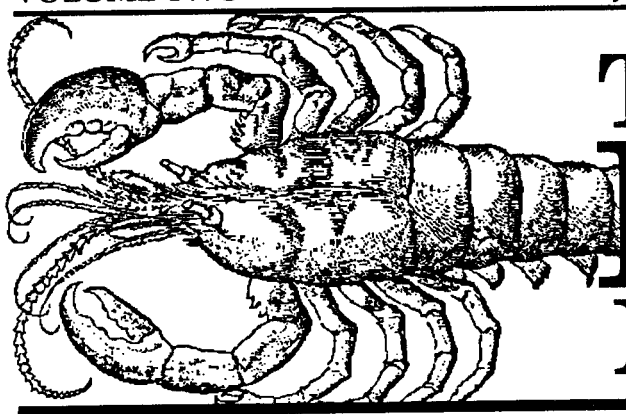
VOLUME TWO JULY 1989 NUMBER TWO



The Lobster NEWSLETTER

PERSPECTIVES

Lobster Recruitment Processes

Recruitment processes (the biotic and abiotic mechanisms affecting the number of individuals surviving to a particular age or life stage) of lobsters are played out in a dynamic physical and biological setting. Physical transport mechanisms, trophic interactions, and the reproductive characteristics of the population each play an important role in determining recruitment success. Recruitment levels of marine invertebrates can vary over several orders of magnitude. What are the determinants of this variability, and to what degree can populations compensate for environmental or human-induced disturbance? Addressing these questions is essential to the development of effective management strategies, particularly for heavily exploited species such as lobsters. The role of recruitment dynamics of marine invertebrates at both the single species and community levels is now also being taken up by ecologists (see Underwood and Fairweather 1989 for an overview).

Consideration of recruitment processes can be partitioned into two interrelated components: 1) understanding population regulatory mechanisms, and 2) identifying sources of variability in recruitment and their implications for the population. A focus on the first component is necessary if the long term consequences of management actions are to be evaluated; short term forecasting of stock abundance is critically dependent on the second.

The character of the response of a population to a sustained disturbance such as fishing is directly related to the presence or absence of a compensatory response in the population. A compensatory mechanism results in an increase in population growth rate as population size decreases or conversely, a decrease in growth rate with increased abundance. An exploited population with no compensatory capacity is doomed to extinction if increased fishing mortality drives total mortality to exceed the population growth rate; more realistically fishing mortality would decrease before extinction occurs. It is vital to determine if an exploited population has some form of compensatory reserve. Examples of compensation include changes in reproductive output via changes in age (or size) at maturity, or in fecundity; cannibalism; density dependent changes in mortality ; and size dependent mortality coupled with density dependent growth resulting in increased mortality. Lobster recruitment processes may include any of these, but specific mechanisms will differ among taxa. Most lobster taxa do sustain high levels of exploitation, sug-

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RESEARCH NEWS

Ecology of the Mediterranean Slipper Lobster

The biological knowledge of the slipper lobsters, Family Scyllaridae, is rather limited. In particular, the available information on the Mediterranean slipper lobster, *Scyllarides latus*, is scanty. This is surprising because *S. latus* occurs throught out the whole Mediterranean and Central-Eastern Atlantic, and is one of the largest crustaceans found in the Mediterranean. This species is fished throughout its distribution, and has high commercial value. Our study is designed to permit an understanding of the life cycle of *S. latus*. It includes studies on adult behavioral ecology as well as on larval development, morphology and ecology in the field and in the laboratory.

Previous investigations by scientists of the Center for Maritime Studies, dealt with facets of *S. latus* behavior, its shelter selection and feeding behavior (e.g. Spanier, 1987; Spanier et al., 1985; 1988). These aspects were studied at artificial reefs off the coast of Haifa, Israel, and in large tanks of the Israel Oceanographic and Limnologic Research (IOLR) facility, Haifa, sited directly at the coast. The artificial reefs have recruited a sizeable population of adults, which enable scientists good access to lobsters.

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RESEARCH NEWS

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Adult lobsters are common in the reefs in winter and spring, but are rare from summer to fall. Preliminary tagging experiments indicate migration to deeper, colder waters, but this has as yet to be confirmed experimentally. Ovigerous females were observed from May to July just before movement from shallow water. One study objective is to determine the pattern and biological causation of adult movement, and to determine whether larval release is related to this long range movement. Lobsters are captured in the shallow (ca. 20m depth) artificial and natural reefs by SCUBA divers. Lobsters in deeper waters are caught with traps. All specimens are weighed, tagged and the presence of eggs and/or spermatophores recorded. The bottom water temperature is recorded.

