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The Lobster NEWSLETTER

ANNOUNCEMENTS

Planning for ICWL in 2022

12th International Conference and Workshop on Lobster Biology and Management (ICWL) tentatively planned for 23-28 October 2022 in Fremantle, Western Australia

The Organising Committee of the 12th ICWL workshop will be **making a decision in early 2022** on whether the workshop occurs next year due to the Covid-19 outbreak around the world.

Please check the website (https://icwl2020.com.au/) for updates as we determine the likelihood of the next conference going ahead in October 2022 and its format. Many international conferences, including the World Fisheris Congress, are going ahead as virtual or hybrid conferences.

The Department of Primary Industries and Regional Development (DPIRD) and the Western Rock Lobster (WRL) council are hopeful of hosting scientists, managers and industry participants in Western Australia in 2022. Don't hesitate to contact us or the conference organisers, Arinex, if you have any questions. Please stay safe and hopefully we can catch up 2022.

Co-hosts of the workshop

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RESEARCH NEWS

Size matters: large spiny lobsters reduce the catchability of small conspecifics

From: Emma-Jade Tuffley, Simon de Lestang, Jason How, Tim Langlois.

Catch rates are often used in both ecology and fisheries science to derive indices of abundance and population demography. This relationship, however, is dependent on constant catchability; that is, how susceptible an animal is to being caught in a particular fishing gear.

There is evidence in many clawed lobster species, as well as some spiny lobsters, that catchability is affected by conspecifics present in pots and that these effects are usually size and sex specific.

The western rock lobster, *Panulirus cygnus*, which is endemic to Western Australia, is the basis of Australia's most valuable single species wild caught fishery. This fishery is governed by stock assessment models, which use, in addition to other data sources, catch rates from breeding stock surveys.

Over recent years, changes in management to this fishery have resulted in dramatic changes in the population demography, with likely more large animals now present. Because the effect of intraspecific interactions on the catchability of *P. cygnus* had not previously been investigated, it was unknown what effect the increased relative abundance of large animals would have on pot-based size and sex-structured catch rate data used in stock assessment modelling.

Through three studies; (1) aquaria trials, (2) pot seeding experiments, and (3) field surveys, we demonstrate that large *P. cygnus* reduce the catchability of small conspecifics; for large males by 26-33%, and for large females by 14-27%.

Conspecific related catchability should be a vital consideration when interpreting the results of pot-based surveys, especially if population demography changes, as it has in the West Coast Rock Lobster Managed Fishery.
Read the full article here:
https://www.int-res.com/articles/meps_oa/m666p099.pdf

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Female size at maturity research at the Maine Department of Marine Resources and the development of new image-based identification guides

From: Jesica Waller, Kathleen Reardon, Sarah Caron, Fraser Clark

Size at maturity datasets for female American lobsters (*Homarus americanus*) can be used by stock assessment scientists to describe the lifetime growth patterns and reproductive potential of the females in each lobster stock. The majority of US lobster landings come from the Gulf of Maine making it crucial to have updated and relevant growth and maturity data available to represent and study females from this region (ASMFC, 2020). To provide size at maturity datasets for females in coastal Gulf of Maine waters the Maine Department of Marine Resources (MEDMR) conducted size at maturity research from 2018 through 2020. By partnering with industry collaborators, MEDMR researchers collected over 1,200 females from across the Maine coast and determined their maturity status via ovarian staging and examination of the pleopods for molt and cement gland staging (Aiken and Waddy, 1982). We documented a latitudinal gradient in the size at maturity across the Maine coast and showed that the size at maturity had decreased over the last 25 years in each area sampled (Waller *et al.*, 2019; 2021). As a result of these efforts, MEDMR now has a repository of female lobster maturity datasets, microscope images, and hemolymph samples collected during the analysis of these females. With support from the 2020 Sea Grant American Lobster Initiative MEDMR is now collaborating with Dalhousie University to analyze the hemolymph samples collected from these females. This analysis is part of a larger MEDMR effort to test and evaluate non-lethal maturity determination methods and leverage this recent work to generate relevant instructional materials and image-based identification guides (full project description: https://seagrant.umaine.edu/extension/american-lobster-initiative/).

American lobster female maturity research conducted via ovarian staging involves making a series of measurements and observations to determine maturity status. It can be difficult to correctly categorize or document these observations without direct training from a researcher experienced in these types of investigations. There is also a lack of publicly accessible and high-quality images available to depict the pleopod stages used to assess the progression of molting (Aiken, 1973). To remedy this, our research team will generate publicly available identification guides and instructional materials that would allow any interested group to learn these techniques. MEDMR currently has over 2,000 high-resolution images of pleopods, whole ovaries, and individual oocytes from our recent female maturity investigations (Figure 1). We plan to review these and identify the images that most clearly represent each pleopod stage as well as metrics of reproductive development such as ovary stage and cement gland stage. We will pair these images with our recent notes on effective field collection and lab practices. Once we have assembled the full suite of images and recommended practices, we will share our image-based guides with experienced researchers and compile feedback from this group. By forming this advisory group to evaluate our materials we hope to ensure that all the images we select for this purpose are clear examples of the stage or point of development being described. All other descriptions and credits will be given to the publication and researchers that originated these methods. Once finalized, all image guides will be made available on the MEDMR lobster research page https://www.maine.gov/dmr/science-research/species/lobster/research/index.html. We recognize that our photographs and experiences will come from biological data collected only in the Gulf of Maine, but we will also strive to include considerations about sample collection, data interpretation, and analysis that could apply to all studies of this nature. It is our hope that leveraging the results of MEDMR's efforts in tandem with the expertise of researchers from across the American lobsters' range will yield instructional materials that make it easier for others to perform these works. If you are interested in collaborating with MEDMR in developing these protocols, image based guides, and instructional materials please contact MEDMR (jesica.d.waller@maine.gov) to learn more about this effort as it develops over the next year.

