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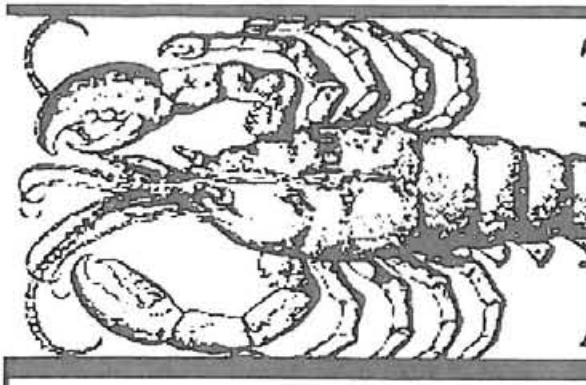

The Lobster NEWSLETTER

EDITORIAL

We're Going Electronic!

For better or worse, we are abandoning the paper version of *The Lobster Newsletter* in favor of an electronic version starting with the next issue – Volume 13; No. 2. The cost of printing and mailing the paper version is the major reason for doing so, especially since we have no regular source of sponsorship or subscription fees to cover these expenses. We hope that this change will not pose any problems for our current readership. It could, in fact, expand our readership. Some of us will miss the feel of the paper newsletter in our hands, but the familiar format and logo of *The Lobster Newsletter* will carry on in the electronic version.

So how will this work? *The Lobster Newsletter* will be sent to our subscribers as an email attachment in PDF format. You will need *Adobe Acrobat Reader* software on your computer to open the file. This software is widely used and can be downloaded from the *Adobe* internet site (www.adobe.com/products/acrobat/readermain.html) free of charge. With *Adobe Acrobat Reader*, you can either view *The Lobster Newsletter* file or print it - all in its original format. You can also forward the email attachment of the newsletter to other colleagues without any copyright restrictions. If you do not have email, please contact one of the Editors.

For this transition to work, however, we need your email address! If you want to continue to receive *The Lobster Newsletter* in its new electronic form you MUST complete the mailing list update form on the last page of this newsletter and mail, FAX, or email the completed form to us at:

Lobster Newsletter Mailing List Update
c/o Shaun Smith-Gray, Department of Fisheries & Oceans, Biological Station,
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We are optimistic that this change will go smoothly and will permit us to continue publishing *The Lobster Newsletter* for many years to come. As always, we depend on your written contributions for the newsletter and encourage you to send us short communications about recent research results, emerging technologies or methods, new research or management perspectives, important announcements, interesting graphics, or humorous anecdotes relating to clawed, spiny, or slipper lobsters. Enjoy this last paper newsletter – its bound to become a collector's item!

- The Editors

RESEARCH NEWS

Spatial Scaling in Coastal Landscapes and the Distribution of Juvenile *Homarus americanus*

From: Robert Rangeley and Peter Lawton

Habitat preferences in the American lobster are well understood (e.g. ,Cobb 1971; Hudon 1987; Wahle & Steneck 1991; Lawton & Lavalli 1995) but we know little about how distribution patterns are affected by the spatial arrangement and scaling of habitat patches and how different geological processes determine the structure of habitats among geographic regions. In our current work we are studying the spatial structure of coastal habitats for a range of scales from centimeters to kilometers using sidescan sonar, remote and diver-deployed video imaging, and physical sampling methods in two geologically different regions in eastern Canada (Fig. 1). Sidescan sonar survey area totalled 7 km^2 at our Val Comeau site in the southern Gulf of St. Lawrence.

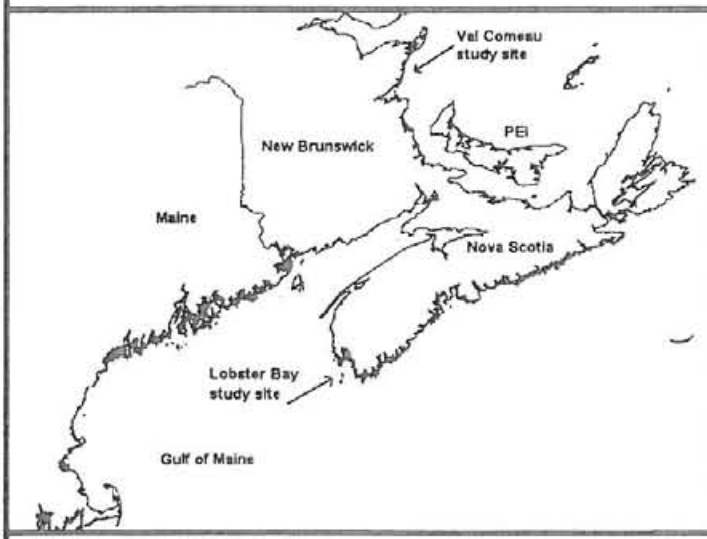

Figure 1: Map of Eastern Canada showing the location of the two study sites.

Sampling intensity (Fig. 2) included approximately 26 km of remote camera survey tracks, over 9000 m^2 of diver-held video images, and over 3000 quadrats (total area = 750 m^2) on 100m transects that were measured and searched. In addition to transect surveys, high resolution imaging and sampling of quadrats, nested in groups of 25 (area = 6.35 m^2) or 100 quadrats (area = 25 m^2), were also completed (Fig. 3). Sidescan sonar survey area at the Lobster Bay site in the Gulf of Maine totalled 12 km^2. At this

