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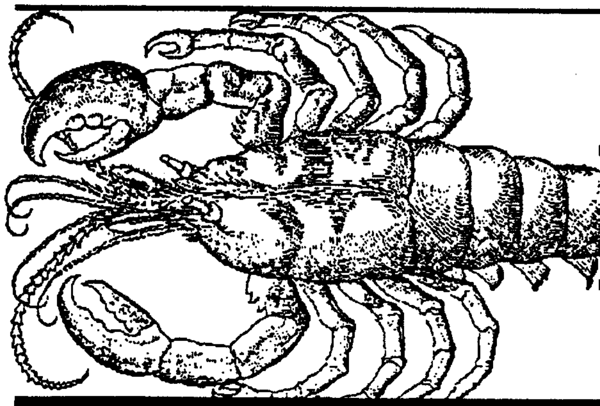

The Lobster NEWSLETTER

FOURTH INTERNATIONAL LOBSTER WORKSHOP

This issue is timed to coincide with the occurrence of the Fourth International Lobster Workshop, in Sanriku, Japan. Dr. Jiro Kittaka, of Kitasato University's School of Fisheries Science, is the host for the workshop. Participants will discuss a wide range of topics affecting the biology and management of spiny and clawed lobsters. In particular, aquaculture and recruitment to natural stocks will be emphasized at this workshop.

The previous international gatherings of lobster workers were in Perth, Australia (1977); St. Andrews, Canada (1985); Havana, Cuba (1990). The workshops have fostered communication among lobster researchers, and have set some of the research agenda that has been followed over the last 15 years. Two major publications have come out of the workshops: Cobb and Phillips' "The Biology and Management of Lobsters" was the result of a breakfast-table discussion in Perth, and the report of the St. Andrews workshop was published as volume 43 (11) of the Canadian Journal of Fisheries and Aquatic Sciences. In addition, the St. Andrews workshop spawned this newsletter, which is now entering its sixth year.

We wish the participants well, and are sure that fruitful discussions will ensue. Perhaps we can also hope that new research findings and directions will come out of this meeting. Look for a complete report of the workshop in the next issue of the Newsletter!

RESEARCH NEWS

Age Determination in Crustacea

FROM: J.F. WICKINS AND M.R.J. SHEEHY

The science of crustacean fishery population dynamics is severely handicapped by the lack of a reliable method for determining age, particularly in long-lived species such as clawed lobsters, marine crawfish and crabs. The frustration stems from the difficulty in determining accurately the number of sizes of individuals in each age group used in cohort analysis. Crustacean growth rate is a function of both molt frequency and the size increment achieved at molt both of which may be altered, to some extent independently, by environmental factors. One example, which may be prevalent in temperate water benthic species, arises when an individual delays its molt until it finds a suitable crevice or place to settle. Such delays over a period of time could cause such animals, which would be small for their age, to be placed in the wrong cohort or year class.

To date, attempts to age crustaceans by meristic attributes (Shelton et al., 1981; Henocque, 1987) or radionuclide decay (Le Foll *et al.*, 1989) have not proved entirely satisfactory. New approaches are needed. The accumulation of lipofuscin age pigment granules in post-mitotic animal tissues is a widespread, if not universal, phenomenon. Certain soluble blue fluorescent age pigments have provided a useful index of age in insects (Ettershank *et al.*, 1983; Mail *et al.* 1983). With comparable objectives in mind, researchers have extracted similar materials from the tissues of various crustaceans and other aquatic species, but there have been few positive results for age determination. Modifications of the original extraction and quantification protocol have recently been made to remove certain methodological artifacts. These have produced seemingly promising results (Nicol *et al*,1991; Hill and Womersley, 1991), but the failure to account for the probable effects on extractable fluorescence of starvation and non age-related *in vivo* lipid oxidation in these experiments has proved particularly misleading. They have also failed to address the most fundamental problem, that of demonstrating a sound relationship between the extractable blue fluorescences and lipofuscin age pigment. Indeed, there are numerous examples in the literature, from a range of species, showing that in the same tissue one bears no relationship to the other (see Sohal, 1987; Eldred, 1987 and Sheehy and Ettershank, 1989). It now seems probable that in key early insect studies, which formed the basis for subsequent aging trials on crustaceans and other aquatic species, age related but insect specific, pteridine fluorescence was misdiagnosed as lipofuscin (Sheehy and Roberts, 1991). Thus there is little basis for expectation of age related fluorescence from aquatic species using the present solvent extraction methodology.

By reverting to histological techniques, the fluorescent pigment lipofuscin, a product of lysosomal degradation, has recently been identified in sections of brain tissue from a variety of crustacean species (Sheehy, 1989 and1990a). Image analysis technology was used to measure the pigment in brain tissue from laboratory reared, red claw crayfish *(Cherax quadricarinatus)* of identical age but dissimilar sizes. It was found that the amount of fluorescent lipofuscin in sections through the base of the olfactory lobe cell mass was related much more closely to age than to crayfish size (Sheehy, 1990b and 1992). Pigmentation measurements placed 45 of the 49 experimental animals in their correct age group, while carapace length correctly placed only 25, and body weight only 21 animals. Confidence limits for age predictions of older animals were at least 5 times better when using lipofuscin than when using carapace length or weight. These findings suggest that morphological lipofuscin has outstanding potential as an index of age in crustaceans.

