

ANNOUNCEMENTS

Breaking News – Postponement of ICWL 2020

12th International Conference and Workshop on Lobster Biology and Management (ICWL) 18-23 October 2020 in Fremantle, Western Australia



The Organising Committee of the 12th ICWL workshop met on the 31 March 2020 and decided to postpone the workshop to next year due to the Covid-19 outbreak around the world. **Please check the website (**<u>https://icwl2020.com.au/</u>**) for updates as we determine the timing of the next conference.**

The World Fisheries Congress which was planned for 11-15 October 2020 in Adelaide, South Australia (wfc2020.com.au) has also been postponed to 2021.

The Department of Primary Industries and Regional Development (DPIRD) and the Western Rock Lobster (WRL) council were looking forward to hosting scientists, managers and industry participants in Western Australia in 2020. However we are committed to having the conference in September / October 2021. Don't hesitate to contact us or the conference organisers, Arinex, if you have any questions. Please stay safe and we look forward to seeing you in 2021.

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E. V. Radhakrishnan · Bruce F. Phillips Gopalakrishnan Achamveetil Editors

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Lobsters: Biology, Fisheries and Aquaculture

- Covers lobster breeding protocols, hatchery production techniques, environmental requirements, culture systems and technologies provided will be a hands-on guide to those who have commercial interest in farming lobsters
- Includes lobster fisheries in India, which covers lobster production by maritime states, fishing methods, geographical distribution of species around India and World
- Provides post-harvest handling techniques, especially the treatment and packing of live lobsters for export and various processes for value addition and preparation of various lobster products will help those engaged in export of this high value seafood

This book is an important addition to the knowledge of lobster research. The book complements other books published on lobster research and management as it focuses on Indian lobster fisheries and aquaculture developments where there have been nearly 350 research papers and reports and 19 PhD awards. The book has 15 chapters written by international experts covering many aspects of the biology of a number of spiny and slipper lobster species occurring in India and world oceans with maps illustrating global distribution of spiny lobster families, genera and species. An updated taxonomy and checklist of marine lobsters, the status and management of lobster fisheries in India and Indian Ocean Rim countries and a review of aquaculture research in India and other major countries have also been presented. The book is timely as the 2nd International Indian Ocean Expedition (IIOE) is currently underway (2015-2020), 50 years after the original IIOE (1959-1965), with some of the original lobster research on the biology and distribution of phyllosoma larvae being undertaken on the plankton samples collected during the first IIOE.

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The Natural History of the Crustacea 9: Fisheries and Aquaculture

Edited by Gustavo Lovrich and Martin Thiel

This is the ninth volume of the ten-volume series on The Natural History of the Crustacea published by Oxford University Press. The volume synthesizes our current knowledge of the diverse topics in fisheries and aquaculture. The chapters have been written by leading experts in their field, are richly illustrated and contain many synthesis tables providing essential data on these fascinating and valuable crustacean resources. The volume will be of great value to scientists, resource managers and also to practitioners from the commercial sector.

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How it all went cray cray for lobsters

From: Daryl Sykes New Zealand Rock Lobster Industry Council

Three C's recently and unexpectedly 'kneecapped' our lobster industry: China. coronavirus, and catching rights unused. Daryl Sykes picks up the pieces and tries to make sense of the most significant and disruptive event in the modern history of the New Zealand rock lobster industry, and explains...



In Ministers' offices and across dining room tables and smoko rooms; in the

newspapers and on television, there is a crisis in the 'crayfish industry'. I agree, at least about the crisis bit, but let's clarify something from the outset. New Zealand rock lobsters are in fact lobsters, not 'crayfish'. There are several species of rock lobsters in our oceans but the two most available are the red rock lobster *Jasus edwardsii* (Koura) and the Packhorse (Pawharu) lobster, *Sagmariasus verreauxi*. They are not crayfish.

Red dragon loses fire

China is our leading market for live rock lobsters, accounting for 99% of all exports. The Chinese Lunar New Year is a peak time for lobster fishermen and exporters, when catch rates are generally high and prices paid have traditionally soared. Rock lobsters are a main feature at New Year celebrations because of the visual association with the red dragon—a symbol of prosperity and good luck in China. Also because they are delicious—a beyond-premium coldwater lobster that can be cooked and served in many different ways.

In the lead up to Chinese New Year, live rock lobsters are stockpiled in holding facilities at sea and on land, ready to meet strong export demand, to await available air freight space, and to capitalise on the very best export prices.

The Lunar New Year holiday this year ran from 25 January to 8 February, which was disrupted by the coronavirus outbreak and massive efforts to contain it. The timing could not have been worse for the New Zealand rock lobster industry. Chinese authorities closed down public transport in many cities and either banned or strongly advised against gatherings or functions associated with the Lunar New Year period. Consequently, demand for all imported seafoods collapsed and buyers cancelled all New Zealand orders, and requested large discounts on the tonnes of product already in transit.