S. latus have phyllosome larvae, the morphology of which suggests an adaptation to long periods in the plankton. This is estimated to be from 9 to 11 months in *S. latus* (Martins, 1985). During this period the larvae, which are not well adapted to active swimming, are subjected to water currents. For the understanding of larval disperal and recruitment, detailed studies of the oceanographic conditions are necessary. Therefore our planktonic investigations are coordinated to physical oceanographic field work conducted by the IOLR, Haifa. These joint planktonic and oceanographic studies are concentrated mainly on mesoscale eddies, which predominates in the currents of the Eastern Mediterranean. Several phyllosomae have already been sampled by us in such eddies.

Our larval field work will be combined with laboratory rearing experiments. Attempts at rearing scyllarid larvae have been successful in only a few cases due to a lack of knowledge about the diet, mechanisms of food intake and developmental requirements. Their fragile bodies and long larval period make them impractical to culture. The proposed work will include several different diets, temperatures and container types in an attempt to reveal possible ways to raise these larvae. In addition, a study of mouthpart ultrastructure will be conducted which might provide essential information on feeding mechanisms.

The last phyllosoma stage molts to a strongly swimming postlarval stage called the nisto. Theory states that this stage swims to nearshore benthic habitats where it settles and molts into the first juvenile. Until now, no findings of *S. latus* nistro have been recorded. Nisto larvae of palinurids were found by several investigators in drifting clumps of seaweed (e.g. Herrnkind and Butler, 1986). Artificial collectors have been constructed which mimic seaweeds. They will be employed by us in shallow water where they will be arranged to both float at the surface as well as be fixed to the bottom. We hope that they will enhance our investigation of nisto on the Israeli coast.

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Spiny Lobster Nutrition

The Marine Science Institute, University of the Philippines has been undertaking research on "Nutritional Studies on Spiny Lobsters (*Panulirus* spp.) since July 1985. This locally funded study has objectives of determining the natural diets and food preferences of *P. longipes longipes, P. ornatus* and *P. versicolor* and suitable diets for optimum growth of lobsters reared in captivity.

Gut content analyses have been conducted to determine the important food items in the lobster's natural diet. Feeding preference experiments are being conducted to measure and compare growth rates of tank/aquarium and cage-held lobsters given different natural diets. Data generated from these studies may provide useful information for future development and assessment of the mariculture potential of these commercially important organisms.

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The Lobster NEWSLETTER

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The Lobster Newsletter is cosponsored by Fisheries & Oceans, Canada and the Rhode Island Sea Grant Program

Design: Ken Davignon
Mailing & Coordination: A. Juinio
The Lobster Newsletter is published twice yearly. Please send change of address to Stan Cobb.

Range Extension

An Indo-Pacific lobster *Panulirus ornatus* (Fabricus 1798) was caught in January 1988 off the Port of Haifa in the southeastern Mediterranean; a first account of this species in the Mediterranean Sea. It is widely distributed in the Indo-Pacific Ocean. Up to recently, its most northern limit was along the Southern Red Sea. Although not yet recorded from the Northern Red Sea, this lobster most probably entered the Mediterranean through the Suez Canal. *P. ornatus* is the most recent entry in a long list of Indo-Pacific species which have become established in the Levant (eastern Mediterranean). A growing number of decapod crustaceans belong to these lessepsian (ed. note- Ferdinand Marie Lesseps was the prime promoter of the Suez Canal. We assume lessepsian refers to this canal?) migrants, yet this is the first lobster known to migrate to the Mediterranean from the Red Sea!

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Rock Lobsters Down Under

The Western Australian fishery for *Panulirus cygnus* (the western rock lobster) got off to an excellent start with good catches commencing almost from the opening day of 15 November 1988. Catches of "white lobsters" were well above average. "Whites" are pale, newly moulted, immature animals that migrate offshore into the deeper water breeding grounds during November to January. Catches by the end of December 1988, had put production well on track for a record season by the time it closes on 30 June 1989.