It is of particular interest that we have recently found measurable amounts of lipofuscin in the olfactory cell mass of the European lobster *(Homarus gammarus)* (Sheehy and Wickins, in prep.) We can now extend the research to a large, temperate water species which supports valuable commercial fisheries. Concurrent work in the UK employing confocal microscopy has demonstrated morphological lipofuscin in the olfactory cell mass of *Nephrops norvegicus*, another commercially important species (P.M. Shelton

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The Lobster NEWSLETTER

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FISHERIES AND AQUACULTURE UPDATE

Molting in Berried Spiny Lobster *(Panulirus homarus)*

FROM: KALEEMUR RAHMAN AND MARY LEEMA JOSEPH

Molting of ovigerous female crustaceans is uncommon. Interestingly, a berried spiny lobster, *P. homarus*, 7.2 cm CL and 212 g, molted while in culture in our laboratory.

The antagonism between somatic and reproductive growth in decapods has been clearly established (Adiyodi and Adiyodi, 1970; Drach, 1955). Maturation has a negative effect on the growth rate of females because of energy diverted to ovary growth and presumed suppression of molt by eggs (Hadley, 1906). Work done on crayfish (Scudmore, 1948) has also generated the assumption that presence of eggs on the pleopods of a lobster inhibits or retards normal progression through premolt. Like other Reptantians, spiny lobsters have a longer intermolt period to accommodate one or more ovarian cycles. In contrast to this we observed the ecdysis of a berried *P. homarus*. It should be noted that the embryos, when examined microscopically, were dead and carried a heavy ciliate infestation along with a possible bacterial infection.

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Spiny Lobster Research in the Phillipines

FROM: M. S. ESTRELLA AND A. JUINIO

The Marine Science Institute at the University of the Philippines has been conducting various research projects on local spiny lobster species *Panulirus ornatus, P. versicolor, P. longipes, P. penicillatus*, and *P. homarus* since 1982. Our earlier projects, while gathering data on many aspects of lobster biology, focused mainly on reproduction and growth. The former included size at sexual maturity, fecundity estimates, and ovarian development, while the latter included natural diet, feeding preferences, and food conversion efficiency of several species.

Currently, the Institute's in-house lobster project is concentrating its efforts on the growth enhancement and grow-out culture of juvenile of the two fastest growing species in captivity, *Panulirus versicolor* and *P. ornatus*. Both have been reared successfully to sexual maturity in floating cages, nearshore pens and tanks and were observed to breed repeatedly throughout the year. At the Institute's marine laboratory in Bolinao, Pangasinan, northwestern Philippines, experiments are underway to determine if eyestalk ablation can enhance growth. Researchers are also exploring effects of prolonged confinement on exoskeleton bleaching and of eyestalk ablation on changes in feeding activity and shelter use. By considering species-specific rearing conditions, behavior, molt stage of the animals, and feeding regime, we hope to refine our present mariculture techniques and explore their applications to the commercial grow-out culture of lobsters in the Philippines.

Starting in June 1993, the Philippine Council for Aquatic and Marine Research and Development will fund a project that will undertake a nationwide networking of information on spiny lobster regional fisheries, distribution patterns, seasonality in abundance, reproduction and nemthic recruitment. This will be undertaken through the participation of other academic institutions, commercial lobster traders, as well as regional representatives of several government and non-government agencies, all under the supervision of Dr. Annette Juinio. We expect this study will gather much needed baseline data and foster national awareness and multisectoral cooperation in managing Philippine lobster resources.

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Spiny Lobster *(Panulirus argus)* Recruitment to Artificial Habitats in Waters off St. Thomas, USA Virgin Islands

FROM: NORMAN QUINN, BARBARA KOJIS AND GINGER CHAPMAN

The western Atlantic spiny lobster, *Panulirus argus* (Latreille, 1804), supports a commercial/recreational fishery in the US Virgin Islands, which is minor compared to other regions in the Caribbean such as Bahamas, southern Florida, and Mexico. The general feeling is that catches in the 1990s are down from 1967 when landings totalled 47.5 t (Swindle et al., 1969). This was approximately one fourth the lobster consumed in the territory in 1967 (Island Resource Foundation, 1977).

Settlement of *P. argus* pueruli was monitored on a fortnightly basis at three locations from July to October 1992, in waters off St. Thomas,

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FISHERIES AND AQUACULTURE UPDATE

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US Virgin Islands. This study seeks to test the following hypotheses:

- There is no significant difference in puerulus recruitment between St. Thomas and other Caribbean and western Atlantic locations;
- There is no significant difference in puerulus recruitment among sites within St. Thomas;
- There is no lunar periodicity in *P. argus* puerulus settlement at sampling sites;
- There is no inter-seasonal variation in puerulus settlement at sampling sites; and
- There is no inter-annual variation in puerulus settlement at sampling sites.

Three modified Witham collectors (Little and Milano, 1980) were placed in Mangrove Lagoon (18 19'N, 64 53'W), on the east end of St. Thomas in June, 1992. An additional four collectors were deployed in July, in waters in waters off two islands, 3 km from St. Thomas; Saba (18 18'N, 65 00'W) on the southwest end and Great St. James (18 19'N, 64 50'W) on the southeast end.

As of 25 October, 1992, 18 transparent, 13 semi-transparent and 124 pigmented pueruli were collected in a total of 56 samples (one sample refers to the single removal of animals from one Witham collector). Settlement of at least one individual was observed in 58% of the samples. Settlement ranged from 1 to 29 pueruli per sample.

The length of immersion appears not to influence the settlement effectiveness of the collectors.

