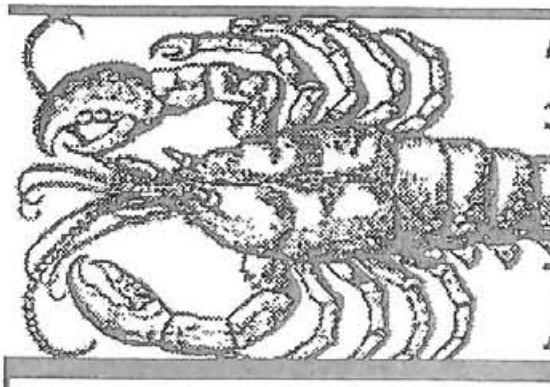
VOLUME ELEVEN JULY 1998 NUMBER ONE



The Lobster NEWSLETTER

PERSPECTIVES

A Brief History of the International Lobster Workshops

From: J. S. Cobb and B. F. Phillips

The following was one of the opening addresses at the Fifth International Workshop and Conference on Lobster Biology and Management in Queenstown, New Zealand. The presentation was given by Professor Cobb. – Eds.

The Fifth International Workshop and Conference on Lobster Biology and Management in Queenstown, New Zealand took place 20 years after the first of the workshops. We, as instigators of the first one, thought this would be a good time to review what the workshops have been about and some of the progress that has come from them.

It was 20 years ago, nearly to the day, that the first workshop was held -- in Perth, January 26 - February 1, 1977. The main purpose of that workshop was to bring together a small group of lobster researchers from the USA and Australia, to talk about common issues and themes. Why have a series of workshops followed and why have they become, apparently, self-perpetuating? Certainly lobsters are commercially important and that drives a lot of the fisheries research. But it is more than that as Bill Herrnkind eloquently said at the end of the 1977 workshop: "*Lobsters are, in fact, a very significant biological entity: widely distributed, speciose, large in size, long-lived, enormous in number, ecologically consequential. ... Understanding how lobsters achieve their biological success is an important scientific contribution and cannot be inferred from sedentary invertebrates, pelagic forms, or terrestrial vertebrates.*" We have important things to learn - in ecology, in physiology, in evolution - from lobsters, and this goes well beyond, while continually feeding back to, the fisheries that support a lot of the work. The workshops have contributed significantly to our knowledge of lobsters and to building a world-wide community of lobster researchers.

Some basic facts outline the history of the workshops (Table 1). They have been held with increasing frequency: eight years elapsed between the first and second workshops (1985, Canada), 5 years intervened before the third (1990, Cuba), and ~ 3.5 years separates the last few meetings (1993, Japan; 1997, New Zealand; and 2000, USA). The size of the workshops also has grown, from 34 participants at first to the nearly 140 in New Zealand. The number of countries represented also grew, from 6 at first to over 20 in New Zealand. Perhaps the most heartening trend is the increase of participation by scientists from small or developing countries. The number of papers has increased proportionately to the number of participants, as you might expect.

The nature of the topics has shifted a bit over the years. The Australian workshop was pretty descriptive, with a lot of emphasis on

(CONTINUED ON PAGE 2)

Table 1: History of the International Lobster Conferences: some basic facts.

Year	Location	Convenor	Number of Participants	Number of Presentations	Number of Countries
1977	Perth, Australia	Phillips & Cobb	34	40	6
1985	St. Andrews, Canada	Campbell & Elner	79	88	14
1990	Havana, Cuba	Baisre	87	60	19
1993	Sanriku, Japan	Kittaka	101	74	21
1997	Queenstown, New Zealand	Booth	140	>100	21

(CONTINUED FROM PAGE 1)

physiology, behavior, and ecology. In Canada,

the workshop had a distinct and stated focus on recruitment issues, so population dynamics and population ecology dominated the discussions. The focus of the Cubans on larval and juvenile ecology was reflected in the proceedings of the 1990 conference. In Japan, the long-term interest of the hosts in aquaculture and larval biology came to the fore, and at the New Zealand meeting, an emphasis on management and ecology was clear. Slipper lobsters were barely recognized until 1993, but there have been a few papers on this group at the last two workshops. In the future it might be worthwhile to include freshwater crayfish in the species mix.

Nearly 150 papers have been published as a direct result of these workshops (Table 2). This is an impressive number. The nature of the publications is equally as important. Over the past 20 years there has been a remarkable synthesis of knowledge about lobster biology. The workshops in 1977, 1985, and 1993 commissioned a total of 26 reviews. *The Biology and Management of Lobsters* (Cobb and Phillips 1980) was a direct result of the first workshop - plans for it were hatched over breakfast on the last day of the meeting. The success of that book and the continuation of the workshops helped to stimulate two other books which have been important, although not directly the result of workshops: *Spiny Lobster Management* (Phillips, Cobb, and Kittaka 1994) and *Biology of Homarus americanus* (Factor 1995). At the New Zealand workshop, Ehud Spanier was looking for authors for a book on slipper lobsters.

The Lobster Newsletter, now in

(CONTINUED ON PAGE 3)

Table 2: Publications directly resulting from the International

Perth 1977	Workshop of lobster and rock lobster ecology and physiology. CSIRO Div. Fish. Oceanogr. Circ. No. 7 - 12 review papers, 40 abstracts *The Biology and Management of Lobsters*: Vol. 1 & II, Academic Press - 18 review chapters
St. Andrews 1985	Canadian Journal of Fisheries and Aquatic Sciences 43 (11) - 43 papers; including 8 reviews and 9 session summaries The Lobster Newsletter - now in its 10th volume
Havana 1990	Revista de Investigaciones Marinas 12 (1-3) - 39 papers
Sanriku 1993	Crustaceana 66 (30), 67 (1-2) - 45 papers; including 6 reviews
Queenstown 1997	Journal of Marine and Freshwater Research 48 (8) - 62 papers

(CONTINUED FROM PAGE 2)

it's 10th volume, was a result of a suggestion made by Jim Stewart at the Canada workshop. It has turned out to be a remarkably good medium of communication and quite popular: the Newsletter now has a mailing list of about 600 people in 50 countries.

The numbers and types of publications are impressive, but has there been a real impact? We used Science Citation Index to determine the number of times five of the workshop papers (selected quite idiosyncratically) resulting from the first two meetings have been cited. The five papers have been cited nearly 250 times in 15 years (Table 3). Most impressive is Aiken's review of molting and growth which first appeared in the proceedings of the 1977 workshop and then updated in *The Biology and Management of Lobsters*. Another measure of impact is to see how often a paper is cited outside its own field - lobster biology in this case. Caddy's stock-recruitment paper and Aiken's review are impressive in this regard (Table 3).

