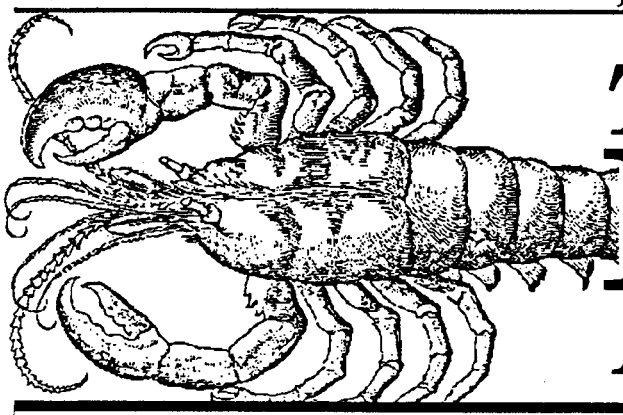
VOLUME SEVEN JULY 1994 NUMBER ONE



The Lobster NEWSLETTER

RECENT EVENTS

New Lobster Book

An important addition to the lobster literature has just arrived. **Spiny Lobster Management**, edited by Bruce Phillips, Stan Cobb, and Jiro Kittaka, was published by the Fishing News Books Division of Blackwell Scientific in early 1994. The editors say, in the Preface, "In deciding to prepare this book, we intentionally focused on spiny lobsters because of the growth in the industry, the concerns about management, some significant developments in biological knowledge, and the exciting developments currently underway in aquaculture." The book opens with a brief review to introduce the biology of spiny lobsters. Following come twelve chapters that review the status and management of major fisheries by geographic region. Case studies present in-depth views of specific recent research efforts that have aided fishery management. These range from issues in reproductive biology, to bioeconomic modeling, to the use of artificial shelters for facilitating catch. The final section consists of thirteen chapters on aquaculture and marketing, and focuses on the Japanese approaches to determining how to culture spiny lobsters, as well as the

CONTINUED ON NEXT PAGE

RESEARCH NEWS

Recent Studies on the Larval Biology of the Spiny Lobster (*Panulirus cygnus*) of Western Australia

FROM: J.W.T.J. LEMMENS, B. MARINOVIC, AND B. KNOTT

Although the spiny lobster of Western Australia, *Panulirus cygnus*, including its planktonic stages, (see Phillips *et al.*, 1980 for an overview) has been extensively studied, remarkably little is known about how such factors as water temperature and light affect behaviour of the phyllosoma and puerulus stages. Recent studies under the supervision of Dr. Brenton Knott at the Marine Biological Laboratories of the Depart-

CONTINUED ON PAGE 10

FISHERIES AND AQUACULTURE UPDATE

Lobster Research in South Australia

FROM: JIM PRESCOTT

Research on the southern spiny lobster, *Jasus edwardsii*, in South Australia has intensified dramatically since August 1993. Research is now cooperative between the lobster fishing industry and the South Australian Research and Development Institute with additional funding from the Fisheries Research and Development Corporation. The cooperative approach has been the result of the fishing industry's desire to have more input into research and a new responsibility for directly managing the fishery through what are known as Integrated Management Committees.

The three year research project has the goal of producing an age/length structured, spatial model of the population. This is not unusual, but another aspect of the project is. The model will be made accessible to biologists and non-specialists through an interactive computer graphics interface. The aim of the interface is to allow biologists, fishery managers and

CONTINUED ON PAGE 5

RECENT EVENTS

CONTINUED FROM PREVIOUS PAGE

marketing and distribution of spiny lobsters in Japan.

The book is 550 pages long, contains many line drawings and photographs, and is indexed. It costs £69.50.

Workshop on *Homarus* Stock Enhancement

A cross-Atlantic workshop on fisheries and aquaculture of *Homarus* was held in Galway Ireland at the Shellfish Research Laboratory in Carna, April 18 — 22, 1994. Hosted by John Mercer, the meeting attracted more than 100 lobster scientists, managers and fishers from Belgium, Canada, France, The Channel Islands, France, Greece, Ireland, Italy, Norway, Great Britian, and the USA.

The workshop was organised in response to the growing interest by Irish lobster fishers in the long-term future and development of the lobster industry. The major objectives of the meeting were to review the status of *Homarus gammarus* and *H. americanus* stocks, to examine the state of the art in lobster stock enhancement, and to explore prospects for and constraints to, stock enhancement for the fishery.

The meeting took place in two parts. The first was a two day conference of formal presentations, starting with keynote addresses by M. Fogarty (Lobster Stocks and Lobster Fisheries) and S. Waddy (Lobster Biology, Behavior, Reproduction and Ecology). This was followed by sessions on stock enhancement programs by country (Norway, Ireland, USA, France, Italy, and the U. K.), and the industry view of enhancement efforts. The second day of the workshop addressed the technologies of enhancement, including artificial reefs, habitat and the efficacy of enhancement techniques. The final session reviewed topics in cultivation practices including nutrition, genetics, and the management of impoundments.

The second part of the meeting was a three-day workshop during which seven expert panels provided instruction and exchanged information on current technologies and new developments in lobster stock enhancement. Topics included care of broodstock, larval handling and management, and restocking techniques for juveniles. A draft manual, "Practices and Techniques in the Production of Juvenile Lobsters" was prepared by the Shellfish Research Laboratory to accompany these sessions. This part of the meeting engendered substantial exchanges among the gathered scientists, fishers, and associated industry and regional development representatives.

Further information about publications arising from the workshop can be obtained from John Mercer at the address below. We hope to have a fuller report of the workshop in the next issue of The Lobster Newsletter.

For further information, contact:

Dr. John P. Mercer
Shellfish Research Laboratory
Carna Co., Galway
Ireland

Mexico-Cuba Workshop on Artificial Shelters

FROM: DR. JAIME GONZÁLEZ-CANO

The spiny lobster *Panulirus argus* is the most important fishing resource in Cuba and on the Caribbean coast of Mexico. More than 50% of catch in Cuba is obtained using artificial shelters called "pesqueros". In Mexico, the same structures are called "casitas", and provide about 22% of the catch. These two countries are the only ones officially using these artificial shelters to capture spiny lobsters. However, given the great interest shown by several other countries for introducing similar structures in their spiny lobster fisheries, the Instituto Nacional de la Pesca from Mexico and the Centro de Investigaciones Pesqueras from Cuba, held the 1st Binational Workshop "The use of artificial shelters in lobster fisheries: their impact in the dynamics and management of the resource" May 17-19, 1993 at Isla Mujeres, México. A second workshop will be held in Havana Cuba, in October 1994 (see Announcements).

About 50 researchers from several Mexican and Cuban institutions attended the workshop. The main topics were: Use and planning of artificial shelters; design and positioning of artificial shelters; as-

The Lobster NEWSLETTER

Editors:

John Booth
MAF Fisheries, Greta Point
P.O. Box 297, Wellington
NEW ZEALAND
FAX: (4) 386 0574

J. Stanley Cobb
Department of Zoology
University of Rhode Island
Kingston RI 02881 USA
FAX: (401) 792 4256

John Pringle
Fisheries and Oceans
PO Box 550
Halifax B3J 2S7
CANADA
FAX: (902) 426 3479

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

Coordination: Ron Duggan

Please send change of address to John Pringle.

sessment and monitoring; and pros and cons of using artificial shelters.

A total of 26 papers were presented. A Proceedings including 20 of the papers will be published and available to anyone interested. Requests should be sent to:

Dr. Jaime González-Cano
Subdirección de Recursos Pesqueros
Instituto Nacional de la Pesca
Chilpancingo 70, Col. Condesa
06100, México, D.F. México
Fax (5) 286 11 41

Here I provide very brief summaries of 17 of the presentations.

Global Analysis of the Introduction of Artificial Shelters in the Lobster Fishery of the Yucatan Peninsula, Mexico. J. González-Cano & C. Aguilar-Cardozo.

In this work the most plausible scenarios of introducing casitas, suddenly or by stages, along the coasts of the Quintana Roo and Yucatan states are analyzed. The analysis consider the impact of these structures on future catch for both closed and open systems. We assumed that casitas have an important role in the behavior of the fishery in peripheral areas along the Quintana Roo state. Recommendations for using casitas are given.