Homefront damage control

Having expressed genuine sympathy for the Chinese population caught up in the coronavirus epidemic, the NZ Rock Lobster Industry Council (NZ RLIC) and Licensed Fish Receivers (LFRs) and exporters, promptly advised commercial fishermen to stop landing rock lobsters until there was some certainty about the market situation. The 2019/20 commercial season is now effectively over, with no-one confident to predict when live exports can resume.

The NZ RLIC initiated urgent meetings with MPI and Fisheries New Zealand (FNZ) to discuss measures to mitigate the impacts of this crisis. These included the safe return of lobsters to sea from holding facilities, and the implementation of carry-forward provisions so that unused annual catch entitlements (ACE) can be used in the 2020/21 fishing year.

Progress was made on MPI-supervised release of lobsters from holding pots at sea and from land-based tanks owned by permit holders. But MPI baulked on the conditions for safe release from LFR holding tanks, and as time elapsed, lobsters in those export facilities were processed to low value product because of concerns that they were now too weak survive release.

Commercial catch balances to mid-March indicate just over 305 tonnes is uncaught across all nine rock lobster management areas, which, if landed and exported into a market where the prices have recovered, will be worth \$46 million in export receipts for New Zealand.

Personal cost potentially punishing

There are 253 commercial rock lobster vessels operating across the nine management areas – 90% having done little or no fishing since late January. Most have been relying on this Lunar New Year period of high volume demand and strong prices, which consolidates the success of the fishing year for the majority of fishermen. There are around 650 skippers and crew across the fleet, who currently have little or no cashflow to service debt or pay living costs. Rock lobster vessels, generally, are not diversified to other species or methods, but are set up specifically to catch and handle live product.

Even more dire are the circumstances created by fishermen's contractual arrangements to pay around \$50/kg plus for annual catch entitlements (ACE) that cannot now be used, or at best, only sold at a loss. The subsequent impacts could, however, be alleviated if the unused ACE can be carried forward for use in the 2020/21 fishing year. If not, that ACE will expire on 31 March and the investment made to obtain it will remain a contingent debt.

Hurry up and wait!

Industry representatives urgently sought a decision from Government, as market uncertainty, impending loss of unused ACE, and disrupted cash flows were already becoming very stressful for individuals and companies.



The best that the Government could manage was to announce in the second week of February that statutory consultation on a range of ACE carry forward options would conclude on 24 February. The short consultation period apparently their effort to reflect the urgency of the situation.

It is worth noting that in Victoria, Tasmania, and South Australia – State governments confirmed lobster industry support packages, including carry over of unused harvest rights, by the first week of February. Similar measures were promptly agreed for Western Australia, Queensland, and NSW. But not in New Zealand.

The level of uncertainty visited upon the local lobster industry by our protracted bureaucratic process and seeming Government indifference, was more than many operators could handle. Some moved immediately to try and cut their losses and secure some cash flow to carry them through the remainder of the fishing year. Fishing promptly resumed but lobsters were landed at discounted prices and at a loss.

Do the math... it ain't lobster science

Since late January, it is estimated that over 180 tonnes of lobsters have been landed to the domestic market or processed, predominantly into frozen tails with a green-weight beach price

equivalent of NZ\$33 to \$45/kg at best. The Lunar New Year beach price expectation was NZ\$85 to \$95/kg, dependent upon grade.

Beach price returns to fishermen since late January are less than they paid for their current ACE, which represents a substantial economic loss. If those operators borrowed to obtain ACE, it is a disaster. But, with no certainty about being able to carry forward unused ACE, some fishermen had no option but to go for cashflow in order to mitigate potential losses.

Extended export market disruption will lead to further massive reductions in revenue and substantial losses by lobster fishermen and companies, which will cause wider socio-economic impacts such as inability to service debt, reduced economic viability, and forced exit and bankruptcy.

Unemployment is already a factor, with those fishing businesses unable to continue having to stand down employees. Some LFRs are asking staff to take leave, and will soon have to stand them down, because their businesses are not set up to diversify into other seafood products.

Social media 'jerks' – off

The success of the lobster industry to maximise the value, to New Zealand, of a quota limited fisheries resource, sustainably harvested and shared with all extractive users, is something regularly applauded in international journals. But not by New Zealand social media commentators. The MPI announcement of the short period of consultation on carry forward options, quickly bought out the industry-bashers and armchair critics of the quota management system. Social media pages dripped with ill-informed and illogical venom. It is hard to know why the current plight of the lobster industry generates such a negative reaction. It was not like anyone in industry was asking for a hand-out.