Large differences in the number of post larvae settling exists among stations. Settlement was highest on collectors at Great St. James with a CPUE (catch per unit effort) of 6.2 pueruli. Pueruli were present in 86% of the samples at that site. The next highest settlement rate was on collectors located closest to the mouth of Mangrove Lagoon, with a CPUE of 2.2 pueruli. Pueruli were found in 65% of the samples. The site located furthest up the Mangrove Lagoon had the lowest settlement rate, with pueruli found in only 22% of the samples. The CPUE was only 0.3. The offshore island of Saba had a CPUE of 1.6, with pueruli present in 33% of the samples.

Overall settlement rates were lower than those in Antigua, Bermuda and Florida.

With only four month sampling, it is too early to draw firm conclusions. There has been a decline in CPUE in the Great St. James and Mangrove sites. The Saba location does not show any trends. Sampling is expected to continue for eight more months.

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RESEARCH NEWS

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and M. Belchier pers. comm., 1992).

What makes these findings particularly timely is the simultaneous availability of microtagged lobsters of known age and size from three (separate but coordinated) British stock enhancement experiments (Bannister *et al.*, 1989). Between 1983 and 1988, over 90,000 hatchery reared juvenile lobsters, stages 9 to 13, were released at four sites around Great Britain. Prior to release, each lobster was tagged internally with a coded microwire tag (Wickins *et al.*,1986). The age of all animals recaptured since 1988 can now be determined precisely. It is the returns of significant numbers of these animals in commercial catches, and from targeted recapture programs, that is now providing us with such a unique opportunity to investigate the value of lipofuscin for lobster age determination. We are currently analyzing recaptured lobsters and expect to report the results in due course.

REFERENCES

Bannister, R.C.A., Howard, A.E., Wickins, J.F., Beard, T.W., Burton, C.A. and Cook, W. 1989. ICES Shellfish Committee CM 1989/K:30 (mimeo) 8 pp.
Eldred, G.E. 1987. Adv. Biosci. 64: 23-36.
Ettershank, G., Macdonell, L. and R. Croft 1983. Aust. J. Zool. 31: 131-138.
Henocque, Y. 1987. La Mer 25: 1-12.
Hill, K.T. and C. Womersley 1991. Mar. Biol. 109: 1-11.
Le Foll, D., E. Brichet, J.L. Reyss, C. Lalou, and D. Latrouite1989. Can. J. Fish. Aquat. Sci. 46: 720-724.
Mail, T.S., J. Chadwick and M.J. LeHane1983. Bull. Entomol. Res. 73: 501-525.
Nicol, S., M. Stolp and G. Hosie 1991. J. exp. mar. Biol. Ecol. 146: 153-161.
Sheehy, M.R.J. 1989. J. Crust. Biol. 9: 387-391.
Sheehy, M.R.J. 1990a. J. Crust. Biol. 10: 613-622.
Sheehy, M.R.J. 1992. J. Exp. Mar. Biol. Ecol. 161: 79-89.
Sheehy, M.R.J. and G. Ettershank 1989. Aust. J. Zool. 36: 611-625.
Sheehy, M.R.J. and B.E. Roberts 1991. Exp. Gerontol. 26: 495-509.
Shelton, P.M.J., R.C.J. Shelton and P.R.

Richards 1981. J. Cons. int. Explor. Mer 39: 239-243.
Sohal, R.S. 1987. Adv. Biosci. 64: 85-91.
Wickins, J.F., T.W. Beard and E. Jones 1986. Aquacult. Fish. Manag. 17: 259-265.

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Nutritional Condition of Field Caught Postlarval Lobsters

FROM: M.J. JAMES

Food limitation, and therefore nutritional condition, may be an important factor influencing recruitment of larval American lobsters (*Homarus americanus*) (Harding *et al.* 1983; Castell and Kean 1986). Recently, the ratio of RNA:DNA has been shown to be a good indicator of recent feeding history and therefore nutritional condition in postlarval lobsters (Juinio et al. 1992, Juinio 1991). Juinio (1991) also suggested that based on RNA:DNA ratios, postlarval lobsters are not food limited in the nearshore coastal waters of Block Island Sound, U.S.A. However postlarvae found further offshore may indeed be food limited if the abundance of prey is lower in offshore waters. If this hypothesis is correct, then postlarvae found further offshore should have lower RNA:DNA ratios compared to animals found in nearshore areas. The objective of this research was to estimate 1) the nutritional condition of postlarval lobsters and 2) the potential prey biomass along a nearshore-offshore transect in Block Island Sound, in southern New England, U.S.A.

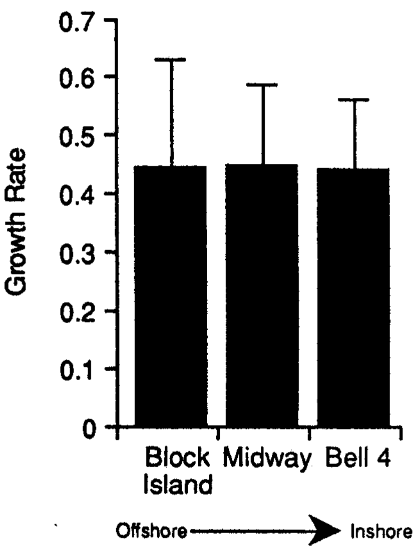

Figure 1: Growth rates of postlarval lobsters along an offshore-inshore transect in Block Island Sound