Use of Artificial Shelters and its Relationship to the Productivity and Efficiency of the Spiny Lobster Fishery. F. Arreguín & J. González-Cano

The use of artificial habitats tends to increase fishing efficiency without having an effect on biological production. In this sense, if for socioeconomic reasons, the use of these devices is considered for exploitation, we recommend control of the magnitude of the fishing operation, based upon the actual productivity of the population and the ecosystem where the fishing activity takes place.

Density of the Spiny Lobster, Panulirus argus, in Artificial Shelters in Bahia de la Ascensión, Quintana Roo, México. W. Aguilar, A. Aguilar, & T. Camarena

The highest density (between 20-80 lobster/casita) for 55-75 mm carapace length lobsters was observed during the closed season. During the fishing season an irregular density pattern was seen and highest value (between 10-40 lobsters/casita) was observed for sublegal sizes or juveniles (25-45 mm CL). During the cold front season density declines sharply with a similar pattern to the fishing season. The highest density for each season one was found on rocky bottoms.

Artificial Shelters as a Fishing Method and Their Importance in Relation to the Regulations of the New Fishing Laws. A. Solórzano & J. Gonzalez-Cano

The development of Mexican lobster fishery management strategies development are described. Some of the articles of Mexican fishing law articles are reviewed in relation to concessions. Emphasis was placed on relation to fishing methods to be used, particularly "casitas".

Application of Technology to the Capture of Spiny Lobsters in the Yucutan. R. Torres-Lara & S. Salas

The technological lobster program in Yucatan is discussed at length. It includes: justification, objectives and scope from 1989 to date. The outcome of the program has not been evaluated yet. Moreover, fishermen accepted it in principle with certain reluctance and has been implemented slowly.

Similarities and Differences Between Artificial Shelters and Other Fishing Methods. J. Gonzáles-Cano

Artificial shelter and fishing device concepts are reviewed and differences amongst them are noted. The different refuge concepts are analyzed. The stabilizing buffer effect of refuges in resource dynamics is described and suggestions made about how its role could change the vulnerability of lobsters due to individual aggregation. The refuge effect, accessibility and vulnerability in the presence of "casitas" are analyzed.

Artificial Shelters used in the Fishery for Spiny Lobsters in Quintana Roo, México. P. I. Caballero

This is a contribution to the knowledge of artificial refuge use as an art of fishing in Quintana Roo. It presents solutions for some construction problems. There are approximately 7 different types of shelters and it is considered that the total number of "casitas" in Quintana Roo is about 3000.

Elements of the Analysis of the Spiny Lobster Fishery using Artificial Shelters in Quintana Roo, México. E. Sosa & A. Ramírez-González

Catch, effort and catch per unit effort patterns and trends in the Ascensión and Espíritu Santo bays are described. These are compared to those in other localities where casitas are employed. The possible consequences using casitas are discussed. Several hypotheses are described: stock-recruitment, casitas distribution against local lobster distribution and variability in relations with abundance, and reduction of emigration from nursery areas to open sea.

Use of Artificial Shelters in the Spiny Lobster Fishery of Quintana Roo, México. E. Sosa & A. Ramírez-González

This is a descriptive work. It reviews briefly the available information on casitas and the actual tendency of its use in the Quintana Roo state.

CONTINUED ON NEXT PAGE

RECENT EVENTS

CONTINUED FROM PREVIOUS PAGE

Fluctuations in Catch of Spiny Lobster *(Panulirus argus)* in Artificial Shelters, in the area of the Gulf of Batabano, Cuba. R. Cruz, R. Puga, & M. de León

The amount of lobsters per artificial shelter can be considered as an index of abundance, inversely correlated to the fishery effort. Estimates of recruitment to the fishery in June display a linear relationship for catches obtained by the "pesqueros". The catchability coefficient (q) shows a wide variability in different seasons.

Fishing Mortality of Spiny Lobsters Associated with Different Capture Techniques in the Gulf of Batabano, Cuba. R. Puga, M. de León, & R. Cruz.

It was proved that the variation in fishing mortality rate, when the season is open, is significantly related to the artificial shelters checked and is more intense over the groups of 3 to 4 years, with size of first capture of 81.2 mm (CL). For the period of massive migration, fishing mortality is related to the traps joined by nets (jaulones) checked and is bigger over groups of 4 or 5 years, while the size of first catch is 83.4 mm.

Intensity of Fishing on the Lobster Resource in the Gulf of Batabano, Cuba. M. de León, R. Cruz, & R. Puga.

Using different models of production, it was possible to estimate a potential catch of 7,300 tons of lobster per year using 102,000 artificial reefs (pesqueros) and 18,110 traps with nets (jaulones). From optimum fishing pressure and CPUE per gear, a lessening of the present density of pesqueros in this area (6.1 pesqueros/Km2) to 4.7 (pesqueros/Km2) is suggested.

Development, Use, and Management of Artificial Shelters in the Cuban Spiny Lobster Fishery. R. Cruz, M. de León, & R. Puga.

The Cuban lobster fishery combines features both from industrial and artisanal fisheries. The latter has reached a high level of development and catches are obtained using artificial shelters, known as "pesqueros". These have been used for more than five decades, although its use in other countries did not occur until the early 1970's. The experience accumulated in the management of this resource has enabled a guarantee of strict administrative control with the strategic purpose of maximizing foreign currency. In this sense, efficient measures to conserve the resource related to the cycle of spiny lobsters and to an extensive use of pesqueros have been put into effect.

Fishery for the Spiny Lobsters *Panulirus inflatus* (Bouvier) and *P. gracilis* (Streets) on the Southeast Coast of the Gulf of California, México. L. M. Flores-Campaña & R. Pérez

Artificial shelters made from concrete blocks may be a way to increase lobster catches, considering that the coast of the Sinaloa state is not a well-protected area and it presents high energy swell with different topographic features, sand and rocky bottoms.

Effects of a Change in the Fishing Season on the Fishery for the Red Spiny Lobster (*Panulirus interruptus*, Randall, 1840) during the period 1992-1993, in the West Coast of Baja California. M. M. Ramade

Last September 9 of 1992, the catch season for the red spiny lobster *(Panulirus interruptus)* changed in the Mexican Pacific Ocean. The coast was divided in two big fishing areas. For zone I, the season begins 15 days before, and ends 30 days after the last season. For zone II, the catch season has not changed. This work compares last three catch seasons and includes a discussion about the effect of changing the catch season for zone I. Male and female monthly proportion of commercial catches and some quality control measures for the product are also reviewed.

Ecological Aspects to be Considered in Site Selection for the Installation of Artificial Reefs. M. Salgado, R. Grión, G. Ramírez, & J. V. Mendoza.

The main objective of the present survey is to carry out the right selection of best sites for placement of artificial reefs. The main goal is to enhance inshore fishery yield of the Colima state.

Selection of Materials and Designs for the Construction of Artificial Reefs for Fisheries on Colima State, México. R. Girón. M. Salgado, M. G. Ramírez, & J. Mendoza.

This work describes the objectives for the selection of appropriate materials and designs for artificial reefs construction and installation, in the coastal zone of Colima, Mexico. Three materials and four designs were selected and described.

Jaime González-Cano
Subdirección de Recursos Pesqueros
Instituto Nacional de la Pesca
Chilpancingo 70, Col. Condesa
06100, México, D.F.
MEXICO

FISHERIES AND AQUACULTURE UPDATE

CONTINUED FROM PAGE 1

fishers to develop insights into the complex way the population may respond to alternative management strategies, and perhaps environmental variables. This method of technology transfer has already proven successful with a model of the southern shark fishery.

The first phase of the study has been an intensive tagging study to provide the biological data for the model. During the first six months of the study, 20,000 lobsters were tagged. About 10,000 of these were tagged by volunteer fishers who had taken part in a two year catch sampling program, and were proven data collectors. About 1,500 recaptures have been made so far. Industry support for the project is so strong that nearly all of the recaptured lobsters were released by the fishers after being measured, sexed and so on. Measurements of lobsters which did not moult between release and recapture indicate that most fishers are measuring the lobsters very carefully. With several more months of fishing season left, it is hoped to tag a further 20,000 lobsters. The intensive tagging program will continue for a further year.

While not without its problems, this cooperative research has resulted in far more enthusiasm from the participants and much more data acquired than would have otherwise been possible. Since fishers are directly involved in the research, it is hoped that they will have greater faith in the results, and will be more prepared to accept adjustments to management if necessary.

