows were made nightly with research midwater trawls in oblique tows from approximately 100 m to near-surface. Station positions on the first survey, together with numbers of phyllosoma larvae captured are shown in Figure 1 [reproduced from Pollock (1991)]. The results show that *Jasus* larvae (most likely a mixture of both the oceanic island species *J. tristani* and the continental species *J. lalandii*) were distributed widely in high densities across some 3,000 km of ocean, some larvae even being found to the west (i.e. up-current) of Tristan da Cunha Island. These larvae were captured by a midwater trawl net with a mouth opening of 8 m^2 (the RMT-8 net), towed at a speed of approximately 2.5 knots.

Figure 2, from the more recent international BEST-1 survey (June 1992) shows station positions, together with the numbers of *Jasus* and *Panulirus* larvae captured. The Methot midwater trawl net, with a mouth opening of 5 m^2, captured surprisingly large numbers of *Panulirus* larvae together with the expected high densities of *Jasus* larvae. Examination of the *Panulirus* larvae by experts in Australia (Drs. Paddy Berry and Paulette McWilliam) indicated that nearly all the *Panulirus* larvae belonged to a single species, *P. versicolor*. Surprising results indeed, because *P. versicolor* is a

tropical Indian Ocean species. The findings therefore suggest that large numbers of phyllosoma larvae originating in the Indian Ocean must have been transported by the Agulhas current into the Cape Basin during the months preceding the survey. Transport of heat, salt and biological material from the Indian Ocean to the South-east Atlantic is known to take place via the shedding of rings and eddies of Agulhas current water near the Agulhas current retroflection area into the S.E. Atlantic, but this is the first evidence obtained from a purely biological source, of large volume transport of thermocline water between the two oceans.

Contrary to some earlier observations (see Research News article in Vol. 5, No. 2 of the Lobster Newsletter), the results presented here suggest that phyllosoma larvae (including those of certain *Jasus* species) are not always, as a general rule, confined to the vicinity of adult stocks, but may be mixed widely over vast distances of ocean, and are even capable of being transported from one ocean basin to another by ocean currents. In other instances, however, phyllosoma larvae appear to be largely retained within distinct oceanographic regions, as in the well-documented case of larvae of *Panulirus cygnus* off Western Australia.

These findings suggest that a variety of larval transport and return mechanisms may exist, with some species occurring in regions where local larval retention predominates (eg. Western Australia), while others occur in regions characterized by much larger spatial distributions within very large scale recirculating systems (eg. S.E. Atlantic *Jasus* species). If this is correct, then a key factor for successful recruitment would appear to be a pronounced ability for phyllosoma larvae to delay metamorphosis until they reach areas suitable for settlement. A major challenge remains to identify what cues are responsible for triggering metamorphosis of final-stage larvae into the puerulus stage.

REFERENCES

Pollock, D.E. 1991. S. Afr. J. Mar. Sci. 10: 1-12

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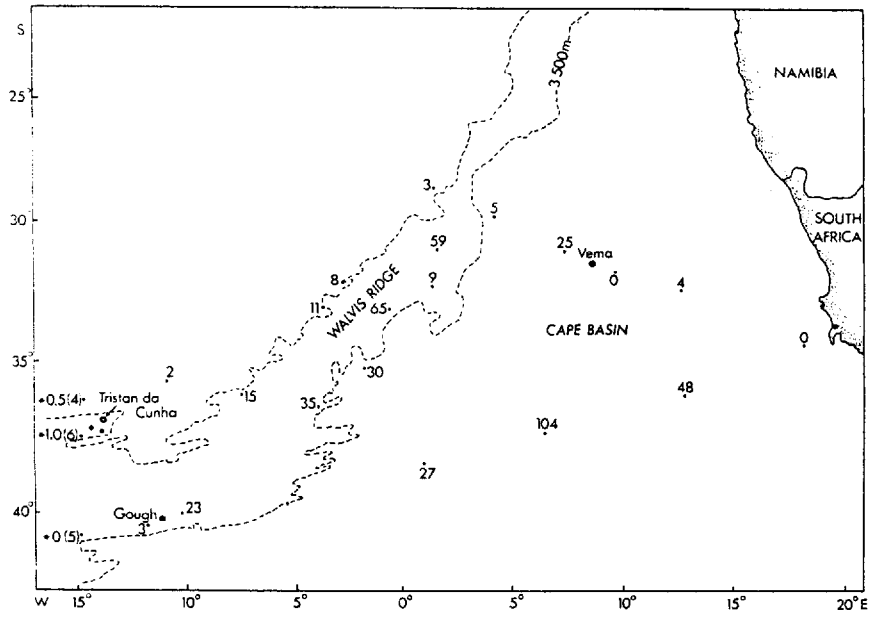

Figure 1. Location of RMT-8 stations occupied by F.R.S. Africana showing numbers of Jasus *larvae caught per one-half hour tow (From Pollock, 1991)*

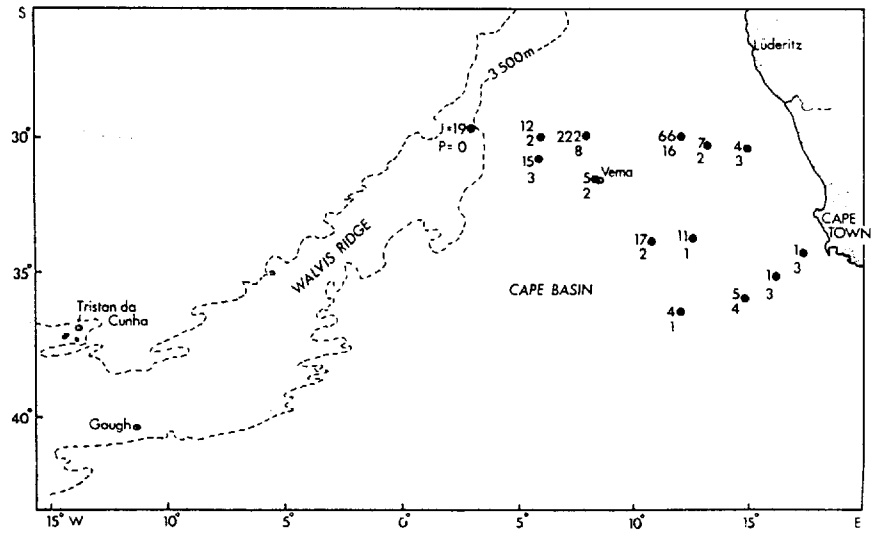

Figure 2. Location of Methot net stations occupied by F.R.S. Africana showing numbers of Jasus *(top value) and* Panulirus *larvae (lower value) caught per one-hour tow in the Cape Basin*

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Lobster Phyllosomata from Offshore NZ Waters

FROM: JOHN BOOTH

Phyllosomata of *Jasus edwardsii* are abundant up to 1,300 km off the southeast coast of New Zealand's North Island. A fine-meshed, midwater trawl was used in March 1995 to determine if the distribution and abundance of mid- and late-stage phyllosomata correlate with year to year variation in puerulus settlement or whether settlement levels are driven by factors such as ocean climate. Our previous sampling showed that phyllosomata were abundant to at least 400 km off shore. To index larval abundance, we needed to know the extent of the larval pool.