Although production is running at record levels, price paid to fishermen is not, having dropped from $A 17.00/ kg at the end of 1987-88 to about $A 12.50/kg. The price drop has reportedly been due to three factors. The two most important were large inventories of tails held in cold storage in the United States, and an unfavorable exchange rate (to Australian minds) due to a strong Aussie dollar. The third factor, was the prediction, by "us", (the "we can't take a trick" researchers at the Fisheries Department of Western Australia's Marine Research Laboratories (WAMRL)) of a very good season. The Rock Lobster Research Unit produces reliable recruitment and total catch predictions one season in advance, using a combination of indices of abundance for various life history stages. The puerulus index (1 year after hatching) is combined with the corresponding juvenile index (4 years after hatching) to produce an estimate of recruit strength (5 years after hatching) to the fishery. The predictions have recently been further refined. We now combine two puerulus year classes with the 4 year old juvenile index to give more accurate predictions of the two parts of the fishery: the "whites" caught in November to January; and the "reds", which are non-migrating animals, caught from February to June. The success of this method suggests that the catch for the first part of the season is best predicted using the puerulus abundance index from year x and the corresponding 4 year old juvenile year index (year x+3), while the second half of the year's catch is best predicted using the puerulus data from year x+1, combined with the same four year old juvenile index (year x+3).

Over the past four years the catch predictions have been very reliable and have assumed considerable importance to fishermen, their financiers and processors. However, it is possible that our success at prediction has contributed to this season's depressed prices due to market expectations of large quantities of product being available. If true, our success story, the ability to predict recruitment and total catch for a fishery, may have its downside, the adverse impact on the market.

The status of rock lobster research in Western Australia is entering a new phase. CSIRO, our sister organization in federal fisheries research, has traditionally researched the juvenile stages. They recently underwent a major shift in program priorities, from rock lobsters to exploration and management of deepwater trawl fisheries off our coast. This dramatic change has been brought about by the recent signing of the Offshore Constitutional Settlement between the seven seaboard Australian states and the Federal Goverment. Now, many of the fisheries formerly under joint State/Federal Government control, have become the sole responsibility of the respective State. In the case of Western Australia, the western rock lobster fishery, among others, is now managed by the Western Australian government.

While passing over management responsibilities to the States, the Federal Government has also scaled down or totally withdrawn its research involvement from those fisheries. CSIRO scientists will now only undertake rock lobster research if funded from external sources. CSIRO project that may be affected by this change are the puerulus collector work and the post puerulus/early juvenile research. The former is a joint State/CSIRO funded programme due for review in May 1989. The latter is scheduled for completion in mid-1989.

There have also been some interesting developments in our research priorities. The first is a large modelling exercise involving the normal WAMRL research team of biologists (Rhys Brown and Chris Chubb), statistician (Nick Caputi) and computer programmer/population dynamacist (Norm Hall). The objective is to produce a bioeconomic model of the western rock lobster fishery.

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In broad terms, it will describe the interaction of *P. cygnus* and its major predator - man.

Also a model has been developed and is running with our "best" estimates of biological (growth, moulting, migration, etc.) and fishery (exploitation rates, effective fishing effort, etc.) parameters. Initial runs to calibrate this model (which incidentally can take all the computing time on our new IBM 9370/60 computer) normally take 5 to 6 days. A less complex model is being developed. The results to date are encouraging, enabling us to target research areas of high priority. Four major areas have been identified; growth variability, spawning stock abundance, catchability and effective fishing effort. These, together with stock and recruitment relationships, will continue to be our major areas of research. Our management section is eager to input management/economic variables in the model to see how the fishery performs under a variety of management scenarios. There should be some interesting days ahead. I will keep you posted as we learn to fly the "Rock Lobster Model".

Chris Chubb's breeding stock programme is being written up. He has identified the Albrolhos as a major breeding ground. It is an area of approximately 400 square miles made up of small islands, coral atolls and extensive coral reefs in the center of the 800 mile latitudinal range of *P. cygnus*. Even though this area is small in total area, it supports high abundances of *P. cygnus*, many of which are breeding well below the minimum legal size. This contrasts sharply with the coast, where the size of maturity is well above the minimum legal size. When all the threads of this program are drawn together it should help us to better understand the breeding dynamics and potential of this heavily exploited species.

The Albrolhos Islands are renown, not only for rock lobster, but also for the many Dutch East India Company four masters, and their treasures, that lie on the reefs. Perhaps the Abrolhos will be the treasure of the rock lobster fishery, by supplying the bulk of egg production for the species.

Wishing all lobster researchers a "dynamic" year, the WAMRL rock lobster team signs off from its current research cruise to the Albrolhos Islands, where, at last, the wind has dropped to 20 knots!