Jim Prescott
Project Leader
P.O. Box 1846
Mount Gambier
South Australia 5290

Traditional Property Rights and Cooperative Management in the Canadian Lobster Fishery

FROM: JEFF BROWNSTEIN AND JOHN TREMBLAY

While there is much discussion about the merits of property rights in fisheries management, the fishers of Little River, northeastern Cape Breton Island, Nova Scotia, have a working system that is grounded in history. In the late 1800s there was a problem with lobster traps being hauled by non-owners. The community was staunch Presbyterian and so religious, fishers would clean bait from trap spindles Saturday, to prevent the trap from fishing on the Sabbath. The Presbyterian Minister of the day was both a spiritual leader and a voice of authority. In answer to those worried about illegal trap hauling, the Minister had a solution—that every man (women were not fishers back then) would fish only those waters fronting his own property. Fishers off someone else's property would be under suspicion. Property boundaries became marked so they could be seen a few miles from shore.

While this system of property rights was never formalized in law, it has served the purpose well, and for most of this century it went unchallenged. About 10 years ago problems developed as some lobster licenses left the area and more were brought in from neighboring ports; in particular the new licenses were brought in by residents who lived a few miles from shore and thus could not claim shoreline property rights. Also, some fishers had come to own long pieces of the shoreline, and some owned property with better lobster bottom.

To deal with these problems the local fisher's association became stronger and developed a system of compromise and democratic-decision making. Today fishers working out of Little River (27 licenses in all) have their own "property" to fish as they like. Adjustments are made if an area becomes less productive than the others. There are also "open grounds" that everybody has access to. The system has many advantages over the system that prevails in most lobster areas (no property rights as such). Among the advantages are less reason to fish in excess of trap limits, and less overcrowding of the best grounds. Fishing traps on trawls (5-6 per trawl) is much easier and Little River fishers are among the fastest to complete their daily hauls of 275 traps. Perhaps the most positive aspect of the Little River system is the sense of stewardship it fosters in those with rights to a piece of the grounds.

With a stronger fisher's association built around the property issue, non-property rules were agreed to including those dealing with dumping of bait, placement of traps in the open grounds and restriction on large "4-bow" traps. Fishermen in the area generally favour an increase in the minimum carapace size, have discussed reducing their trap limits, and are providing boat time and experienced assistance to a Halifax Fisheries Research Laboratory team studying growth, movement, and pre-recruit lobster abundance. The progressive nature of the Little River lobster fishers is traced to their cooperative system of "lobster ground ownership". With the world wide trend in governments to reduce fisheries management costs, the Little River example is encouraging; it shows that communities can agree upon rules that restrict effort and contribute towards conservation.

J. Brownstein
R. R. # 4, Baddeck, Nova Scotia
Canada, B0E 1B0.

J. Tremblay
Halifax Fisheries Research Laboratory
P. O. Box 550, Halifax,
Nova Scotia, Canada, B3J 2S7.

FISHERIES AND AQUACULTURE UPDATE

CONTINUED FROM PREVIOUS PAGE

Molting Periodicity in a Captive Population of Juvenile Spiny Lobster (*Jasus edwardsii*)

FROM: CRAY CORPORATION LTD.

Observations on molt frequency have been made over four months on juvenile spiny lobsters held at constant temperature in a pilot-scale recirculating farming system. Juvenile *Jasus edwardsii* collected as early post-pueruli from Castlepoint near Wellington, New Zealand on 5 May 1993 were transported by air to our recirculating plant in Dunedin. The 100 juveniles (wet weight 1.5 - 7.9 g) were evenly divided among four 0.05 m3 white, opaque plastic tanks. In addition, four larger juveniles (wet weight 22 - 50 g), collected from Castlepoint on 25 August 1992, were held in a separate 0.175 m3 tank. All animals were fed green-shelled mussels, *Perna canaliculus*.

The tanks were covered by 2 cm thick blue styrofoam, and some light could pass through this and the sides. A skylight over the plant allowed some ambient lighting; the room was also lit with fluorescent lighting during the day. From 18 October (Day 1) to 18 November (Day 32), the seawater was held at constant at 15° C, at which time water temperature was increased over eight hours to 18°C. On 30 December 1993 (Day 74), water temperature briefly rose to 21.5°C due to a circuit fault.

Observations of molt frequency were made by counting and removing empty exoskeletons in the tanks each morning. Here we report results to 4 February 1994 (Day 110). Over this period, 14 small juveniles died, but there were no deaths among the larger juveniles.

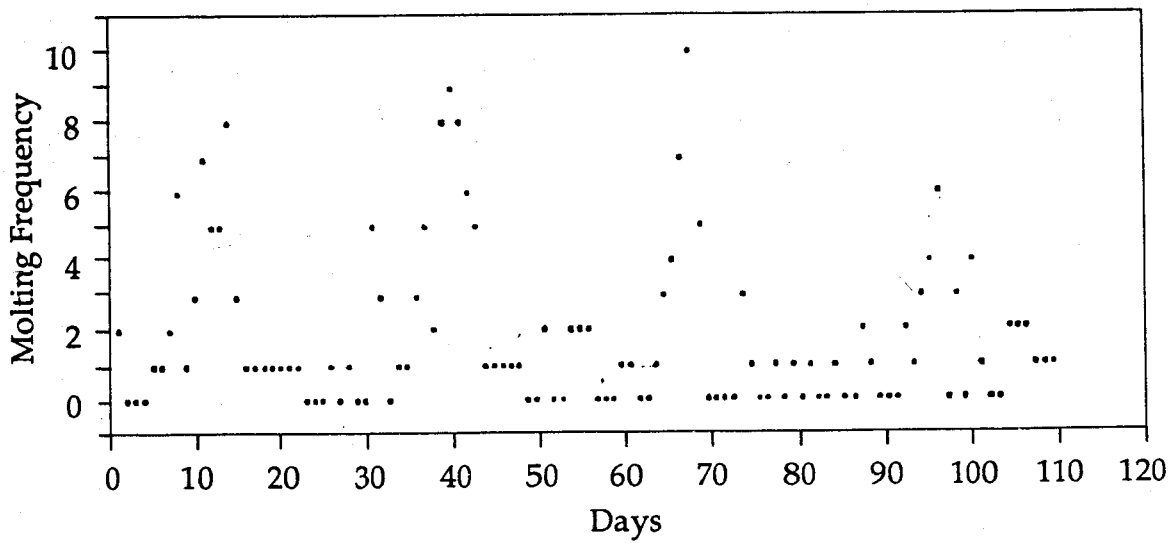
Four distinct peaks in molting were observed among the small juveniles (see Figure) - centered on about Days 14, 40, 68, and 97. The peaks occurred just before full moon each lunar month, and an average of 27.7 days apart. Molting was observed at others times of the month, but at a much lower frequency.

Between Days 5 and 35 (from the first peak of molting to the beginning of the second peak), 59 shells were found, suggesting that roughly 60% of the small juveniles had molted. Similarly, about 70% of the small juveniles molted between Days 36 and 63, and about 36% between days 64 and 92. Clearly, not all juveniles molt at each peak.

The four large juveniles molted between Days 24 and 33 (before the molting peak for the smaller juveniles) and again between Days 98 and 104 (during the molting peak for the smaller juveniles) - an interval of roughly 2 months. During our observations, the smaller juveniles grew from a mean of 2.7 g to 9.1 g wet weight. The larger juveniles grew from 26.0 to 41.8 g wet weight.

We will continue to monitor the molt frequencies in this captive population to determine how long this cycle is sustained. If the trend persists, then the next step will be to design experiments to identify the proximate factor(s) cueing molting. It may then be possible to manipulate to the aquaculturist's advantage the specific environmental factors that stimulate molting.