The trawl was 65 m long with a mouth area of 80 m². The 12 mm mesh retained larvae from about stage 5 onwards. Sampling occurred at night, with 30-min tows at 20-100 m. An average of 135 larvae per 0.5 h tow were captured, but at stations 1,100 km from shore we caught up to 900 (average over 600) per tow (see Figure). Phyllosomata numbers fell dramatically beyond the Louisville Ridge; the ridge thus marks the eastern extent of the area of high larval abundance. Most larvae were mid-stage *J. edwardsii* from the previous spring's hatch, but there were also many final-stage larvae from hatchings in some previous year. There were also small numbers of *Scyllarus aoteanus* and *Ibacus alticrenatus* larvae.

It was remarkable how dominant *J. edwardsii* phyllosomata were in the offshore macrozooplankton, both numerically and in biomass. The 600 l of plankton collected in the 66 trawls contained almost 9,000 *Jasus* larvae. There were typically 2-3 l of plankton at each offshore station containing 100-900 larvae. We do not know if March 1995 was unique for the numbers of larvae present, but we think not because the numbers we caught 50-400 km from shore on this voyage were similar to those taken there in 1994.

New Zealand lies within a general west to east oceanic flow, so why don't larvae continue to drift east, away from New Zealand? Waters southeast of North Island are noted for recirculation and eddying; we assume the East Cape Current (ECC) System retains larvae nearshore, but physical oceanographers have yet to define the eastern boundary of this system. Judging from the above biological evidence the Louisville Ridge, a prominent feature often rising 4000-5000 m to within 300 m of the surface, may contain the ECC system.

Where do larvae come from? This is an important management question, but one not easily answered. There are large commercial populations of *J. edwardsii* along the southeast coast of North Island. Larval production is high because females breed for 8-10 years before recruiting. It appears most larvae in the ECC System are from local hatchings, but they may come from other parts of New Zealand.

The numbers of larvae we caught in March 1995 can be contrasted with what we caught with the same net on a transect through the South Atlantic and Indian Oceans, and the Tasman Sea in June 1991 (*The Lobster Newsletter 5(2)*). Similar numbers of *Jasus* phyllosomata were found in the latter survey, but only within 400 km of South Africa and southern Australia. Numbers decreased further from shore.

The scale of the larval pool off southeast North Island seems to be larger than observed elsewhere for *Jasus* , and similar to that found for *Panulirus cygnus* off Western Australia.

Literature cited

Booth, J.D. 1994. Crustaceana 66: 295-317.

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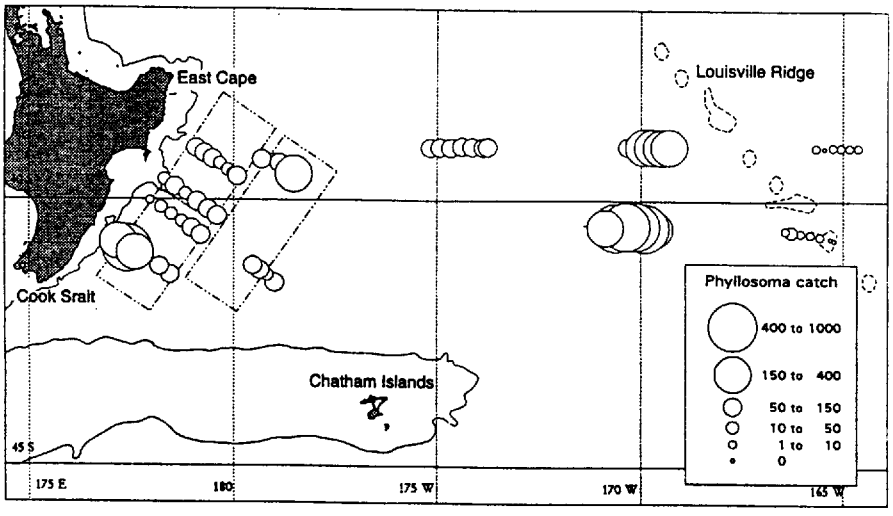

Figure Catches (number per 30-min trawl) of mid- and late-stage phyllosoma larvae of Jasus edwardsii *off the east coast of the North Island, New Zealand, March 1995.*

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(maximum observed carapace length: 47 mm). The chelae, and to a lesser extent the carapace and tail fan, are covered with plumose setae. Photographs in the article show a distinct red coloration. Other morphological differences between the new genus and *Homarus* include structure of the male pleopods, tooth pattern on the cutting edges of the first chelae, and the shape of the rostrum. The authors also report that there is significant divergence in the sequence of the mitochondrial 16s rRNA gene between the new genus and the two species of *Homarus* found in the North Atlantic. Apparently, Williams and other carcinologists had long been aware that the Cape lobster should not be included in the genus *Homarus*, and the independent genetic work by Kornfield and Steneck provided the final impetus for the joint taxonomic decision and publication.

In the most recent number of the Journal of Crustacean Biology (15 (2): 376-394), T.-Y. Chan and H.-P. Yu reviewed and illustrated the distinguishing characteristics of the four species of the rare spiny lobster genus *Palinustus*. A total of 54 specimens are known for the entire genus. From this material, the authors described the new species *P. holthuisi*. The new species is most closely related to *P. unicornutus*, from which it can be separated by the lack of serration on the posterior margin of abdominal tergite VI. *Palinustus holthuisi* is distributed around Japan and Taiwan at a depth of about 100m.

Two New Records of Scyllarids from the Indian Coast

FROM: E.V. RADHAKRISHNAN, C. KASINATHAN AND N. RAMAMOORTHY

Two female specimens of *Parribacus antarcticus*, both measuring 70 mm carapace length, and one male *Scyllarides tridacnophaga* (71 mm CL) were found off Mandapam in the Gulf of Mannar, on the southeastern coast of India. Earlier, a single male specimen of *P. antarcticus* was recorded from Minicoy, an island off the southwest coast of India. *S. tridacnophaga* is reported for the first time from Indian waters. A paper on this is in preparation.

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Second Mexico-Cuba Workshop: Langosta '94

FROM J.A. BAISRE AND R. CRUZ

The Second Binational Mexico-Cuba Workshop on the management of artificial shelters and population dynamics of the spiny lobster, took place October 17-21, 1994 in Havana, Cuba. Julio Baisre and Raul Cruz were co-chairs of the workshop. Sixty-five participants from 10 countries of the region were in attendance as well as Bruce Phillips from Australia who came to the meeting as a representative of FAO.