ACE forward way forward

Based on the export market disruption being temporary and that business relationships can be restored by mid-2020, the lobster industry can manage its own way through the current downturn if the unused ACE can be carried forward into the new fishing year. It will have no adverse impact to lobster fisheries or to other extractive users — no more lobsters caught than would have already been landed if it were not for the coronavirus. And there is no cost to Government or to taxpayers. Why then, has the New Zealand Government shown no urgency in assisting the lobster industry through this most unusual and unexpected event that has caused such distress to the victims of the coronavirus in China and elsewhere?

In times like these it's nice to know who your friends really are.

Postscript: The NZ Government agreed a partial carry forward of 111.5 tonnes of unused ACE. More than 194 tonnes will be forfeit.

Western Rock Lobster recommendations in Western Australia in response to coronavirus impacts

From: Simon de Lestang Department of Primary Industries and Regional Development Western Australia

The impacts of the COVID-19 (coronavirus) epidemic have been significant on many fisheries world-wide. In Western Australia this has been most evident for the export-focussed West Coast Rock Lobster Managed Fishery. Traditionally 95% of its landings are shipped into China with about 30% of this being shipped around the Chinese New Year period, a period when both catch rates and market demand are at their highest.

With the outbreak of COVID-19, demand for lobster in China reduced precipitously, causing a price drop for Western Rock Lobster from between 55 - 80/kg (depending on size) to zero demand over the space of 24 hours. A subsequent freeze to landings ensued and, even though price have since risen to 30 - 40/kg, the fishery remains essentially closed, only landing small numbers to satisfy local demand (figure below shows daily catches since start of quota season on 15 January). Through to the end of January and most of February the fishery would have historically landed ~ 40 t day⁻¹, whereas this year it has been landing <1 t day⁻¹.

In some respects the Western Rock Lobster fishery is in a fairly good position, its quota season has just begun (started 15th January) and it has another 11 months to land this quota before the traditional end of season (14th January in following year). However with the potential for the reduced marked demand to continue well into the austral winter, the state government has been in negotiations with the fishing industry to develop a package aimed at reducing the impact of COVID-19.



Daily catches since the start of the fishing season. Seasons 2018 and 2019 have been averaged.

Currently the Minister for Fisheries, Western Australia, Mr Peter Tinley is considering a number of changes to the management arrangements. These include:

- 1. an increase in the current fishing season (15 January 2020 to 14 January 2021) by 5.5 months so that it will end on 30 June 2021;
- 2. an adjustment in the total allowable commercial catch (TACC) for the extended season from about 6500 to 9,000 tonnes, bringing forward a proportion of the quota from what would have been the normal future season;
- 3. expressly continuing existing temporary transfers of entitlement through to 30 June 2021;
- 4. normalisation of the season from 15 January 2022, including a truncated 6.5 month season from 1 July 2021 to 14 January 2022 with the TACC for that period to be determined in consultation with industry during the second half of 2020;
- 5. arrangements for access fees arising from the season extension to be recouped over the subsequent two fishing seasons;
- 6. back of boat sales of lobsters as per above with details to be finalised with industry;
- 7. promotion of arrangements for local businesses, including restaurants, to become registered receivers; and
- 8. measures to be finalised with industry to mitigate whale entanglements during the winter months including a revision of winter pot usage rates.

COVID-19 pandemic disrupts the North Atlantic lobster industry

Submitted by Cathy Billings Associate Director, Lobster Institute, University of Maine, Orono, Maine 04469 cbillings@maine.edu

As the COVID-19 pandemic continues its global surge, the human toll across the world is devastating, and the economic toll immense. Lobster (*Homarus americanus*) fishing communities throughout Atlantic Canada and the Northeast U.S. have not escaped its reach. In these communities, numbers of confirmed cases are relatively low, yet still growing at this writing.

Mandates to stay at home are in place in most areas across the U.S. and Canada to help ensure social-distancing to reduce the spread. Non-essential businesses are being required to shutter their doors and restaurants are prohibited from providing dine-in service. While food processors, and by extension seafood processors, are exempt from closure; markets for both live and processed lobsters (*Homarus americanus*) are drying up.

The market in the U.S. had already been reeling from the high tariffs on exports to China imposed as part of the U.S. - China trade wars. In February, there seemed to be a light at the end of the tunnel as extreme tariffs were being lifted. However, in March, the Coronavirus pandemic sent overseas trading into a tailspin in both the U.S. and Canada.

Canada had seen increased lobster exports to China during the time of elevated tariffs imposed on U.S. lobster. Now it is being hit especially hard with the closure of Asian borders resulting in a drop in overseas shipments. Canadian distributors shipped over 30 million pounds (13,607 MT) of lobster to China in the first six months of 2019, approximately 15 times what U.S. distributors shipped in the same time period. By early 2020 the picture had changed dramatically. Tangier Lobster Company in Nova Scotia reports shipments during and since the Chinese New Year had dwindled to a mere 5% of normal volumes.

Behind China, the second largest importer of North Atlantic lobsters overseas is Italy. With the entire country literally self-quarantined, exports of lobsters to Italy have fallen through the floor.