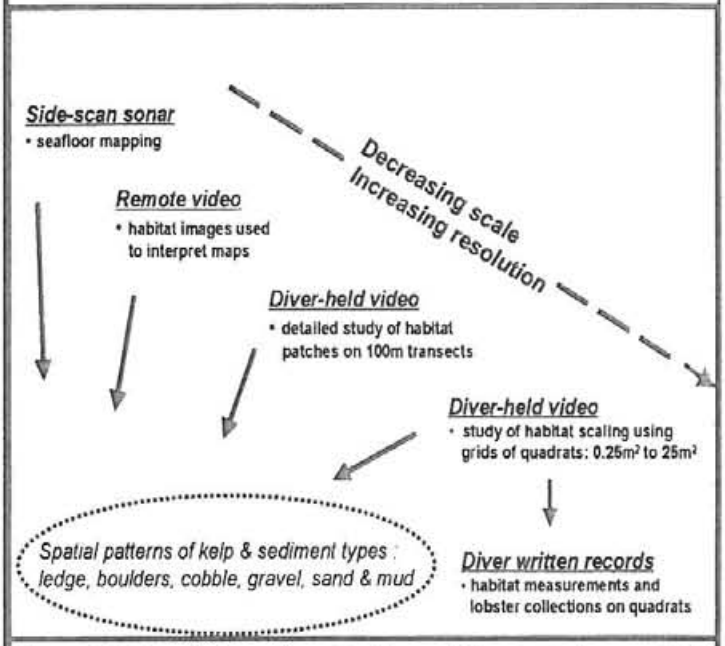

Figure 2: Description of methods used for studying spatial pattern of benthic habitats.

site, approximately 12 km of remote camera and over 2000 m^2 of diver-held video images were taken and 400 quadrats (0.25m^2) were physically measured and searched. Differential GPS was used to geo-reference all sampled substrates and benthic organisms from video transect and quadrat data.

Val Comeau consists of bedrock reefs, fissured bedrock with scattered fragments of relatively flat cobbles and boulders on sand. Habitat patches at the Val Comeau site were extremely complex and fragmented at large spatial scales yet the flat cobble and bedrock substrates yielded relatively little crevice space at the scale of individual lobster shelters. In contrast, Lobster Bay is made up of a diverse assemblage of habitats ranging from mud flats to shoals with large boulders originating from eroding mounds of glacial debris. Patch sizes were very large and fragmentation was low. Lobster densities were highest in structurally complex cobble/boulder habitats at both sites but in Val Comeau densi-

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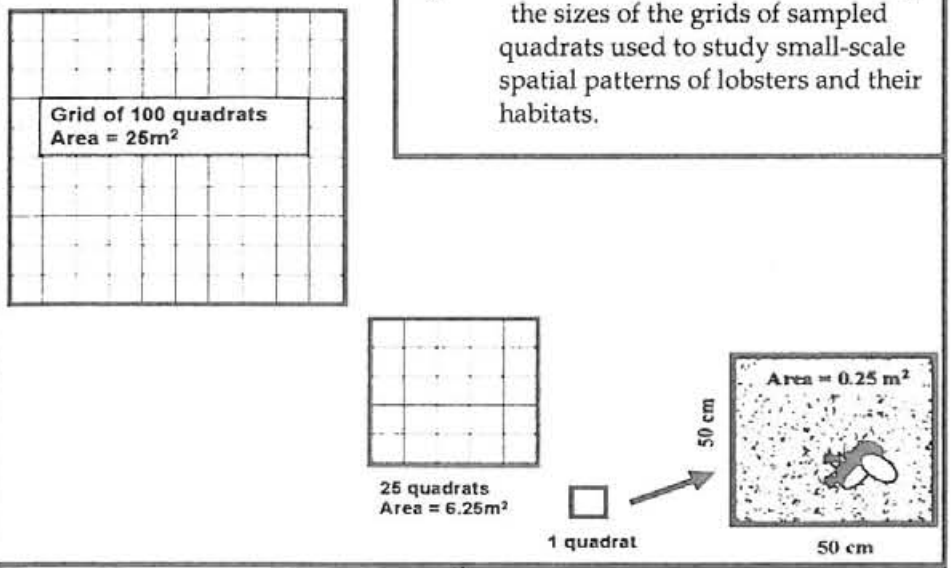

Figure 3: Schematic representation showing the sizes of the grids of sampled quadrats used to study small-scale spatial patterns of lobsters and their habitats.

ties were low ($0 = 0.13 \pm 0.04$ SE individuals $\cdot m^{-2}$) compared to those in Lobster Bay ($0 = 0.72 \pm 0.11$ SE individuals $\cdot m^{-2}$).

At small scales we have been investigating the relationship between rock size distributions and use of shelters by different lobster size classes. In $25m^2$ grids, all rocks from gravel to boulder sizes (1 to 100 cm diameter) were measured from videotaped images. The analyses are still in progress but the fractal nature of the shelter size distributions combined with knowledge of shelter size requirements (e.g., Wahle 1992) suggests we may be able predict the size of lobster for which the availability of shelters is limiting (i.e., a habitat or recruitment bottleneck; e.g. Butler & Herrnkind 1997).

As one component of the Canadian Lobster Atlantic-wide Studies (CLAWS) program, the results from this juvenile lobster habitat project will be interpreted in a larger context with other lobster studies investigating predation, catchability, and growth and production. The overall goal of the CLAWS program is to develop a long-range recruitment-forecasting program for the Canadian lobster fishery.

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Lobster (*Homarus americanus*) Catchability Studies in Atlantic Canada

From: John Tremblay

In recognition of the importance of Atlantic Canada's lobster fishery, CLAWS (Canadian Lobster Atlantic Wide Studies) was initiated by Fisheries and Oceans Canada in 1996. With CLAWS funding biologists and physical oceanographers have progressed on a number of projects related to improving assessment methods and understanding recruitment processes. One of the projects within CLAWS addresses questions related to the catchability of lobsters in traps. This project was possible only with the expert help of field workers from the Gulf Fisheries Centre (Moncton), the Bedford Institute of Oceanography, and the St. Andrews Biological Station.

Most assessment data for the lobster fishery in Atlantic Canada comes from the catch of the commercial trap fishery. Fishery-independent surveys are still in the experimental stage and are limited to a few small areas.

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Lobster traps are very selective for certain components of the lobster population, so size and catch rate data from commercial traps are biased. The catchability project utilized SCUBA to obtain the size structure of lobsters on the bottom for comparison with the size structure of lobsters collected by baited traps.