The main goal of the workshop was to develop scientific exchange within the framework of biological and fisheries research on lobster in the Caribbean region and the American Pacific, to make a direct exchange among scientific in the region possible, to create a basis for future coordinated research, and to develop a cooperative and integrating view in such a way that all the countries can benefit from these results.

A total 40 papers were presented in 5 sessions. Three software programs for the evaluation and management of lobster fisheries were demonstrated.

The program included 4 introductory conferences showing the status of knowledge on taxonomy and evolution of Palinuroidea (J.A. Baisre); Oceanic processes, recruitment of puerulus and management of Western Australia lobster (B.F. Phillips); Ecological data of lobster living in the deeper reefs to SW of Cuba (A. Herrera); Artificial Shelters used for the spiny lobster (*Panulirus argus*) fisheries in Cuba (R. Cruz). The book entitled "Spiny Lobster Management" (B.F. Phillips) and a paper on Spiny Lobster Fisheries in the Caribbean (R. Cruz) were presented.

In Session 1 (Larvae and Oceanography) the result on the vertical

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distribution of larvae and different oceanographic aspects related to the life cycle of the species were debated.

Session 2 (Recruitment and Forecast) covered aspects related to the variability of larval and juvenile lobster recruitment. An abstract on the procedures that should be used for the catch of puerulus through collectors as well as significant aspects on the feasibility to do a forecast for lobster catch, in regions and area, by using the abundance of juveniles.

In Session 3 (Biology and Ecology) a review of reproduction dynamics of *Panulirus argus* in its area of distribution was presented as well as aspects related to fecundity, breeding, the latitude and gonadal cycle, and recruitment in *Panulirus interruptus*. An update of age and growth in the four fishing regions of the Cuban archipelago and the different biological-fishing aspects of the lobster in Costa Rica, Providencia and Santa Catalina islands and Colombian Caribbean. The role of natural shelter in the distribution of *P. argus* and *P. guttatus* also was discussed. The variation of microecology of lobster juvenile was an interesting aspect.

Session 4 (Artificial Shelters) included aspects related to the use and management of artificial shelters (called pesqueros or casitas) in spiny lobster (*P. argus*) fisheries in Cuba and Mexico. Aspects related to fishery intensity in artificial shelters and traps during the mass migration in Cuba were discussed, as well as the feasibility of the introduction of artificial habitats in other areas of the Mexican Caribbean and the presentation of a research project to assess their impact on benthic environments.

Session 5 (Fishery) included papers on the status and development of lobster fisheries in Cuban waters; the present status of fisheries in the SW of the Gulf of California; the space-time variation of lobster catches in Baja California and lobster fisheries in the Dominican Republic. The interpretation and use of CPUE index in lobster fisheries as well as new works on the selectiveness of the traditional spiny lobster traps used in Baja California and Cuba were discussed.

After four days of discussion a plenary session addressed the following points:

- The economic importance of lobsters for many countries in the region.
- The long larval stage of the species, which could allow an interconnection of populations or population segments from different countries.
- The high fishery intensity to which the stocks are submitted in many countries of the region.
- That any overfishing problem could affect not only a particular country but some other countries of the region.

All participants agreed:

1. To promote the establishment of a permanent regional spiny lobster group.
2. To request from FAO technical and financial support to develop a five-year working programme.
3. To entrust the Steering Committee of the Workshop and Dr. B.F. Phillips with the preparation of a proposal of working plan to be discussed with FAO.

The proceedings from the First Binational Mexico-Cuba Workshop, held from May 21-27, 1993 in Isla Mujeres, Quintana Roo (Mexico) were distributed to all the participants and countries interested in them. The proceedings of the Second Workshop will be published in 1995-1996.

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Nova Scotia Fishermen Hold Lobster Quality Workshop

FROM: GREG ROACH

In October 1994, lobster fishermen and dealers met in Yarmouth, Nova Scotia, Canada to discuss quality concerns associated with their lobster (*Homarus americanus*) fishery. The workshop addressed issues specific to one fishing area in Southwest Nova Scotia where approximately 970 licensed fishermen have landed from 8,000 to 11,000 mt per year over the past 5 years. They are permitted to fish from November until the end of May. Most fishermen take their traps to shore for the coldest winter months so there is effectively a fall season and a spring season.

The Workshop was requested by industry to address problems of quality that occurred while lobsters were being stored during fall seasons. Many lobster fishermen hold their catch in crates or large floating rafts during the early part of the fall season. Early in the fall prices usually are low and then increase as the winter holiday season approaches. Fishermen and buyers alike play the risky game

of guessing when to hold and when to sell to get the best price. If lobsters are sold too soon, revenues are lost. If they are held too long, markets will be lost, prices will decline and fishermen may be stuck with their lobsters. Storage-related damage and mortality make the stakes even higher. In recent years, excessive rain or snow and heavy winds have caused substantial losses. All industry participants agreed that lobster quality was of paramount important and a forum such as the workshop was needed to get at these issues.

Large volumes of lobsters are caught during the first two weeks of the season (40% of the annual catch), yet a much smaller amount is sold (10%). The difference between what is caught and sold is held until about the 10th week into the fishery when landings match sales. It is the quality and are of these stored lobsters that has raised concerns among buyers and fisherman alike.

The workshop started with an overview of lobster biology in relation to water quality factors. W. Young-Lai stressed the importance of good water quality in all situations where lobsters are held. He reviewed the lobster's requirements in relation to salinity and oxygen concentrations, gill function and the importance of keeping the gills moist, and the relationship between temperature and metabolic rate. All these factors affect the condition of lobsters.

Fishermen described their techniques for handling lobsters. They explained different methods used on board vessels to ensure that lobsters are kept wet, cool and out of the wind and rain. All stressed the importance of banding claws immediately when lobsters are removed from the traps. Different on-board holding systems were described and fishermen noted that lobster should be sold or stored immediately upon landing. Buyers described the handling techniques employed on land. Lobsters should be checked to remove weak or damaged animals from the catch and the lobsters should be placed back in the water as soon as possible after delivery. Handling should be minimize at all stages of fishing, buying, storage and shipping to avoid injury or stress.

Discussion on air shipping and international-distribution networks followed. Industry representatives expressed concern about the shortage of air cargo space for shipping lobsters, especially during the peak Christmas season. Factors such as low international traffic volume at the Halifax airport and competition for cargo space during the peak landing periods result in the space limitations. Live Canadian lobsters enjoy a good reputation in the international market place, but air freight services may have to improve if markets are to expand.