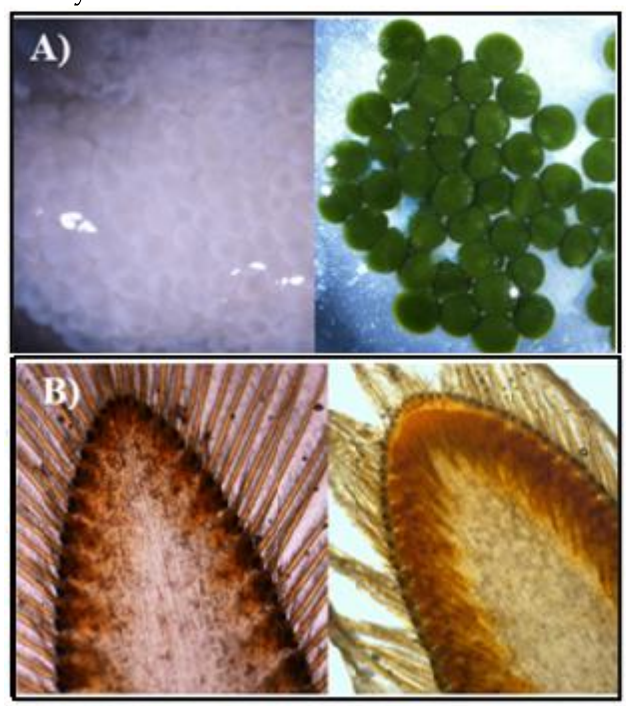

Figure 1. Example images of *Homarus americanus* (A) oocytes and (B) pleopods photographed during MEDMR's 2018-2020 maturity research. These images will be reviewed and used to generate pleopod, cement gland, and ovarian staging guides and recommended practices that will be made publicly available on the MEDMR website.

This project is funded through an award from NOAA's National Sea Grant Program, American Lobster Initiative. For more information, please

visit: *https://seagrant.umaine.edu/extension/american-lobster-initiative/*

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Stock assessment of the red spiny lobster (*Panulirus interruptus*) fishery for the 2019/20 fishing season in the west central region of the Baja California peninsula by means of a structured age model

From: Armando Vega Velázquez, Rafael Puga Millán, Romina Alzugaray Martínez, Armando Vega Bolaños and Gabriel A. Jiménez Llanos

Key words: Lobster, *Panulirus interruptus*, stock assessment, sustainable management

Introduction

The red spiny lobster (*P. interruptus*) holds a riparian, artisanal community fishery of high social and economic impact in the western coast of the Baja California Peninsula (BCP). Traditionally, fishing is carried out with traps and small crafts by fishermen organized in Cooperative Societies of Fishery Production (SCPP, acronym in Spanish), in which concessions are renewable every 20 years for exclusive fishing areas (Vega *et al*., 1996). In this study, we present the results of a quantitative assessment in the central Pacific region of the BCP, between Bahía Vizcaíno and Punta Abreojos, with the purpose of updating the reference points of the current status of this resource up to the 2019/20 fishing season. The central region contributes around 75% of the total red spiny lobster catch in the BCP, where a higher larval concentration of *P. interruptus* has been registered (Johnson 1960; Pringle, 1986; Vega, 2006).

The status of this resource is annually evaluated by means of the lobster investigation and survey program implemented by INAPESCA, in coordination with the central region SCPPs, where this fishery has been certified as sustainable since the year 2004, under the Marine Stewardship Council standards (MSC, 2004, 2011, 2016). This long-term program has supplied the scientific foundations of the regulatory improvement and sustainable management of the resource, as well as for MSC certifications (Vega, 2006; Vega et al., 2018).

Materials and Methods

An age-structured sequential population analysis (SPA) model was applied through the Adaptative Framework (ADAPT) developed by Gavaris (1988). This is one of the most used methods in fishery resource assessment, for instance, for the Caribbean spiny lobster *P. argus*, where the Lassen and Medley's (2000) procedure was followed by Puga *et al*. (2005) and Alzugaray and Puga (2012). The input biological information of this model is age-structured data of the catches in a 30-year series, as well as their life cycle parameters such as length-weight relationship, growth, reproduction, fertility, natural mortality (M) and index of abundance by ages. These indexes correspond to the annual CPUE series, which are calculated as the number of captured lobsters per trap during the fishery. Values are fitted by minimizing a target function, which is calculated using the residuals between abundance indexes and population size for ages estimated through the model. The information used here derives from biological fishing surveys carried throughout the years 1989/90 to 2019/20 by the lobster research program of CRIAP-La Paz, in coordination with eight SCPPs from the North Pacific zone (panel B, Fig. 1) of Baja California Sur (BCS), which allows an update on the database for catch, effort, reproduction and population structure information.

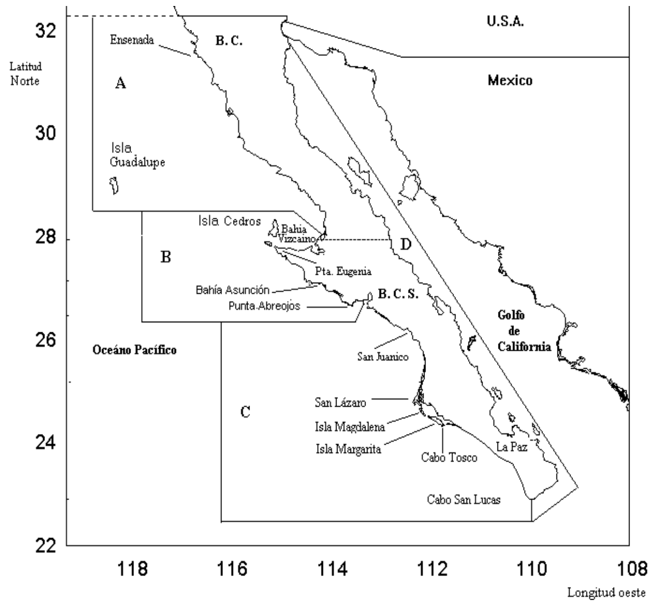

Figure 1. Main lobster fishing regions in the Baja California peninsula: north (panel A), central (panel B) and south (panel C).

From this model, estimates for fishing mortality (F), number of individuals (N) by age and years, biomass (B), spawning potential (number of eggs) and recruitment (R) in the smallest age group (6 years) were obtained for each fishing season. Using the results of recruitment and egg spawning of the population, a potential stock-recruitment relationship was analyzed through Ricker's model (1954).