According to industry analyst John Sackton, publisher of SeafoodNews.com, as the export of lobsters overseas has come to a virtual halt in both Canada and the U.S., more lobster is available in domestic markets. Restaurant closures imposed by social-distancing mandates have compounded the drop in demand, and in turn, price.

Market research company Urner Barry reports this drop has lowered wholesale prices behind March 2019, and fully 33% behind March 2018. According to their statistics, as reported by Liz

Cuozzo, lobsters weighing 1.5 pounds (0.68 kg) are currently at USD 8.10; the lowest since 2016 and below the 10-year-average of USD 9.85.

Dire market conditions during the pandemic have caused government and industry leadership to consider extraordinary measures. Maine's Commissioner of the Department of Marine Resources Patrick Keliher took the unprecedented step on March 16, 2020 of asking lobstermen to voluntarily stop landing lobsters, and dealers to stop buying, if there is no market. Responding to public calls to mandate a halt to the fishery entirely, he indicated that it is not within his legal charge as commissioner to do so.

The Nova Scotia Seafood Alliance has urged fishers in LFAs 33 and 34, which produce the largest lobster landings in Canada, to temporarily shut down their fishery due to the market collapse. The suggestion has not been well-received by fishermen. Not all lobster dealers agree that shutting down the industry is the best solution either. Some are calling for the government to step in and subsidize some of the bigger processing plants to stay open to clean up stored inventory that has backed-up since the collapse of the Asian markets in order to make way for the fresh caught supply.

Maine's Governor Janet Mills called on U.S. President Donald Trump for help to support Maine's fishing industry; asking the administration to consider direct Federal financial assistance, subsidies, operating loans or loan deferment, or tweaking existing programs to make them more accessible to fishing and seafood businesses. In the long term, "it is clear that the collapse of the international and larger domestic markets will devastate Maine's commercial fisheries," wrote Mills in a letter to President Trump on March 21, 2020. "In the short-term, harvesters have only limited opportunities within their communities to sell small quantities of product in hopes to earn just enough money to buy weekly necessities."

The Massachusetts Lobstermen's Association (MLA) says it is working with federal and state officials to stabilize local markets and explore potential means of relief for the industry. "We've reached out to the staff of Senator (Edward) Markey, who sits on the small business subcommittee," said Beth Casoni, executive director of the MLA. "We're also talking with them about the possibility of including the industry and our members in any relief package." Casoni noted on the state level, the MLA is working with the Massachusetts Division of Marine Fisheries to increase availability and awareness of a state retail boat permit that would allow harvesters to sell their catch directly to the public off their boats.

On March 25, 2020 the U.S. Senate unanimously approved a bill providing a USD 2 trillion economic stimulus package. The bill passed in the U.S. House of Representatives on March 27, and the President Trump signed it into law that same evening. Included in the package is USD 300 million to the seafood industry. Funds will be available to tribal nations, fishermen, fishing communities, other fishery-related businesses and certain aquaculture businesses. As outlined in the bill, those entities can receive aid if their revenue losses due to COVID-19 cause "any

negative impacts" to fisheries or a loss greater than 35 percent of their prior five-year average revenue. The stimulus sunsets in September, 2021.

As U.S. states and Canadian provinces also scramble to make economic aid available to the lobster industry, the path forward remains uncertain. "There is no business as usual in these unusual times," says Richard Wahle, director of the University of Maine's Lobster Institute. "Situations change daily, and we must do what we can to stay safe and stay informed." The Lobster Institute has provided a resource menu on its website (lobsterinstitute.org) that those in the U.S. and Canadian can tap into to access the latest news, and links to government announcements and financial resources for those in the North Atlantic lobster industry.

March 27, 2020



RESEARCH NEWS

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Optimising larviculture of Norway lobster (*Nephrops norvegicus*)

From: Adam Powell, Daniel Cowing, Jacob Scolding, Tamsin Shepherd-Waring, Susanne Eriksson, Magnus Johnson, Ingrid Lupatsch, Robin Shields, Dennis Gowland.

Norway Lobsters ("Nephrops") are the most valuable decapod crustacean fishery in Europe, annually worth over €100 million. This has driven an historic research effort surrounding larval recruitment, and more recently the impact of ocean acidification, disease, pollution and fishing practices (Ungfors et al., 2013). Lobster management techniques (for related Homarus spp.) include stock enhancement to supplement natural populations. Hatcheries collect larvae from captive gravid female promoting broodstock, survival of vulnerable pelagic larvae ("Zoea") across

three stages, with onward release of benthic juveniles at sea (Nicosia and Lavalli, 1999). Up to 5,000 larvae, housed in circulating 90 litre vessels, typically achieve 25% survival to initial (stage 4) juveniles.