Table 3: Citation analysis of five papers resulting from the 1977

Author	Number of Citations	Percent of Citations in Non-Lobster Publications
Phillips and Cobb 1980	60	8%
Aiken 1977 & 1980	106	26%
Phillips and McWilliam 1986	32	0%
Caddy 1986	27	44%
Fogarty and Idoine 1986	16	13%

The workshops in 1977 and 1985 were very deliberate in asking participants to summarize the results of the workshop and make recommendations for future research needs. What has been recommended and has the advice been followed? It would be impossible to review all the recommendations here, so we will take only a few.

In 1977 and 1985 there were calls by Paddy Berry, John Caddy and Bruce Phillips for emphasis on the larval stages, particularly with regard to the need for culturing phyllosomata, as well as better knowledge about the interaction among larval duration, advection, and behavior. The Japan workshop demonstrated the enormous strides in larviculture, and the New Zealand meeting showed that we are starting to make progress on the advection question, although slowly. In 1977, Don Hancock pointed out the continuing need to determine the age of crustacea. Although not yet perfected, there have been several recent

reports demonstrating the utility of lipofuscin in this regard. Radway Allen, at the 1977 workshop, made a plea for developing genetic techniques for stock or larval identification. Now, in the 1990s, molecular tools are available to do just that, and have been applied to spiny and clawed lobsters, but not to many species or areas.

The remarkable ability to predict the catch of a lobster fishery was hinted at by the Western Australians during the first workshop, and became a model at all subsequent ones. In Perth, Radway Allen called for a further exploration of the stock-recruitment relationship in lobsters. A SRR for *Homarus americanus* was presented at the 1985 workshop, and catch predictions have been developed for fisheries in Australia, Cuba, and New Zealand. The success of puerulus collectors, which became known at the 1977 meeting, has been widely copied.

In 1985, Conan pointed out that very little enhancement work had been done for any species of lobster. Now, restocking or artificial reef work is completed or underway in Ireland, England, Norway, France, Israel, Canada, and the USA.

(CONTINUED ON PAGE 4)

(CONTINUED FROM PAGE 3)

An important recommendation came from John Caddy in Canada: he called for more

interdisciplinary collaboration in the science of lobster biology. He pointed out the need for greater interaction with physical oceanographers, mathematicians, and economists. To these, we would add that the rewards of working between fields in biology (e.g., neurobiology and ecology, endocrinology and behavior, or genetics and recruitment) are large, and great strides can be made at these frontiers. Although some collaborations have started, by and large this challenge has not yet been accepted.

The most important results of the workshops include enhanced communication among researchers, a continuing synthesis of research, and recommendations that point the direction for further work. The most remarkable development may be the emergence of a worldwide interacting community of lobster biologists and managers with a common interest in understanding these large, long-lived, ecologically consequential beasts. We look forward to continuing the communication about lobsters (perhaps also with physical oceanographers, mathematicians, and economists) at the turn of the millennium during the next workshop in Key West, Florida.

J. Stanley Cobb
Department of Biological Sciences
University of Rhode Island
Kingston, RI 02881
USA
Scobb@uriacc.uri.edu

Bruce F. Phillips
Curtin University
Perth, Western Australia
AUSTRALIA

LITERATURE CITED

Aiken, D.E. (1977). Pp. 41-73 in CSIRO Div. Fish. Oceanogr. (Aust.) Cir. 7.

Aiken, D.E. (1980). Pp. 215-276 in *The Biology and Management of Lobsters*, Academic Press, NY.

Caddy, J.F. (1986). Can. J. Fish. Aquat. Sci. 43: 2330-2344.

Cobb, J.S. and B.F. Phillips (1980). *The Biology and Management of Lobsters*. Vols I, II. Academic Press, NY.

Factor, J.R. 1995. *Biology of the Lobster Homarus americanus*. Academic Press, San Diego.

Fogarty, M.J. and J.S. Idoine (1986). Can. J. Fish. Aquat. Sci. 43: 2368-2376.

Phillips, B.F. and J.S. Cobb (1977). CSIRO Div. Fish. Oceanogr. (Aust.) Cir. 7.

Phillips, B.F. and P. S. McWilliam. (1986). Can. J. Fish. Aquat. Sci. 43: 2153-2163

Phillips, B.F., J.S. Cobb and J. Kittaka (1993). *Spiny Lobster Management*. Fishing News Books, Oxford.

RESEARCH NEWS

Could a phyllosoma larva caught off Chile be the Australasian species *Jasus verreauxi*?

From: David Pollack and Richard Webber

During a cruise of the R.V. Anton Bruun in 1966, a number of phyllosoma larvae were captured at approximately 30°-34° S in the vicinity of the Juan Fernandez Islands, some 700 km offshore from Chile. The larvae were described by Pedro Baez in 1973, who identified them as *Scyllarus delfini* and *Jasus frontalis*, species endemic to the Juan Fernandez Archipelago (Baez 1973). In addition, he described an unidentified phyllosoma (Phyllosoma 'X') which he suggested might be a late stage of *Projasus bahamondei* (previously *P. parkeri*), a deep water species found in the eastern Pacific off the Juan Fernandez Islands, and the Saint Felix and St. Ambrosio Islands.

Webber and Booth (1988) noted, however, that the late stage Phyllosoma 'X' described by Baez is similar in size to the equivalent stage in *Jasus* species and probably far too small to belong to *P. bahamondei* since known pueruli of the genus (*P. parkeri*) are twice the size of *Jasus* pueruli. This opinion was

(CONTINUED ON PAGE 5)

(CONTINUED FROM PAGE 4)

debated by McWilliam (1994) who suggested that *Projasus* could have more than one puerulus stage implying the existence of a smaller first stage puerulus more in keeping with the size of Phyllosoma 'X'.

Phyllosoma 'X' is not likely to belong to *Jasus caveorum*, which occurs on seamounts about 4500 km west of Juan Fernandez (Webber and Booth 1995). Larvae of *J. caveorum* are not known but the species clearly belongs in the *'lalandii'* group of *Jasus* lobsters in which an exopod with natatory setae does not occur on the larval fifth pereiopod (Pollock 1995).

Jasus verreauxi, the packhorse lobster of the North Island of New Zealand and southeast Australia, is the only species of rock lobster whose larvae are known to have an exopod with natatory setae on the fifth pereiopod. This setose exopod develops in mid-stage phyllosomas. *Jasus verreauxi* is also the only species with a phyllosoma bearing an exopod on the third maxilliped. The illustration by Baez of Phyllosoma 'X' is reproduced below (Fig. 1) beside a final 'gilled' stage phyllosoma larva of *J. verreauxi* extracted from McWilliam and Phillips (1987).