Finally, equilibrium curves were developed as functions of F, and Reference Points (RP) for fishery management were calculated considering a constant recruitment and the presence of an evident stock-recruitment relationship (S-R). Equilibrium curves were determined through the combination of exploitation pattern, biological parameters of yield per recruit, reproductive potential per recruit and stock-recruitment relationship. The results obtained from the recent fishing seasons (average of 2015/2016 to 2019/2020) via this model were compared with the RP in order to diagnose the current status of this resource.

Results and discussion

Figure 2 shows the pattern of lobster catches in BCP regions for the 1985/86 to 2019/20 period. The central region determines the trend of the total catch of red spiny lobster in the BCP, and represents its stock, which is certified as sustainable under the MSC standards.

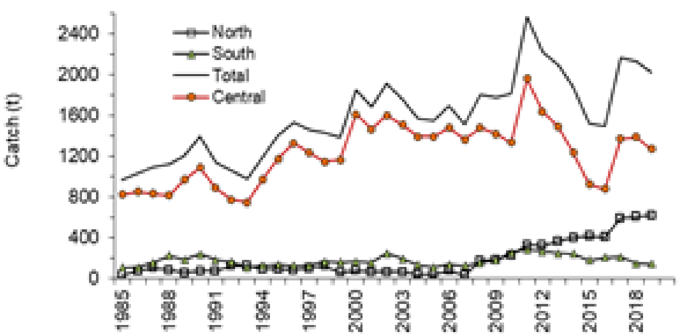

Figure 2. Total and regional (north, central, south) lobster catches in Baja California peninsula. The X axis indicates the first year of fishing season.

Throughout the period in which the MSC certification has been acquired, from 2004 until the present day, the average production was 1407 t, which is equivalent to 76.6% of the total production. In the 2000/01 to 2013/14 period, captures were more abundant, with a historical peak on 2011/12, followed by a sharp decline on the next 5 seasons, until 2015/16. At the present day, a recovery is shown during the last 4 fishing seasons.

In the 2018/19 season, a 1359 t production was obtained with an effort of 2.017 million traps and a 0.673 kg/trap CPUE. On the other hand, a 1250 t production with an effort of 2.023 million traps and 0.616 kg/trap CPUE was obtained in the 2019/20 season.

The size structure of the commercial catch indicates that this fishery is mainly supported by individuals that were recently recruited by the exploitable stock. Over the 2018/19 and 2019/20 seasons, 75% of catches occurred in the 82.5 to 85.4 mm carapace length (CL) interval. Indeed, the 82.5 to 91.4 mm CL interval, represented by ages between 6 and 8 years, concentrates 96% of the total production.

Results obtained from the SPA/ADAPT model are shown in Figures 3, 4, 5 and 6.

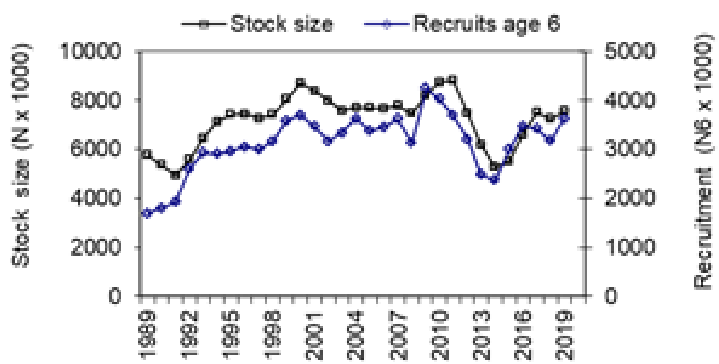

Figure 3. Population size and recruitment at age 6.

Figure 3 shows that population size and its interannual variations are determined by recruitment at an age of 6 years. Subsequently, a strong relationship (R^2 = 0.85) between recruits (age 6) and the catch after 2 years was found, which shows coherence given that the group of age 8 contributes to more than 50% of catch weight.

Nevertheless, a weak stock-recruitment relationship was observed (R^2 = 0.58), possibly due to the influence of the environmental variability in the California Current ecosystem over the life cycle biological processes and recruitment of *P. interruptus* (Vega, 2003).

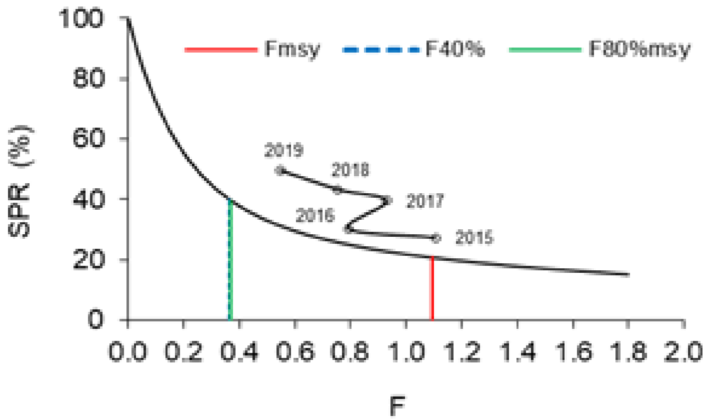

Figure 4. Spawning Potential Ratio (SPR%) equilibrium curve according to F from 2015/16 to 2019/20. Vertical lines indicate RP: F_{MSY} (red), $F_{40\%}$ (blue – partially obscured) and $F_{80\%MSY}$ (green).

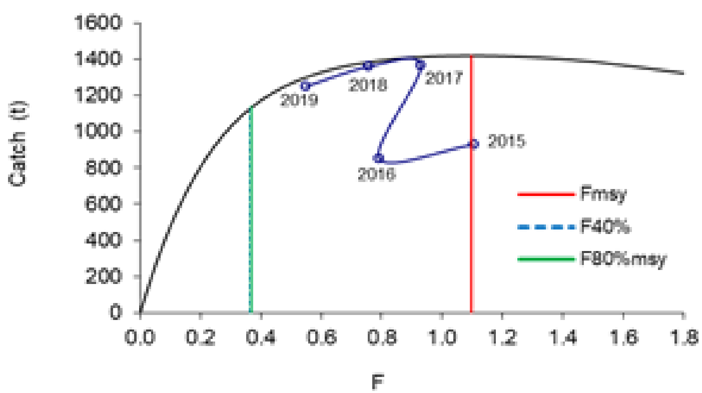

Figure 5. Catch equilibrium curve according to F with Ricker type stock-recruitment relationship, from 2015/16 to 2019/20. Vertical lines indicate RP: F_{MSY} (red), $F_{40\%}$ (blue – partially obscured) and $F_{80\%MSY}$ (green).