Fishermen then presented their perspective on holding, noting that it makes good business sense to take the risk and wait for prices to improve. Many techniques were described which ensure good survivorship for stored lobsters. The fishermen believe they can provide top quality lobsters after a holding period of a few weeks. Opening prices are too low and there is a belief that this may be due to collusion among buyers. Holding lobster may be the only way for fishermen to maintain their independence. Buyers noted that lobster quality declines if fishermen hold lobsters too long. Concerns were expressed about shell disease if lobsters are held for too long a period. An advanced holding system was described by a Clearwater representative, whose system can hold lobster without deterioration in quality for months.

In the discussions that followed, fishermen and buyers had frank discussions about lobster quality in relation to holding, and lobster pricing in relation to supply and demand during the fall season. Many concerns were expressed by both fishermen and buyers about prices that may start out too low and expectations for prices that may be far greater than the market can bear. In the middle is the practice of holding lobster, which works well to serve a market if done correctly, but which may result in mortality and quality problems if taken too far. The workshop concluded with an agreement among participants that the benefits of good holding practices and top quality lobsters can be shared by all segments of the industry, but better communication is essential to reach that end.

Few quality problems associated with holding were reported during the 1994 fall season that followed the workshop. Many pricing arrangements between fishermen and buyers were made prior to the season opening. The weather conditions were very good for holding, which may partially explain the success. We hope the communication lines have been opened and a maturing industry can address its problems.

Copies of the workshop proceedings can be requested from the author (address below).

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forms small fisheries in the southwest and southeast and *P. penicillatus* and *P. longipies* appear occasionally in catches.

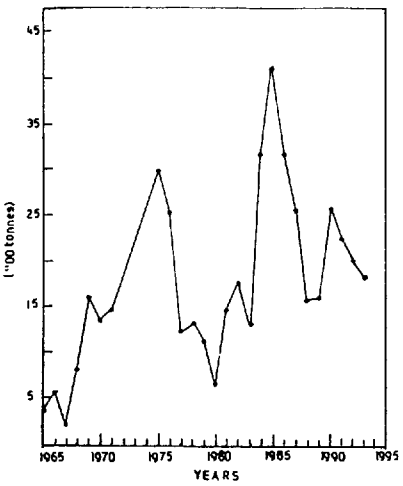

Fig. 1: Annual lobster landing in India.

Commercial fisheries have yet to develop in Minicoy and Andaman and Nicobar Islands but commercial quantities of the deep sea lobster, *Linuparus somniosus*, have recently been found off the east coast of Andamans. The commercial significance of *Palinustus mossambicus* (*waquiensis*) in deep waters off Quilon is also unclear. The scyllarid *Thenus orientalis* is taken in trawls throughout India, especially in the northwest.

Northwest coast

P. polyphagus is the principal species. Annual landing declined from 650 t with a CPUE of 13.9 kg/unit/day in 1986-87 to 93 t with a CPUE of 3.2 kg/unit/day in 1993-94. the fishery in 1975-76 was dominated by 4 and 5 year olds but is now dominated by 3 and 4 year olds (CMFRI [Central Annual Report, 1993-94); this change was possibly brought about by recruitment overfishing and the fishing of ovigerous females, which form 25-30% of females. Large quantities of juvenile *P. polyphagus* are also taken intertidally in the Bhavnagar district for ongrowing. Catches of *T. orientalis* have also declined. For example, the average annual catch in Bombay slumped from 185 t in 1978-85 (CPUE 4.4 kg/unit/day) to 7 t in 1992-93.

South coast

The fishing grounds of Colachel and Muttom (between Colachel and Quilon) were the most productive grounds in India in the 1960s and 1970s but the present production of around 2 t is only 1% of that in 1964-65. *P. homarus* is the predominant species, and is fished from September to April. Reduction in catch is through to be largely due to the fishing of berried females, immature lobsters, and undersized lobsters. Introduction of trammel and gill nets has led to increased pressure compared with the traditional traps.

P. homarus, followed by *P. homarus*, are the major species at Tuticorin and Mandapam in the southeast. Gill nets are widely used but some lobsters are also taken by trawlers.

East coast

The principal species in Madras is *P. homarus*, with the fishing extending from January to September. Fifty per cent of females are mature at 56-60 mm CL (carapace length). Gill nets were most commonly used until 1986, when trammel nets were introduced. Lobsters in the trammel nets range from 18 to 106 mm CL (predominantly 46-50 mm CL) and in the gill nets 31-100 mm CL (61-65 mm CL). The dominant size class of lobster in the gill nets decreased from 76-80 mm CL in 1979-80 to 61-65 mm CL in 1986-88. Many juveniles are caught and wasted in this fishery, so unless gear and size restrictions are introduced, further decline in landings can be expected.

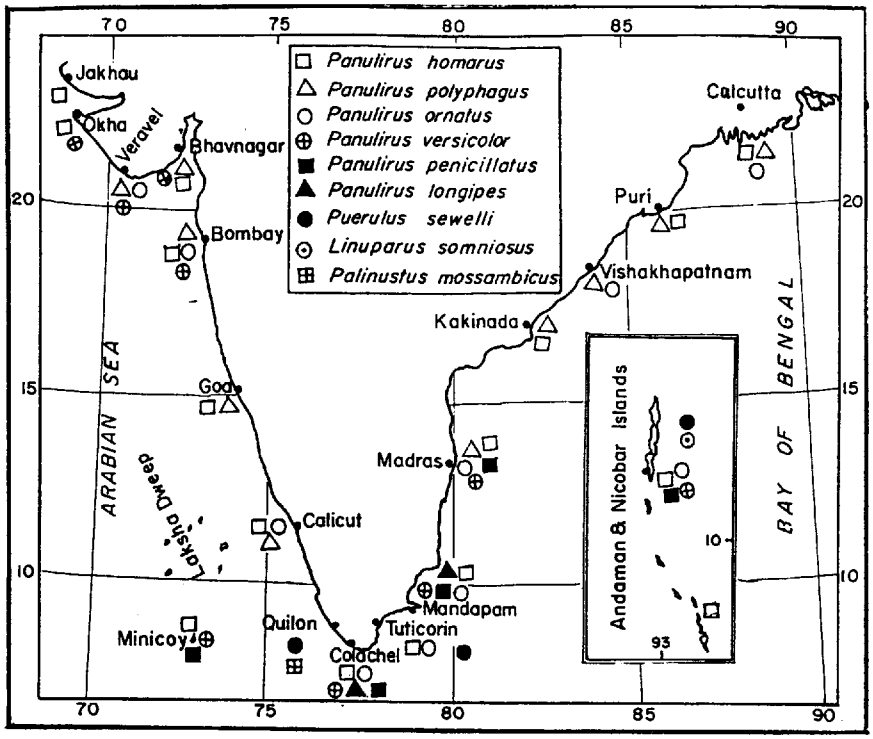

Fig. 2: Distribution of palinurid lobsters along the Indian coast.