In 2010, an established Homarus gammarus hatchery expressed interest in diversifying its products and services. The NEPHROPS project, funded by EU Framework 7, arose as a collaboration between UK, Irish and Scandinavian universities and industry. A subsequent review of Nephrops larviculture summarized infrequent research over the preceding four decades (Powell and Eriksson, 2013): Larvae were generally reared individually in static vessels up to a few litres volume, using various feeds, with survival limited to 5% through larval stages. Other than identifying a thermal optimum (ca. 16°C), there was little consensus toward optimization, or comparable success to Homarus spp. hatcheries.

Using Homarus spp. hatchery technology as a platform (together with iterative research over 3 successive seasons) and following a 5year embargo since project conclusion, the results of a pilot scale Nephrops hatchery have been published (Powell et al., 2015). This details broodstock procurement and maintenance, management of larval release, design and operation of a rearing vessel during larval development, and maintenance recommendations on of mature larvae and juveniles.

To reduce physical stress, gravid female Norway lobsters were procured from a static gear (potted) fishery off south west Scotland, (March-May), and driven to a distant pilot hatchery (Swansea University, Wales). Batches of lobsters were transported for 9 hours by commercial haulier (immersed individually in a cellular "tube tray" matrix), then transported for an additional 2 hours in emersed but humid, dark conditions (*ca.* 8-10°C). Clearly, a local hatchery would be preferable, however high survival (over 90%) was achieved.



Figure 1. Gravid female *Nephrops norvegicus* showing a clutch of orange eggs, likely to hatch within days.

Adult lobsters were placed in RAS raceways, physically separated to avoid claw banding. Water input was 2 litres per minute, dissolved oxygen above 80%, with regular feeding and cleaning. To avoid egg loss, clutches were gently inspected weekly using a dental mirror, and embryo development graded according to egg colour to negate destructive egg sampling (dark green unripe; pink/orange imminent hatching, **Figure 1**). Adults were moved between raceways of different temperatures (11-16°C) to manage clutch development and promote steady larval supply throughout the season. Larvae were collected directly from raceways after dusk, using a large pipette to avoid snagging in net mesh, into 90 litre cylindro-conical vessels ("hoppers"), allowing first feeding immediately after hatching. A hopper was populated over no more than 4 successive days (up to 500 larvae per hopper), stocking density limited by the physically smaller species and number of eggs per clutch (compared to *Homarus* spp).

Hopper design broadly followed that of a conventional hatchery (e.g. Burton 2003; a banjo filter, significant aeration to circulate larvae, with water input from above). Since *Nephrops* larvae were more fragile, with longer spines, key changes to design and operation were required.

Firstly, water entered from the hopper base via a large baseplate with many 2 mm apertures spaced equally 1 cm apart, creating upwelling water jets that aided circulation (aeration damaged larvae). Water inflow was higher, *ca.* 4 litres per minute upon initial stocking, increasing to 10 litres per minute for semi-benthic Zoea 3 larvae. This caused feed to slowly accumulate against the outflow filter on the central standpipe, reducing availability of feed. This was avoided by creating a gentle air curtain of small bubbles (5-10 per second) against the sides of the filter face (**Figure 2**).

Offering a dry formulated or sterilised plankton feed (typically used in *Homarus* spp. hatcheries) resulted in poor feed circulation and fouling on larval spines, resulting in rapid mortality.



Figure 2. Circulating pelagic larvae collected into a 90 litre hopper, with perforated baseplate and bubble air curtain to clean central filter.

Live enriched Artemia salina was successfully fed (4 per ml). Previous day's feed was removed at the start of the day using a filter-syphon, i.e. a 2 cm width flexible tubing incorporating a terminal 1 mm mesh-covered funnel, which was placed into the hopper. The outflow filter, baseplate and scumline were cleaned daily using a pipette or paper towel, and every 6 days larvae were briefly removed into an aerated bucket to allow the hopper to be internally cleaned with an ethanol spray.

Following 18 days post-hatch, larvae had developed to Zoea 3, which were physically larger and showed two paddle shaped structures (a developing fantail) either side of the tail spines. At this stage larvae were routinely placed in Aquahive trays (Shellfish Hatchery Systems Ltd, Orkney, UK) floated in a hopper (Figure 3). This allowed daily inspection, reduced injury during metamorphosis, and improved stage IV recruitment. Using this method, communal rearing in upwelling hoppers permitted survival between 30-50%, with over 500 stage 4 Nephrops reared in the final season, across only 5 active hoppers.



Figure 3. Late Zoea 3 and young juveniles placed in an Aquahive plate.