In this regard, throughout the last decade, several ocean-climate events have arised in the western coast of BCP such as "La Niña" in 2010-11 and 2016-17, "El Niño" in 2015-16, and an intense warming known as "the Blob" in 2013-2014 (Bond *et al.*, 2015; Hernández de la Torre *et al.*, 2018). The shift to warm stage has also been documented in PDO, which could be associated with the extreme warming event "the Blob", which by interacting with "El Niño" in 2015-16, produced severe impacts in the ecosystem (Bond et al. 2015; Hartmann 2015, Litzow *et al.*, 2020). These conditions affected key biological processes for recruitment of *P. interruptus*, such as the timing of spawning and puerulus settlement (Vega Bolaños *et al.*, 2019), as well as changes in the spatial-temporal availability of *P. interruptus* (Vega *et al.*, 2018).

Figure 4 shows the trend of the Spawning Potential Ratio (SPR%) in the last five fishing seasons. This ratio was 38% on average, with a minimum of 27% in 2015 and notable recoveries to 43% in 2018 and 50% in 2019. In general, SPR values were greater than 21% of F generated by MSY (F_{msy} = 1.096). Moreover, SPR values from 2017/18 to 2019/20 were above 40% of the theoretically pristine population level, considered as an appropriate RP to recover recruitment losses due to fishing, and thus, guaranteeing the sustainability of the exploited population (Goodyear, 1993).

Figure 5 shows the catch equilibrium curve determined by the F function in the 2015/16 to 2019/20 period, including the Ricker type stock-recruitment relationship. The catch trend and its relationship with F according to estimated RPs (F_{MSY}, $F_{80\%MSY}$ and $F_{40\%}$) is described. In this period, average catch was 1150 t, and mean F was calculated at 0.826, and generally, catches where obtained at lower F levels (F_{MSY} = 1.096), except for the 2015/16 season, when F = 1.105, almost the same as F_{MSY}. Subsequent seasons show a moderate F decline.

In Table 1 we present a summary of the RP results and a fishery status diagnosis based on its current status (seasons 2015/16 to

2019) according to RPs, which is graphically shown in the Kobe diagram (Figure 6).

The RPs recovered from the equilibrium curve with two recruitment variants indicate that the current production was proximate to the MSY level, between 80% and 87% of the MSY, and the current F proportion was found between 73% and 75% of the F_{msy}.

With regard to the 80% MSY value (rated as *Pretty good yield*, by Hillborn, 2010), it is worth mentioning that it is more precautionary than MSY, and has been recommended in some fisheries as a feasible fishing quota (Puga et al., 2018).

Table 1. Fishery status diagnosis determined by the current conditions (2015/16 to 2019/20) according to RP obtained from two recruitment (R) variants in the equilibrium curves from SPA-ADAPT model results.

	$B_{current}$ (t)	$F_{current}$	B_{MSY} (t)	MSY	F_{MSY}	80% MSY t)	$F_{80\% MSY\%}$	f_{MSY} ($x10^6$)	F/F_{MSY}	B/B_{MSY}
R constant	3,261	0.83	2,997	1,328	1.13	1,063	0.223	3.251	0.73	1.09
S-R Ricker	3,261	0.83	3,235	1,419	1.10	1,135	0.370	3.152	0.75	1.01

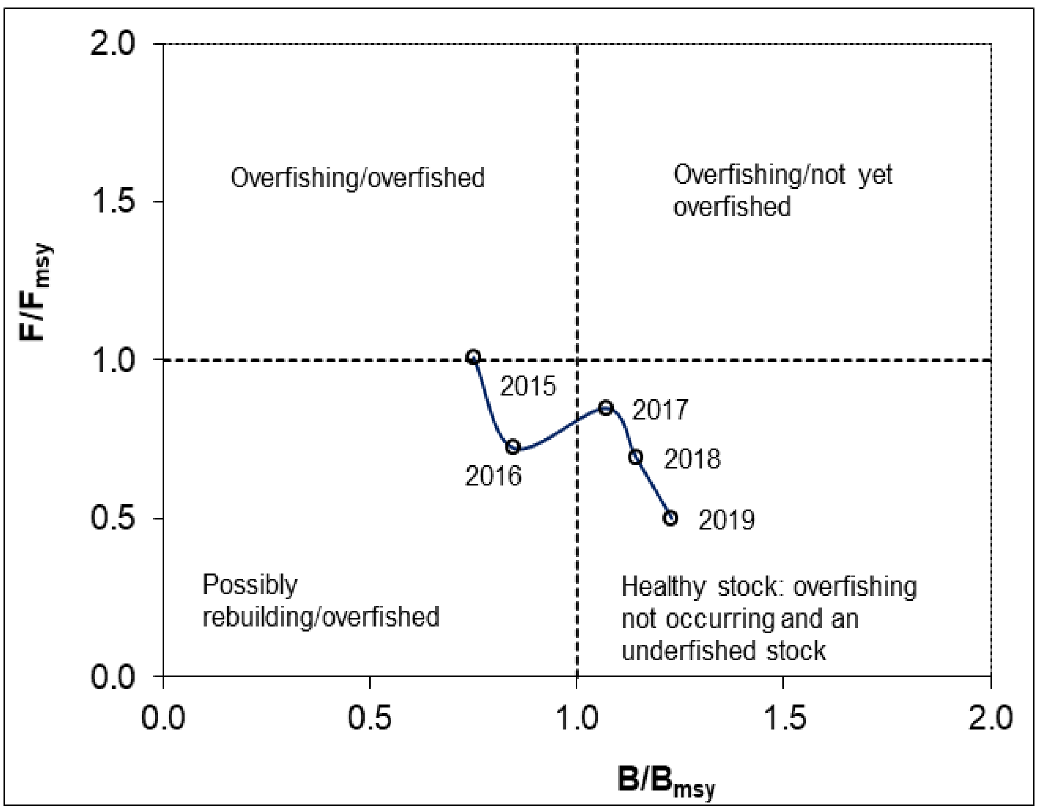

Figure 6. Kobe diagram. Fishery status determined by current conditions (2015/16 to 2019/20) according to RP.