Study areas in Lobster Bay (southwestern Nova Scotia) and the Baie des Chaleurs (northeastern New Brunswick) were 200-400 m long by 150 m across and were limited to areas where lobsters could be effectively counted. This eliminated areas with numerous or stacked boulders, or dense kelp. Size and sex-specific catchability (q) coefficients were estimated by dividing the catch rate in traps by the lobster density estimated from SCUBA transects. A standard research trap was used in all areas; traps with different entrance ring diameters and commercial traps were also tested.

Prior to this project, the few catchability estimates for *Homarus* were for late August-September (Miller 1995). As in these studies, we found that males were more catchable than females at this time of year in both the Baie des Chaleurs and Lobster Bay. A different picture emerged when we estimated lobster catchability for June, shortly after the closure of the commercial season in Lobster Bay. Females > 80 mm carapace length were more catchable than in September, and more catchable than males of the same size. This work was repeated in June 1999 and larger females were again much more catchable than in September. The higher catchability of females in June probably contributes to the increase in the catch of larger females in the spring months of the commercial fishery.

As part of the Lobster Bay studies, three different areas representing habitats of different complexity were surveyed in September 1998 and June 1999. Bottom habitat at the first site surveyed was characterized by mud, sand, boulders, gravel, and low-moderate density kelp patches. The bottom at sites added in 1998 and 1999 was less complex, with a predominance of either mud or sand, and fewer boulders. Preliminary findings indicate that lobsters on the less complex bottoms are more catchable than those at the site with higher relief. In addition the seasonal differences in catchability were not as pronounced at the simpler bottom habitats.

A preliminary result from comparison of the size distribution of all lobsters collected during dive transects with that from all traps is that large lobsters (>110-120 mm CL) are underselected by traps. This underselection is also suggested by the catch of large lobsters in trammel nets (pers. comm. M. Lanteigne, Gulf Fisheries Centre) and by data on tag return rate by size (Pezzack & Duggan 1995). We hope to better quantify the underselection of large lobsters in traps as it has important implications for estimating exploitation from trap size distributions.

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Abundance and Movement of *Palinurus elephas* in a Northwestern Mediterranean Marine Reserve

From: Raquel Goñi, Olga Reñones and Antoni Quetglas

The archipelago of Columbretes (Northwestern Mediterranean; Fig. 1) and the grounds to the North, West and South have sustained red spiny lobster (*Palinurus elephas*) fisheries at least since the mid eighteeth century. Since the creation in 1990 of a marine reserve in the Columbretes archipelago (14 km^2), lobster fishing effort in those grounds concentrates along the outer boundaries of the reserve and in traditional fishing grounds mainly to the East and North of the archipelago.

In 1997, we initiated an ongoing series of experimental fishing sur-

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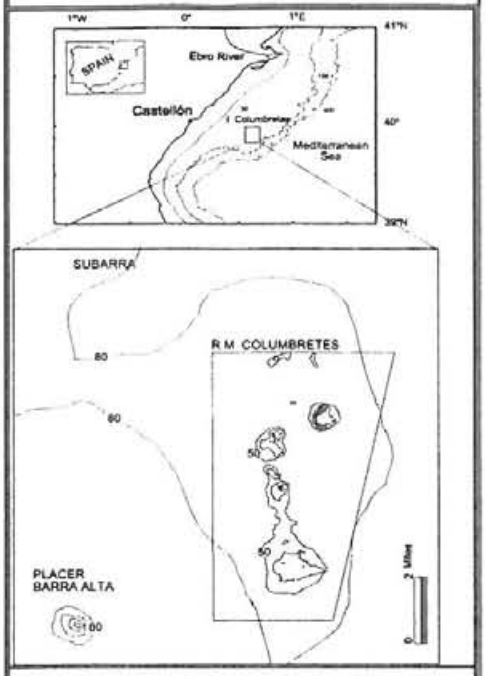

Figure 1: Location of the study areas within the marine reserve of the Columbretes Islands (COL) and the control areas: Placer de la Barra Alta (PLA) and Subarra (SUB). Depths are in meters.

veys to evaluate for the first time changes in the abundance of red lobster in this marine reserve. Since no assessments of the *P. elephas* population were done before the creation of the Columbretes reserve, for this study we have compared the population in the marine reserve with other red lobster populations or sub-populations open to exploitation. The prediction was that after more than eight years of protection lobsters would be more abundant within the reserve than in comparable areas where fishing is allowed. Along with the surveys, tag-recapture experiments were conducted to assess movement patterns of red lobster that may have a bearing on migration or spill-over effects from the reserve.

The estimation of red lobster abundance has been done by experimental fishing with traps in surveys carried out in June 1997, August 1998 and February 1999. Long-lines were made with 36-40 baited traps separated 10-12 m between them and these were soaked overnight in depths ranging from 50 to 80 m. Although the selective properties of these traps are unknown (study in progress), on the basis of the size of the opening it is clear that they do not sample juveniles below 30-35 mm of caparace length (CL). For the spatial comparison, two areas outside the reserve - PLA and - SUB - were used as controls of the effects of protection in the reserve area (COL) (Fig. 1). The reference areas are traditional lobster fishing grounds visited by artisanal units operating off the nearest harbors in the mainland. Effort was standardized to 40 traps per line and used to estimate catch per unit effort in number of lobsters (CPUE). CPUE has been assumed to be proportional to abundance, except in the marine reserve were theseindices of abundance must be considered minimum values as trap saturation may occur in high-density areas. To strengthen the spatial comparison of abundance indices, use is also made of lobster CPUE data of artisanal vessels fishing with the same type of traps and bait in the Island of Menorca (Balearic Islands) (160 km SE of Columbretes) during the summer of 1998.