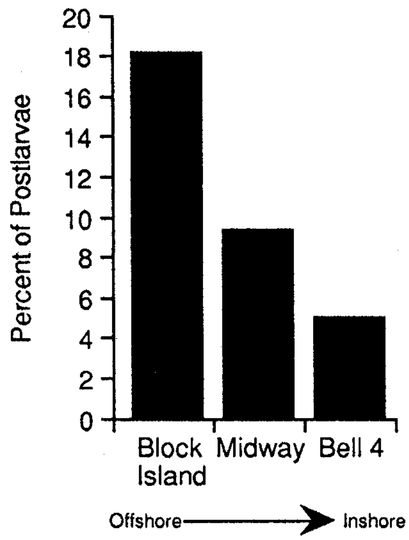

Figure 2: Percent of postlarvae in poor nutritional condition along an offshore-inshore transect in Block Island Sound

Postlarval lobsters were sampled with 500µm neuston nets along an inshore-offshore transect in Block Island Sound. Three transect stations were sampled approximately biweekly from May 30 to August 2, 1991 (weather and sea conditions permitting). The station locations sampled were approximately 1km, 12km and 40km from the mainland (Bell 4, Midway, and Block Island, respectively). Upon removal from the plankton sample, postlarval lobsters were put in vials containing seawater and placed on ice. Care was taken to exclude any other zooplankters from the vials as newly ingested food items would bias the RNA:DNA ratios of the postlarvae. Carapace length and molt stage (after Sasaki 1984) were recorded. RNA:DNA ratios were estimated using a modification of the Schmidt-Thannhauser method for larval fish (Buckley, 1979) and adapted for postlarval lobsters by Juinio (1991). Growth rates were calculated from the equation by Juinio (1991). Only postlarvae in molt stages C and Do were used, as these stages reflect recent feeding history, and therefore nutritional condition, most accurately (Juinio 1992). In order to assess biomass of potential food, bongo net (333µm) plankton samples were also collected at each station where postlarvae were found.

An ANOVA comparing RNA:DNA ratios and growth rates of postlarvae from the three stations showed that there was no significant difference between sampling locations (Fig. 1) The average ratio was 4.0 mg protein/day, higher than the 3.2 mg protein/day Juinio (1991) found in full ration treatments in the laboratory. There was, however, a significant difference in the ratios and the growth rates throughout the sampling season, with higher ratios and growth rates occurring in early summer (June) than later in the season (July). The trend in decreased ratios later in the sampling season was found at each location. I found significantly less plankton biomass, particularly in the larger size fraction, at the station furthest offshore (Table 1).

Station	Mean Total Biomass (gm/m3) wet weight
Block Island	.0017*
Midway	.0039
Bell 4	.0037

Table 1. Mean total biomass from the three transect stations.
(Significant difference p<.05)*

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Although there was no difference in the RNA:DNA ratios between the stations, there was a trend of a higher proportion of postlarvae in starved condition found at stations farther from shore (Fig. 2). Postlarvae in starved condition were defined, according to Juinio (1991), as those having a growth rate of less than 0.22 mg protein/day, which corresponds to the lowest growth rates in the full ration treatment in the laboratory. At the station farthest from shore (Block Island), 18.2% of the postlarve in molt stages C and Do were in starved condition, at the intermediate station 9.4% and at the station closest to shore 5.1% were found to be starved. This suggests that even though the majority of postlarvae had very high growth rates, there is a proportion of the population which is experiencing food limitation. This may be an important factor influencing recruitment if postlarvae from offshore supplement inshore stocks to a large degree.

The growth rates and the RNA:DNA ratios found along the inshore-offshore transect are similar to those observed by Juinio (1991) in nearshore areas of Rhode Island. It appears that in Block Island Sound, most postlarval lobsters found further offshore are not in lower nutritional condition compared to postlarvae found inshore. This study further supports the observation by Juinio (1991) that the majority of postlarval lobsters are not food limited in Block Island Sound.

REFERENCES

Buckley, L.J. 1979. J. Fish. Res. Bd. Can. 36:1497-1502.

Castell, J. D. and J.C. Kean. 1986. Can. J. Fish. Aquat. Sci. 43:2320-2327.

Harding, G.C., K.F. Drinkwater and W.P. Vass. 1983. Can. J. Fish. Aquat. Sci. 40:168-184.

Juinio, M.A.R. 1991. Ph.D. Thesis, University of Rhode Island, Kingston, Rhode Island.

Juinio, M.A.R., J.S. Cobb, D. Bengtson and M. Johnson 1992. Mar. Biol. 114: 1-10.

Sasaki, G.C. 1984. Ph.D. Thesis, Massachusetts Institute of Technology, Woods Hole, Massachusetts, WHOI-84-8.

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Chitinoclastic Shell Disease in American Lobsters: A Progress Report

FROM: REGINA SPALLONE

In 1988, commercial fishermen on the East coast of the United States began to report an increase of shell disease in lobsters and crabs from offshore canyons along the east coast of the United States. Fishermen blamed this alleged increase of shell disease on dumping activity at the 106-Mile Deepwater Dumpsite (DWD-106), a site approximately 115 nautical miles east of Atlantic City, New Jersey. Reports started one year after a "blitz" of media attention on the subject of ocean dumping, and two years after dumping of domestic sewage sludge began.

Crustacean shell disease, or chitinoclasia, is often referred to as burn spot disease. The condition results from bacterial action on the shell by, among others, *Vibrio* or *Pseudomonas* sp.. The protective epicuticle which covers the shell must be breached for this infection to occur (Stewart 1980; Getchell 1989; Sawyer and Taylor 1949). As its colloquial name implies, the condition exhibits localized discoloration, pitting and crater-like lesions resembling burns in the shell. In severe cases, underlying tissues are exposed (Malloy 1978; Estrella 1984; Bullis 1989; Getchell 1989; Stewart 1980; Roald et al. 1981; Johnson 1983).