Conclusions

The red spiny lobster fishery is mainly sustained by individuals that have been newly recruited into the exploitable stock. The 82.5 to 91.4 mm CL interval, which is represented by ages 6 to 8 years, comprised 96% of total production.

F and B results for the 2015-2019 period, in relation to the F_{MSY} and B_{MSY} reference points, show that this fishery is characterized by a sustainability status (Table 1, Fig. 5)

The MSY results with two recruitment variants in the equilibrium curves derived from the SPA-ADAPT model are reasonably consistent, with a 91 t difference between each other.

Both the equilibrium curves and the Kobe diagram indicate a tendency towards improvement of the resource's status for the last fishing seasons, and the results obtained allocate this fishery in the healthy and sustainable state quadrant.

The average Spawning Potential Ratio (SPR%) of the 2017/18-2019/20 period was 38%. In general, SPR values where higher than 21% of F generated by MSY (F_{msy} = 1.096). In particular, the 2017/18 to 2019/20 period showed values greater than 40%, which ensures an adequate larval spawning, allowing stable recruitment rates and guaranteeing the sustainability of the exploited stock.

The results of this assessment agree with previous evaluations, and uphold that the lobster fishery in the north Pacific region is sustainable and adequately managed (Vega, 2006; Vega *et al.*, 2018).

Recommendations

1. Regarding the resource status reference points for the assessment of the evaluated stock, we suggest the use of maximum sustainable yield (**MSY**) as a **limit reference point**, considering that these are levels that are not advisable to reach.

2. To consider the **80% MSY** value as **target reference point**, given that it is more precautionary and conservative.

3. In the case of approaching or reaching the RP limits, a recovery strategy is necessary, which could include actions such as reducing fishing effort and F, adjusting the legal size of capture and/or fishing season, capture quotes, fishing-prohibited areas, among others. In case of reaching target RP, a fishing regime strategy at an appropriate exploitation level must be established in order to optimize a sustainable use of this resource.

4. The limit and target RP that were described here are to be considered as preliminary, for at least one or two years from now. These will be updated and discussed with producers in a management workshop in order to reach agreements on the pertinent control strategies and rules.

Acknowledgments

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Orkney Shellfish Hatchery update

From: Nik Sachlikidis, Matthew Johnston, Callum Henagulph, Charlene Bergeron

Located on the remote island of Lamb Holm, Scotland, the Orkney Shellfish Hatchery (OSH) has been quietly making headway towards its goal of supporting the restoration of iconic UK fisheries and the coastal communities that support them. While the primary focus has been on the culture of disease-free European native oysters (*Ostrea edulis*), the Orkney team has also had recent success in producing European clawed lobster (*Homarus gammarus*).

The hatchery in Orkney has historically produced oysters and lobsters, but it was non-operational when it was acquired by the current owner, Cadman Capital Group, three years ago. The group did a major overhaul of the facility, renovating and fitting it with high-tech recirculating aquaculture systems (RAS) and other state-of-the-art aquaculture technology to enable strict biosecurity facilities and protocols. All native oyster broodstock undergo rigorous testing, including histological and the latest eDNA testing, for relevant oyster diseases to ensure spat quality and cleanliness. OSH currently produces European native oysters for the United Kingdom and European restoration market.

Recently, the hatchery has turned its focus towards clawed lobster restoration and hatchery technology improvement.

European clawed lobsters are an ecologically and economically important species throughout their range, however, due to overfishing, numbers have decreased dramatically in the past several decades. Efforts have been ongoing throughout Europe to restock areas that are suitable for lobster growth and success of cultured lobsters reaching adult size has been recorded in the UK and Norway (Ellis et al. 2014).

Whilst clawed lobster hatcheries have been technologically possible for many years, the problem with hatcheries, especially for lobsters, has always been variable larval survival and high production costs. Generally, traditional lobster hatcheries rely on flow-through or partial recirculating technology, which limits the ability to control the seawater quality and can negatively impact larval survivorship. American and European clawed lobster hatcheries have reported larval survival from hatch to stage IV as highly variable, ranging from 10 – 85%, and averaging between 15 - 30% (Beal and Chapman 2001). The OSH hatchery team has been working with its self-contained, mobile hatchery RAS, Hatchery-in-a-Box, to improve and stabilize larval survival through consistent water quality and feed supply.

Hatchery-in-a-Box (HIB), refined and built by OSH's sister company, Ocean on Land Technology (OOLT), is a clawed lobster hatchery solution contained within a re-purposed 20 (or 40) ft shipping container (Fig. 1), which is fitted-out internally to laboratory quality standards, and a complete clawed lobster hatchery system. The latest Hatchery-in-a-Box RAS and hatchery modifications are focused on improving larval survival.

OSH's experiments in hatching European clawed lobster began in September of 2020 and the first broods were successfully hatched in two trial batches in October and November 2020. The 2021 hatching season started in January from broodstock collected in late 2020, 3 months ahead of the first expected wild hatchings. This was made possible by manipulating the environmental conditions within the incorporated broodstock maturation system.

Figure 1. The Hatchery-In-a-Box containerised clawed lobster hatchery installed at the Orkney Shellfish Hatchery. The containers are re-purposed shipping containers (top) which are re-fitted to a laboratory standard and house a clawed lobster hatchery system (bottom) compete with broodstock maturation tanks. The units are fully transportable and are independent of the OSH main hatchery facilities.

Hatching larvae so early in the year and ahead of the wild hatching season, which runs locally from March to September, enables this small hatchery to produce far more lobsters throughout the season, by better utilization of tank facilities over a longer period of time. When combined with improved survival rates, the production over-head costs per juvenile lobster are substantially reduced.

Figure 2. *H. gammarus* berried females like this one are housed in the HIB system's broodstock manipulation tanks until larvae are released.