Red lobsters were tagged with Hallprint TB1 T-bar anchor tags and were released in predetermined locations inside and outside the reserve. This type of tag causes little mortality (5%) in *P. elephas* (Hepper 1977). Although shedding rates for *P. elephas* are not known (study is in progress), shedding rates for this type of tag in the spiny lobster *Jasus verreauxi* have been estimated at around 8% annually (Montgomery & Brett, 1996).

Analysis of the survey data analysed so far (1997 & 1998) showed that lobster availability is significantly and consistently greater inside the Columbretes reserve (15-27 lobs/40 traps) than in the control areas open to fishing (0-1 lobs/40 traps). Estimates of catch rates of the trap fishery in the productive grounds of Menorca Island (1.4 losb/40 traps) were similar to those of the PLA control area and well below the abundance indices observed in the reserve in the same season/year. The most plausible cause of the differences in abundance observed between areas is the reduced fishing mortality in the marine reserve since 1990. This effect of increased population abundance in protected areas has been reported for other species of spiny lobsters, such as *Panulirus argus* in the Dry Tortugas National Park in Florida (USA) (Hunt *et al.*, 1991) and *Jasus edwardsii* in Cape Rodney to Okakary Point (CROP) marine reserve in New Zealand (Cole *et al.* 1990; MacDiarmid & Breen 1992). As in other cases, the effectiveness of the

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protection afforded by the Columbretes MR appears to be limited by the impacts of fishing on individuals that undergo daily foraging movements or seasonal migrations out of the reserve. Although the spatial comparison suggests a protection effect, the lack of other comparable protected sites and of temporal data, in particular before protective measures were in place, prevents a reliable assessment of the effects of protection on red lobster.

The size of the *Palinurus elephas* population in the marine reserve of Columbretes as estimated by the June 1997 and August 1998 surveys differed by a factor of two. This remarkable temporal variability in lobster abundance suggests that segments of the population reside outside the reserve at certain times of the year. Large seasonal variations in abundance of spiny lobsters in protected areas have also been noted for *Jasus edwardsii* (MacDiarmid & Breen 1992) and *Panulirus argus* (Hunt *et al.* 1991). This is important because if true, it would mean that the Columbretes reserve does not encompass all the necessary habitats to ensure protection of the lobster local population all year round. However, it is clear that seasonal changes in catchability are partially responsible for the temporal variability observed in catch rates. It is well known, and we have corroborated it in simultaneous sets of traps and nets, that catchability of lobsters varies substantially with time, probably in relation with the moult and reproductive state, and that it is sex-dependent.

Recapture rates of lobsters released outside the marine reserve during June 1997 were very high (20-61%) indicating that a large portion of the adult lobsters in those grounds are removed each year. A similar observation was made by Davis & Dodrill (1980) concerning *P. argus* in the Florida reefs. Recapture rates of tagged *P. elephas* released inside the Columbretes reserve were 7% outside the reserve and 4% inside. The larger number of tagged lobsters inside the marine reserve compared with other areas together with the lower fishing effort in the reserve than in open fishing grounds may result in a bias towards net movements away from the reserve. This problem has been encountered by other researchers working in marine reserves where the only fishing effort in them is that of the surveys (e.g., MacDiarmid 1991).

Analysis of recaptures from the 1997 tagging experience indicate that tagged lobsters released in open fishing locations were primarily recaptured near the position of release. As expected, most lobsters that moved away from the points of release were caught where the fishing activity concentrates, in this case the boundaries of the marine reserve. An unknown proportion of the lobsters released inside the reserve underwent movements in depth away from it with no particular trend in direction. These were also primarily caught by the fishery operating in the boundaries of the reserve (Fig. 2). All of the red lobster recaptures were made within 10 km from the points of release even after times at large of up to 448 days.

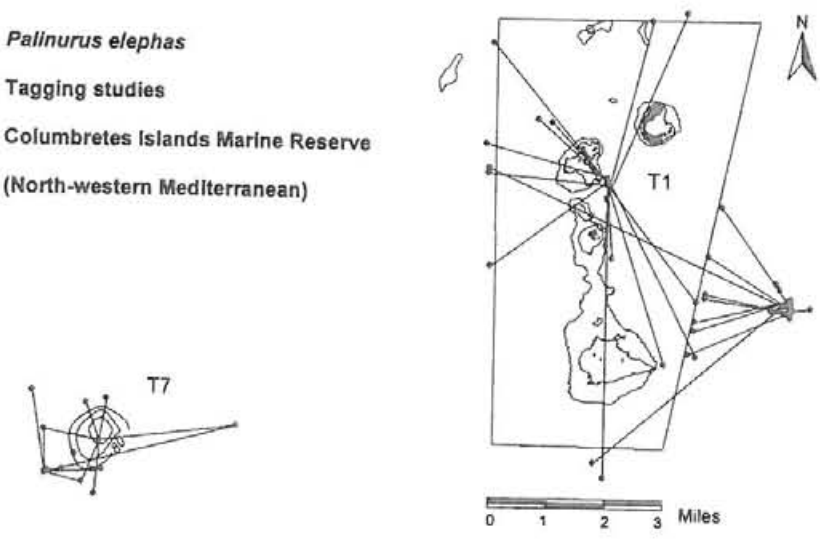

Figure 2: Lines linking sites of release T1, T5 and T7 and recapture locations of lobsters tagged during the June 1997 survey. Times at large range from 8 to 488 days.

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On the basis of the available results from tag-recapture experiments, it appears that adult *P. elephas* does not undergo long-range movements or migrations in this area and that in Columbretes islands there is a resident adult population that exhibits limited movements. Results of tagging studies of *P. elephas* off Corsica (NW Mediterranean) (Marin 1987) and off Cornwall (NE Atlantic) (Hepper 1977) also corroborate that adults of this species realize limited movements. This may effectively explain why the Columbretes reserve, despite its relatively small size, has been effective in rebuilding the abundance of adult red lobster population locally.