Phyllosoma 'X' clearly exhibits setose 5th pereiopods, suggesting it could be *J. verreauxi*. Judging by the relative state of development of the two, Phyllosoma 'X' falls about midway between the middle and final stages of *J. verreauxi*. If so, some mechanism may be operating to prolong larval life enabling the larvae to undertake this immense journey to the eastern Pacific because the adults of this species are not known outside Australasia.

There are differences between the two phyllosomas but most may be interpreted as differences in the level of development. Phyllosoma 'X' has a much longer exopod bud on maxilliped 3; shorter antennae; an antennular endopod much shorter than the exopod; a spine on the proximal segment of the antennal peduncle; the cephalic shield not truncated posteriorly; an abdomen of 5 segments; and no single, lateral spine on the uropods.

Not readily attributable to the level of development are small spines and rows of spinules on the basal segments of pereiopods 1-5. There is evidence, however, that morphological variation occurs in the phyllosomas of *J. verreauxi*. While the exopod of maxilliped 3 is "a minute bud" in the phyllosoma of McWilliam and Phillips (1987), that of laboratory reared final instars can develop earlier and may even be setose like the pereiopod exopods (Kittaka et. al. in press). Thus, the nature and degree of development of some characters may vary in different environments.

The propensity for wide dispersal of phyllosoma larvae by ocean currents is well known, but is it possible that a

(CONTINUED ON PAGE 6)

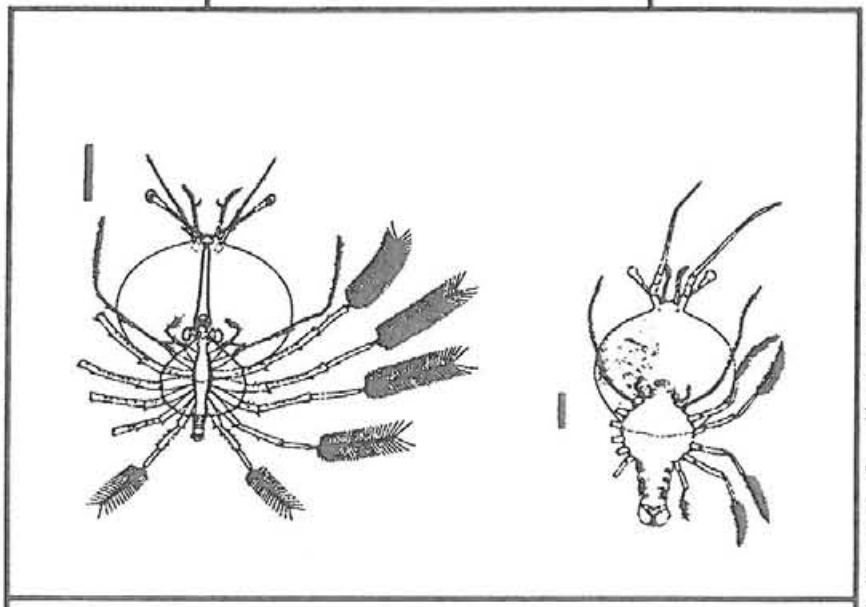


Figure 1: On the left is a ventral view of Phyllosoma 'X' (from Baez 1973) and on the right a ventral view of a final stage Jasus verreauxi (from McWilliam and Phillips 1987). The scale bars in this figure are 5 mm long.

(CONTINUED FROM PAGE 5)

larva of *J. verreauxi* could have traversed the South Pacific Ocean, a voyage of probably more than 3 years, and still not even have attained its final stages? This paper does not provide the answer to this question but instead, poses another, which is: "could such a larva eventually find its way back to the Western Pacific via the South Pacific Equatorial Current, thereby completing a circuit of many years duration?"

Retention of phyllosoma larvae in local current systems is a more popular concept than their navigation of the great ocean gyres. However, with its palinurid characters and setose exopod on the fifth pereiopod, Phyllosoma 'X' cannot easily be attributed to any known species other than *J. verreauxi*. Therefore, some form of mark-time moulting (Gore 1985), may well be the key to phyllosoma larval recruitment in some species of rock lobsters.

LITERATURE CITED

Baez, P. (1973). Rev. Biol. Mar., Valparaiso 15(1): 115-130.

Gore, R.H. (1985). Pp. 1-66 in *Crustacean Issues 2, Larval Growth*. Balkema, Rotterdam,.

Kittaka, J., Ono, K. and Booth J.D. (in press) Bull. Mar. Sci.

McWilliam, P.S. (1994). The Lobster Newsletter 7(2): 1 & 5.

McWilliam, P.S. and B.F. Phillips (1987). Crustaceana 52(1): 1-24.

Pollock, D.E. (1995). Bull. Mar. Sci. 57(2): 516-526.

Webber, W.R. and J.D. Booth (1988). Nat. Mus. N.Z. Rec. 3(8): 81-92.

Webber, W.R. and J.D. Booth (1995). N. Z. J. Mar. Freshw. Res. 29: 613-622

David Pollock,
Sea Fisheries Research Institute
Private Bag X2 Rogge Bay
8012 Cape Town
SOUTH AFRICA
dpollock@sfri.sfri.ac.za

Richard Webber
Museum of New Zealand Te Papa Tongarewa
PO Box 467
Wellington
NEW ZEALAND
rickw@tawera.monz.govt.nz

Lobster Social Behaviors: Cooperation or Coincidence?

From: Michael J. Childress

Along with the recently discovered eusocial snapping shrimp (Duffy 1996), spiny lobsters have some of the most complex social behaviors of any crustacean. But unlike the shrimp societies made up of close relatives, spiny lobster sociality has evolved in the absence of kin selection. Groups of unrelated individuals performing acts of cooperation are rarely found in nature (Axelrod and Hamilton 1981, Mesterton-Gibbons and Dugatkin 1992). Spiny lobsters are attracted to non-kin conspecifics, share dens with them and migrate together in coordinated queues. Are these behaviors acts of non-kin cooperation? I examined this question in my dissertation, "The Ontogeny and Evolution of Gregarious Behavior in Juvenile Caribbean Spiny Lobster, *Panulirus argus*," under the supervision of Bill Herrnkind at Florida State University (USA).