To supply larvae to the hatchery, broodstock (Fig. 2) were held in hatching tanks with manipulated environmental conditions until larval release and collection. Newly hatched larvae (stage I) were transferred to conical up-welling tanks on temperature-controlled RAS. Used seawater from the larval tanks is recycled through a series of treatments including mechanical and biological filtration, fractionation, and UV sterilization, and ozone before being returned to the culture tanks. The RAS itself exchanges less than 5% per day, which improves the biosecurity of the hatchery, reduces the need for incoming seawater filtration, and lowers heating costs while maintaining consistent temperature and water quality. Once the larvae metamorphosed to stage IV, they are transferred to Aquahive™ units, bee-hive-like containers designed for on-growing to Stage VI (Fig. 3).

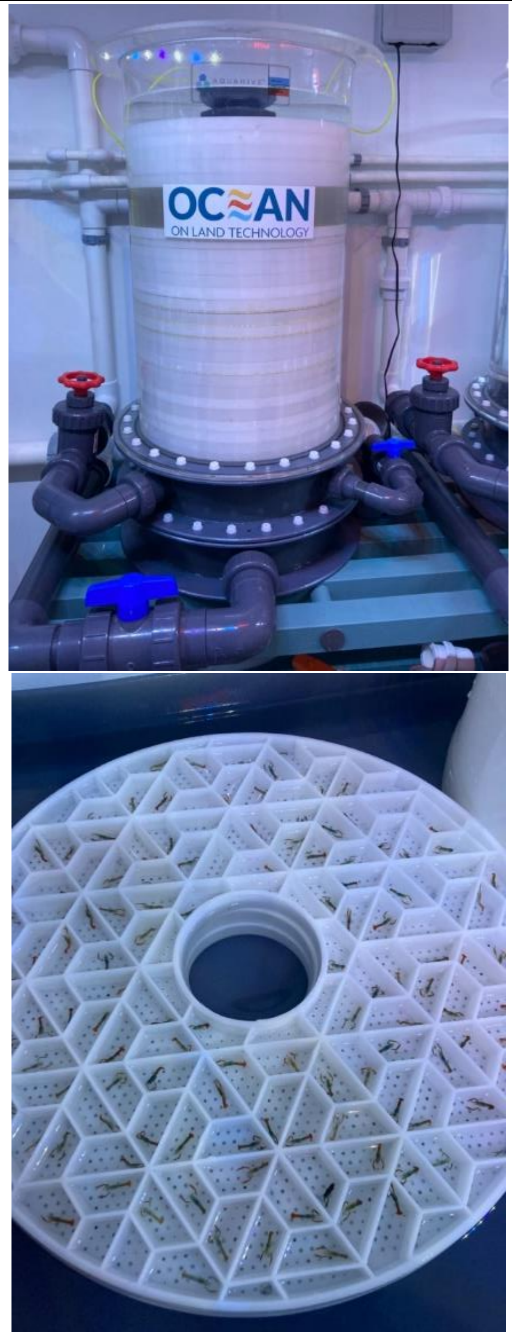

Figure 3. Operating Aquahive™ system developed by OOLT can hold 28 trays at a time and uses recirculating pump to automatically feed lobsters (top). One Aquahive™ tray fully stocked with 134 Stage IV lobsters (bottom).

Since the first hatching in October 2020, larval survival rates from hatch to stage IV continue to increase with survival in May of 51.4%, the highest recorded in this project to date (Fig. 5).

Figure 4. Juvenile *H. gammarus* in on-growing Aquahive™ cell.

Ongoing in 2021, The Orkney Shellfish Hatchery team continues to test improvements in technology to further increase survival from hatch to post-larvae using RAS, as well as testing new systems to further on-grow larval lobsters through to larger sizes beyond stage VI within the mobile hatchery's Aquahive™ units.

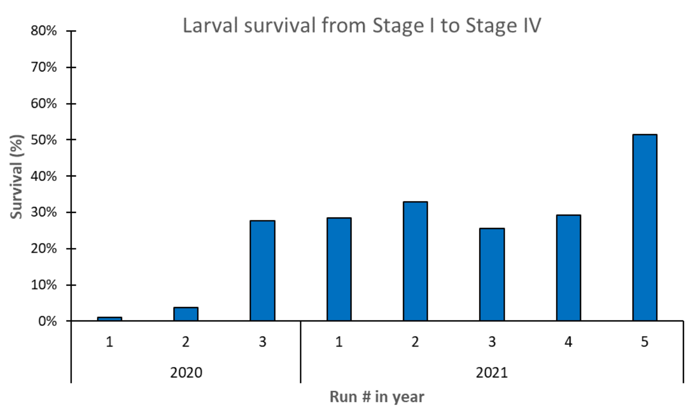

Figure 5. Larval survivals (Stages I-IV) from successive larval runs at the OSH hatchery. Larval runs 1 and 2 were used to adjust and adapt new systems, modification which have resulted in substantial increases in larval survival.

As for now, at OSH, we currently have a good supply of juvenile lobsters and are interested in hearing from any UK based researchers or fisheries enhancement groups who might be looking for a local supply, please do reach out to us at: info@orkneyshellfishhatchery.co.uk

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Effective gear modifications reduce whale entanglements in Western Australia

From: Jason How

Entanglements of large whales, particularly humpback whales, became a significant issue in the West Coast Rock Lobster Managed Fishery in Western Australia as it transitioned from an effort to quota managed fishery in 2010. The year-round fishing permitted through the shift to quota management significantly increased the value of the fishery, but also increased the temporal overlap of fishing and the humpback whale migration along the west Australian coast leading to increased entanglements. Reverting to the traditional closed season that would reduce overlap with whales was estimated to wipe ~AU$100 million off the value of the fishery, providing a significant incentive for fishers and regulators to maintain access to year-round fishing while reducing entanglements.


Figure 1. Entangled whale

Gear modifications that eliminated surface rope, shortened rope lengths, and reduced float numbers were implemented in June 2014 to reduce whale entanglements. To determine if these management arrangements were effective in reducing entanglements an assessment was required which accounted for changes in humpback whale population size (estimated to be increasing at ~10% per year), fishing effort, the inter-annual timing of whale migration and probability of entanglements being reported. The assessment indicated that gear modifications reduced entanglement in fishing gear from the rock lobster fishery by at least 25% (with 95% probability), with a median reduction of 64% [How et al. 2021; https://onlinelibrary.wiley.com/doi/abs/10.1111/mms.12774].