Despite the apparent limited scale of the movements of adult red lobster, the high seasonal variability in availability observed in the reserve may be an indication that it realizes restricted seasonal migrations in depth. Since its deep distribution prevents direct observation by divers, partitioning the role of seasonal movements and of changes in capturability is not readily possible in *P. elephas*. Further mark-recapture data may reveal seasonal migration patters by size and sex that will permit a better assessment of the impacts of fishing mortality in the boundaries of the Columbretes marine reserve. The challenge now is to locate juvenile habitats and to investigate movement patterns of juveniles in order to understand whether the Columbretes population is self-recruiting and how the exploited populations get replenished annually.

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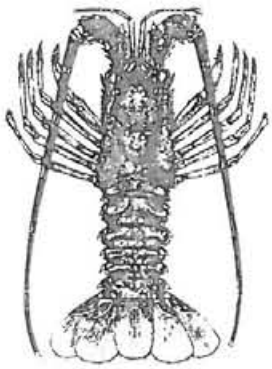

Palinurus elephas

Swimming by *Jasus edwardsii* Pueruli

From: Andrew Jeffs and Rebecca Holland

There is growing evidence that swimming plays an important role in the onshore movement and settlement of spiny lobster pueruli (Jeffs et al. 1999). Recent research in New Zealand suggests that *Jasus edwardsii* are capable of swimming onshore at speeds of 8 – 10 cm s^{-1} (Chiswell & Booth 1999). Furthermore, energy stores measured in pueruli caught in offshore areas indicate that they have sufficient reserves to actively swim across the continental shelf and into shallow coastal waters where they settle (Jeffs et al. 1999). There have been few observations of swimming in *J. edwardsii*, either in culture or in the field (Kittaka 1990, Booth pers. com.). Therefore, we set out to describe the swimming behavior in this important pelagic phase in the life cycle of this lobster.

Under dark red lighting, we observed and video recorded the swimming behavior of pueruli caught from the wild and which had been placed in a 1.3 m diameter tank and in a flume tank. Pueruli undertook two types of swimming; forward swimming using only the pleopods, and backward swimming using the entire tail in a rapid flick. Forward swimming was spontaneous and often continuous for several minutes, until interrupted by obstacles in the tank. The swimming posture is illustrated

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Figure 1: Swimming posture of postlarval *Jasus edwardsii*.

in Figure 1. Forward swimming velocities were measured for 12 pueruli and ranged from 13.0 – 30.7 cm s^{-1}, with a mean of 16.1 cm s^{-1}. Attempts to measure the duration of forward swimming in a flume tank failed as the pueruli did not exhibit consistent rheotactic behavior. Backward swimming was typically an escape response to striking an obstacle whilst swimming or walking. Instantaneous velocities from stationary ranged from 28.6 to 52.2 cm s^{-1} for 6 pueruli, which translated to a mean distance travelled of 5.3 cm after 0.2 s.

The results of this study indicate that, like the pueruli of other spiny lobster genera, those of *J. edwardsii* are capable of quite rapid forward swimming. If these swimming speeds can be sustained it has important implications for the onshore movement processes of the pueruli.

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Influx of *Jasus verreauxi* Pueruli into Tasmania

From: Caleb Gardner, Barry Bruce, Steve Montgomery, Geoff Liggins, Andrew Cawthorn, & Sam Ibbott

The Tasmanian rock lobster fishery is based on *Jasus edwardsii*, although *J. verreauxi* are also taken occasionally, especially in the north-east of the state. As part of management of the *J. edwardsii* fishery, we have been monitoring puerulus settlement since 1990 at several sites around the coast using arrays of crevice collectors. Not surprisingly, pueruli captured are mainly *J. edwardsii*, although two other lobster species are occasionally seen. These are Mawson's slipper lobster (*Scyllarus mawsonii*) and the eastern, or packhorse, lobster, *J. verreauxi*. Mawson's slipper lobster is not taken commercially while *J. verreauxi* forms the basis of the rock lobster fishery further north, in New South Wales (NSW).

In the previous two years we had captured four *J. verreauxi* pueruli at Bicheno, one of the sites on the east coast of Tasmania, whereas the total annual catch of rock lobster pueruli from the site averaged around 600. This low level of *J. verreauxi* settlement seemed to match observations of low levels of catch of *J. verreauxi* in the Tasmanian fishery and only the occasional phyllosoma of that species taken in plankton samples from off our east coast.

In 1999, the situation was quite different. Total settlement for the year was average (570 from the site) but the proportion of *J. verreauxi* increased dramatically: we caught 103 *J. verreauxi* pueruli at Bicheno (18% of the total). Older fishers from eastern Tasmania recall getting substantial catches of *J. verreauxi* in the past, so we're hopeful that this influx will be reflected in catches in the future.

The big question is what caused the event? One probable cause is an unusual current movement for that time of year. The boundary current on the eastern Australian seaboard, known as the East Australian Current (EAC), cycles north and south on a seasonal basis. It extends to within a couple of hundred kilometers south of Tasmania at its maximum extent in March-April before retreating to well north of Tasmania in late winter. *Jasus verreauxi* phyllosoma have been found in EAC water and this current would appear to be the mechanism whereby *J. verreauxi* are transported to Tasmanian waters. Sea surface temperature plots indicate a filament of the EAC off the eastern Tasmanian

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coast during 1999 which was a little earlier than normal. However, there have been other years over the last decade with similar plumes that have not been associated with unusual settlement events. Interestingly, this year has also seen some other unusual and earlier than normal captures of warm water species from eastern and southern Tasmania, including yellowfin tuna (*Thunnus albacares*), yellow-tail kingfish (*Seriola lalandii*) and mako shark (*Isurus oxyrinchus*).

Off NSW, where *J. verreauxi* is the target species of both recreational and commercial fishers, the pueruli settle on the seaweed-type collectors predominantly between September and November. It is worthy to note that the 1999 settlement in New South Wales was the highest since data were first collected in 1992. Because *J. verreauxi* has a relatively short settling season, we expected its distribution to be more sensitive to the timing of current movement than *J. edwardsii*.