Deepwater lobsters

Puerulus sewelli occurs off southern coasts between 150 and 400 m, with most at 150-250 m. Surveys during 1967-70 revealed potential grounds off Quilon and in the Gulf of Mannar (near Tuticorin), with MSYs of 8,000 t and 1,200 t respectively (CMFRI News Letter No. 44, 1988). Surveys in 1969 and 1970 gave catch rates of 15- 330 kg/hr trawling in the southwest and 200-300 kg/hr in the southeast. Heavy fishing of berried females and immature lobsters (less than 40 m CL) are thought to have brought about reduction in catches and CPUE, with landings from the Gulf of Mannar in 1993-94 falling to around 90 t with a CPUE of 15 kg/hr trawling.

Recent surveys by Fishery Survey of India have located a potential resource of *Linuparus somniosus* off the east coast of Andaman and Nicobar Islands (Fig. 2) where catches averaged 450 kg/vessel/day with a CPUE of 1.6 kg/hr trawled. *L. somniosus* occurs at depths of 279-360 m and is associated with *P. sewelli*. Carapace lengths ranged from 64 to 180 mm, the average weight was 350g, and the maximum weight 1010g.

Management

The maritime states manage their own fisheries, but regulations differ between states and often are not strictly enforced. Use of trammel nets and the taking of berried females and juveniles are thought to have contributed to the collapse of several fisheries. A particular management problem is where lobsters are taken as by-catch in shrimp and fish trawls.

Regulations should include fishery closure during the breeding season, a minimum legal size (60 mm CL is recommended for *P. homarus*), and gear restrictions. Escape gaps should be enforced for trap-caught species, and mesh regulations are needed where gill nets are used. The trawls used for *P. polyphagus* need to be designed exclusively for lobsters. Trammel nets should be banned as they take juveniles. More research can lead to better information to support these measures.

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Cuban Spiny Lobster: Predicting the Catch

FROM: R. CRUZ, R. PUGA, AND M. E. DE LEON

Predictions of the catch of the spiny lobster (*Panulirus argus*) in Cuba have been made by the Centro de Investigaciones Pesqueras (CIP) since 1992. The predictions are based on the number of juveniles in the nursery area. This article describes the sampling techniques and prediction methods used.

Cuba is the main producer of the spiny lobster *P. argus* and one of the principal lobster exporting countries of the world. Catches over the last 15 years have averaged 10,833 metric tons, resulting in exports worth US $100 million per year. Most of the catch is taken in the Gulf of Batabano (Fig. 1).

Panulirus argus has a complex life cycle with ten pelagic larval stages before metamorphosis to the puerulus (Baisre, 1964). The peak of puerulus settlement occurs mainly from September-December (Cruz et al, 1991). Ten months after settlement we refer to the new recruits as juveniles. The juvenile lobsters remain in the shallow nursery area for between 8 and 10 months, and then migrate offshore and are recruited to the fishery at 76 mm CL (Cruz et al, 1986b). Entry of the recruits to the fishing zone occurs during March-May (Cruz and Phillips, 1994). Sexual maturity is attained at a size of 78-81 mm CL (Cruz and Leon, 1991; Baisre and Cruz, 1994) and mating takes place mainly in February-March.

Data Collected

Sufficient long-term, accurate data on the abundance of juveniles had to be collected. CIP scientists had earlier shown that juveniles could be captured with artificial concrete block reefs (Fig. 2) in a nursery area (Cruz et al, 1986a). With these block structures we were able to measure the abundance of juveniles.

An index of juvenile abundance was obtained from monthly monitoring of 60 block structures since 1982. Lobsters were caught by divers between 1.5 and 2.5 m depth. The data collected include the number of juveniles in the size range 14-50 mm CL in each block structure and carapace length measurements for females and males. The annual juvenile index was calculated as the mean number caught per block per month.

Method of Prediction

The prediction of the commercial catch in the spiny lobster fishery was made possible when a math-

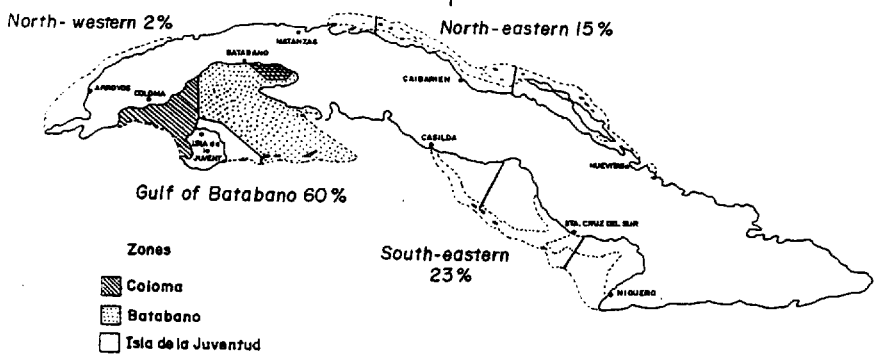

Fig. 1. Fishing regions for Panulirus argus *in Cuba.*

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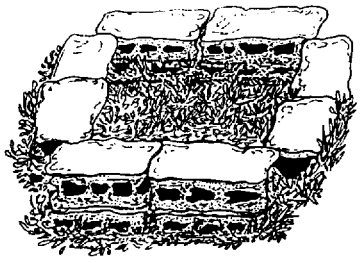

Fig. 2. Artificial concrete block reefs used in a nursery area for sampling small juveniles (14-50 mm CL) as part of the predictive system.

ematical relationship was found between the number of juveniles in the nursery area in one year and the number of pre-recruits to the fishery one year later. (Cruz et al, in press). The commercial catch in any year is composed of a number of year-classes, but because 50 to 75% of the total catch is made up of new recruits to the fishery, they strongly influence the total catch. The juvenile index plotted

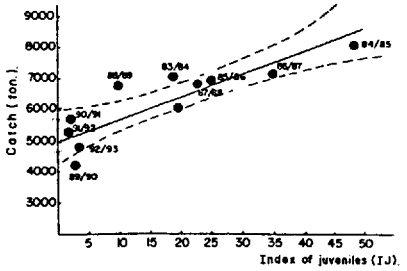

Fig. 3. Relationship, with 95% confidence limits, between the index of juvenile abundance for 1982-1992 and the commercial catch of Panulirus argus *one year later in the Gulf of Batabatio.*

against the total commercial catch in the following year at the Gulf of Batabano is shown in Fig. 3. A linear regression showed a strong relationship ($r=0.87$, $p<0.001$). Using a regression of total catch against the juvenile index for 1982 to 1990, and the abundance of juveniles in 1991, we predicted that the total catch in 1992 would be 5,373 mt; the actual catch was 5,322 mt. Based on the 1982-1991 regression and the level of juveniles in 1992, we predicted the 1993 catch would be 5 469 mt; the actual catch was 4 902 mt.