A working group involving the U.S. National Oceanic and Atmospheric Administration (NOAA) and the U.S. Environmental Protection Agency (EPA) examined information on shell disease and DWD-106 but could not establish a correlation between increased disease and the dumping (Sindermann, et al. 1989). However, the paucity of data available on shell disease in offshore crustaceans, and the relationship established between shell disease and pollution at inshore sites, justified increased research on the offshore stocks.

In July 1990, the Milford Connecticut Laboratory of NOAA's National Marine Fisheries Service began an investigation of shell disease in lobsters (*Homarus americanus*) inhabiting continental shelf canyons from George's Bank to Virginia. The work was supported by funds administered by NOAA's National Ocean Service. About 16,000 animals were examined for signs of chitinoclasia.

During the 2 year study, we sampled lobsters from vessels returning from nine sites (mid-George's Bank, in the vicinity of Lydonia Canyon, and Veatch, Block, Hudson (two locations), Tom's, Baltimore, Washington and Norfolk Canyons along the shelf south and west of George's Bank) on a monthly basis. We examined about 100 lobsters from each vessel each month, representing 5-15% of the vessel's catch. Sex, length and shell hardness, as well as fouling growth and scarring, were noted for each lobster. Specific location and size (mm^2) of each anomaly were recorded as they appeared on diseased lobsters. Anomalies are categorized as necrotic spots (discoloration) and lesions (open sores).

Statistical comparisons of shell disease prevalence levels at each site have been complicated by differences in male:female ratios,

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lobster migration patterns, predominant size of lobsters, and seasonality of the disease prevalence levels, as well as the complex ocean circulation patterns around DWD-106. For example, it is known that mature female lobsters, as a result of ovarian development, have a longer time between molts than do males (Phillips et al. 1980). After finding increased prevalence of shell disease in female lobsters from Massachusetts inshore areas, Estrella (1991) concluded that the longer time between molts results in an increased opportunity for chitinoclastic bacteria to invade the shell. Lobsters from offshore canyons may molt at any time of the year, migrating annually to warmer shoal water in search of optimal conditions (Cooper and Uzmann 1971). This continuous molt may account for variable prevalence levels, since minor shell disease may be lost with the molt.

Field work for this study concluded in September 1992. The complex factors noted above increase the requirements for rigorous and extensive statistical analyses to determine whether, in fact, dumping at DWD-106 is associated with an increase of shell disease in lobsters.

References

Bullis, R. A. 1989. Bio Bull. 177(2):327.
Cooper, R.A., and J.R. Uzmann. 1971. Science 171:288-290.
Estrella, B. T. 1984. Mass. Div. Mar. Fish. Pub. No. 14049-19-125-5-85-C.R. 17pp.
Estrella, B. T. 1991. J. Shell. Res. 10(2):483-488.
Getchell, R.G. 1989. J. Shell. Res. 8(1):1-6.
Johnson, P.T. 1983. In J.P. Provenzano Jr. ed. The Biology of Crustacea, Pathobiology. Academic Press, N.Y. 6:1-78.
Malloy, S. C. 1978. J. Wildlife Dis. 14:2-10.
Roald, S. O., J. Aursjø and T. Håstein. 1981. FiskDir. Skr. Ser. HavUnders. 17:153-160.
Sawyer, William and C.C. Taylor. 1949. Maine Dept. Sea & Shore Fish. Res. Bull. 1:1-10.
Sindermann, C.J., F. Csulak, T.K. Sawyer, R.A. Bullis, D.W. Engel, B.T. Estrella, E.J. Noga, J.B. Pearce, J.C. Rugg, R. Runyon, J.A. Tiedemann, and R.R. Young. 1989. NOAA Tech. Memo. NMFS-F/NEC-74. 47 pp.
Stewart, J. E. 1980. In J. S. Cobb and B.F. Phillips eds. The Biology and Management of Lobsters, Vol. 2. Ch. 6. pp. 301-342. Academic Press, N.Y.
Phillips, B.F., J.S. Cobb, and R.W. George. 1980. In J. S. Cobb and B.F. Phillips, eds. The Biology and Management of Lobsters, Vol. 2. Ch. 1. pp. 2-82. Academic Press, N.Y.

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ANNOUNCEMENT

THE NEWSLETTER HAS A NEW EDITOR!

The editors are pleased to announce that we are now three. John Pringle and Stan Cobb, being distinctly northern hemisphere oriented, and clawed lobster-centric, thought it was far past time to ask a colleague from the spiny lobster, southern hemisphere guild to join them. Many of you know John Booth, either from informative publications, pithy articles in the Newsletter, or witty remarks at Lobster Workshops. John has agreed to have his arm twisted and share in the real pleasures of editing this newsletter, and communicating with all of our readers. John will be looking for articles, news, old drawings, whatever that will continue to make this newsletter an informative, sprightly publication. Please write John and tell him what you will contribute to an upcoming issue of the Newsletter! His address is:

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NEW ZEALAND

More about Habitat for Juvenile *Homarus americanus*

FROM: ROBERT J. MILLER

Caddy (1986) and Fogarty and Idoine (1986) stirred interest in the question of whether physical habitat limits abundance of juvenile American lobster. They proposed that survival of some lobster sizes might be limited by the number of shelters offering protection from predators. Thus, shelter would be a bottle-neck controlling recruitment to the fishery. Hudon (1987) and Wahle and Steneck (1991) found that small juvenile lobsters, 5-40 mm CL, were usually confined to cobble/boulder habitat. These sizes are clearly shelter dependent (Cooper and Uzmann, 1980; Lawton, 1987). Wahle and Steneck (1991) observed that this habitat bordered only 11% of the shoreline at a central Maine study site, and speculated that because of its scarcity it could represent a bottleneck for survival of the small juveniles. Miller *et al.* (1992) found that about 35% of the bottom area 0-15 m deep bordering 5 000 km of Nova Scotia coast was cobble/boulder. Because recent lobster landings in eastern Nova Scotia were two to three times higher than at any time during the history of the fishery, and because the number of lobsters landed/km^2 of cobble/boulder habitat was higher there than in the rest of Nova Scotia (for which habitat area was available), we argued that carrying capacity of the physical habitat has likely not been exceeded. This argument assumes predators are now no less abundant or effective at penetrating shelters than in the past, that the physical habitat has not changed, and that landings are a good measure of lobster abundance. We also quoted results of small scale field and laboratory stocking experiments which suggested that carrying capacity for small juveniles was higher than the density necessary to support current landings. The assumptions are considered below.

In the last issue of the *Lobster Newsletter*, J. Addison and M. Fogarty (1992) also discussed whether physical habitat might be limiting to juvenile American lobster. They pointed out that important lobster predators are not fished commercially (see also Pezzack, 1992; Wahle and Steneck, 1992), so fishing impact should not have diminished predation. Levels of abundance of unfished predators and their changes are unknown. On the Nova Scotia coast obvious physical change such as dredging and filling nearshore habitat has not been extensive. Macroalgal abundance has varied, and its importance as a structural component of lobster habitat has been debated (Wharton and Mann, 1981; Miller, 1985). However, the timing of abundance cycles is such that macroalgae cannot be the only cause of lobster increases. Addison and Fogarty (1992) provided alternatives to our assumption that landings are a good measure of lobster abundance; the subject of the remainder of this note.

They argued that exploitation of new fishing grounds, more fishing effort, and higher catchability due to higher temperature waters could account for a significant portion of the recent increase in landings in Maine and Canada. I concede that fishing grounds expanded during the history of the fishery, and this could have increased the size of the fishable stock for a species of small home range like lobster. For example, the addition of power trap haulers in the 1940s increased the depth range fished, and may have contributed to the landings increase seen about that time. However, of the five major inshore lobster fishing districts in Nova Scotia, the area fished during the 1980s expanded in only one, southwestern Nova Scotia. And, that expansion is thought to have accounted for less than 20% of this districts landings (D.S. Pezzack, pers. comm.).

The other two factors, increased catchability and fishing effort, would both raise the annual exploitation rate (i.e. the percentage of legal animals removed), but would not have a lasting effect on landings. Two examples will illustrate (Table 1). If exploitation increased from 40-90% in one year (an unusually large increase) and recruitment remained unchanged, the catch would increase 125% in the first year then return to near the catch level achieved at 40% exploitation in following years. If instead, exploitation increased from 40-90% over 5 years, catch would increase by a maximum of 35%, then gradually return to the level at 40% exploitation. In the five fishing districts referred to above during the 1980s, the change from low to high annual landings were by factors of 2.6, 10.8, 7.8, 3.7, and 1.6. The high and low years were 4 to10 years apart. None of these large and sustained increases could have been caused by increasing exploitation.

More variables could be added to a discussion of habitat carrying

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Table 1. Effect of increased exploitation rate on catch assuming constant recruitment to the fishable stock. A. Exploitation increases from 40-90% in 1 yr. B. Exploitation increases from 40-90% over 5 years.

	A			B		
Year	Exploitation rate (%)	Catch and Stock size		Exploitation rate (%)	Catch and Stock size	
1	40	1000	stock	40	1000	stock
		-400	catch		-400	catch
		+400	recruits		+400	recruits
2	90	1000		50	1000	
		-900			-500	
		+400			+400	
3	90	500		60	900	
		-450			-540	
		+400			+400	
4	90	450		70	760	
		-405			-532	
		+400			+400	
5		445		80	628	
					-502	
					+400	
6				90	526	
					-473	
					+400	
7				90	453	
					-408	

capacity: food, disease, competition for space, and physical disturbance. For lack of data on these variables we could conclude that we have nothing to say. However, not one to withhold an opinion, I advocate the following working hypotheses: 1) physical habitat for juvenile lobsters has not reached carrying capacity in Nova Scotia in recent decades, and 2) major changes in landings reflect major changes in abundance of legal and sublegal sized lobsters.

REFERENCES

Addison, J.T. and M.J. Fogarty 1992. The Lobster Newsletter: 5 (2).

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

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

Cooper, R.A., and J.R. Uzman 1980. Biology and management of lobsters. Vol. 2, Academic Press, San Diego, CA.

Hudon, C. 1987. Can. J. Fish. Aquat. Sci. 44: 1855-1869.

Lawton, P. 1987. Can. J. Fish. Aquat. Sci. 44: 1855-1869.

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

Miller, R.J., A. Campbell, G.J. Sharp, and C. Hudon 1992. Can. Tech. Rep. Fish. Aquat. Sci. 44: 1855-1869.

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

Wahle, R.A. and R.S. Steneck 1991. Mar. Ecol. Prog. Ser. 69: 231-243.