Caribbean spiny lobsters (*Panulirus argus*), like many other palinurids, share crevice shelters with conspecifics (Herrnkind et al. 1975, Cobb 1981, Zimmer-Faust and Spanier 1987, Trendall and Bell 1989, MacDiarmid 1994). This often begins during the early juvenile phase (Berrill 1975, Marx and Herrnkind 1985, Jernakoff 1990, MacDiarmid 1994). Den sharing can result from attraction to a conspecific odor in the absence of all other cues (Zimmer-Faust and Spanier 1987, D. N. Pencheff and R. K. Zimmer-Faust pers. comm., M. J. Butler and A. B. MacDiarmid unpub. ms.). I examined the behavior of juvenile Caribbean spiny lobsters in the presence and absence of similar-sized conspecifics to determine if there is an ontogenetic shift in gregarious behavior. I found that algal phase juveniles (6-16 mm carapace length-CL) did not alter their nocturnal activity pattern nor their diurnal shelter choice when in

(CONTINUED ON PAGE 7)

(CONTINUED FROM PAGE 6)
the presence of conspecifics.

However, postalgal phase juveniles (24-34 mm CL) increased their activity and chose shelters that contained conspecific (Childress and Herrnkind 1994, 1996). This suggests that postalgal lobsters may be the youngest life history stage to benefit from an association with conspecifics.

Crevice shelters reduce the risk of predation for clawed and spiny lobsters across a range of sizes (Lavalli and Barshaw 1986, Barshaw and Levalli 1988, Eggleston et al. 1990, 1992, Smith and Herrnkind 1992, Wahle and Steneck 1992). Den sharing behavior in juvenile *P. argus* (35-55 mm CL) is influenced by the presence of lobster predators (Eggleston and Lipcius 1992) and may decrease the risk of predation (Mintz et al. 1994). Yet, several hypotheses (I - IV) concerning the evolution of this behavior may apply. Den sharing among small postalgal spiny lobsters (24-34 mm CL) resembles (I) cooperation by group defense, but may also be favored by (II) increasing competitive ability against den competitors, (III) dilution, or (IV) attraction to a denned conspecific. In the latter case, obtaining a protective den may be the selfish advantageous outcome of conspecific attraction. I conducted a series of experiments to distinguish between these four alternative hypotheses for den sharing among postalgal lobsters, the first ontogenetic phase to show this behavior.

Den Selection: I found that juvenile lobsters did not consistently occupy the most defensible dens nor fill dens to capacity. In the field, juveniles were equally likely to use octocorals and loggerhead sponge crevices in proportion to their abundance. No individual den was used more than expected by random selection. Large shelters capable of holding four or more lobsters usually contained only one. In fact, juvenile lobsters in the field often aggregate at spatial scales larger than a single den. I found significant aggregations of lobsters within a single den in 4 of 28 field surveys, but in 9 surveys, lobsters aggregated on a scale of 64 m^2 encompassing from 3 to 8 dens (Childress and Herrnkind 1997). In a mesocosm where postalgal lobsters were placed under extreme predation risk, lobsters also preferred small shelters scaled for individual occupancy over those large enough to be shared with conspecifics.

In another mesocosm experiment, postalgal lobsters found dens more often and in less time when conspecifics were present in a den. Those searching for a crevice shelter were twice as likely to find the shelter by the following morning if conspecifics were present in it. Of all those finding the shelter overnight, those without conspecific cues took three times longer.

Consequences of Den Sharing: The frequency of den sharing did not correlate with predator or competitor density. I measured the density of juvenile lobsters, crabs, octopods, toadfish, crevice shelters, and algal cover for seven locations in Florida Bay (Florida, USA) and compared them for two measures of den sharing. Only lobster density was correlated (positively) with den sharing. In a mesocosm, postalgal lobsters occupied large crevices alone or in pairs rather than filling shelters to capacity despite the presence of nurse shark predators (Childress and Herrnkind 1997).

Postalgal lobsters did not have higher survival when sharing dens. Those tethered within natural crevice shelters in the presence and absence of conspecifics had similar survival. Postalgal lobsters tethered at locations with either high or low juvenile lobster densities also had similar survival rates whether alone or with conspecifics. Similarly, nurse shark predators were equally successful capturing individuals from dens with multiple or single postalgal lobsters in a mesocosm.

Postalgal lobsters were not better competitors when sharing dens. Those tethered with and without conspecifics were equally likely to be

(CONTINUED ON PAGE 8)

(CONTINUED FROM PAGE 7)

evicted by stone crabs. In the mesocosm, postalgal lobsters competing with stone crabs for crevice shelters did no better when conspecifics were present as when they were solitary.

Conclusions: These results support only hypothesis (IV), what I have named the "guide effect". Postalgal spiny lobsters benefit from conspecific odor cues when searching for new shelters by reducing their time of exposure to predators. Attraction leads to aggregation, which leads to den sharing under limited shelter availability. Den sharing does not confer any additional advantage for postalgal spiny lobsters over solitary occupation of a shelter. This suggests that den sharing may be a selfish behavior, rather than a cooperative act, with no benefit to others.

Although the evidence suggests that den sharing may not represent cooperation among postalgal Caribbean spiny lobsters, this does not imply that den sharing never involves cooperation. Study of den sharing at other life history stages, other habitats or in other species may reveal support for cooperation. For example, den sharing among large juvenile red rock lobster, *Jasus edwardsii*, may significantly reduce the risk of predation over solitary den occupation, although small juveniles do not benefit from this (M.J. Butler and A.B. MacDiarmid unpub. ms.). The recently discovered den sharing behavior of Mediterranean slipper lobster, *Scyllarides latus*, provides an opportunity to test for non-kin cooperation in lobsters apparently lacking the weapons useful in group defense (Barshaw and Spanier 1994).

Although my results support the notion that non-kin cooperation is rarely found in nature, the social behaviors of adult palinurid lobsters seem a promising area for future research. Other behaviors, such as migratory queues and reproductive aggregations, deserve further careful evaluation. Future work on these behaviors should address alternative hypotheses to determine if the behavior is selfish with no benefits to others (e.g., the guide effect), selfish with by-product benefits to others (e.g. ,dilution), cooperative with direct mutual benefits to others (e.g., group defense), or even altruistic with benefits to others exclusively.

Michael J. Childress
Department of Biology
Reed College
3203 SE Woodstock Blvd.
Portland, Oregon 97202-8199
USA

LITERATURE CITED

Axelrod, R. and W. D. Hamilton (1981). Science 211:1390-1396.

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

Barshaw, D. E. and E. Spanier (1994). Crustaceana 67:187-197.

Berrill, M (1975) Bull. Mar. Sci. 25:515-522.

Childress, M. J. and W. F. Herrnkind (1994). Bull. Mar. Sci. 54:819-827.

Childress, M. J. and W. F. Herrnkind (1996). Anim. Behav. 51:675-687.

Childress, M. J. and W. F. Herrnkind (1997). Mar. Freshw. Res. 48:751-758

Cobb, J. S. (1981). Aust. J. Mar. Freshw. Res. 32: 399-409.