Cross correlations between catches by region and enterprise indicated that the two were closely associated. Growth and recruitment variations do not show differences between region (Leon et al, 1994 and Puga et al, 1994), allowing us to make capture forecasts by region and zone. Table 1 shows the prediction of commercial catches by region in 1994, based on the 1982-1992 regression and the index of juveniles in 1993. (Cruz et al, 1994).

Predictions may be further refined, based on the number of puerulus settling in the collectors composed of artificial seaweed (Phillips, 1972). A measure of puerulus recruitment might provide a basis for a successful prediction of the catch two years in advance. Seven years (1988-1994) of puerulus settlement data have now been collected and provide a solid basis for analysis of the variability of collector catches in the Gulf of Batabano and determination of an index of larval recruitment.

In the years in which the prediction was used (1991-1994) the abundance of juveniles was very low. Strong fishing pressure, combined with a low abundance of juveniles since 1988 could possibly reduce the size of breeding stock below the critical level to maintain recruitment to the fishery. Setting quotas on catches is an option that could be considered by those managing the lobster fishery. The predictive system would be useful for calculating such quotas if they were introduced.

Region	1994 Catch Prediction	1994 Actual Catch	
National	9,500	9,696	
Gulf of Batabano	5,400	5,517	2.1%
North-Western	211	169	
	15,111	15,382	1.76
Zones in Batabano Gulf			
Coloma	2600	2634	
Batabano	1940	1931	
Isla de la Juventud	854	952	

Table 1. Predicted and actual catch (in metric tons) of Panulirus argus *during 1994 by region in Cuba.*

Use of the Catch Predictions

A system to estimate the abundance of post-larval and juvenile *P. argus* in Cuba has allowed us to develop a preliminary forecast of the catch one year in advance. Given the short data series, this is essentially exploratory, but it holds promise for advising industry and fishermen about future changes in catch and of matching catch to the likely level effort required. Data will continue to be collected to test the robustness of the catch forecast, and to extend it to other regions.

Literature Cited

Baisre, J.A., (1964). Contrib. Cent. Inv. Pesqu., 19: 1-37.

Baisre, J.A. & R. Cruz, (1994). Ch. 8 in: B.F. Phillips, J.S. Cobb and J. Kittaka, (eds). Spiny Lobster Management, Fishing

News Books. Oxford.
Cruz, R. Brito, E. Diaz and R. Lalana, (1986a). Rev. Inv. Mar., 7(3): 3-17.
____, _____, _____ & _____, (1986b). Rev. Inv. Mar., 7(3): 19-35.
Cruz, R. & M.E. De Leon (1991). Rev. Inv. Mar., 12(1-3): 234-245.
Cruz, R., M.E. De Leon, E. Diaz, R. Brito & R. Puga, (1991). Rev. Inv. Mar., 12(1-3): 66-75.
Cruz, R. & B.F. Phillips. (1994). Ch 21 in: B.F. Phillips, J.S. Cobb, & J. Kittaka, (eds), Spiny Lobster Management, Fishing New Books, Oxford.
Cruz, R., R. Puga & Ma. E. de Leon. (1994). Taller Binacional Mexico-Cuba, Manejo de Refugios Artificiales en las Pesquerias de Langosta y Dinamica de sus poblaciones, Ciudad de la Habana, Cuba, 17-21 de Octubre de 1994.
De Leon, M.E., R. Cruz & R. Puga. (1994). II Taller Binacional Mexico-Cuba, Manejo de Refugios Artificiales en las Pesquerias de Langosta y Dinamca de sus poblaciones, Ciudad de la Habana, Cuba, 17-21 de Octubre de 1994.
Phillips, B.F., (1972). Crustaceana, 22: 147-154.
Puga, R., M.E. de Leon & R. Cruz (1994). II Taller Binacional Mexico-Cuba, Manejo de Refugios Artificiales en las Pesquerias de Langosta y Dinamica de sys poblaciones, Ciudad de la Habana, Cuba,, 17-21 de Octubre de 1994.

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RECOLLECTIONS

Early Australia-Canada Cooperation in the use of SCUBA to Study *Homarus americanus*

EXTRACTED FROM A LETTER BY A.M. OLSEN

The use of diving suit and helmet to provide abundance estimates of commercially important marine species was first used in Australia in 1947. SCUBA gear replaced "hard hat" technology in 1954, and I used it immediately to study the ecology and behaviour of the spiny rock lobster, *Jasus edwardsii* in south-east Australian waters. At about the same time, Dick Wilder of the Fisheries Research Board (FRB) of Canada's St. Andrews Biological Station was carrying out interesting population studies of *Homarus americanus*. As part of a six month "overseas study", I spent a most enjoyable few weeks in the summer of '59 with Dr. Wilder and his lobster research team.

Dr. Wilder was using a dredge to study recruitment in Northumberland Strait lobster stocks. My offer to use SCUBA to supply direct underwater observations was keenly accepted by Dick, but we had one significant hurdle to overcome: A prohibition on the use of SCUBA at the Biological Station! It seems a staff member had gotten into difficulties when using SCUBA for the first time, likely because there was no proper instruction available. The Director, Dr. J.L. Hart, after learning of my 12 years diving experience, granted me permission to dive, provided a strong line attached me to the boat tender. Dr. Wilder was delighted.

The first SCUBA equipped dive to study Canadian lobsters occurred August 27th, 1959, off St. Louis, New Brunswick in 10m of water. The objective was to examine lobsters on both rocky and sand/silt substrates where commercial lobster traps had been placed. Lobsters were thinly scattered on the sea floor. Over-all, five dives were made and 32 lobsters were captured by hand: the smallest, a male, was 0.68" CL; the largest, a female, was 2.75" CL. There were more lobsters moving over the sand/silt than over the rocky bottom. The latter bottom did, however, provide more shelter for the smaller lobsters, thus we may have missed some lobsters. Another diving foray occurred in September, when a 35mm camera was used to photograph lobsters *in situ* for the first time in Canada. During this trip, I also assessed the effectiveness of the dredge to capture lobsters. Of interest was the foraging of both *H. americanus* and *H. gammarus* (which I later observed off Whitby, Yorkshire England) in daylight; *J.edwardsii* back home forages only during darkness.

Photographs taken during my trip were subsequently shown to FRB's Board of Directors by Dr. Hart. He was obviously excited about the potential of SCUBA techniques. I agreed to teach two of his science staff (Paul Elson and Don Graham) the techniques of SCUBA; the prohibition on diving was then rescinded for those St. Andrews' staff having taken such training. Dick Wilder went on to use it in FRB's trans-continental relocation of lobsters in 1965 and Don Graham continued lobster diving studies up to his recent retirement.

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AMUSEMENTS

Plus ça Change ...