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

Wharton, W.G. and K.H. Mann.1981. Can. J. Fish. Aquat. Sci. 38: 1339-1349.

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PERSPECTIVE REVISITED

CONTINUED FROM PREVIOUS PAGE

Lobster Landings Reprise

FROM: JULIAN ADDISON AND MICHAEL FOGARTY

Bob Miller (this issue) nicely continues the dialogue onfactors underlying the decadal increase in landings of the American lobster. Miller defends the view that an increase in catch has been due to a sustained increase in abundance and that the landings reflect population size increases. We suggested (Addison and Fogarty, Lobster Newsletter 5[2]) that it is necessary to use caution in interpreting the landings data as an index of abundance. Before we infer that abundance has increased dramatically, we should first eliminate other sources of change in the fishery that might affect the catch.

Catch per unit of standardized fishing effort is routinely used as a measure of population size when fishery-independent measures of abundance are not available. Catch alone, however, is not an independent measure of abundance. We cited several interrelated factors that can lead to an increase in catch without an increase in abundance including an expansion of the area fished, an increase in catchability, and an increase in fishing effort.

Fishing effort has escalated dramatically in many parts of the range during the last decade. We suggest that this resulted in an expansion of the areas fished after prime habitat regions became saturated with effort. The expansion into areas previously deemed marginal in terms of catch per unit effort has been possible because of the relatively high unit-value of lobsters. An increase in catchability with increased temperatures in the last several years could have resulted in an increase in catch rates that fueled further expansion of the fishery leading to a cascading effect of increasing catch and effort. Miller correctly notes that an increase in exploitation rates (either through an increase in effort or catchability) yields only a transient increase in catch at moderate to high exploitation rates. This result assumes that the population being fished remains the same. We suggest that the boundary of the fishable population has changed in many areas. This can lead to a longer term increase in catch, depending on the nature of the linkage between the 'original' population and the 'new' population.

We suspect that the cause of the increase in lobster landings involves elements of an increase in production (recruitment and growth), an increase in catchability and related increases in effort and area fished. If the increase is due solely to an increase in abundance, we must determine why the production regime has changed so markedly over the last 15 years. This has extremely important management implications deserving careful consideration. If we fail to find changes in fisher's activities that could account for the change we must then concentrate on the much more difficult problem of discerning the factors controlling stock abundance.

The thrust of our article was to ensure that due consideration was given to fishery-related factors prior to moving to the much more complex ecological system. The reasons for the landings increase may differ among regions and we of course accept Miller's assessment of the Nova Scotia case. It will ultimately be necessary to also address the common factors in the increases on a broader geographical scale.

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BOOK REVIEW

The Western Rock Lobster *Panulirus cygnus* Book 1: A Natural History

Howard Gray, 1992. Westralian Books, Geraldton, Western Australia. ISBN 0-9594105-2. ix + 112 pp. Numerous color and non-color photographs, line drawings, and tables. To order copies send AUD$25.00 (softcover), AUD$35.00 (hardcover) to Westralian Books, P.O. Box 1559, Geraldton, 6530, Western Australia. Overseas postage $15.00 (surface) and $25.00 (airmail) per copy; surplus will be refunded.

REVIEWED BY: BRUCE HATCHER

It cannot be universally said that the biology and ecology of animal species are known in proportion to their value to humans. Witness our rudimentary knowledge of the great whales; so long a source of industrial products. Nor, conversely, can it be said that extensive knowledge of commercial species ensures continued high yield for humans. Witness the recent collapse of the Canadian northern cod fishery, one of the longest studied fish species. The Western Rock Lobster is the rule to these exceptions. Supporting the most valuable monospecific fishery in Australia, it is undoubtedly the most studied subtidal marine invertebrate in the antipodes (which is saying something in the country of Great Barrier Reef corals and Crown-of-Thorns starfish!). The application of this knowledge to managing human impact on the species appears to have sustained and enhanced its value since the virgin biomass was fished out around 25 years ago. This book, from a high school science teacher/environmentalist, summarizes the species' phylogeny, life cycle and habitat in a lively, conversational text liberally interspersed with diagrams, photographs and special topic 'windows'.

It is an unusual book in several respects. First, it is not clear initially for whom it is written. The treatment of scientific aspects is too detailed to hold the interest of readers with no knowledge of marine biology, yet too many simplifications and omissions are made for it to qualify as a scientific monograph on the species. Secondly, it mixes journalistic devices and personal anecdotes with hard data and formal citations. The result is versatile communication, but the book makes few points effectively about the value of various research and management strategies, or the motivations and influences which have caused our knowledge of the animal to develop as it has. I cannot help but think that a good opportunity to expose some essential facets of the scientific process and the West Australian psyche has been missed. Thirdly, I could find but a single error of fact, labeling or typography in the book[1] (which is not to say, of course, that no others exist!). The product is meticulously edited, proof-read, presented and bound. The acknowledgments are a "who's who" of rock lobster research, and these scientists have obviously given their time and images generously.

Having spent eight years in Western Australia, I am impressed by the compactness of the research effort there. The work of nine men accounts for over half the 205 literature citations in the book (and most of the remainder deal with aspects of the species' habitat). The author does a good job of humanizing some key individuals with pictures and anecdotes. He recognizes the necessary interaction of fisheries, museum and university scientists, policy makers and the fishing community in research and management. Some of the major research efforts and management policies were not only facilitated by an informed and cooperative fishing community, they were conceived and initiated by them. The admirable lack of counter-productive animosity between harvester and resource manager was made possible in part by a sharp separation of research ambits within and among agencies. The state fisheries department (which regulates) stuck to the traditional fisheries science on the adult stock, the federal research agency (CSIRO) focused on the larval and juvenile phases, and the museum and universities handled taxonomy, environmental and more esoteric aspects. On the fishing boat, the person asking about juvenile catch rates is very distinct from the officer arresting you for overpotting!