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ANNOUNCEMENTS

A symposium on Shellfish Life Histories and Shell Fishery Models will be held under the auspices of the International Council for the Exploration of the Sea (ICES) June 25 -- 29, 1990 in Moncton, New Brunswick, Canada. Authors wishing to contibute either papers or posters were to have submitted title and a short description for consideration by June 1, 1989; complete abstracts of accepted papers are due by May 1, 1990. Participation is open to all who announce their intention of attending before April 1, 1990. Lobsters are specifically mentioned in the context of key issues identified by the convenors of the symposium. For further information, contact:

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PERSPECTIVES

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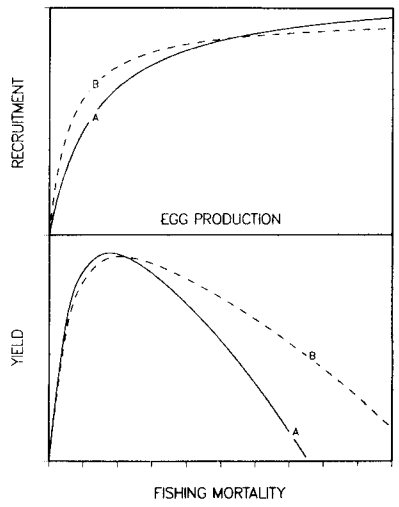
gesting that compensatory mechanisms may be well developed.

These compensatory factors are the focal point of stock-recruitment theory. For example, the well known Beverton-Holt and Ricker models are based on within-cohort competition for limited resources and cannibalism, respectively. The Ricker model can also be derived from certain assumptions about size specific mortality (vulnerability to predators) (for a review, see Rothschild 1986). The form of the relationship between spawning stock size or total egg production and recruitment governs the response of the population to exploitation; subtle differences in the recruitment function can have dramatic effects. Consider the two hypothetical recruitment curves shown in the upper panel of the figure below. The curves differ principally with respect to the slope at the origin.



The lower panel illustrates how these slight differences in recruitment dynamics translate into different responses to fishing mortality. Both curves exhibit similar maxima but at higher levels of

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fishing mortality, the population represented by recruitment curve A declines much more rapidly than for curve B and yields are sharply reduced. Population A is less resilient to exploitation despite only minor differences in recruitment dynamics.

The traditional approach to determining the form of the stock-recruitment relationship has been to examine the empirical relationship between spawning stock size and recruit abundance (or between life history stages). Unfortunately, time series of abundance estimates for different life stages are available for few lobster species (but see Phillips 1986, Fogarty and Idoine 1986). Furthermore, the relationships between life stages can be obscured by variability in survival rates and by measurement error. In addition, there are many aspects to recruitment processes and models that ignore significant biotic and abiotic factors affecting recruitment may give misleading results, particularly if there are sustained trends in these factors (e.g. Garcia 1983; N. Caputi, personal communication).

These limitations suggest that the simple, traditional methods should be augmented. How should we proceed? First, development of consistent time series of abundance estimates at different life history stages is essential. However, we cannot always wait for nature or the fishery to perform the necessary 'experiments' for us, nor can we ignore the potential problems with the empirical approach. There are sufficient biological and ecological data on the major lobster taxa to guide formulation of hypotheses regarding the mechanisms likely to be important for each group. Manipulative experimental studies in the field and laboratory are critically needed to vigorously test these hypotheses. Time series of abundance estimates alone are not sufficient. A focus on the issues so identified (for example, recruitment 'bottlenecks', Caddy 1986) will provide a way to interpret empirical relationships developed through 'traditional' stock-recruitment models.

I have concentrated on population stabilizing mechanisms up to this point, yet variability is pervasive in the marine environment. What are the implications of an uncertain environment on lobster population dynamics? A consideration of stochastic harvesting models permits the following generalizations (see Sissenwine et al. 1988 for an overview). First, the probability of fishery collapse increases when harvest rates increase in a highly variable environment. This is particularly true when the sources of variability are autocorrelated. Second, variability in yield and population size increases with increasing environmental variability and harvesting (especially when the level of maximum equilibrium yield is surpassed).
Which lobster taxa might we expect to exhibit higher levels of recruitment variability and therefore, to be most vulnerable to high levels of environmental variability and fishing mortality? Recruitment variability will be highest in those species with high fecundity, and reduced parental investment (traits that reduce variability in survival rates). Species with a prolonged, pelagic larval phase will be particularly vulnerable to random fluctuations in environmental conditions, which will translate into greater recruitment variability. We might therefore expect the spiny lobsters to exhibit higher levels of recruitment variability than clawed lobsters, particularly those spiny lobster taxa in more variable environments.