Ken Collins (Oceanography, University of Southampton, England) recently sent us a photocopy of a page from the "Museum of Animated Nature," published in about 1850, in which a fine description of lobster (we presume Homarus gammarus*) biology is encapsulated. Most of the article comes from a letter from Mr. Travis, of Scarborough, dated the 25th of October, 1768. We can't reprint it all here, but thought the readers of The Lobster Newsletter would be edified by some of the information. Clearly the author addressed the same issues as trouble us: Recruitment, Growth and Molting, Migrations, Minimum Size, Fishing Methods, and Overfishing, although they were not identified as such.*

ON RECRUITMENT

"The female or hen lobster does not cast her shell the same year that she deposits her ova, or, in the common phrase, is in berry. ... Hen lobsters are found in berry at all times of the year, but chiefly in winter. ... Though the ova are cast at all times of the year, they seem only to come to life during the warm summer months of July and August. Great numbers of them may then be found, under the appearance of tadpoles, swimming about the little pools left by the tides among the rocks, and may also be found under their proper form, from half an inch to four inches in length."

ON GROWTH AND MOLTING

"In casting their shells it is hard to conceive how the lobster is able to draw the fish of their large claws out, leaving the shells entire and attached to the shell of their body; in which state they are constantly found. The fishermen say the lobster pines before casting, till the fish in its large claw is no thicker than the quill of a goose, which enables it to draw its parts through the joints and narrow passage near the trunk. ... Lobsters only grow in size when their shells are in their soft state."

ON MIGRATIONS AND MOVEMENTS

"In summer the lobsters are found near the shore, and thence to about six fathoms' depth of water; in winter they are seldom taken in less than twelve or fifteen fathoms. The are much more active and alert in warm weather than in cold. In the water they can run nimbly upon their legs or small claws, and, if alarmed, can spring tail foremost to a surprising distance as swift as a bird can fly."

ON FISHING METHODS

"Lobsters are not taken here in pots, as is usual where the water is deeper and more still than it is upon our coast. Our fishermen use a bag-net fixed to an iron hoop, about two feet in diameter, and suspended by three lines like a scale. The bait is commonly fish-guts tied to the bottom and middle of the net. They can take none in the daytime, except when the water is thick and opaque: they are commonly caught in the night ... "

ON MINIMUM SIZE

"We have vast numbers of fine lobsters on the rocks near our coast. The large ones are in general in their best season from the middle of October till the beginning of May. Many of the small ones, and some of the larger sorts, are good all the summer. If they be four inches and a half long, or upwards, from the tip of the head to the end of the back shell, they are called sizeable lobsters. If only four inches, they are esteemed half-size, and, when sold, two of them are reckoned for one of size. If they be under four inches, they are called pawks, and are not saleable to the carriers ..."

ON OVERFISHING

"The consumption of lobsters in England is almost incalculable; but the vast destruction made is counterbalanced by an according increase. By a wise provision, the maintenance of the species is fully secured, so great is its fecundity. Dr. Basten says that he counted twelve thousand four hundred and forty-four eggs under the tail of one female lobster; and that this number was not the total amount."

NEW ZEALAND LOBSTER MEETING

Arrangements are well advanced for the *Fifth International Conference and Workshop on Lobster Biology and Management* to be held in Queenstown, New Zealand during 9-14 February 1997. The meeting is hosted by an Organizing Committee representing New Zealand researchers, managers, industry, and Maori.

Workshops will focus on topics of wide interest with participants encouraged to contribute preliminary results from ongoing work. Contributions on all aspects of all lobsters - spiny, slipper, clawed, and scampi - will be considered. There will be sessions for formal papers and posters, as well as workshops in which researchers, managers, and industry will take part. The formal welcome will be on Sunday evening, 9th February and the farewell party on Friday evening, 14th February. During the week, there will be formal papers in the mornings and workshops in the afternoons (except that Thursday afternoon will be free). The formal papers and the conclusions from the workshops will be published after normal refereeing. We expect publication late in 1997 or early in 1998.

Full registration will be about $(NZ)400, students $200, and partners about $150. Full and student registrations give publication of a paper (up to 12 published pages), a copy of the proceedings, the conference dinner, two additional evening functions, and morning and afternoon teas.

The meeting is in summer in Queenstown, a South Island alpine resort known for its spectacular beauty and range of outdoor activities (white-water rafting, jet-boating, nature walks, mountain climbing, bungy jumping, and a host of others). The town is small and compact and served by many and varied restaurants. The conference and main accommodation is in the Lakeland Hotel, on the shores of Lake Wakatipu, overlooking the Remarkables Range, and 10 minutes stroll from the heart of Queenstown. The nightly room rate in February 1997 will be about $(NZ)170 for 1 or 2 people (plus $17 for a third person). Staying at the Lakeland Hotel brings superior accommodation at the conference venue, great views of the lake and mountains, access to the hotel pools and sauna, close contact with other conference participants, and easy access to helpful conference and hotel staff. Other accommodation will also be reserved at nearby motels and backpacker lodges.

Queenstown is particularly busy over the summer so accommodation will have to be confirmed at least 3 months before the meting, by November 1996. In the first call for papers, in February 1996, you will be asked your preferred accommodation.

Post-meeting field trips are being arranged. These will include visits to nearby spiny lobster fishing area, nearby coasts including Fiordland, and to MAF Fisheries' main campus in Wellington (with a visit to Castlepoint).

The conference organizers want your ideas for workshop themes. These might include larval recruitment mechanisms, post-settlement ecology, tagging techniques, or the effectiveness of minimum legal sizes. Can you suggest others?

For further information and to contribute your ideas on workshop topics, please contact:

Dr. John Booth, Convenor,
Fifth International Conference and Workshop on Lobster Biology and Management
MAF Fisheries Greta Point
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Wellington, New Zealand
Phone +64 4 386 1029
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e-mail jdb@frc.maffish.govt.nz

TERMINOLOGICAL TRIBULATIONS

Occasionally, as editors, we come up against a word or phrase whose meaning is not entirely clear, or seems to have a different usage in other contexts. In earlier "tribulations" we addressed the use of Postlarva and the use of common names. More recently we have been bemused by the usage of "molt stage" and "nursery area."

MOLT STAGE

The increasing importance of knowing the stage of the molt cycle in crustacea was reviewed in a Perspective by Juinio and Cromarty in The Lobster Newsletter 6(2). Since editing that article we have browsed the literature somewhat and find that Drach's (1939) characterization of the molt cycle into distinct and recognizable stages is commonly referred to as "molt stage" or "molt cycle stage." Sometimes it even is used (horrors!) as a *verb*, as in 'We molt staged the animals before subjecting them to such-and-such a treatment.' The two ways of referencing the same phenomenon might not cause too much confusion but for the fact that the entire intercdysial period also may be referred to as a molt stage. This is common usage in the *Homarus* literature, particularly for the larval and early benthic phases. Thus the first molt stage larva (commonly, in shorthand, "stage I"), as well as subsequent stages, will progress through molt cycle stages of A, B, C, D_0, etc. In our role as terminological police of The Lobster Newsletter (a tricky and dangerous profession, we assure you) we have started to make sure that the term 'molt stage' is reserved for the entire period between two molts, while 'molt cycle stage' is used to refer to Drach's physiological and morphological stages that characterize the time spent recovering from, and preparing for ecdysis in all crustaceans.