In the postscript, Gray notes that all but the fisheries management research on the rock lobster has ceased, since the CSIRO switched its mandate to environmental research (and, I might add, the museums and universities had their marine research funding reduced). Areas of profound ignorance remain. The environmental cues and response behaviors, by which the phyllosomes and pueruli interact with the region's oceanography to return to the coast after a year's pelagic existence, remain in the realm of speculation. The causal relationships underlying the 20 year correlation between puerulus settlement on artificial substrata at two sites, and total catch in the fishery three to four years later ($r \approx 0.88$), are known. There is little understanding of the special case rock lobster populations at the Houtman Abrolhos coral reefs (near the shelf edge off central Western Australia). Animals there reach maturity at a significantly smaller size, spawn earlier in the year and exhibit different migration behaviors than their coastal counterparts. The diverse and productive benthic communities of the Abrolhos yield about 15% of the total rock lobster catch from about 3% of the area fished, over a season which is half as long as that in the rest of the fishery.

The answers to these questions lie as much in an improved understanding of the oceanography and benthic ecology of the region as in the basic biology of the organism. Gray implicitly recognizes this fact in the generous presentation of information on the rock lobster's habitat, including, for example, succinct descriptions of detritus food webs and the ENSO phenomenon. It turns out that much of the good oceanographic and ecological research on Western Australian marine ecosystems over the past forty years has been done in the name of the rock lobster.

In the end, I realize this book was written for me: someone with an informed interest in the species, who has neither the time nor inclination to wade through the voluminous, dry and obscure primary literature. Someone who likes to be entertained as well as informed, without enduring misleading simplification or disguised ignorance. Someone who wants accurate references to supporting documentation for statements of interest or dispute. I recognize about 1800 people in this category: 700 who fish rock lobster, 650 who study marine science in Australia, and 500 who receive this newsletter (the latter two somewhat overlap). It will be interesting to learn how many copies are sold. I certainly would have bought one had I not received the copy just reviewed, gratis!

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1 In the photograph on page 94, Eric "Sticklegs" Barker is shown wearing long plans: in true Aussie "Techo" tradition, he always wears shorts!

LETTERS

Dear Colleagues,

For a number of years now, I have been receiving The Lobster Newsletter, and have found the comments and reviews relevant to crustaceans in general as well as being informative. However, with my primary interest in crabs, I have felt that a complimentary newsletter focused on crabs was also needed. Although some issues are common between the two crustacean groups, I believe crab biologies and fisheries are enough distinct to warrant separate consideration in their own newsletter.

I see the main objectives of a newsletter as encouraging information exchange, establishing greater awareness of controversial subjects, and strengthening crab research by allowing rapid dissemination of information relating to upcoming articles or events. I believe a crab newsletter would be relevant both to professionals involved in crab research and management and to crab fishers interested in events which might influence their livelihoods.

I am therefore taking the initiative to solicit opinions of as many colleagues as possible who have published on commercial crab species in the past few years or who are active in crab fisheries management. In this context, I would appreciate your comments as to whether you feel that a "crab newsletter" is needed and would be of value to you. I also ask, if you feel a newsletter is needed, what should the content be in order to ensure that the newsletter is always as relevant as possible. Any other views or opinions as to the structure or production of a crab newsletter are welcomed.

If there is sufficient interest in a "Crab Newsletter", Dr. Dave Armstrong, University of Washington, Seattle, USA, has agreed to explore with me ways in which we can publish one.

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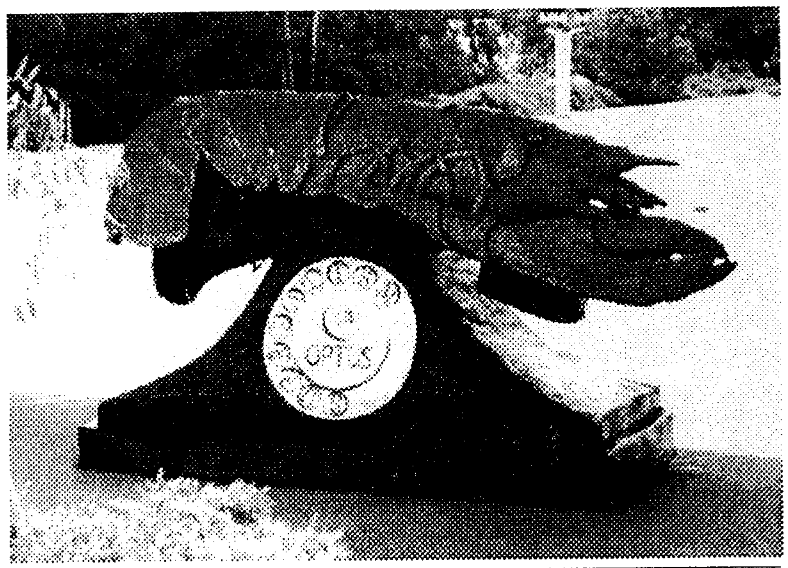

Salvador Dali had it right. To enhance communication, use the lobster phone!

July 1993

The Lobster NEWSLETTER
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Halifax, NS B3J 2S7
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ADDRESS CORRECTION REQUESTED