Ongrowing juvenile stages has proved challenging, with high mortality occurring at subsequent moults (de Figueiredo, 1979; Powell and Eriksson, 2013). Efforts using a variety of rearing vessels (Aquahive; small cells; 5 litre containers), substrates (sand; mud; no substrate) and feeds (dry pellet with and without probiotics; Artemia salina; sterilized plankton) did not improve survival compared to earlier studies (de Figueiredo, 1979). For research purposes, juveniles appeared to be maintained best in groups of 4-6 individuals in 30 litre vessels filled with muddy sediment to enable preferably burrowing, sourced from Nephrops fishing grounds, and fed ad lib. with shrimp pieces, Pandalus borealis (Eriksson and Baden, 1997). For commercial restocking purposes, where sediment may be inconvenient to use, we advocate release into the wild within days (stage 4; Figure 4) or a further 2-3 weeks (stage 5).

VOLUME THIRTY THREE



Figure 4. Detail of stage 4 juvenile Nephrops norvegicus.

Although juvenile culture was somewhat disappointing, we have established a preceding step - to produce sufficient early stage *Nephrops* for onward research and commercial initiatives, and to develop transferable techniques for other crustacean species.

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Lots of phyllosomas, but where are the adult slipper lobsters?

From: Johan Groeneveld and Sohana Singh

Whereas adult lobsters are generally easy to find and catch, the same cannot be said of their drifting phyllosoma larvae, which disperse in ocean currents for extended periods before settling on the seafloor. Phyllosomas are nearly always scarce in zooplankton samples collected with standard plankton tow nets, because they occur in low densities over large areas, have high seasonality, and undertake diurnal vertical migrations. They appear to be more abundant in surface waters at night, during moon. Successful phyllosoma dark collections exist for only a few lobster species world-wide (Sekiguchi and Inoue 2010; Koslow et al. 2012; Canto-Garcia et al. 2016), with some recent studies suggesting the existence of pelagic larval nursery areas, or regions in the ocean where larvae spend much of their planktonic existence, before later settling into coastal benthic nurseries (Kough et al. 2013).

Two significant phyllosoma collections exist for eastern South Africa, from sampling undertaken nearly 50 years apart. Berry (1974) describes a survey using plankton tow nets in surface waters off Durban and Richards Bay (some 160 km north of Durban) between 1970 and 1973, to catch and identify phyllosomas. In all, some 368 horizontal tows of 20 minutes duration caught >2000 phyllosomas, of which 84% were scyllarids. Moreover, of the scyllarid phyllosomas, a single species (tentatively attributed to *Scyllarus rugosus*) made up 96% of the total numbers, and the next most abundant species (*Scyllarus martensii*) only 4%. Both species have since then been reclassified to different taxa by Holthuis (2002): *S. rugosus* to the genus *Petrarctus* and *S. martensii* to *Eduarctus*.

The second collection was made rather opportunistically, during a once-off survey of eastern South African shelf waters by the Norwegian research vessel (RV) Dr Fridtjof Nansen, early in 2018. Only 2 plankton tows of 5 minutes each in surface waters near Richards Bay (3 knots tow speed; 500 um mesh size) caught a total of 150 phyllosomas. Most of the phyllosomas appeared to be in a mid- to late developmental stage and looked to be of the same species. Total length (mm) measurements showed two clear cohorts, with peaks at 10 - 11 mm and again at 16 -18 mm TL, correlating with developmental Stage 6-7 and Stage 8-10, respectively (Berry 1974; Prasad et al. 1975). Few, or no phyllosomas were caught by plankton tows using the same nets at 35 other stations the during survey, suggesting that phyllosomas were concentrated in a relatively small area along the coast.



Figure 1. Late-stage phyllosoma s collected with a plankton tow net on the RV Dr Fridtjof Nansen, February 2018

We identified individual phyllosoma larvae and developmental stages microscopically, based on keys in Berry (1974) and Prasad et

al. (1975). Of the 150 specimens, 145 were scyllarids, of which 144 (>99%) appeared to be *Petrarctus rugosus* and one was *Eduarctus martensii*. Verification of the species identity using DNA barcoding was, however, complex. Neither the standard COI barcode region nor 16S rDNA sequences of samples matched the *P. rugosus* barcodes available on BOLD or GenBank. The sequences also failed to match any of the scyllarid lobster species known from South African or SW Indian Ocean waters - i.e., Scyllarides elisabethae (abundant, caught in commercial trawls and traps), Scyllarides squamosus, haanii, Ibacus novemdentatus Scyllarides (abundant, caught in trawls), Thenus orientalis or Scammarctus batei. А phylogenetic tree based on COI sequences of all scyllarids available from BOLD, GenBank and a database in Taiwan (pers. comm. TY Chan) placed our samples closest to Acanthurus posteli (formerly Scyllarus posteli) although it was only an 87% match - and hence not the same species. A. posteli is known from the East Central Atlantic and Mediterranean Sea only. Scyllarus arctus (also from the East Central Atlantic) and Scyllarus depressus (West Central Atlantic) also clustered close to our specimens on the Counter phylogenetic tree. to the expectation, our sequences suggested a closer relationship with scyllarid species occurring in the Atlantic, than those from the Indo West-Pacific region.