Attempts to partition recruitment variabilitiy into its component sources will be most successful in systems characterized by a dominant environmental signal -- for example, upwelling systems or systems subject to ENSO events. Development of predictive models incorporating environmental components will be more feasible in these systems than in those characterized by more diffuse environmental signals. A full understanding of lobster recruitment processes will require information on both population stabilizing factors and responses to environmental variability.

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FISHERIES UPDATE

Spiny Lobster Recruitment in South Florida

Since 1983, we have investigated several key aspects of spiny lobster (*Panulirus argus*) recruitment in south Florida under Sea Grant support. Our goal is to understand the nursery recruitment process by correlating postlarval (PL) settlement to late-stage juvenile abundance. Hopefully, this will provide a mechanism for predicting adult stock. Some results on PL/juvenile substrate selection, juvenile mortality and emigration, and the effect of siltation on recruitment have been published (Herrnkind and Butler, 1986; Herrnkind et al., 1988; Butler and Herrnkind, 1989), but much of our long term work has yet to "hit the press". Here we summarize the conclusions of several studies in an effort to stimulate interaction with other scientists interested in similar problems.

Postlarval Metamorphosis: In a series of laboratory experiments examining the influence of various environmental cues on metamorphosis, we determined that PL time-to-pigmentation and metamorphosis appears to be physiologically constrained. It was not altered by the presence of algae, seagrass, artificial substrates, or algal chemical cues. PL entering Florida Bay metamorphose within 7-10 days, they therefore must settle within that time.

Patterns of Settlement: By manipulating benthic substrates and by monitoring both PL influx and juvenile abundance we have indications that local settlement is: 1) strongly dependent on current flow, largely conforming to a passive settlement model; 2) patchy at different scales, depending on distance from the "source" of PL influx; 3) positively correlated with local juvenile densities; and 4) not necessarily correlated to surface (Witham) collector catch.

Juvenile Crypticity, Sociality and Mortality: Experiments conducted in the field and in large pools revealed that solitary residency, characteristic of algal-phase juveniles in Florida Bay, results from patchy settlement, not antisocial behavior. Solitary, dispersed distribution significantly reduced predatory mortality.

Currently, we are investigating the sources and magnitude of predation on postlarvae and are seeking to establish quantitative relationships between planktonic PL abundance, Witham collector catch, benthic settlement, and recruitment to the postalgal juvenile phase in the Florida Bay nursery. This information is directly relevant to management of the Florida fishery and protection of nursery habitat.

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New Zealand: Spiny Lobster Resources and Research

In New Zealand we have two commercially valuable species of spiny lobster, *Jasus edwardsii* and *J. verreauxi*. The more important species, *J. edwardsii*, is fished around the mainland and at the Chatham Islands 800 km to the east. Annual landings are around 5000 t. A third palinurid *Projasus parkeri* was discovered recently in very deep water (500-900m), but so far is known from just a few specimens.

The commercial fishery has been a limited entry fishery (about 750 vessels) since 1980. Other controls include a minimum legal size and protection of egg-bearing females. Minimum legal size was based on tail length to allow for removing tails at sea in more remote parts of the country. However for *J. edwardsii* this recently was changed to tail width (similar to the measurement used in Hawaii) for enforcement and conservation reasons. Several marine fisheries in New Zealand have come under individual transferrable quota management, and similar measures may soon be introduced for spiny lobsters.

We are concerned about the biological state of the *J. edwardsii* fishery. It is the major inshore fishery of New Zealand by value, yet it is not able to produce at its full potential because fishing effort is too high and stocks too low. The resource is declining, and we believe it is not in a safe state.

Two Ministry of Agriculture and Fisheries (MAFFish) scientists work on spiny lobsters. Paul Breen makes stock assessments and hopes shortly to set up a nationwide catch sampling programme; a pilot study has been going on for a couple of years. He is also interested in dive surveys for juvenile pre-recruit strengths, and in the

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intrinsic rate of increase in an area closed to fishing. My main interest is in larval recruitment and recruitment mechanisms; this involves sampling of late-stage phyllosomata to relate to catches of pueruli on collectors around the country. I also am tagging small juveniles to study movements which may be important in recruitment. A small project on phyllosoma rearing is also being conducted by our Aquaculture group.