But changed management practices in the fishery for *J. verreauxi* in NSW may have also contributed to the event by increasing larval supply. The abundance of lobsters off NSW was thought to have been below optimum due to a combination of high exploitation rates and inappropriate size limits. The onset of maturity in females occurs at around 165 mm CL, while the size limit was 104 mm CL. But recent indications from the daily log-sheets provided by fishers are that the relative abundance of the spawning stock is increasing. The reduced number of fishers participating in the fishery from 1992 and the introduction during 1993-94 of quota management into the commercial fishery, a legal maximum size, and a reduced "possession" limit for recreational fishers may be contributing to the observed increase in stock biomass in NSW.

Any stock recruitment relationships are difficult to detect in rock lobsters but we expected the link to be more obvious in this species due to its shorter larval duration (around 9 mos.) and the chance that the size of the spawning population is increasing from what was probably very low abundance. NSW Fisheries have set in place fishery-independent surveys, not only to monitor the abundance of recruits, but also to monitor the relative abundance of the spawning population (and hence egg production). It may be possible in the future therefore, once many years of data have been collected, to investigate the association between the size of the spawning population and the level of recruitment to the *J. verreauxi* population.

If the increased settlement of *J. verreauxi* in 1999 was due to increased egg production, then the settlement of *J. verreauxi* in Tasmania may continue to remain higher than that seen during the rest of the 1990's. It may even signal a return to the regular catches of *J. verreauxi* in the north-west of Tasmania that the older commercial fishers talk about. The next few years will be interesting.

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FISHERIES & AQUACULTURE UPDATE

Jasus verreauxi Phyllosomas Cultured

From: Graeme Moss, Phil James and Len Tong

Packhorse (*Jasus verreauxi*) phyllosomas have been reared through to pueruli and settlement at NIWA's Mahanga Bay aquaculture research facility in Wellington. This is the first step towards possible farming of this species.

Experiments looking at the effects of temperature and food ration on growth and survival of early and mid-stage larvae had shown that the best temperature was between 21 and 24°C. Intermolt period was reduced and growth increased with increasing temperature up to this range for most of the instars tested. For the mid-

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stage larvae (instars 5 and 7) fed high food rations, the intermolt period was also significantly reduced over those fed less.

The results show that there is considerable potential to enhance the growth of packhorse larvae by manipulating temperature and food ration. At the rates of growth we have achieved using the higher temperatures, it should be possible to shorten by about 25% to fewer than 75 days the time taken to reach instars 8-10.

Larvae were reared initially at temperatures of 18°C and then at temperatures of 20-24°C and fed exclusively *Artemia*. Good growth and survival of the larvae were achieved up to instar 10, when the larvae contracted disease and survival dropped to less than 5%. The disease, later identified as *Vibrio harveyi*, was possibly introduced with their food. A number of the larvae that survived have developed to the puerulus stage, averaging about 240 days from hatching.

However, getting the larvae through to pueruli is only the first step in culture; getting them to the juvenile stage is the next. Feeding and nutrition of the larvae will be critical for successful culture, particularly for the later stages which need to lay down appropriate reserves to get them through the non-feeding puerulus stage. These are the areas of research that we will be concentrating on in the coming year.

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Developing a Commercial Puerulus Collector for *Jasus edwardsii* in Tasmania

From: D. Mills, B. Crear, and P. Hart

Aquaculture earns over $100 million annually for Tasmania, the vast majority from domestic and export sales of Atlantic salmon and Pacific oysters. The industry recognizes the need to diversify, and there is considerable interest in farming the southern rock lobster, *Jasus edwardsii*. While research into closing the life cycle is gaining momentum, commercial culture from the egg to market size is still a long way off. Meanwhile, the Tasmanian Government and Australia's Fisheries Research and Development Corporation have funded an investigation into the technical viability of commercial collection and on-growing of wild-caught pueruli.

Central to the success of this initiative is an efficient method of puerulus capture. Puerulus collectors developed for one species seldom work well for another (Herrnkind *et al.* 1994). Accordingly, our project was built on what was already known for *J. edwardsii* in Tasmania. Settlement has been monitored since 1990, providing useful information on spatial and temporal variability for resource management (Gardner *et al.* 1998). Also, where marine farm structures have been left in the water for extended periods, observations by marine farmers of puerulus settlement patterns have been invaluable.

For the commercial ongrowing of wild pueruli to be viable, collectors need to be cheap to build, easy to maintain, efficiently serviced, and be able to catch adequate numbers of pueruli. Research collectors currently used throughout Australia fall short on several of these. Booth crevice collectors (plywood sheets held in a metal frame to form crevices - Booth & Tarring 1986), as used to monitor settlement in southern Australia, are easy to maintain, but are heavy and are generally serviced by divers. Phillips artificial seaweed collectors (PVC sheets with synthetic fibre tassels - Phillips 1972) used in Western Australia require regular replacement of the tassels and are expensive. Also, we believe that for collections to be commercially feasible, collectors need to be suspended on long-lines; this influences collector design.

In March 1998, we began trials aimed at developing a commercial collector appropriate for Tasmanian conditions. Bicheno, on the east coast, is one of three long-term sites for regular recruitment monitoring in Tasmania and was where catches from new collector designs could be compared with current and his

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torical catches of crevice collectors.

Our trials included nine individuals of three types of collectors suspended 2 - 4 m above moorings by trawl net floats: a crevice collector adapted for long-lines, a similar sized collector with carpet glued to the plywood surfaces, and a "TAFI" (Tasmanian Aquaculture and Fisheries Institute) collector consisting of knotted, light gauge, polyethylene 12 cm trawl mesh compacted within a 40 cm cube oyster mesh frame. Standard crevice collectors on the seafloor were the controls. The water was 10-15 m deep, all collectors had been conditioned for the same time (4 months), and all were cleared monthly on the same days.