Cray Corporation Ltd.
P.O. Box 6351
Dunedin
New Zealand



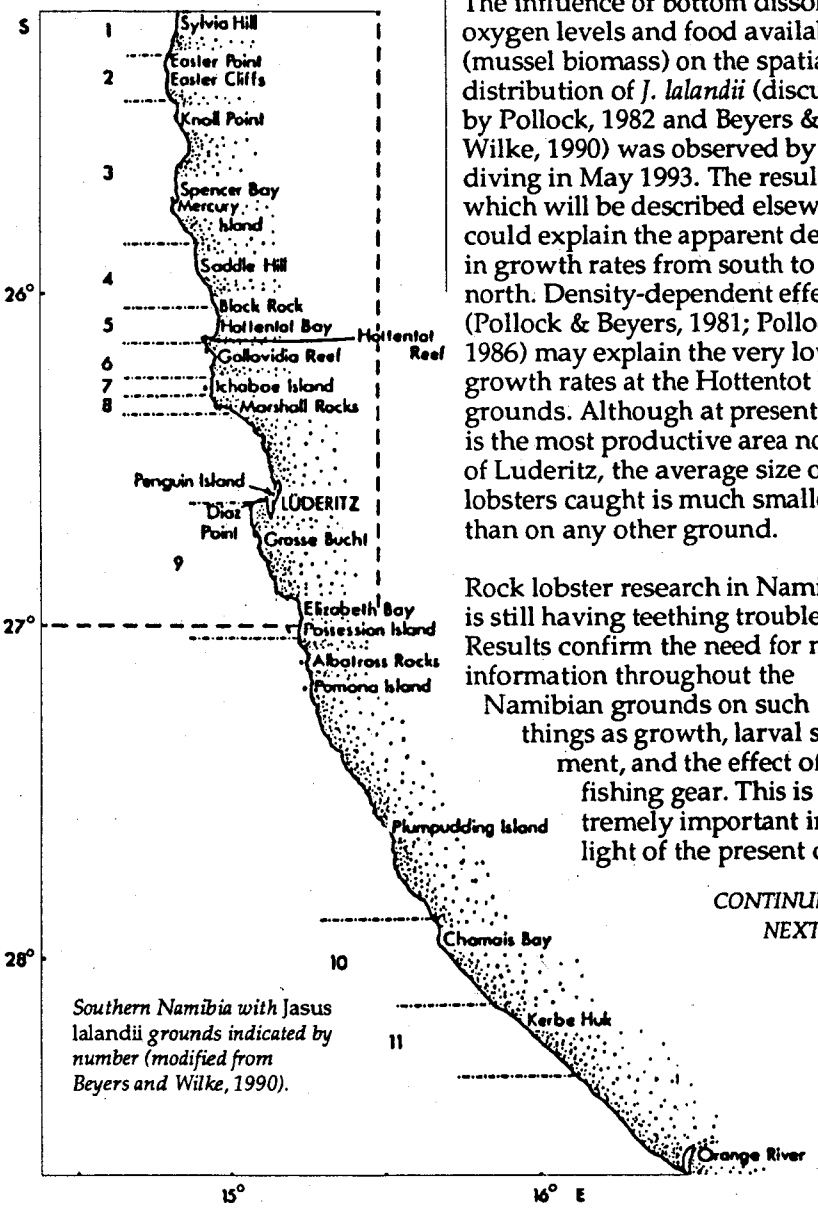
An Overview of the *Jasus lalandii* Fishery of Namibia and Research Recommendations

FROM: KOLETTE GROBLER

Exploitation of the Namibian spiny lobster, *Jasus lalandii*, dates back to the early 1920s (Matthews, 1962). A highly productive resource in the early 1950s, it produced up to 9000 t annually. However, during the last 40 years a gradual decline has occurred in annual catches, until the early 1990s when the annual Total Allowable Catch was reduced to about 200 t. It appears that a combination of factors, including over-exploitation (Beyers & Wilke, 1990) and environmental effects (Pollock & Shannon, 1987) contributed to the decline. The fishing grounds at SW Blinder (Marshall Rocks) were the most productive in the 1960s (Matthews 1962, Beyers, 1979, Beyers & Wilke, 1990), but after population crashes there in the mid 1970s and the late 1980s, this area now has low production. Possible contributing factors include over-exploitation, environmental factors (low dissolved oxygen levels at the bottom), and predation. During a recent dive survey, whelks, which probably are important predators on *J. lalandii* were in much higher numbers in the SW Blinder area than at the Ichaboe Island Sanctuary or any of the neighbouring lobster grounds. Southern areas (e.g. Kerbe Huk), relatively unimportant in the late 1980s (Bailey, Beyers & Lipschitz, 1985), are now among the most productive both in total catch and CPUE.

The present commercial grounds extend from just north of the Orange River to Easter Cliffs/Silvia Hill, with the main ones being the Hottentot and Gallovidea Reefs and Kerbe Huk (see figure). Management measures include a minimum lower size limit (65mm carapace length), a quota system, and restriction on effort. There are also spiny lobster sanctuaries, one east of Ichaboe Island and another in Luderitz Harbour. There is no limit on mesh sizes for traps or ring-nets and those in use restrict the escape of undersized lobsters. Undersized spiny lobsters can make up to 70% of catches, so there is probably high mortality from handling and recycling.

As sexual maturity of females appears to be age related and not size specific (Beyers & Goosen, 1987; Chittleborough, 1976, 1977; Pollock, 1987), the size at which 50% are mature was used to indicate differences in growth rate between locations. Along with length weight correlations, the results suggest that growth rate declines from south to north; a similar trend is present in the South African *J. lalandii* (Pollock & Beyers, 1981; Pollock, 1986; Pollock & Shannon, 1987). In addition, lobsters from southern grounds are heavier than similar-sized individuals from northern areas. At the Ichaboe Sanctuary, however, both males and females appear to grow much faster than on any other Namibian ground except Kerbe Huk (see table next page).



Southern Namibia with Jasus lalandii *grounds indicated by number (modified from Beyers and Wilke, 1990).*

The influence of bottom dissolved oxygen levels and food availability (mussel biomass) on the spatial distribution of *J. lalandii* (discussed by Pollock, 1982 and Beyers & Wilke, 1990) was observed by diving in May 1993. The results, which will be described elsewhere, could explain the apparent decline in growth rates from south to north. Density-dependent effects (Pollock & Beyers, 1981; Pollock, 1986) may explain the very low growth rates at the Hottentot Point grounds. Although at present this is the most productive area north of Luderitz, the average size of lobsters caught is much smaller than on any other ground.

Rock lobster research in Namibia is still having teething troubles. Results confirm the need for more information throughout the Namibian grounds on such things as growth, larval settlement, and the effect of fishing gear. This is extremely important in light of the present de-

CONTINUED ON NEXT PAGE

FISHERIES AND AQUACULTURE UPDATE

CONTINUED FROM PREVIOUS PAGE

pleted state of the resource. Research planned includes a study of the effect of a modification in fishing gear to reduce the numbers of undersized spiny lobster being handled, temporary closure and intensive survey of the SW Blinder area, monitoring of annual growth rates, puerulus settlement, and seasonal inshore-offshore migrations, as well as the long-term monitoring of environmental factors affecting distribution and survival of spiny lobsters.

CAF Grobler
Sea Fisheries Research Station
PO Box 394
Luderitz
9000
Namibia

Size at which 50% and 100% of female *Jasus lalandii* are mature on the coast of Namibia, sampled from commercial catches (*) and dive surveys during 1993.

Area	Carapace Length (mm) at Maturity	
	50%	100%
Kerbe Huk	59.0*	65.5
SW Blinder	51.1*, 52.0	56.5*, 56.8
Ichaboe Island	54.5	62.0
Gallovidea	52.5	56.8
Hottentot Point	48.0*, 50.9	56.5*, 56.8

Literature Cited

Bailey, G.W., Beyers, C.J. de B. and Lipschitz, S.R. 1985. S. Afr. J. Mar. Sci., 3: 197-214.

Beyers, C.J. de B., 1979. Invest. Rep. Sea Fish. Brch. S. Afr., 117: 26 pp.

Beyers, C.J. de B. and Goosen, P.C. 1987. S. Afr. J. Mar. Sci., 5: 513-521.

Beyers, C.J. de B. and Wilke, C.G. 1990. S. Afr. Sea Fish. Res. Inst. Invest. Rep., 133: 56 pp.

Chittleborough, R.G. 1976. Aust. J. Mar. Freshwat. Res., 27(3): 499-516.

Chittleborough, R.G. 1977. Rapp. P.-v. Reun. Cons. perm. int. Explor. Mer., 175: 217-222.

Matthews, J.P. 1962. Invest. Rep. Mar. Res. Lab. S. W. Afr., 7: 61 pp.

Pollock, D.E. 1982. Invest. Rep. Sea Fish. Inst., 124: 57 pp.