Some recent highlights for *J. edwardsii* are:

- Evidence is mounting that the fishery has problems. Surplus production models suggest that current surplus production is below recent landings. Catch sampling has shown that the fishery is dependent on only 1-2 year classes. Egg production models indicate that egg production is lower than desirable. There has been significant decrease in puerulus settlement in some areas.

- We have found good correlation at Stewart Island (in the far south of the country) between puerulus settlement strength and year-class strengths of prerecruits through to at least the 3-year olds.

- The major factor in the much higher settlement of pueruli along the southeast coast of the North Island is the high density of late-stage phyllosomata offshore. Phyllosoma densities and puerulus settlement rates are much lower elsewhere around the country.

- Australia is almost certainly a source of larval recruitment for New Zealand, with significant gene flow via larval transport across the Tasman Sea. The biochemical genetics and the morphological, colour and general biological features of the populations on each side of the Tasman Sea are almost identical.

- Fishermen and industry find the new tail width a practical and convenient measure. However, because of regional morphometric variability, the new measures of 54 mm tail width for males and 58 mm for females impacted heavily on catches in some areas in the first year.

Several others work on rock lobsters. Going from south to north (we Southern Hemispherians are often told we do things front to back), fisheries consultant Bob Street studies movements, growth and pre-recruit strengths in the south of the country. Nick Rayns at Otago University (Dunedin) is finishing a PhD on the growth and survival in captivity of small juvenile *J. edwardsii* with respect to culture density, diet, and various factors that affect moulting. Fran Waldron at Canterbury University (Christchurch) is completing a PhD on the physiological effects on adults of handling and aerial exposure. Tony Brett at Victoria University (Wellington) has been studying the effects of various light cycles on growth and survival of small juveniles. Bruce Gabites at Auckland University is looking at habitat requirements of juveniles and adults.

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Hawaiian Larvae

As noted in Vol. 2(1), lobster researchers in our laboratory are studying spatial and temporal distribution of phyllosoma larvae with emphasis on the commercial species *Panulirus marginatus* and *Scyllarides squamosus*. Along with this dispersal work we have been working on species identification, trying to match the phyllosomes to adult types known to be present locally. To date we have found 13 species of phyllosomes which we are matching to the 12 known adult species. Apparently there is still one species of *Scyllarus* waiting to be recorded from HAwaiian waters. To aid in verifying suspected identifications, we have conducted some partially successful hatching and rearing runs with survival up to about 90 days.

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ANNOUNCEMENTS

JASUS EDWARDSII BIBLIOGRAPHY

An annotated bibliography, with subject and geographical index, of the spiny lobster *Jasus edwardsii* in New Zealand, has been prepared by Paul Breen and John McKoy. It includes and extends the earlier bibliography of McKoy (1979). Papers from primary scientific journals as well as technical reports and articles from trade journals are to be found in the bibliography. The cost is NZ$ 10.00. If you want a copy, write to:

Publications Officer
MAFFish Fisheries Research Center
Box 297
Wellington, New Zealand

Ask for Breen and McKoy 1988, An Annotated Bibliography of the red rock lobster *Jasus edwardsii* in New Zealand. Occ. Publ #3

MORE ANNOUNCEMENTS ON PAGE 4

BOOK REVIEW

Aspects of Decapod Crustacean Biology

A.A. Fincham and P.S. Rainbow, eds. Symp. Zool. Soc. Lond. 69.Oxford. 375 pp. US$98.

Decapod biology was the topic of the 59th symposium of the Zoological Society of London, and these proceedings show that the topics addressed spanned a wide variety of topics from larval biology to physiological ecology. Three chapters addressed lobsters directly, and a number of others will be of interest to lobster biologists.

Nichols and Thompson review methods used for assessing the abundance of lobster (*Homarus* and *Nephrops*) larvae near the British Isles and present some of their data. Larval sampling for *Nephrops* seems quite successful, but *Homarus* is more difficult, principally because of low abundance. They also review a technique for obtaining estimates of fishable stock size from estimates of larval production and apply it to populations of *Nephrops* and *Cancer pagurus*.

Nephrops is also the topic of a chapter by Chapman and F.G. Howard. They point out that variations in population abundances can be attributed to sediment type. Low densities and fast growth rates are found in areas with fine muds. The patchiness of sediments leads to patchiness in populations, and their suggestion that there is little interchange of juveniles and adults between patches. They propose that future management must take into account the "stocklet" and its variability.