Duffy, J.E. (1996). Nature 381:512-514.

Eggleston, D. B. and R. N. Lipcius (1992). Ecology 73:992-1011.

Eggleston, D. B., R. N. Lipcius and D. L. Miller (1992). Fish. Bull. U. S. 90:691-702.

Eggleston, D. B., R. N. Lipcius, D. L. Miller and L. Coba-Cetina (1990). Mar. Ecol. Prog. Ser. 62:79-88.

Herrnkind, W. F., J. Van Der Walker and L. Barr (1975). Sci. Bull. Mus. Nat. Hist. Los Angeles Co. 20:31-45.

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

Lavalli, K. L. and D. E. Barshaw. (1986). Mar. Ecol. Prog. Ser. 32:13-16.

MacDiarmid, A. B. (1994). Crustaceana 66:341-355.

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

Mesterton-Gibbons, M. and L. A. Dugatkin (1992). Quart. Rev. Biol. 67:267-281.

(CONTINUED ON PAGE 9)

(CONTINUED FROM PAGE 8)

Mintz, J. D., R. N. Lipcius, D. B. Eggleston and M. S. Seebo (1994). Mar. Ecol. Prog. Ser. 112:255-266.

Smith, K. N. and W. F. Herrnkind (1992). J. Exp. Mar. Biol. Ecol. 157:3-18.

Trendall, J. T. and R. S. Bell (1989). Bull. Mar. Sci. 45:564-573.

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

Zimmer-Faust, R. K. and E. Spanier (1987). J. Exp. Mar. Biol. Ecol. 105:57-71.

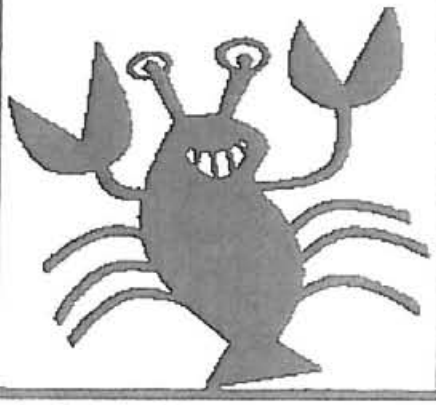
Puerulus settlement trials in Namibia

FROM: Kolette Grobler

Jasus lalandii supports an important commercial fishery in southwest Namibia, with associated research based at the Luderitz Marine Research Center. Two crevice collectors (Booth 1979) donated by B. Bowen and R. Brown (Perth, Western Australia) were tested from May 1994 to April 1995. The collectors were set on the seafloor in waters 10 m deep in lobster sanctuaries, one next to a seaweed farm and the other next to a kelp bed. Planned monthly checks were not always possible because of sea conditions.

Pueruli (both transparent and pigmented) and young juveniles occurred commonly on the collector near the seaweed farm but were less frequent in the other collector. Pueruli were 7-9 mm CL and were found only in August and October. Juveniles on the collectors were 13.6 to more than 35 mm CL (most were 15-30 mm CL) and occurred on each of the seven checks. The highest catch in a single collector was 15 lobsters (of which 7 were pueruli), in October 1994. Pollock (1973, 1986) reported pueruli to be most abundant further south, in the South Western Cape, from December to April, but our sampling missed much of this period; our February and April checks yielded no pueruli.

These initial results justified expansion of the project so 10 more collectors are being built for use in lobster sanctuaries. Settlement and growth rates and environmental parameters (temperature and oxygen) will be monitored, and there will be concurrent laboratory growth and behaviour studies. We may later expand the project to other Namibian lobster grounds as part of a long-term program to measure larval recruitment, female fecundity, and juvenile growth.



LITERATURE CITED

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

Pollock, D.E. (1973). Invest. Rep. Sea Fish. Branch, South Africa 106.

Pollock, D.E. (1986). Can. J. Fish. Aquat. Sci. 43: 2107-16.

Kolette Grobler
Luderitz Marine Research Centre
Ministry of Fisheries and Marine Resources
P.O. Box 394
Luderitz 9000
NAMIBIA

Bilateral Eyestalk Ablation Induces Morphological and Behavioral Changes in Spiny Lobsters

FROM: E.V. Radhakrishnan and M. Vijayakumaran

Bilateral eyestalk ablation can accelerate somatic and reproductive growth in spiny lobsters (Quakenbush and Herrnkind 1981, Radhakrishnan and Vijayakumaran 1984a, b). In studies of the spiny lobsters *Panulirus homarus* and *P. ornatus*, we observed interesting changes in morphology and in feeding and reproductive behavior after eyestalk ablation.

Morphological changes: Lobsters had sharper spines on the

(CONTINUED FROM PAGE 9)

carapace and antennae, and stouter walking legs two or three molts after bilateral eyestalk ablation compared with lobsters with intact eyes and of similar size. Structures resembling antennae, sometimes single, other times bifid or trifid, developed in place of the ablated eyes in some lobsters. Secondary sexual characters such as the decalcified 'window' on the sternal plates and ovigerous setae on the pleopods of females did not develop in lobsters that had been ablated either as juveniles or just before reaching maturity. This suggests the need for eyestalk hormones for the development and maintenance of these characters.

Behavioral Changes: Panulirus homarus is generally gregarious, preferring to live communally in shelters during the day and to forage for food at night, both in captivity and in the wild. Eyestalk ablation resulted in less gregariousness and less use of shelters. Ablated lobsters always moved with the abdomen extended and were more aggressive than normal lobsters.

Ablation induces hyperphagia, with feeding rates 40% higher than in normal lobsters (Radhakrishnan 1990). Ablated lobsters fed continuously, and had no difficulty locating or consuming food. Bilateral eyestalk ablation can also accelerate gonad development in spiny lobsters (Radhakrishnan and Vijayakumaran 1984b). In males, ablation causes an increase in the weight of the vas deferens and hypersecretion of matrix. We observed sexually active males following other lobsters and forcefully depositing spermatophoric matrix on individuals irrespective of sex. Interestingly, some ablated males carried asymetric spermatophores on their sternums, apparently a result of unsuccessful matings. Also, when males do not mate, the matrix oozes from the gonopore and sticks around the opening.

Most physiological changes in eyestalk-ablated lobsters are due to the loss of eyestalk hormones. The role of MIH (Moult Inhibiting Hormone) and GIH (Gonad Inhibiting Hormone) in controlling molting and reproductive physiology of spiny lobsters is now better understood (Radhakrishnan 1990). Hormones and neurotransmitters in the central nervous system may also influence behavior. For example, increased locomotor activity and non-occupation of shelter by eyestalk-ablated lobsters may be due to loss of Neuro-Depressing Hormone (NDH), a low activity component of the circadian activity rhythm of nocturnal crustaceans (Arechiga & Huberman 1980). Likewise, the higher feeding rates and the abnormal feeding behavior in ablated lobsters could be due to hyperphagia resulting from removal of Crustacean Hyperglycemic Hormone (CHH) from the eyestalk (Radhakrishnan 1990).