Pollock, D.E. 1986. Can. J. Fish. Aquat. Sci., 43: 2107-2117.

Pollock, D.E. 1987. S. Afr. J. Mar. Sci., 5: 531-545.

Pollock, D.E. and Beyers, C.J. de B. 1981. Trans. Roy. Soc. S. Afr., 44: 379-400.

Pollock, D.E. and Shannon, L.V. 1987. S. Afr. J. Mar. Sci., 5: 887-899.

Lobster Fishing in Iran

FROM: MOHSEN HADJIRASOULIHA

Iran coastal waters total about 2500 km along the Sea of Oman and the Persian Gulf (see Figure). The presence of spiny and slipper lobsters along the southeast coast from the Port of Chabahar to the Strait of Hormoz has been known to local fishers for many years. A well established fishery, however, did not develop for lack of an available market. Fishers did not target lobsters, catching only the occasional lobster while fishing for other species.

The author carried out the first fisheries resource science study of the lobster species along this coast; emphasizing taxonomy, descriptive ecology, spawning, fishing techniques stock assessment. The most important commercial species belonged to the Palinuridae and Scyllaridae.

1. *Panulirus homarus* - the numerically dominant species along the southeast coasts of Sistan and Baluchestan Provinces is represented by the subspecies *P. homarus megasculpta* and *P. homarus homarus*. They grow up to 12 cm CL (30-32 cm total length) and tend to inhabit rocky shores in waters of 1-5 m depth with the juveniles in the nutrient-rich nearshore and the adults in the deeper offshore waters.

2. *Panulirus versicolor* -this species inhabits the transparant, shallow (5-15 cm deep), coral outcrops of the Persian Gulf islands and grows to 46 cm total length with a mean length of 30 cm.

3. *Panulirus polyphagus* -is distributed along muddy/rocky shores at the mouths of rivers at depths of 3-40 m. Their maximum total length is 45 cm, and mean length is 20-25 cm.

4. *Thenus orientalis* -this Scyllarid, or slipper lobster, has been found

in all sandy and muddy coastal areas of the Oman Sea and Persian Gulf. They tend to live in waters 10-50 m deep; their maximum total length is 25 cm with a maximum CL of 8 cm.

5. *Scyllarides squamosus* - a non-commercial species, is infrequently distributed in 20-50 m water.

Fishing Methods

Prior to 1987 lobsters were only captured as by-catch because there was no local market and the fishers were not willing to risk loss of gill nets fishing lobsters on rocky reefs. Government, in an attempt to develop the fishery, offered gill nets for fishing lobsters and offered a market at a set price. The loss of gill nets, however, proved uneconomical, thus efforts were placed on local manufacture of lobster traps from local materials. This proved unsuccessful, but it did result in the import of plastic traps from abroad. The new plastic traps were distributed free to fishers by the Iranian Fisheries Co. (Shilat) and a good price offered for the catch; and a bonus offered to the fisher with the highest landing.

The private sector strategy worked; there is now a thriving lobster fishery in the Oman Sea and Persian Gulf. Plastic traps and gill nets are used to harvest spiny lobsters and slipper lobsters are yet only a by-catch of the trawl fishery.

Processing

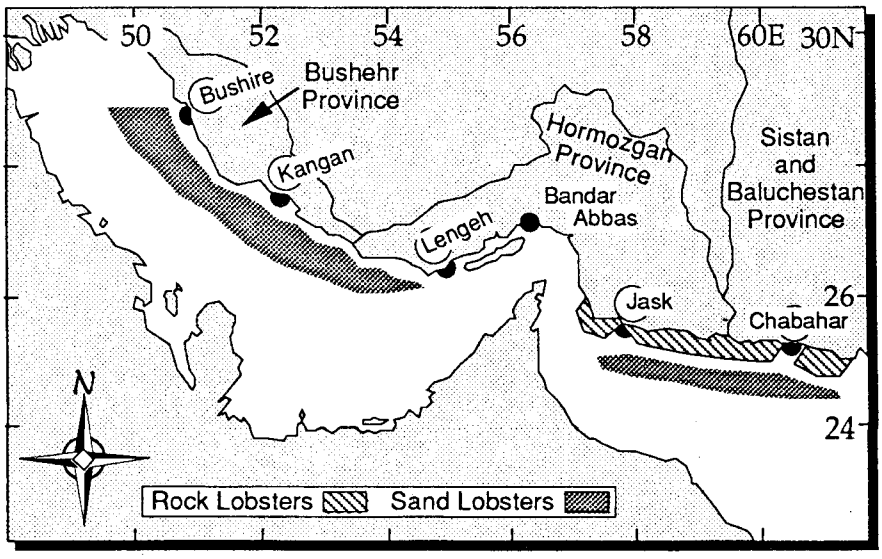
Lobsters are transported live to the processing plants. They are beheaded, washed and sorted and then packed in 5-10 kg boxes and frozen to -30°C for storage and shipment. The major market is Europe.

Summary

Briefly, lobstering was promoted as a fishery only since 1988, but is now a proven fishery. Individual quick frozen lobster tails have been successfully marketed in Europe. The next step is to attempt to manage the stocks, thus the following resource science research projects were undertaken at the Shilat Research and Training Organization:

- discernment of optimal trap design and bait type;
- determination of spawning season in order to set open fishing seasons;
- stock monitoring; and
- assess the potential for the growing-out of lobster larvae and juveniles.

Mohsen Hadkirasouliha
Shilat Research and Training Organization
Shilat, Iran



A New Monitoring and Assessment Program in Victoria, Australia

FROM: PATRICK COUTIN

In 1993, the Victorian fishing industry and fisheries managers made *Jasus edwardsii* research and monitoring a priority and a 3-year research project has been funded through the Fisheries Research and Development Corporation. The program is based at the Marine Science Laboratories in Queenscliff, south of Melbourne near the southwest corner of Port Phillip Bay. Cynthia Elliot and Dale Thomson were appointed in 1994, and you will probably meet them at the next lobster workshop, in New Zealand.

A long-term program will be established to collect data from the commercial and recreational fisheries. The quality and completeness of the historical commercial catch and effort data will be assessed and the data developed for use in stock assessment models. These data are reported at fine area (10 x 10 miles) and depth resolution which may enable detailed spatial modelling. Commercial catch sampling by research staff and fishermen will provide length frequency data by sex as well as information on maturity and molt cycles. Monitoring of recreational catches will depend on surveys by enforcement officers and voluntary logbooks distributed to dive shops. Finally, a small-scale program monitoring puerulus settlement will begin using crevice collectors in an experimental design similar to that used in New Zealand, Tasmania, and South Australia.

The 3-year research project will focus on tagging juveniles and adults from commercial boats to determine growth, movement, and mortality rates. This information, together with data on fecun-

CONTINUED ON NEXT PAGE

FISHERIES AND AQUACULTURE UPDATE

CONTINUED FROM PREVIOUS PAGE

dity, will be incorporated into yield and egg per recruit assessments. One area off Apollo Bay will be intensively tagged by Ph.D. student Rod Treble from Melbourne University to examine stock depletion methods of stock assessment. Further offshore, fisherman Andrew Levings, who is working towards a Masters degree with Deakin University, will tag Giant King Crabs (*Pseudocarcinus gigas*). This species, found in waters deeper than 100m, was a bycatch of the 450 t a year Victorian lobster fishery but is now targeted with landing exceeding 200 t a year.

Patrick Coutin
Rock Lobster Program
Marine Science Laboratories
Victorian Fisheries Research Institute
P.O. Box 114
Queenscliff
Victoria 3225

RESEARCH NEWS

CONTINUED FROM PAGE 1

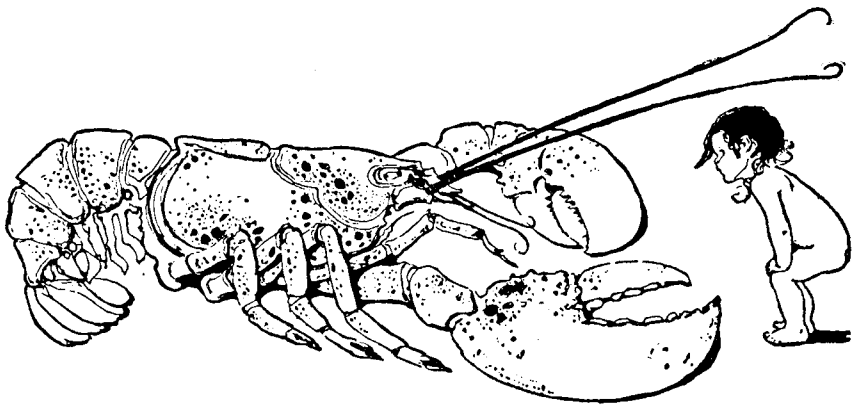
ment of Zoology, University of Western Australia have shed new light on issues like diurnal vertical migration and energetics, and the way in which these affect growth and survival during larval development.