Attempts at seeding *Homarus gammarus* to increase the size of natural populations have been underway for some time. A.E. Howard reviews his studies which show that water velocities at the sediment-water interface influence the behavior of lobsters, and must be taken into account when choosing areas in which to attempt enhancement.

Lobsters are mentioned in other chapters as well, and feature prominently in a review of larval nervous systems by Laverack. As he points out, there certainly is fertile ground here for investigators interested in the interactions among development, neurobiology and behavior. Atkinson and Taylor's review of terrestial and aquatic burrowers highlights the advantages and disadvantages of this mode of life.

You needn't browse through the book only for lobsterly articles. Topics range from phylogenetic analyses using larval features through trace metals to the ecology of decapods living in mangroves. In particular, I was intrigued by a chapter on photoecology of pelagic decapods by Herring and Roe.

Lobster biologists will find some chapters in this book useful and may want to suggest their library buy it. The high price seems likely to keep it off most of our personal bookhelves.

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THANKS

...to George Cresswell and to Godfrey Howard for sending us photocopies of old woodcuts, some of which appear in this issue. They come from Fredol (1881) "Le Monde de la Mer"(3rd edition) and from Bell (1853) "A History of British Stalk-eyed Crustacea." You will see illustrations from both of these in the next few issues. More will be welcome, especially of southern hemisphere lobsters.

NEW METHODS AND APPLICATIONS

A Commercial Vaccine to Prevent Gaffkemia in Lobsters: Development and Performance

Every year the Northwestern Atlantic live lobster (*Homarus americanus*) industry suffers significant economic loss due to Gaffkemia caused by the bacterium, *Aerococcus viridans*. Aqua Health has designed a disease containment laboratory for marine animals. We used this facility to develop, and license, an injectable vaccine to prevent Gaffkemia (publication in preparation). Significant protection from an injected challenge of a variety of vaccine preparations was conferred by both injection (federally licensed) and immersion (unlicensed) administration. Protection conferred by the injectable vaccine was present 10 days after administration and persisted about 100 days. Field vaccination of hundreds of pounded lobsters with licensed vaccine in the Spring and Summer of 1987 resulted in increased recovery of up to 26%. Field trials of the vaccine in the fall and winter of 1987-1988 have demonstrated increased production by 13% when lobsters were immersed in the vaccine.

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HALL OF FAME

Martin W. Johnson 1893-1984

Dr. Martin W. Johnson was a plankton researcher of great ability who worked at the Scripps Institution of Oceanography in La Jolla, California. Among other honors, he received the Agassiz Medal from the Washington Academy of Sciences in 1959 for his contributions to oceanography. Dr. Johnson had two distinguished careers as a zooplankton ecologist and systematist, each lasting over 30 years, the first concentrating on copepods, the second on lobster phyllosome larvae.

Phyllosomes had interested him since he participated in the 1949 federally operated "Operations Crossroads" in the central Pacific. His 1951 publication of the giant palinurid larvae taken on this cruise began a series of 22 papers on phyllosomes. Early in the 1950s, although still working with copepods, he began to study phyllosome development from material taken by ships of opportunity along the coasts of California and Mexico. This lead to laboratory rearing of phyllosomes from eggs with Dr. Margaret Knight, work that was published in 1960. In 1966 they published on the the production and distribution of larvae of the spiny lobster *Panulirus interruptus*.

In the late 1950s he participated in the intensive multi-ship cooperative hydrographic expeditions involving ships from Scripps, California Fish and Game, the Inter-American Tuna Commission, and the National Marine Fisheries Laboratory in La Jolla. These were multi-disciplinary studies of currents and their biological and physical components. It took several years of study before a true picture of larval abundance and dispersal could emerge. He was able to determine that the phyllosome stages of P. interruptus lasted for seven to eight months. These studies were published in two lengthy papers in 1960.

With the success of the first multi-ship eastern Pacific operations, studies were extended through the Gulf of California and down to Peru. The California ships joined National Marine Fisheries vessels from Hawaii and took plankton samples from Hawaii, the South China Sea, and the Philippines. He then described and published two papers on their distribution as related to the prevailing hydrography in those areas. This was followed in 1974 by reports on dispersal of phyllosomes into the East Pacific Barrier. From 1975-1979 six papers were published on developmental stages of various slipper larvae that had been omitted from the areas earlier studied and from the North Pacific.