Instead of providing answers to the longstanding question of which species the bulk of phyllosomas caught over the shelf of eastern South Africa belongs to, preliminary analysis of the 2018 survey data raised only more questions. Key among these are where the adults are (local or upstream in the SW Indian Ocean), whether the phyllosomas

belong undescribed species to an (alternatively a known species without a DNA barcode), and whether eddies that form in the KwaZulu-Natal (KZN) Bight near Richards Bay retain or accumulate phyllosomas in a temporal 'pelagic larval nursery' area. Answers to these questions require expeditions to find adult slipper lobsters (taxonomy and DNA barcodes that match the phyllosomas) and regular sampling of the Richards Bay area, to investigate the hypothesis that it is a pelagic larval nursery for slipper lobsters.

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Sea Grant American Lobster Initiative Gets Underway

From: Beth Bisson

In September 2019, the National Sea Grant Program of the US National Oceanic and Atmospheric Administration (NOAA) announced new funding for research aimed at understanding physical and chemical

changes affecting American lobster (Homarus americanus) in the Gulf of Maine, Georges Bank, and the southern New England coast, as well as a regional lobster extension program. Collectively, the research projects and regional extension program comprise the Sea Grant American Lobster Initiative (ALI). The ALI is modeled after a Lobster Research Collaborative developed by the Maine Department of Marine Resources, and continues in collaboration with that ongoing effort.

The seven two-year research projects were selected through a competitive process that included review by subject matter experts. The research competition solicited proposals aimed at addressing one or more of the priorities: following 1) increased understanding of life history parameters, including but not limited to, migration, growth, and maturity; 2) larval studies and early biology; 3) spatial distribution; and 4) socio-economic lessons learned from southern New England's lobster fishery collapse as they pertain to the neighboring Georges Bank and Gulf of Maine stock areas.

The following projects received funding in 2019, and the work is underway in collaboration with co-PIs, partners, and advisors throughout the region.

- Projecting climate-related shifts in American lobster habitat and connectivity: integrated modeling to inform sustainable management Damian Brady (University of Maine)
- Fish less, earn more: assessing maximum economic yield effort levels in Gulf of Maine's lobster fishery, incorporating lessons learned from southern New

- *England, Canada and Australia* Kanae Tokunaga (Gulf of Maine Research Institute) and Alexa Dayton (University of Southern Maine)
- The potential influence of increased water temperatures in the Gulf of Maine on the distribution of female American lobsters and the impacts of these distribution shifts on larval recruitment Jason Goldstein (Wells National Estuarine Research Reserve)
- *Resilience, adaptation, and transformation in lobster fishing communities* Kathy Mills (Gulf of Maine Research Institute)
- Growth in large offshore lobsters: addressing a critical data gap in the US Lobster Stock Assessment Tracy Pugh (MA Division of Marine Fisheries)
- Reproduction in an era of rapid environmental change: the effect of multiple stressors on reproductive success, embryogenesis, and emerging larvae of the American lobster Emily Rivest (Virginia Institute of Marine Science)
- Bridging the 'Great Disconnect': linking the Gulf of Maine pelagic food web to lobster recruitment dynamics Richard Wahle (University of Maine)

The National Sea Grant Program released a second call for ALI research proposals in 2020, and this research competition is still underway.

In addition to new baseline research, Sea Grant launched a Northeast regional lobster extension program to complement and

enhance the ALI research program. The Maine Sea Grant Program based at the University of Maine will coordinate the effort in collaboration with the other state Sea Grant programs in New Hampshire, Massachusetts, Rhode Island, Connecticut, and New York to deliver locally relevant components that contribute to the overall program objectives. The extension program is designed to work with communities to link lobster research with the industry, resource managers, and other stakeholders across the region, who can both use the results and inform additional studies and decisions. The specific objectives of this part of the initiative are to:

- Increase understanding of biological, economic, and social impacts of ecosystem change in the Gulf of Maine and Georges Bank;
- Identify attributes of a resilient lobster industry;
- Identify research, technical assistance and outreach needs; and
- Increase opportunities for cross-sector collaboration.

While scientific expertise on American broadly lobster mav be distributed geographically, the stakeholders that can benefit from that research are concentrated in the Northeast region. The newly created regional lobster extension program will ensure that industry and management stakeholders across the northeast region benefit from the research conducted to support American lobster and its fishery. Additionally, the extension program informs research and management decisions by amplifying the voices of stakeholders and understanding needs, emerging trends, and other information gained only by living the life of the lobster industry. The extension MARCH 2020

program will collaborate with ALI research teams and other regional partners to co-host an annual American lobster summit, which will showcase new and ongoing lobster research and monitoring efforts and provide opportunities for engagement and discussion with lobster industry and resource managers.