Results from the first six month trial were conclusive (Fig.1). The collector with carpet frequently filled with sand and became too heavy to hold in the water column and was too difficult to handle. The suspended crevice collectors caught low numbers of pueruli, and were also difficult to handle. The TAFI collectors caught significantly more animals than the suspended crevice collectors, at times more than double the catch. TAFI collectors also caught more animals than the control collectors but the differences were not significant in all months.

Comparisons between catches of the TAFI and control collectors continued beyond this six month trial. Patterns remained similar, the TAFI collectors catching more animals than the control collectors. The TAFI collectors also proved more resilient to heavy swells, a regular feature of Bicheno and other Tasmanian shores. In the last two months of the trial, the control crevice collectors were destroyed by swell action, while there was no damage to the TAFI collectors. The TAFI collector was also the cheapest and easiest to build, the easiest to handle, and was well suited for use on long-lines. So, we are developing it further.

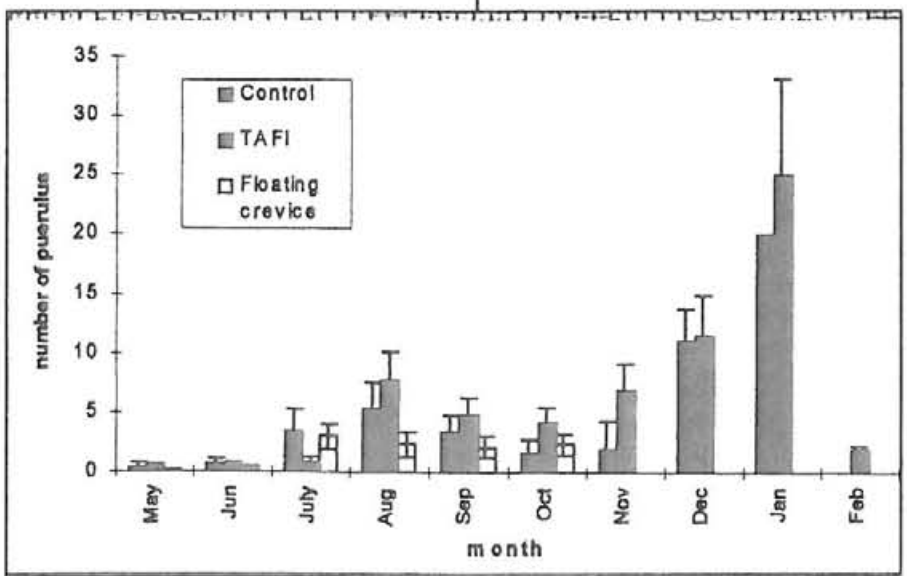

Figure 1: Number of pueruli caught (+ 1 SE) per collector on control and TAFI collectors over 10 mos and floating crevice collectors over 6 mos. Control collectors were progressively destroyed by wave action, with only a single collector remaining in Jan and Feb.

For commercial harvesting of pueruli it will be important to maximize all aspects of collection efficiency. While all stages of pueruli are found in collectors, the rate of emigration from collectors after settlement is unclear. If animals leave collectors soon after settling, the best yields will be obtained by servicing collectors frequently during peak recruitment periods. To resolve this issue, a group of 30 TAFI collectors were established at Bicheno in autumn 1999. Over the winter settlement peak, 10 collectors were serviced daily for 7 days, 10 every 7 days for 2 months, and 10 serviced every 14 days for 2 months. Settlement over the period of the usual winter peak was poor. As a result few animals were caught in daily collections making meaningful analysis of these data difficult. However results showed that collectors cleared every 7 days yielded significantly more animals than those serviced every 14 days.

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PERSPECTIVES

The French Overseas Territories: Tempting But Unregulated Areas for Spiny Lobster Exploitation

From: E. Riclet and E. Coutures

The economic importance of spiny lobsters is clear, especially for *Panulirus argus*, which is fished in most Caribbean countries from Brazil to Bermuda and represents 54 % of world catches of Palinuridae (39,700 tons in 1996). However, those valuable resources are still underestimated in France, the only country that has overseas departments or territories (DOM-TOM) in the inter-tropical portion of the three world oceans. Yet, no long-term studies have ever succeeded in any of these areas. Between 1995 and 1999, two doctoral dissertation projects have been completed in New Caledonia (south-west Pacific) and Martinique (French West Indies). After four years of scientific investment, the general report confirms the urgency of management measures and public education.

In the French West Indies, *P. argus* stocks are endangered by both overexploitation and degradation of the scarce settlement habitats (Riclet in press). Fishers are now more and more involved in the exploitation of pelagic fishes after the depletion of all major coastal populations. Imports actually provide live and frozen lobsters for all significant markets (Riclet 1998). The New Caledonian stocks of Palinuridae (mainly *Panulirus longipes femoristriga* and *P. penicillatus*) are only fully exploited in a few areas but deserve great attention. In fact, exploitable areas are very large (1,600 km of continuous barrier reef around the main island) and approximately half of it is accessible to lobster fishing. Lobster densities are low and local recruitment processes are still poorly understood (Munro, 1994). Moreover, the artisanal fishery is represented by a few professionals, and local markets are usually subject to a reduced supply of lobsters (17 tonnes in 1996).

Pragmatic management in the DOM-TOM is needed, but still remains unpopular. For example, private companies plan to collect spiny lobster postlarvae and culture juveniles. Even though the geographic isolation and cost of living negatively influences corporate activities in these islands, Caribbean and Pacific lagoons usually offer near-perfect conditions for grow-out projects. In addition, puerulus collections in these areas were deemed sufficiently successful for aquaculture and a new lobster food should be available within a few years. However, corporate interests will have to conceal their activities from the artisanal fishery if they are to succeed. In the absence of management of overexploited stocks in these regions, scientists will thus have the responsibility to support private projects and to avoid excessive collections of postlarvae.