Despite the successful implementation of gear modifications, industry and the government management agency have convened a number of workshops to identify other possible management strategies to further reduce entanglements. With the continued predicted increase in the humpback whale population, additional measures are likely to be required to maintain access to year-round fishing and solidify industry's social license to access this public resource.

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The endangered North Atlantic right whale: many factors at play

From: Jack Merrill

The North Atlantic right whale has long been considered an endangered species and some environmental groups are riding its tail fins to gain support for themselves, at the same time endangering the highly respected, sustainable, and iconic Maine lobster fishery; striking at the soul of Maine culture.
The loss of right whales in the last four years is indeed tragic. It should be pointed out, however, that the right whale population has shown dramatic growth from the 1990s

up until the last few years, when birth rates leveled off. Without a doubt, 2017-2019 was a terrible time period for them, but, as pointed out by California marine scientist Erin Meyer-Gutbroad, this was largely due to entanglements occurring in Canada, caused by a snow crab fishery that had no whale friendly regulations (Fernandez 2018). No deaths can be, or ever have been, attributed to Maine lobster gear.

It is irresponsible for any scientist or oceanographer to take an extreme year (2017) and say that the population is headed to extinction. The bigger picture shows a much more hopeful story. After all, the population had grown from an estimated 264 to 481 in a remarkably short time. From 1990 to 2011, we saw the right whale population rebound and reproduce at a rate that was indicative of recovery. Their birth rates pointed to a long-term, sustainable existence.

In recent years right whales have changed their travel routes and primary habitats. Unfortunately, no one predicted the movement of the copepods that they depend on for their food source. This scarcity of food and the journey to find it undoubtedly caused excess stress, and contributed heavily to years of slow birth rates. Further adding to their stressors, the new food source they found was in the Gulf of St. Lawrence which had more shipping traffic and contained fishing gear that didn't come close to complying with the protective regulations that Maine lobstermen have adopted.

Everyone knows the results. The combination of ship strikes and snow crab gear entanglement was catastrophic, but had nothing to do with Maine lobster gear. The "guilt by association" assumption by environmental groups and NOAA/NMFS is unwarranted and unacceptable. All gear does not pose the same risk. Furthermore, the risk of entanglement in Maine lobster gear, almost negligible to begin with, has been greatly reduced by these changes in travel patterns taking them well outside almost all of Maine's lobster efforts.

Even with the recent devastating estimated decline in population, from 1980 to 2020 the population has increased 56% (from 162 to 366), while other marine animal species have decreased rapidly (a 71% decline in sharks and rays worldwide) (Einhorn 2021).

The fact is that in 2020 a very encouraging uptick in right whale births was observed with at least 14 newborns ultimately reported. Philip Hamilton, research scientist at the New England Aquarium said, "that's very positive news…that hasn't happened in years, likely because of the stress whales are experiencing finding enough food. The North Atlantic right whale population have recently moved into unfamiliar and more hazardous waters in search of a dwindling food supply (Fowler 2021)."

I've been fishing for 44 years off Mount Desert Rock, approaching 60,000 hours of sea time and have yet to see a right whale. No one cares more about Gulf of Maine and all its creatures than fishermen whose livelihoods depend on a thriving ocean. The lobster industry is not only an integral part of Maine's coastal culture, it supports tens of thousands of people, many hundreds of related businesses including tourism, with a conservative estimated contribution of at least $1.5 billion on the Maine economy counting only the value of lobster landings and the distribution chain (Donihue 2018).

It is frustrating that Maine lobstermen have no control over the environmental factors at work here. Equally frustrating, is that whales swim outside our territorial waters, so that no matter what we do, how much we try to protect the right whales, or how expensive it is, we can't guarantee their safety. Obviously, both the Canadian fisheries and shipping industries need to step up their efforts to protect them. Very recent changes in Canadian regulations are good indications that they are now showing equal concern about the right whales' future.

Despite the fact that no right whale death has ever been attributed to Maine lobstermen, they have already made numerous expensive and time-consuming changes to their gear to protect marine mammals. We've added weak links to buoy lines and all floating devices, made floating rope at the surface illegal, minimized knots, added multiple gear markers, eliminated 27,000 miles of floating rope between traps, and trawled up, removing 2,700 miles of vertical lines. There has only been one known entanglement in Maine waters in the past 20 years (2012). That whale was disentangled and set free.

Many changes made by the Maine lobster industry to date have been in an effort to reduce potential contact and scarring. That said, scarring rates have remained consistent, and interpreting their source is an inexact science. Very little recognition is given to scars caused by ship strikes, or natural scarring caused by attack from other marine animals. Also underappreciated is that right whales are known for deep dives, with clear evidence that they scrape along the sea floor, in an apparent attempt to rid themselves of ever-present orange sea lice.

The 60% vertical line reduction now proposed is supposed to be based on probability. How do Maine lobstermen reduce from the number of deaths and serious injuries to right whales when none are due to Maine gear? The proposed rule seems based on possibility, an imaginary world a long way from probability. Worse yet, proposed additional reductions over the next ten years would result in a 98% reduction in vertical lines. Say goodbye to the most successful, responsible, and sustainable fishery in the world.

As long as life has existed on the planet species have gone in and out of existence. Dinosaurs are the easiest example, and you can't blame humans for that one. Survival of the fittest was in play long before we stood up. What about the other endangered species, currently estimated to be over one million in number? It is safe to say there are endangered species in every major city in the United States and in the world. Yet we are not talking about radically altering or abandoning cities. What's motivating environmental groups that are terrifying fishermen with lawsuits? Why are they advocating for certain species while ignoring millions of others? Is it concern about the species or economic concerns?

If we were to adhere to the strict parameters of the Endangered Species Act, it would be next to impossible for us to inhabit the U. S. Aware of it or not, we are all interacting with endangered species, by replacing habitat, using chemicals/pesticides and plastics, and contributing greenhouses gases to the atmosphere affecting global warming.