Is the increased aggression, acquisition of stouter legs, and sharper spines on the carapace, and the abnormal feeding and reproductive behavior of adaptive significance? We presume that lobsters acquired these characters as compensation for the loss of the eye, which is important for them to locate predators and to orient in encounters. Thus, the timing of the shift in lobsters from gregarious behaviour to the solitary life may be induced by ablation. Greatly enlarged and stronger spines on the carapace and antennae may improve protection from predatory attacks. Lack of response by bilaterally eyestalk-ablated lobsters to light cycles indicates loss of neural photosensitivity, with alteration to natural feeding and locomotor activity. Further work may provide more information on the adaptive significance of the behavioral changes induced by eyestalk ablation.

LITERATURE CITED

Arechiga, H. & A. Huberman (1980). Front. Horm. Res. 6: 16-34.

Radhakrishnan, E.V. (1990). Physiological and biochemical studies on the spiny lobster *Panulirus homarus* (Linnaeus). PhD Thesis, University of Madras, India.

(CONTINUED ON PAGE 11)

(CONTINUED FROM PAGE 10)

Radhakrishnan, E.V. & M. Vijayakumaran (1984a). Indian J. Fish. 31: 130-142.
Radhakrishnan, E.V. & M. Vijayakumaran (1984b). Indian J. Fish. 31: 209-216.
Quakenbush, L.S. & W.F. Herrnkind (1981). Comp. Biochem. Physiol. 69A: 523-527.

E.V. Radhakrishnan
Calicut Research Centre of CMFRI
West Hill
Calicut-673 005
INDIA

M. Vijayakumaran
Madras Research Centre of CMFRI
68/1 Greams Road
Madras
INDIA

Lobster (*Homarus gammarus L.*) Research in the northern Adriatic Sea

From: T. Scovacricchi and C. A. Burton

Stocks of the European Lobster (*H. gammarus*) are under extreme pressure in the northern part of the Adriatic Sea; both from illegal collection and environmental factors, particularly anthropogenic degradation and occasional anoxic events. In many locations, they are considered close to extinction.

Within the shallow and homogeneous sandy basin of the northern Adriatic Sea, their distribution is restricted to 'Tegnùe' or 'Beachrock' outcrops. The outcrops are discrete, low lying reefs of sedimentary and/or biogenic rock strata. These outcrops are widespread and significantly effect the marine ecosystem, providing both habitat and nursery areas for many commercial and non-commercial species.

Researchers at the CNR, Istituto di Biologia del Mare, Venezia have embarked upon a program to learn more about lobsters ecology and, ultimately, the prospects for stocking depleted areas with hatchery reared animals. The research is financed by the Ministero delle Risorse Agricole Alimentari e Forestali. Collaborative links were established with researchers from the Sea Fish Industry Authority in the United Kingdom and personnal exchanges have occurred between the institutes under the CNR Short-term Fellowship scheme. Utilizing locally caught broodstock, a pilot batch of juveniles has been reared and will be marked prior to release on to a selected area of tegnùa. The fate of the released stocks will be followed using both visual census and trapping techniques.

T. Scovacricchi
Instituto di Biologia del Mare
Riva Sette Martiri 1364/a
30122 Venezia
ITALY
tisco@vecnr8.ibm.ve.cnr.it

C.A. Burton
Sea Fish Industry Authority
Marine Farming Unit
Ardtoe, Acharacle
Argyll PH36 4LD
UNITED KINGDOM
Crag_Burton/sfia@fc.uhi.ac.uk

FISHERIES & AQUACULTURE UPDATE

Growout of Juvenile *Panulirus argus* in Cages

From: Luís Tadeu Assad

The lobster fishery in Ceará State (Brazil) for the Caribbean spiny lobster, *Panulirus argus*, has been in crisis since 1986: there has been a constant decline in production and yield brought about through high fishing effort and the intense fishing of undersized lobsters (MMA 1997). Fishers urgently need to diversify so that they can increase their revenue and employment opportunities. With this in mind, we have initiated with the fishing community semi-intensive cultivation of juvenile *P. argus* in which undersized lobsters are grown to legal size in cages.

Methods: Preliminary trials at Ponta Grossa's Beach in 1994 used a 50 m^2 caged pond. After

(CONTINUED ON PAGE 12)

(CONTINUED FROM PAGE 11)

59 days, the 2000 lobsters held in the pond had grown from a mean tail length (TL) of 10.6 cm to 11.8 cm, 22% having reached the minimum legal size (MLS - 13.0 cm TL) (Assad 1994). We therefore initiated a larger scale experiment in which a 500 m^2 rigid plastic cage was built in another shallow (0.3 m) section of Ponto Grossa's Beach that is protected by fringe reefs. About 15,000 undersized lobsters (10 cm TL and above) taken from the commercial area by local fishers were held in this cage for three months, from June to August 1995. We kept the number of lobsters more or less constant by replacing dead individuals. The lobsters were fed items taken from the local area (e.g., fish, mussels, and seaweed); 78 kg and 248 kg of food were provided in the first and second months, respectively. The condition of 400 lobsters held in a 24 m^2 module within the cage was evaluated monthly. We assumed that growth and survival of these animals represented those for lobsters elsewhere in the cage. Temperature remained around 27 °C throughout the experiment and salinity around 33 ppt: water transparency was low (5-10 cm) because of the high rainfall during the study period.

Results: There was no significant increase in the TL of lobsters between June (mean TL=12.1) and July (12.2 cm) - but only 13.5% of lobsters were pre- or post-moult in June compared with 43.2% in July. However, there was significant growth to a mean 12.9 cm TL between July and August; males grew faster (8%) than females (6%). Over the term of the experiment, the percentage of lobsters ≥ MLS increased from 14 to 48%. There was also a significant increase in the weight of the lobsters between June and July (283 to 318 g) and between July and August (338 g). Growth averaged 0.9 g per day, yielding a 19% increase in weight in 60 days. Again, males grew faster, with a 23% increase in weight compared with 15% for females.

The food conversion ratio was 1.2:1 in the first period and 4.7:1 in the second; overall it was 2.5:1 (2.1:1 for males and 3.1:1 for females). The striking difference in efficiency over time was probably related to metabolic demand during molting. No cannibalism of live lobsters was observed, but moribund or dead lobsters were rapidly consumed.