After extensive trails, Baldo Marinovic succeeded in developing a system for rearing *P. cygnus* phyllosoma larvae in the laboratory under various environmental conditions. A similar system was successfully used to study larval development of the scyllarid Balmain Bug *Ibacus peronii* (Marinovic et al., 1994). He demonstrated that growth of *P. cygnus* larvae was significantly higher at a constant, elevated water temperature compared with a daily fluctuation in temperature. Thus, temperature fluctuations associated with daily vertical migration do not appear to provide a metabolic advantage. We suspect the adaptive nature of daily vertical migration should possibly be sought in other factors (e.g., predator avoidance).

The rearing system also allowed study of the photoresponse of phyllosomas. At a given isolume, the directional response of phyllosoma larvae became progressively more negative with age. This supports the hypothesis that changing larval photo-response facilitates transport initially offshore and subsequently onshore off Western Australia, with larvae possibly using differential circulation patterns (Phillips 1981).

Studies on *P. cygnus* pueruli by Sjaak Lemmens have provided convincing evidence for non-feeding during this transition stage (Lemmens, 1994c). Late-stage phyllosomata, pueruli of various phases of development, and juveniles were collected through plankton sampling and with inshore puerulus collectors (Phillips, 1972). External and internal feeding structures are poorly developed in pueruli and possibly allow feeding only on small, soft food particles (Lemmens, 1991; Lemmens and Knott, 1994); calcification of feeding structures does not occur until after metamorphosis to the juvenile. Cellular changes in the hepatopancreas during puerulus development are consistent with a functional change from a storage to a digestive function (Lemmens, 1991).

Changes in cellular activity during larval development were determined using nucleic acid levels (Clemmesen, 1988). There is a high cellular activity in late-stage phyllosoma larvae, with a gradual decline in RNA/DNA ratio dur-



ing puerulus development. RNA/DNA ratios reached a minimum value after metamorphosis to the juvenile, before gradually increasing again. These observations are consistent with negative growth, expected where there is a non-feeding stage. Carbon/nitrogen (C/N) analysis was used to determine levels of energy reserves (Lemmens, 1994a). Late-stage phyllosomata accumulate energy reserves which gradually diminish during the puerulus stage and do not increase again until after the moult to the juvenile. With metabolic data, these results show that pueruli can survive for 2-4 weeks on internal energy reserves. Metabolic needs of post-settlement pueruli are low, while Q10 values (a measure of the effect of temperature on metabolic rate) are moderate compared with those of phyllosomata and juveniles (Lemmens, 1994b). Ash-free dry weight and C/N ratio in post-settlement pueruli decreased as summer progressed: the rate of energy consumption was temperature-dependent (Lemmens, 1994a). The observed processes may well explain seasonal fluctuations in puerulus settlement. Although there is little doubt that (apart from the time of egg hatching) water temperature, wind and currents are the main factors determining puerulus settlement seasons (e.g., Phillips et al., 1991), the way these variables act on recruitment are placed in a completely new perspective when our results are taken into account. It seems likely that our conclusions can, to a considerable extent, be extended to other palinurid (and possibly scyllarid) lobsters. A number of papers on the above studies are being published.

J.W.T.J. Lemmens
B. Marinovic
B. Knott
Marine Biological Laboratory
Department of Zoology
Nedlands, Western Australia 6009
AUSTRALIA

REFERENCES

Clemmesen, C.M. 1988. Meeresforsch 32: 134-143.

Lemmens, S. 1991. In: Ed. P. Lavens, P. Sorgeloos, E. Jaspers, F. Olevier (eds.). Fish & Crustacean Larviculture Symposium. Special Publication No. 15. European Aquaculture Society, Gent. pp. 266-268.

Lemmens, J.W.T.J. 1994a. Mar. Biol. 118: 383-391.

Lemmens, J.W.T.J. 1994b. Exp. Mar. Biol. Ecol. (in press).

Lemmens, J.W.T.J. 1994c. The Western Rock Lobster (*Panulirus cygnus*; Decapoda: Palinuridae): feeding biology and energetics of puerulus larvae. Ph.D. thesis, University of Western Australia, Perth. 205 pp.

Lemmens, J.W.T.J. and Knott, B. 1994. J. Morphol. (in press).

Marinovic, B., Lemmens, J.W.T.J., and Knott, B. 1994. J. Crust. Biol. 14(1): 80-96.

Phillips, B.F. 1972. Crustaceana 22: 147-154.

Phillips, B.F. 1981. Oceanogr. Mar. Biol. Ann. Rev. 19, 11-39.

Phillips, B.F., Morgan, G.R., and Austin, C.M. 1980. FAO Fisheries Synopsis. Food and Agriculture Organization of the United Nations, Rome. pp. 1-64.

Phillips, B.F., Pearce, A.F., and Litchfield, R.T. 1991. J. R. Soc. West. Aust. 74: 93-100.

Chemical Signals in the American lobster

FROM: CHRISTY KARAVANICH

The laboratory of Dr. Jelle Atema at the Boston University Marine Program in Woods Hole, Massachusetts has been studying the social behavior of the American lobster, *Homarus americanus* for over 20 years. Recent work has concentrated on finding the source and function of chemical signals in the agonistic and mating behavior of the lobster.

Lobsters are aggressive animals, making them useful subjects for the study of agonistic (fighting) behavior. It has been shown that lobsters will form hierarchies in captivity. However, little is known of how these hierarchies are maintained. Using the one-on-one "boxing match" as an experimental design, many facts concerning how lobsters fight and how they maintain the memory of their fights have been discovered. If two lobsters who have no previous knowledge of one another are allowed to interact, one of the animals usually will become dominant after a period of intense fighting. Experiments by Christy Karavanich have shown that when these two animals are separated for 24 hours and placed either in isolation or in two communal tanks between fights, they will maintain the memory of the first fight if allowed to interact again. The loser from the first fight will almost immediately back away from the dominant lobster and avoid a second fight. This memory can last for about 1 week if the animals are kept in isolation between the first and second fight. If the sense of olfaction is ablated (Karavanich and Atema, 1991) or urine is blocked from release during a second fight, the memory of the first fight is lost.

Work by Thomas Breithaupt, in which lobsters had a catheter permanently placed in the urinary pore, revealed that more urine is released in the presence of a second lobster than during resting or activity initiated by non-social disturbances such as being chased by a stick (Breithaupt and Atema, 1993). Additionally, urine release occurs during aggressive behaviors but not during defensive behaviors. These results suggest that urine is used during agonistic encounters and contains a chemical signal for recognition of the "agonistic partner". The recognition may either be of an individual nature or of a dominant status. Further boxing matches in which the subordinate from a first fight was matched with an unfamiliar dominant in the second fight revealed that the subordinate does

CONTINUED ON NEXT PAGE

RESEARCH NEWS

CONTINUED FROM PREVIOUS PAGE

not back away from all dominant lobsters in a second fight. The subordinate lobsters actively fought the unfamiliar dominant lobsters, in some cases even winning the match (Karavanich and Atema, 1993). Experiments are in progress to investigate further this apparent "individual recognition" by collecting and manipulating urine from familiar and unfamiliar agonistic partners. If individual recognition truly exists, lobsters will join a very short list of invertebrates known to be capable of this feat (Caldwell, 1985; Halpin, 1980; Hazlett, 1969; Johnson, 1977; Seibt, 1973).

There is evidence that chemical signals in urine also play an important role in the mating behavior of the American lobster. Previous work by our laboratory has shown that it is the female who selects the male with whom she will mate. Current work by Paul Bushmann has demonstrated that females find males and evaluate potential mates using information carried in male urine. He has also discovered a gland in all lobsters that releases a product into the urine (Bushmann and Atema, 1993). This gland is unlike anything previously described in lobsters and is an excellent candidate for a pheromone source. Conclusive evidence for this possibility requires more research, examining both lobster behavior in response to the gland product and the biochemistry of the gland itself.