NURSERY

As attention recently has focussed on early life history stages of lobsters, and recruitment issues in particular have become a hot topic (cooled off a bit recently, however), we have seen a lot more use of the term "nursery area." The meaning seems to vary, but the most common usage suggests reference to the location where larvae settle in great numbers and the animals spend the first part of their early benthic phase. However, we also have seen it used in reference to nearly any location where juveniles are found. None of the four scientific dictionaries we consulted contained the word nursery. Our dictionary of the English Language defines nursery as "a place set aside for young children" suggesting at first glance that the use of 'area' is redundant when accompanying 'nursery.' It also implies that older children (how much older?) are not found in nurseries. The verb to nurse either means to attend to the needs of the sick or infirm, or to attend to infants, the latter suggesting that only the very young are found in nurseries. We suggest that the usage of 'nursery' in ecological terms should be limited to describing areas where the earliest (but post-larval) stages first settle and remain for some circumscribed period. Clearly this usage is not appropriate for sessile species which do not move after settlement. For these, nursery would be the same as adultery.

By Don Bosquet, Rhode Island Cartoonist. With permission.

ANNOUNCEMENTS

Publication Schedule

The three editors of the Newsletter try to keep to a somewhat regular publication schedule: one issue in July and another in December of each year. We edit the correspondence and articles received from you about 2 months before the issue is mailed. From that you might deduce some deadlines: in order to be included in the JULY issue, letters, news items, articles, etc, must be received by EARLY MAY. For inclusion in the DECEMBER issue, please plan to submit material by EARLY OCTOBER. We look forward to receiving contributions from all of you!

Electronic Submissions

As you might guess, we edit the Newsletter on computers, and the text is composed on an Apple Macintosh before printing. You can help us out by submitting your material in an electronic form, as well as on paper. If at all possible, we ask that you send us, along with your article, a disk with the article on it. Please identify the format (Macintosh or IBM) and word processing program you used. Alternatively, you could submit material via e-mail. That is equally easy for any one of us. If you submit by e-mail, please also send a "hard" copy by regular mail. Our e-mail addresses are given in the masthead on page 2. Again, it will be very helpful if you could submit material in electronic, as well as paper, format. Thanks!

Mailing List

As you remember, we enclosed a card in the last issue, asking everyone who wanted to stay on the mailing list please to return it. A great many people did — more than 450 of you, in 50 countries. The results were a bit confusing, however, since a number of our colleagues, including some who we know well and others who have contributed to the Newsletter, were not among those who responded. Cards do continue to come in, and we hope that will continue. If you did not return a card but wish to continue to receive the Newsletter, please write to John Pringle today! And if you know of someone who would like to receive a copy of The Lobster Newsletter, but does not, please tell them how to subscribe.

Lobster Culture a Success!

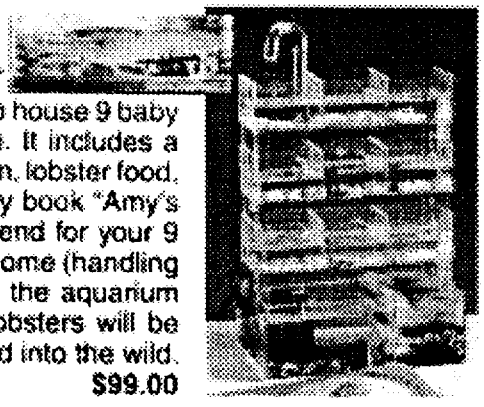
You can buy almost anything from a catalog in the United States ... and here is proof that the American lobster (*Homarus americanus*) has joined the array of saleable commodities. For only US$99.00 you get 9 "baby" lobsters and your own aquarium to grow them in. When they outgrow the containers, just ship them back to the sender, who will release them to the wild for you! We reckon these lobsters cost only US$300-400 per kg. Quite a deal, we say.

LOBSTER LAB

• Join the "Lobster Grow and Release Program"

The lobster lab is a three story aquarium designed to house 9 baby lobsters in a "condominium" fabricated from Lucite. It includes a circulating pump, complete biological filtration system, lobster food, instruction manual and the full color illustrated story book "Amy's Aquaculture Adventure." Included is a coupon to send for your 9 baby lobsters, which are expressed mailed to your home (handling fee required). When the lobsters are too large for the aquarium return them to the Aquatic Farm and new baby lobsters will be shipped to you. The large lobsters are then released into the wild.

Grow-Your-Own Lobster Lab **M52.508** **$99.00**



ANNOUNCEMENTS

Nemuro International Workshop on Lobster '95

Dr. Jiro Kittaka has announced that he will host a workshop on the biology of lobsters in the city of Nemuro, Hokkaido, Japan, November 19 - 22, 1995. The focus of the Nemuro workshop is "Biological and oceanographic processes in recruitment of spiny and clawed lobsters." The workshop will consist of several invited presentations and contributed papers. The proceedings will be published in a peer-reviewed journal. Kittaka points out that this meeting falls about half-way between the Sanriku workshop (1993) and the planned workshop in New Zealand in early 1997. If you are interested in attending this workshop, please write to Dr. Kittaka:

Dr. Jiro Kittaka
Research Institute for
Marine Biological Science
Research Institute for
Science and Technology
The Science University of Tokyo
74 Onnemoto, Nemuro
Hokkaido 087-01
JAPAN
Fax: 81-1532-8-2282

The Biology of Crustacea

The Biology of Crustacea, a conference to celebrate and acknowledge the contributions of Ernest Naylor, will be held at the University of Plymouth , U.K., will be held April 1-3, 1996. The main categories of contributions will be Behavior, Genetics and Biochemistry, Ecology and Taxonomy, and Physiology. For more information write:

Dr. Malcolm Jones
Department of
Biological Sciences
University of Plymouth,
Drake Circus
Plymouth, Devon,
United Kingdom PL4 8AA
Fax: 44 (0) 1752 232970

The Second World Fisheries Congress

The Second World Fisheries Congress, to be held in Brisbane, Australia 28 July - 2 August 1996 is likely to have a fair amount of lobster-related talks due to its location and sponsorship. The theme of the congress is "Developing and sustaining world fisheries resources: The state of science and management." For further information, write:

Congress Secretariat.
Second World
Fisheries Congress
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July 1995

The Lobster NEWSLETTER

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