There was a high proportion of damaged lobsters (missing legs and antennae and/or tail damage) after the first month, suggesting the influence of such things as rough handling at capture or high stocking density. After fisher training, there was a substantial decline in the frequency of damage, most of which was attiributed to handling. Lobsters which were violet/red (probably due to diet and extended exposure to sunlight) were considered anomalous, and the frequency of these red lobsters declined from around 35% in June to 25% in August.

Mortality during the experiment was estimated to be 30%. Most of this in the first few hours after the lobsters were introduced to the cage and this is probably associated with the stress of original capture and transport.

Conclusions: The food conversion efficiency, growth, and survival of *P. argus* were considered satisfactory given the preliminary nature of the trial, the 'low-tech' approach, and the use of inexpensive, local foods. The harvest from the cage in August was 1400 kg, worth $(US)16 500. It appears that low-cost coastal ongrowing projects such as this have particular value in low-income areas. Improved performance may be achieved using local foods that have been nutritionally supplemented.

Luís Tadeu Assad
Ministério do Meio Ambiente, dos Recursos Hídricos e da Amazônia Legal
Esplanada dos Ministérios Bl. B
sala 802
Brasília - DF
CEP 70068-900
BRAZIL
smacrn15@mma.gov.br

LITERATURE CITED

Assad, L.T. (1994). Dissertaçâo de Graduaçâo, Departamento de Engenharia de Pesca, UFC, Fortaleza, Brazil.

(CONTINUED ON PAGE 13)

(CONTINUED FROM PAGE 12)

Ministério do Meio Ambiente dos Recursos Hídricos e da Amazônia Legal. (1997). Diretrizes ambientais para o setor pesqueiro: diagnóstico e diretrizes para a pesca marítima. Brasília, Brasil, MMA.

Ishikawa, N.E., P.M. Alemans, and P.D. Valencia. (1984). Biol. Inv. Inst. Tecnol. Pesq. 2(1): 57-61.

LETTERS

"Wild" *Homarus* in Japan!

From: L.G. Eldredge

I just saw your Lobster Newsletter and thought that you might be interested in learning that *Homarus americanus* has been found in Sagami Bay, Japan – although apparently not for the first time Unsubstantiated specimens were collected near Ohiso, Kanagawa Prefecture in December 1990, with two individuals being reported even earlier. The specimen confirmed from Sagami Bay was 580 g and had a carapace length of 123 mm (Watabe, H. (1993). Cancer 3: 3-4.)..

L.G. Eldridge
Pacific Science Association
1525 Bernice Street
P.O. Box 17801
Honolulu, HI 96817
USA

ANNOUNCEMENTS

3RD INTERNATIONAL LOBSTER INDUSTRY CONGRESS FOR SOUTH AUSTRALIA 1999

The South Australian Rock Lobster Advisory Council (SARLAC), in partnership with Primary Industries and Resources South Australia (PIRSA), will host the 3rd International Lobster Industry Congress in Adelaide, South Australia, in September 1999. The previous two Congresses have been held in the United States and have each attracted up to 1000 participants from around the globe.

The aim of the 1999 Congress will be to present a leading edge program on a wide range of issues associated with fishing and marketing clawed and spiny lobster, with a practical fisher focus. Issues covered at the meeting include: consideration of government service delivery, methods and costs of management, resource sharing, industry development and new technology, and industry success stories.

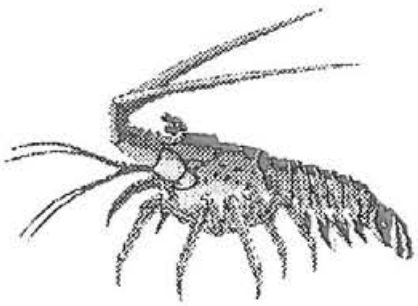
The importance of this event for the lobster industry has been recognized by the Australian Fisheries Research and Development Corporation (FRDC), which has granted financial support for the meeting. We expect that a mix of formal papers and workshops will ensure full participation from those attending.

We welcome interest from all nations. Input from a wide cross section of industry in Australia is being arranged. Please email us your contact details if you are interested in finding out more, if you plan to attend, or if you can assist as a contact person for your country.

For more information contact:

Karen Raymond
South Australian Rock
Lobster Advisory Council
12 Greenhill Road
Wayville
South Australia 5034
AUSTRALIA

Phone: +61 (8) 8272 7766
Fax: +61 (8) 8272 7767
kraymond@gazebo.os.com.au



(CONTINUED ON PAGE 14)

(CONTINUED FROM PAGE 13)

Sixth International Conference and Workshop on Lobster Biology and Management

Mark your calendars now! The 6th International Conference and Workshop on Lobster Biology and Management will be held at the Casa Marina Resort in Key West, Florida (USA) on September 10 - 15, 2000.

The first official "Call for Papers" and meeting description will be sent out early in 1999 to individuals who attended the last meeting in Queenstown, New Zealand, and to those on the mailing list for *The Lobster Newsletter*. If you, or someone you know, is not on these lists and would like to receive the first meeting announcement, contact the Chair of the Organizing Committee (Mark Butler).

We also seek financial support for the conference and welcome inquires from potential sponsors. For more information contact:

Mark Butler
6th International Lobster Conference and Workshop
Department of Biological Sciences
Old Dominion University
Norfolk, VA 23529-0266 USA
mbutler@odu.edu
Phone: 757 683-3609
Fax: 757 683-5283

AMUSEMENTS

Let Lobsters Live!

The following is from a handbill distributed by PETA (People for the Ethical Treatment of Animals). PETA recently moved their international headquarters to Norfolk, Virginia USA... much to the chagrin of one editor who also resides there. – Eds.

Many people feel uncomfortable about cooking and eating lobsters – and for good reason: lobsters suffer severe and prolonged pain when cut or boiled or broiled alive. Did you know:

- Lobsters are sensitive beings who cherish their lives and struggle against death. Dr. Loren G. Horsley, an invertebrate zoologist, states that a lobster has a "sophisticated nervous system" and feels pain when cut or cooked.
- Lobsters carry their young for nine months and have a long childhood and awkward adolescence.
- Lobsters, like dolphins, use complicated signals to establish social relationships.
- Some lobsters are right-handed and some are left-handed. They have been observed walking hand-in-hand, the old leading the young.
- Lobsters take long-distance seasonal journeys and can cover 100 miles or more each year.
- Lobsters and other crustaceans are unhealthy to eat. They are often highly contaminated with bacteria and pesticide run-off.
- Lobsters can live 145 years or longer if they survive the world's most devastating predator, the human being.
- Lobsters show compassion toward each other. Won't you show them compassion, too?