The extension partners are assembling a regional steering committee for the effort, which will consist of fifteen representatives drawn from lobster resource management and industry sectors in Northeastern states. The steering committee will be key to the success of the program, providing input and for ALI-supported research guidance activities, as well as research priority-setting efforts, and other collaborative research, outreach, and science communication initiatives throughout the region.

In addition to their efforts to facilitate and enhance communication and collaboration among and between the funded ALI research teams industry and and management sectors, participating Sea Grant extension programs are collaborating to generate new educational resources, citizen science opportunities, and science communication materials related to

American lobster. These include: 1) a literature review of several decades of scientific articles, reports, oral histories, and interviews to consolidate the status of knowledge about American lobster into a database of information and resources that is publicly available; 2) a focus on new citizen science and other on-the-water programs to help engage lobstermen in collecting observations and information about ecosystem changes in the Gulf of Maine and related impacts on their practices and activities; and 3) a regionally-coordinated science communication effort to share results and outcomes of ALI-supported research, as well as news, updates and information about other lobster science, industry, and resource management activities with the lobster industry, the public, and other targeted audiences.

To that end, we encourage you to continue reading the next article for our first research update from Jason Goldstein. For more information on the Sea Grant American lobster initiative, as well as summaries for all of the currently-funded projects, please visit <u>our website</u>. If you would like to be added to our email list for project updates and news, please contact our Northeast Regional Lobster Extension Project Coordinator, Amalia Harrington:

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The potential influence of increased water temperatures in the Gulf of Maine on the distribution of female American lobsters and the impacts of these distribution shifts on larval recruitment

From: Jason Goldstein (Wells National Estuarine Research Reserve); Steve Jury (Saint Joseph's College of Maine); Win Watson & Tom Lippmann (University of New Hampshire); Josh Carloni (New Hampshire Fish & Game); Anita Kim (New England Aquarium); Ben Gutzler (Wells Nat'l Reserve); and Andrew Jeffs (University of Auckland).

Abundance estimates of American lobster (Homarus americanus) are currently at an alltime high in the Gulf of Maine, but all-time lows in southern New England. As southern New England water temperatures have warmed over the past 15 years, the trend has been for lobsters to move to deeper, cooler offshore waters, and this, along with associated problems, such as shell disease, is correlated with low levels of recruitment to inshore nursery grounds. This same trend now appears to be underway in the Gulf of Maine. This water mass is warming at an alarming rate and lobster recruitment to inshore nursery grounds has been below median levels throughout much of the Gulf since 2012. American lobster is the most valuable single-species fishery in the U.S. and persistent low levels of recruitment in the region have created concern over the future sustainability of this resource. The overall goal of this new research is to better understand the impacts of warming Gulf of Maine waters on the movements of sexually mature female lobsters, and the fate of their larvae that recruit into the fishery. This information will help predict the impacts of a changing climate on the future of this critically valuable marine resource.

This two year project aims to determine how warming coastal waters in the Gulf of Maine might impact lobster distribution, reproduction, and recruitment and we will work towards completing the following specific objectives:

<u>Objective 1:</u> Determine the thermal preferences of sexually mature lobsters, including ovigerous lobsters (Fig. 1) using both a thermal gradient tank (Fig. 2) and a temperature avoidance chamber.



Fig. 1. Testing the thermal preferences and avoidance temperatures of egg-bearing (ovigerous) lobsters, such as the one shown here, is a key component for this project.

<u>Objective 2:</u> We will use GPS-enabled satellite drifters, and computer modeling in tandem with physical oceanographic components applicable to the Gulf of Maine, to estimate the trajectories that would be experienced by larval lobsters that hatch at selected locations in the southern Gulf. <u>Objective 3</u>: We will test the swimming capabilities of postlarval (stage IV) lobsters to determine the extent to which they might adjust their ultimate recruitment location under varying temperatures and food availability regimes; these data will be linked to the models developed as part of Objective 2. The data from this objective will allow us, in part, to ascertain if postlarval transit to recruitment grounds is altered under changing environmental factors in the Gulf of Maine.



Fig. 2. Part of our approach is to evaluate small-scale changes in lobster thermal preference and avoidance and match these data with potential changes in movement patterns and larval dispersal through oceanographic modelling. A: Diagram of our thermal gradient test tank, showing temperature controlled water baths (dashed line) and test arenas within the baths (solid lines). B: Thermal camera image showing constructed thermal gradient tank. Temperatures show expected range of the gradient achieved.

We look forward to providing updates and preliminary data findings as these become available. This project is funded through an award from NOAA's National Sea Grant Program (award ID: NA19OAR4170397). For more information, please visit: <u>https://seagrant.noaa.gov/</u>.



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Contact Nick Caputi (southern hemisphere) or Rick Wahle (northern hemisphere) about article submissions and inquiries or corrections to the Lobster Newsletter mailing list.