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Nighttime Courting Behavior of *Panulirus argus* in south Florida

From: Rodney Bertelsen and Lance Horn

On the evening of March 11, 1999, we had the good fortune to observe the courting activities of "Eddie", a 100 mm carapace length (CL) male Caribbean spiny lobster (*Panulirus argus*), residing at 27 m depth along a low, narrow coral ridge south of the Dry Tortugas National Park, Florida (USA). Although large by Florida Keys fishery standards, Eddie's size is about average (mean CL = 101 mm) for the Dry Tortugas region, which includes a large (~150 km^2) no-take marine reserve and adjacent fished areas. We followed Eddie from 18:30 hrs until 21:30 hrs using a remotely-operated-vehicle (ROV) from the National Undersea Research Center (NURC, Wilmington, North Carolina, USA). We used a color video camera to record lobster movement and behavior until 18:51 hrs when twilight forced a switch to a sensitive black and white camera. Ten minutes later we switched on low intensity deep red lights to continue observations.

Over the course of three hours, Eddie courted six different females (sizes ranged from ~65-80 mm) and spent an average of 30 minutes courting; courting times ranged from 13 to 48 minutes. After finding a potential mate, Eddie faced the female and postured, by drawing the first two sets of legs off the substrate, arching them near his head. While posturing, he held his antennae at right angles parallel to the substrate. Then he would arch his tail and lean forward or lunge at the female, stroking her with his antennae and second walking legs, apparently to prod the female from her den. If the female moved, Eddie retreated, but generally maintained contact with her. Often the female turned away, but Eddie then rotated around her to maintain frontal contact. On those occasions when both moved across a flat surface, Eddie would maintain himself upcurrent of the female.

Interactions with males (3 or 4 in 3 hrs) were brief by comparison, typically lasting about 30 seconds. However, one encounter continued for five minutes but consisted mainly of Eddie and his rival standing motionless less than a meter apart. More typically, when one male charged the other retreated and left the area. During the chases, males twice used a "tail wag" - a rapid undulation of the tail - which might enhance their forward speed.

To better understand how Eddie budgeted his time, we categorized his behaviors into the following: (1) courting (e.g., posturing, touching, positioning), (2) rival defense (e.g., posturing, repelling) and (3) solitary actions (e.g., looking for a mate, foraging, and sheltering in a den). Eddie never foraged, nor did he take up residence in a den. Thus, 100% of his solitary time was spent looking for a mate. Actual courting consumed 83% of the time, rival defense took 4%, and searching for mates consumed 9% of the time. This does not add up to 100% because we occasionally lost sight of him or had to reposition the ROV in the current and on a few occasions we simply could not see what he was doing. During courting, roughly equal amounts of time were spent posturing, touching, and positioning. Eddie moved ~ 60 m during this period within a 15 m by 20 m rectangle. While a majority of his time was spent on the reef proper, he once followed a female 10 m off the reef to a small isolated sponge-coral comple where he found a second female and courted both for 20 min.

In the future, we hope to make additional observations to compare reproductive activity in a fished population (Florida Keys) with the Tortugas sanctuary population to help us better understand the potential effects of altered lobster size and density on reproductive behavior.

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ANNOUNCEMENTS

Sixth International Conference and Workshop On Lobster Biology and Management

Key West, Florida (USA)
September 10-15, 2000

The *Sixth International Conference and Workshop on Lobster Biology and Management* will be held at the Casa Marina Resort in Key West, Florida (USA) from September 10 - 15, 2000. Oral or poster presentations in English on any topic pertaining to lobsters (spiny, slipper, clawed, or scampi) that is of scientific or management interest will be considered. The Proceedings of the conference will be published as a single, regular issue of *Marine and Freshwater Research*. Along with the scientific sessions at the conference, there will also be ample opportunity for participants and accompanying persons to enjoy the many attractions available in Key West and Florida. For more information, visit our web site at: *www.odu.edu/~biology/lobsters* or contact:

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RECENT EVENTS

European Decapod Fisheries : Assessment and Management

Approximately 27 species of decapod crustacean are targeted or occur as by catch in the landings of Europe's fishing fleets. These species occur both inshore on the continental shelf and in deep offshore waters. They are becoming increasingly important in a number of regions due to declining finfish stocks and have high unit value. They are of particular socio-economic importance to Europe's artisanal fisheries which support many thousands of small vessels throughout the community.

The population assessment of decapods is problematic as suitable models have not been developed that adequately account for particular aspects of their life history and behavior. The age stucture is usually unknown, the population structure and connectedness between neighbouring sub-populations and sources and sinks for the pelagic larvae, the effects of non-randomly distributed fishing effort on spawning stocks and density dependent processes are fundamental issues that have not been addressed. The management intervention in these fisheries is currently at a low level. Technical conservation measures are the principle management tool used but even the biological information used to guide these regulations are often not available. Direct census or other indirect methods that give indices of abundance are valid for the sub-population but the effects of spatially heterogenous fishing effort on the subsequent

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population response (egg production, growth, habitat availability) is not usually accounted for.

Therefore, a concerted action project called European Decapod Fisheries : Assessment and Management (EDFAM) has been funded by the 5th Framework Program of the European Commission.

The EDFAM project has 2 principle objectives :

1. To review current sampling and assessment programs currently in place in Europe
2. To recommend new approaches in the sampling, assessment and management of these resources by taking into account world wide developments in decapod research .

The output from EDFAM which runs for 3 years (2000-2002) will be:

1. Research papers which present state of the art information on the life history of each species presented in the context of the issues that are important for management
2. Reports describing the current sampling and assessment protocols
3. Metadata databases which provide an inventory of research and monitoring activities in Europe
4. Published conference proceedings which presents an international view on recent developments on assessment and management of decapod species.

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From The Florida State Archives

The Lobster NEWSLETTER

The Lobster Newsletter is cosponsored by Fisheries & Oceans, Canada and The Florida Fish and Wildlife Conservation Commission - Florida Marine Reserch Institute, USA.
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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.

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The **Lobster** *NEWSLETTER*

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