For more information contact:

People for the Ethical Treatment of Animals
501 Front Street
Norfolk, Virginia 23510
USA

www.peta-online.org

REQUESTS

Information Please: Octopus and Lobster Predator-Prey Interactions

The Lobster Research Group at our center wishes to initiate a study of predator-prey interactions between the common Mediterranean octopus *Octopus vulgaris* and the Mediterranean slipper lobster *Scyllarides latus*. These two macro-invertebrates share general rocky habitat on the shallow continental shelf of Israel.

We have observed predation of lobsters by octopus in the laboratory and in the field and now want to study the behavioral and ecological adaptations of lobsters to this predator. But we have found very little literature for any species anywhere: Berry (1971), Ritchie (1972), and Joll (1975).

Please let us know of any other information on octopus-lobster interactions, including published articles, technical reports, and personal communications.

Ehud Spanier
Center for Maritime Studies
University of Haifa
Mount Carmel
Haifa 31905
ISRAEL
Fax 972-4-824-0493
spanier@research.haifa.ac.il

LITERATURE CITED

Berry, P.F. 1971. Ocean Res. Inst. Invest. Rep. 27.
Joll, L. W. 1977. Austr. Dept. Fish. Wildl. Rep. 29.
Ritchie, L.D. 1972. NZ Mar. Dept. Fish. Tech. Rep. 81.

Hey, Send Us Something!

We have now cleared the backlog of articles that had been submitted to *The Lobster Newsletter* and are anxious for more news from the community of lobster biologists, managers, fishers, and bystanders. Our next issue of the newsletter will be published before the new year - providing that we have enough to print!

We welcome short articles and announcements (generally 1000 words or less), as well as amusing tidbits and graphics, on nearly any subject pertaining to lobster biology or management. As Stan Cobb and John Pringle put it in the first issue of *The Lobster Newsletter* published a decade ago:

" A newsletter such as this will not be a success if only a few people contribute. The attraction of this newsletter should be in its diversity and eclectic nature."

We couldn't have said it better!

Mark Butler
John Booth
Peter Lawton

The **Lobster** *NEWSLETTER*

Editors:

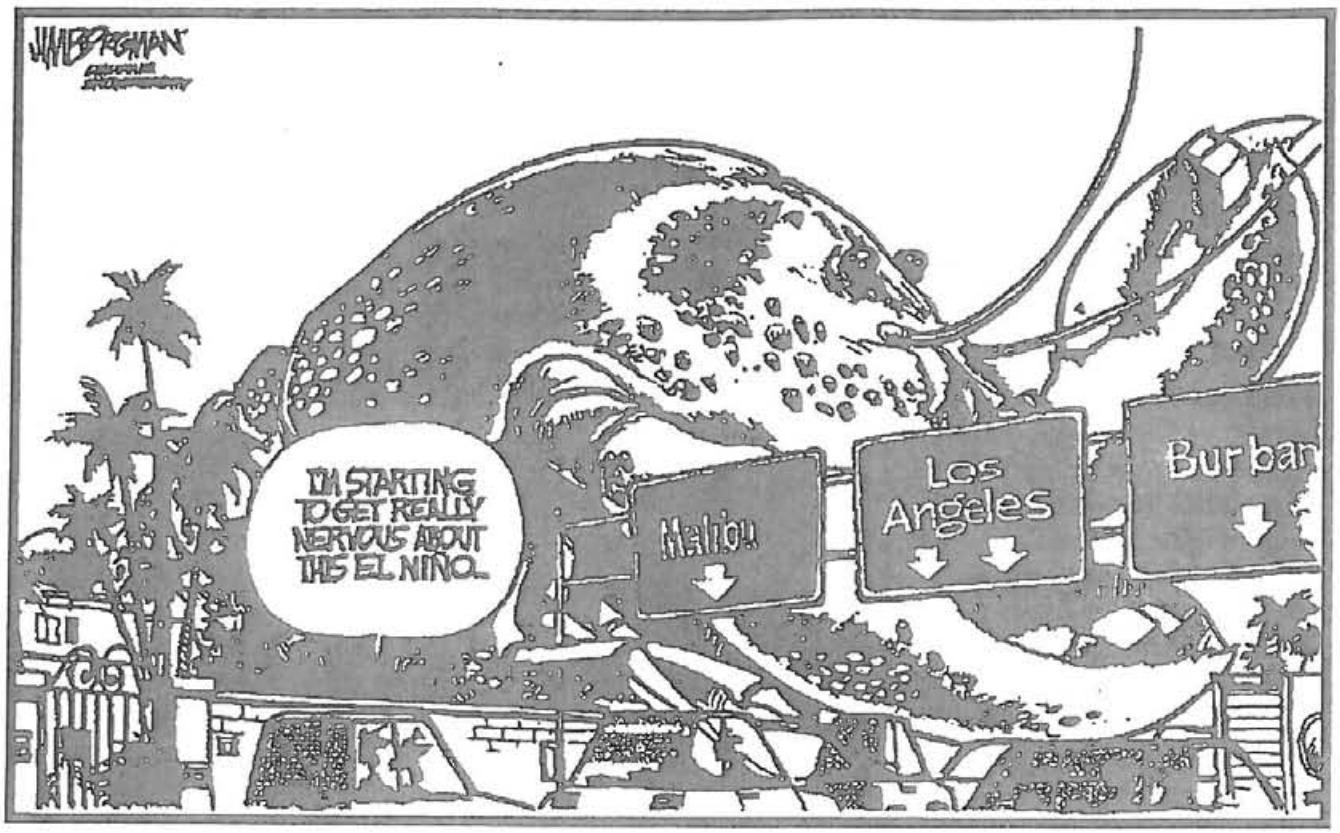
John Booth
NIWA
P.O. Box 14-901, Kilbirnie
Wellington
NEW ZEALAND
FAX: (4) 386 0574
j.booth@niwa.cri.nz

Mark Butler
Department of Biological Sciences
Old Dominion University
Norfolk, VA 23529-0266
USA
FAX: (757) 683 5283
mbutler@odu.edu

Peter Lawton
Department of Fisheries and Oceans
Biological Station
St. Andrews
New Brunswick E0G 2X0
CANADA
FAX: (506) 529 5862
lawton@sta.dfo.ca

The Lobster Newsletter is cosponsored by Fisheries & Oceans, Canada and The Florida Department of Environmental Protection, USA. It is published twice yearly.

Contact any Editor about submission of articles. Send change of address requests to Peter Lawton. Comments on final editing and production should be sent to Mark Butler.



July 1998

The Lobster NEWSLETTER

Department of Fisheries & Oceans
Biological Station
St. Andrews
NB E0G 2X0
CANADA

ADDRESS CORRECTION REQUESTED