The Atema laboratory will continue its multi-faceted approach to studying the chemically mediated behavior of the American lobster with investigation of behavioral, biochemical, histological and electrophysiological data. We strive to understand more completely how this animal utilizes chemical signals in many aspects of its life history from aggression to reproduction.

Christy Karavanich
Boston University Marine Program
Marine Biological Laboratory
Woods Hole MA 02543
USA

REFERENCES

Caldwell, R. 1985. Anim. Behav., 27: 194-201.

Breithaupt, T. and Atema, J. 1993. Biol. Bull., 185: 318.

Bushmann, P. and Atema, J. 1993. Biol. Bull., 185: 319.

Halpin, Z. 1980. Biol. of Behav., 5: 233-243.

Hazlett, B. 1969. Nature, 222: 268-269.

Johnson, V. 1977. Anim. Behav., 25: 418-428.

Karavanich, C and Atema, J. 1991. Biol. Bull., 181: 359-360.

Karavanich, C. and Atema, J. 1993. Biol. Bull., 185: 321-322.

Seibt U. 1973. Micronesia, 9: 231-236.

Phyllosomas Riding Jellyfish

FROM: JOHN BOOTH AND RUSSELL MATTHEWS

Early in December 1993, in Bay of Plenty on the east coast of the North Island of New Zealand, Russell Matthews found a final-stage phyllosoma of the scyllarid lobster *Ibacus alticrenatus* associated with each of 6 medusae. Association of scyllarid phyllosomas with medusae is not new, but we think this is a first for our *Ibacus* species.

Russell was surface bait fishing under a lantern at night in 10 m of water off White Island. The line separating the "blue" and "green" water was near White Island at the time. Over the 2 hours starting around 2100, 6 small red medusae (yet to be identified) drifted past and were netted. The bell of each was about 50 mm in diameter and had on its dorsal surface one final-stage phyllosoma. When the medusa with phyllosoma attached was placed in a tank and then approached, the phyllosoma would raise its exopods. When separated from the medusa, the phyllosoma fell to the bottom of the tank where it remained.

Close-up color photographs of the larvae quickly established their identity. *I. alticrenatus* is a slipper lobster widespread in New Zealand waters and which also occurs in Australia. Its phyllosoma development, described by Atkinson & Boustead (1982), takes around 4-6 months. Final-stage larvae are most abundant from November to March. Unlike the *Jasus* spp in our waters, it seems that *Ibacus* can complete its entire larval development within the shelf edge.

What is the basis of the association between phyllosomas and medusae? Are they food; do they ensure phyllosomas are not carried too far offshore; are they camouflage and protection?

Literature Cited

Atkinson, J.M. and Boustead, N.C. 1982. Crustaceana 42: 275-287

John Booth
MAF Fisheries Greta Point
P.O. Box 297
Wellington
NEW ZEALAND

Russell Matthews
37 Kawaha Point Rd.
Rotorua
NEW ZEALAND

ANNOUNCEMENTS

MORE ANNOUNCEMENTS ON BACK PAGE

Artificial Shelter Workshop, "Langosta '94"

A workshop on "Artificial Shelters in the Fisheries for Spiny Lobsters and Population Dynamics" will be held in Havana, Cuba, October 17-21, 1994. The main focus will be on the Cuban and Mexican fisheries and their use of "casitas" or "pesqueros" as techniques for capturing spiny lobsters, and their effects on the population dynamics of the species. Since there has been so much interest in the use of artificial shelters, the members of the organizing committee extends an invitation to scientists and fishery managers from other countries to attend and participate in the workshop.

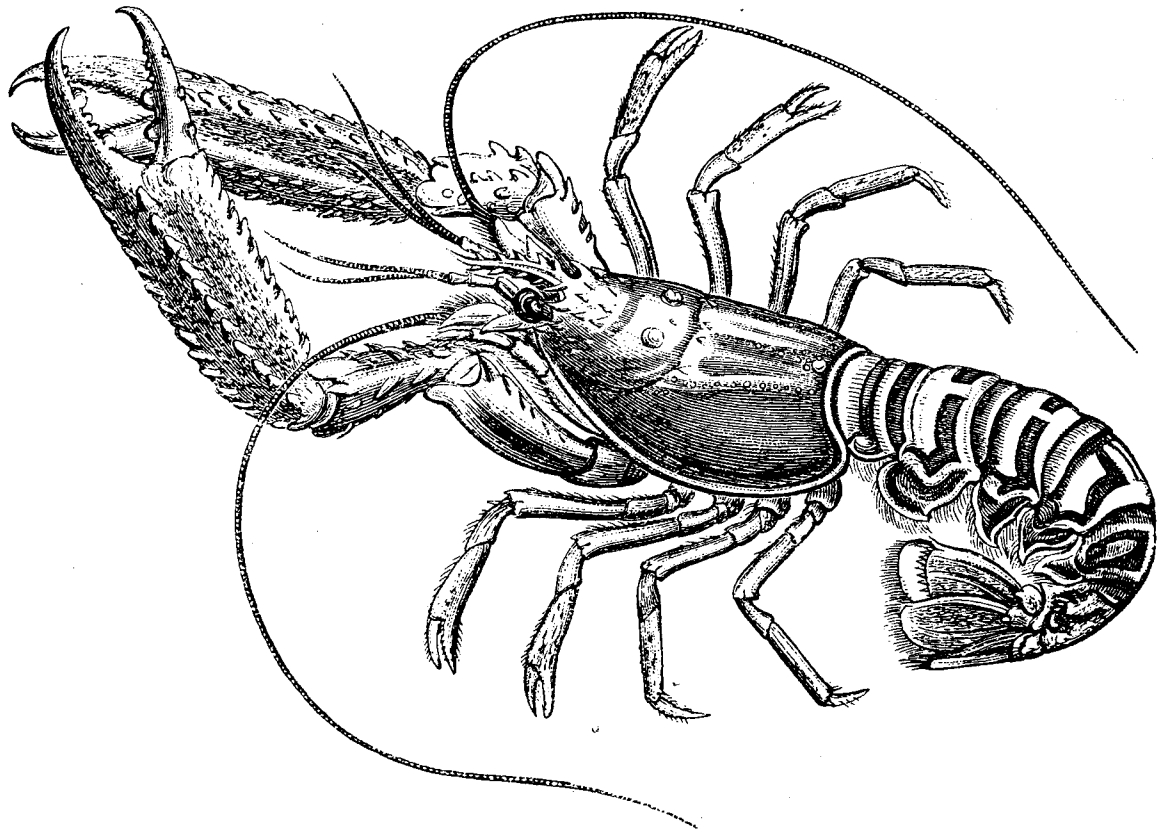
Registration fee is US$80, and accomodations at the university for 7 nights, airport transfer, and breakfast and one meal per day is offered for US$290.

For further information, write or fax to:

Lic. M. H. Ceballos, Secretaria
Comité Organizador
Centro de Investigaciones Pesqueras
5ta Ave. y 248
Barlovento, Santa Fé
La Habana, Cuba
Telef: (537) 227089 / 233614
Fax: (537) 311108 / 33534

AQUACULTURE AWARD

Congratulations are due to Dr. E. V. Radhakrishnan and Dr. M. Vijayakumaran, scientists of the Central Marine Fisheries Research Institute in Cochin, India. They were selected for the "Aquaculture Award" in appreciation fof their contribution to lobster culture research. The award was presented by the Marine Products Export Authority of India during 'INDAQUA.' the first-ever aquaculture show, held at Madras in March 1994.



PERSPECTIVE

Why Are There So Many American Lobsters?

FROM: BOB MILLER

The above question has exercised the imaginations of fishers, fishery scientists, and fishery managers for over a decade. The increase in landings has been very widespread during the 1980s, extending from New Jersey to the Magdalen Islands in the central Gulf of St. Lawrence. Newfoundland is the only area of significant catches that is excluded. Although the explanation for the increase is an intellectually challenging question, I believe it isn't very important in a fisheries management context. A great deal of effort could be spent in attempting but failing to answer this question, or in finding the answer but not knowing how to use it. There are more important questions about managing lobster fisheries.