Handling of these leaf-like animals is difficult and he and Dr. Knight prepared slides of the distinct larval stages. Dr. Knight still remembers the overpowering fumes of the clove oil that Dr. Johnson preferred to use as a clearing agent. The phyllosomes were stained in Fast Green, run up through the higher ethyl alcohols, cleared in clove oil, mounted on a glass pane (because so many of these are larger than the standard 1"x 3" or 2"x 3" microscopic slides), and then flooded with balsam or Clarite. He finished the preparations by covering with another glass pane. Meticulous craftsmanship yielded slides with no, or only a few bubbles. The largest slide that I remember was mounted on a glass pane about 8"x 10". These large mounts dried agonizingly slowly, but it did make the fragile phyllosome much easier to manage and to store. The Bernice P. Bishop Museum in Honolulu has five phyllosome, taken from around the Hawaiian Islands, mounted on 1"x 3" and 2"x 3" slides. Other slides were deposited either in the Museum at Scripps Institution of Oceanography in La Jolla, or at the Department of Invertebrate Zoology in the US National Museum of Natural History at the Smithsonian Institution.

I sincerely thank Dr. Margaret Knight for her time and abundant references on the work of a friend whom we both admired.

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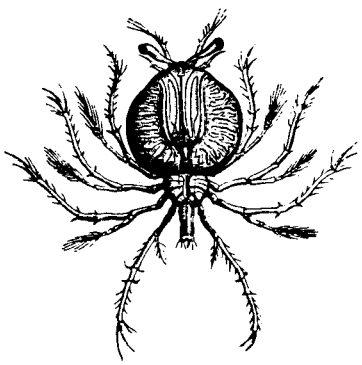
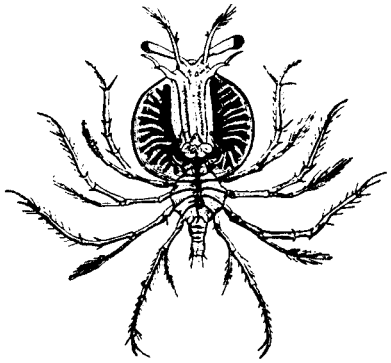
EDITOR'S NOTE: Beatrice Burch first met Martin Johnson in 1939 at UCLA when, as a senior, she took her first invertebrate zoology class. She writes: "Martin Johnson was a very shy man, but not really standoffish and he was a very conscientious teacher with his students and keenly interested in furthering their careers. He was a life long friend and we corresponded to the end of his life. He didn't start on phyllosomes until he was 65. When I was amused, he said 'Well, copepods are too small, but I'm not ready for the shelf.'... (When I was 65, I switched from bigger molluscs to work on forams. I think he was smarter)."





MAILING LIST

We have been gratified by the excellent response to the Lobster Newsletter. We now mail nearly 500 copies of each issue. Many of you have sent address changes, and a few copies have been returned as undeliverable. We feel it is now time to clean up the mailing list and to ask for an active response if you wish to continue receiving the Lobster Newsletter.

A postcard has been enclosed for this purpose. It is addressed to Stan Cobb, and your mailing label is attached to it. IF YOU WISH TO REMAIN ON THE MAILING LIST FOR THE LOBSTER NEWSLETTER, PLEASE RETURN THE POSTCARD. The next issue of the Lobster Newsletter will be mailed only to those people who return the cards. If the address is wrong, please correct it on the card. Thanks very much.

ANOTHER EXHORTATORY NOTE

Again we are pleased with the response to the Lobster Newsletter. In the last number we reported that we had received many complementary letters and comments. We didn't say that we had to cajole many of the articles you saw, and to write several of them ourselves. This time the situation is quite different; your response in terms of contributions to the newsletter has been very gratifying. In particular, it is a real pleasure to note that articles or notes have come from Israel, Hawaii, the Philippines, New Zealand and Australia as well as the North American continent.

We are tempted to say, simply, "keep up the good work!" but a glance at these pages will indicate we would be a bit remiss if there were not a further exhortation. A large proportion of the subject matter in this number of the newsletter is oriented towards fisheries and ecology. This probably reflects the interests of the editors to some degree, as well as the general proportion of the current readership. Nevertheless, the biology of lobsters is being investigated at all levels, and one of our goals for the newsletter is to provide a forum for communication among all people working on lobsters. We urge our readers who work on topics as diverse as neurobiology, systematics, molecular biology, physiology and so on to contribute. As we said in our first editorial, one of the attractions of this newsletter should be its eclectic nature.

July 1989

The Lobster NEWSLETTER

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ADDRESS CORRECTION REQUESTED