One approach to problem solving which scientists are taught is to falsify hypotheses one at a time until we find one that cannot be falsified. That hypothesis is then accepted (until it is also falsified). However, devising adequate tests of hypotheses concerning large scale field events such as this one is difficult. The following discussion is an extension of more scholarly treatments by Ennis (1986), Elner and Campbell (1991), and Pezzack (1992). The possible explanations for the increase in landings are reviewed, then alternative lobster management questions are introduced.

The starting date of the landings increase was not synchronous among areas, but peak catches were nearly so, and catches in all areas have increased significantly since 1980 (Table 1).

Increased lobster abundance rather than increased fishing effort was responsible for most of the change in landings. Catch per unit effort remained constant or increased in spite of a large increase in effort in nearly all areas (Miller et. al 1987; Krouse 1993). However, Addison and Fogarty (1993) believe expansion in fishing area could have contributed to the increase in the U.S.

The very large area over which landings increased argues against favorable management regimes or changes in regimes as causes. Seasons, minimum sizes, fishing effort, etc. vary a great deal over the area considered (Dow 1980); and changes in management during the 1970s and 1980s were small.

A low level of broodstock (recruit overfishing) was a popular explanation for the depressed catch rates during the 1970s (Robinson 1979); however the very large year classes which occurred in the 1980s, some of which were produced by these low population levels, weakens this argument (Pezzack 1992).

If size at female maturity decreased, egg production would increase because more lobsters would have a chance to spawn before being taken by the fishery. However, there was no systematic change in size at maturity in four Nova Scotia ports over 4 years during the late 1980s (R. Miller and F. Watson, unpublished).

Two changes in the biological community have been proposed as causes. Groundfish catches have declined precipitously, perhaps releasing lobsters from predation. However, I am aware of no study finding lobster to be a significant dietary component of commercial groundfish. Furthermore, a field study that identified the predators of tethered lobsters found that non-commercial species, cunner and sculpin, were the most important (Wahle and Steneck 1992). Non-commercial mud crabs were also shown to be an effective predator (Barshaw and Lavalli 1988). Change in abundance of kelp on Nova Scotia's outer coast was almost in synchrony with the time of lobster recovery, but lobster catches started increasing 1-3 years before kelp recovery. In the adjacent areas to the east and west, which also experienced increases in lobster, kelp cover did not change (Miller 1985). K.H. Mann (pers. comm.) has pointed out, however, that lobster landings in the 1970s did not fall as far in the area that retained their kelp cover.

Change in the benthic physical habitat over the area considered is an unlikely cause, and any changes in lobster food supply are unknown.

Temperature has been the variable most commonly correlated with lobster yields, using lags of 0-7 years (see Elner and Campbell 1991, and Pezzack 1992 for reviews). However, I know of no lobster fishery, in fact no shellfish fishery, where temperature has persisted as a reliable predictor of landings.

In summary, because landings increased over such a large geographic area, we are, by default, left with a best guess that the cause was a widespread, but unidentified environmental factor (Miller et al. 1987; Campbell and Elner 1991; Pezzack 1992).

After all the above considerations we still don't have the answer, or even a promising testable hypothesis. Well, so what? From a fisheries management perspective the factor responsible probably cannot be controlled and thus not useful for manipulating stock abundance. Furthermore, because it was such an unprecedented event in many areas it may have no use as a predictor of landings. If we think of another reasonable hypothesis and can assess it at reasonable cost, fine, but lets not get our "knickers in a twist" over this problem.

Also from a fisheries management point of view, we would do better

spending our efforts improving the yield from the year classes nature gives us. Yield from a year class can be enhanced by reducing waste from trap ghost fishing and handling mortality. The minimum size can be set for a high yield per recruit, and both season and size set to maximize market price.

Furthermore, instead of focusing on the causes of peak catches we could try to increase lobster abundance in the troughs. Table 2 shows a finer geographic breakdown than Table 1, including only the Nova Scotia coast from the Bay of Fundy to the Gulf of St. Lawrence. The areas with the largest proportional increases (southwest and southeast Nova Scotia) also had 100 year record lows in the late 1970s and early 1980s. It is possible that yield from this smaller area might be more malleable than the larger area, and enhanced by expanding reproductive capacity. The usual options include a larger minimum size, a maximum size, tail notching of ovigerous females, reducing overall fishing mortality, and spatial refuges closed to fishing.

In conclusion, I suggest we follow the first rule of problem solving, that is to choose a solvable problem.

Table 1. Catch ratios of lobster landings in the year of peak landings versus the early 1980s. Areas are arranged from south to north.

Location	Year of low landings	Year of peak landings	Catch ratio
N.J.-N.Y.-Conn.	80	90	3.8*
Rhode Island	81	91	4.0
Massachusetts	80	90	1.7*
Maine	84	91	1.6
Bay of Fundy	80	90	2.2
Atlantic Nova Scotia	80	91	4.3
S. Gulf St. Lawrence	80	89	2.2*
Central Gulf St. Lawrence	80	91	2.3*
Newfoundland	80	91	1.0

*Increase began before 1980. The ratio would be higher using an earlier year.

Table 2. The same treatment as Table 1 for a smaller geographic area.

Location	Year of low landings	Year of peak landings	Catch ratio
Western Nova Scotia	80	91	3.9
Southwest Nova Scotia	80	91	10.8
Southeast Nova Scotia	80	91	7.1
East Nova Scotia	80	90	3.8
Northeast Nova Scotia	80	91	2.1

REFERENCE

Addison, J., and M. Fogarty. 1993. Lobster News Letter 65(1): 10.

Barshaw, D.E., and K.L. Lavalli. 1988. Mar. Ecol. Prog. Ser. 48: 119-123.

Dow, R.L. 1980. In: The biology and management of lobsters. Vol. II, p. 265-316,. J.S. Cobb and B.F. Phillips eds. Academic Press.

Elner, R.W., and A. Campbell. 1991. Memoirs Queensland Mus., Brisbane 31: 349-363.

Ennis, G.P. 1986. Can. J. Fish. Aquat. Sci. 43: 2072-84.

Krouse, J.S. 1993. U.S. commercial and recreational American lobster, *Homarus americanus*, landings and fishing effort by state, 1970-1992. Unpub. ms., Maine Dept. Marine Resources.

Miller, R.J. 1985. Can. J. Fish. Aquat. Sci. 42: 2061-2072.

Miller, R.J., D.S. Moore, and J.D. Pringle. 1987. CAFSAC Res. Doc. No. 85: 20p.

Pezzack, D.S. 1992. J. Northw. Atl. Fish. Sci. 14:
115-127.

Robinson, D.G. 1979. Fish. Mar. Serv. Tech. Rep. 834 (Pt. 3): 77-99.

Wahle, R.A., and R.S. Steneck. 1992. J. Mar. Biol. Ecol. 157: 91-114.

R. J. Miller
Halifax Fisheries Research Laboratory
P. O. Box 550,
Halifax , N.S.,
Canada, B3J 2S7

ANNOUNCEMENTS

If you wish to remain on the mailing list for The Lobster Newsletter, please return the post-card enclosed with this issue.

It is time again to "clean house" in our mailing list. Nearly 600 people in 47 countries receive the Newsletter, and we value each and every one of our readers. However, we know that some of you have moved on, or that your interests have changed. Many of you have sent address changes, and a few copies come back from each mailing marked as undeliverable. The last time we cleaned up the mailing list was in 1989, and we must do it again.

Your name and mailing address as we have it is on the card. Please check the address and make any necessary corrections. You will also find spaces for telephone, fax and e-mail addresses if you wish to provide them; these will facilitate communication among lobster researchers. The mailing list is available for non-commercial purposes to any subscriber of the Newsletter.

Thanks very much. We look forward to continuing to serve lobster scientists, managers, and other interested folk around the world.

Illustrations Needed!

We always are looking for interesting old woodcuts, modern illustrations, amusing anecdotes or sayings about lobsters to enliven the pages of the Newsletter. If you find something that you think would be of interest to our readers, please send it or a good photocopy to one of the editors. Thanks very much!

JULY1994

The Lobster NEWSLETTER

P.O. Box 550
Halifax, NS B3J 2S7
Canada

Dr. P. Lawton
Biological Station
Dept Fisheries & Oceans
St. Andrews
NB
E0G 2X0
Canada

St. Andrews

ADDRESS CORRECTION REQUESTED