Recently, an article by Bob Duchesne in the Bangor Daily News caught my attention, "Why have 2.9 billion birds disappeared?" Citing international scientists under the Cornell Lab of Ornithology, he states, "Over the past 50 years …One out of every 4 birds is gone." Why? While the answer is complicated, he identified population explosion (from 200 million to 329 million people), the resulting need for land for housing, food and energy production, wetland drainage, pesticide use, and climate change. Shorebird populations have shrunk by a third, and forest birds almost as much. *"What most scares the bejeebers out of ornithologists is the decline in common birds… We've worried about endangered species for so long, we failed to comprehend how un-endangered species were doing."*

The planet is rapidly evolving, with humans at the center of the change. A close look at the evidence shows that Maine lobster gear has not contributed to a decline in the right whale population. We've made many time-consuming and costly changes in our fishing practices to help maintain the population, and will continue to do so. It's become clear to me that the environmental groups that are pushing the lobster fishery to extinction are more interested in their own agenda than the truth. The money they spend on lawsuits could be better spent on research, whale surveillance by drones, and ways to prevent global pollution.

In addition to economic interests, whale scientists, environmental groups, whale watchers, and fisherman have at least two other things in common. We all love the natural world that we live and work in. We all want the right whale to continue its slow journey away from near extinction to a point of sustainability. We should strive to work together to achieve that goal instead of filing countless lawsuits against each other. Maine lobstermen will continue to work to help this magnificent mammal thrive in the future.

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Jack Merrill is a long-term director of the Maine Lobstermen's Association, has been an advisor to the Lobster Institute of the University of Maine since its inception, and has been a member and occasional officer in the Cranberry Isles Fishermen's CoOp for 40 years. His comments are independent of any organization.

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International working group promotes discourse on the global importance of crustacean fisheries

From: Bowen Chang, Robert Boenish, Yong Chen

Why should we consider crustacean fisheries as "global fisheries"? After all, neither the American lobster *(Homarus americanus)* nor the blue swimming crab *(Portunus armatus)* traverse the world's oceans, as do large tunas and sharks. The harvesting of crustaceans is localized. From an alternative perspective, however, we begin to see complex global connections and common practices in the ways different societies use, manage, and trade crustaceans. Moreover, as a recent paper (Boenish et al., *in press*) attests, crustacean fisheries are rising in their global importance in meeting the needs of global food and nutrition security and economic development in the era of climate change. So, in these senses of the words, they truly can be considered "global fisheries".

The rise of crustacean fisheries globally is a long-standing trend: crustacean fisheries represent the fastest-growing component of the world's fisheries, outpacing the growth of cephalopod fisheries and stand in stark contrast to the static or negative growth of most finfish fisheries (Figure 1A, Boenish et al., in press). Furthermore, they're even more economically significant than they are abundant: at present, crustaceans account for approximately 8% of global fishery landings, but a disproportionate 21% of economic value (Figure 1B, Boenish et al., in press).

This is the reason that the Lenfest Ocean Program, the University of Maine, and the Environmental Defense Fund (EDF) teamed up to form the Crustacean Task Force in March 2020. Together, they seek to answer the shared questions in crustacean fisheries management worldwide and propose globally relevant tools and solutions.

Fitting for its global scope of inquiry, the Crustacean Task Force brings together scientists and fishery managers from four of the biggest crustacean fishing nations – Indonesia, China, the Philippines, and the United States – as well as experts from the United Nation's Food and Agricultural Organization (FAO). This is an opportune time for international collaborations: many of these nations involved are driving profound transformations in their fisheries management frameworks.

The task force is further organized into five distinct workstreams, each carefully chosen to meet key scientific and management challenges in these countries. The first stream aims to improve our capacity to effectively evaluate the performance of crustacean fisheries using data-based indicators.

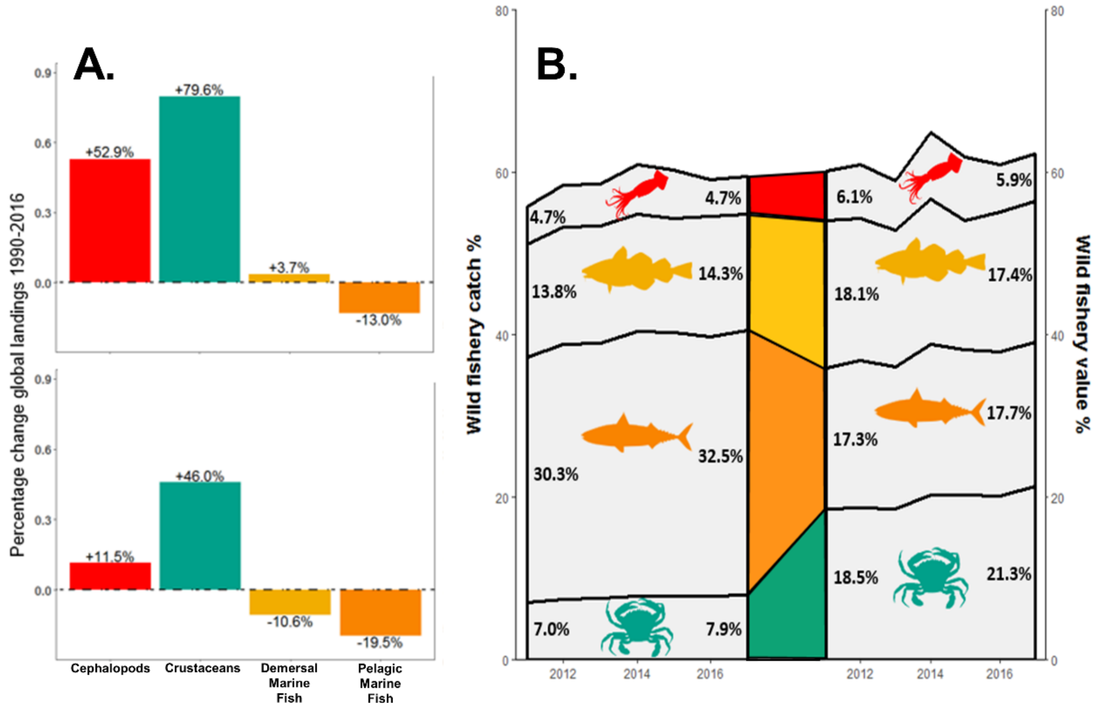

Figure 1. The growth and value of global crustacean fisheries. A) Changes in landings for major taxonomic groups with (top) and without (bottom) China. B) Comparative catch volume (left) and economic value (right) of major taxonomic groups. (Boenish et al. in press).

The second stream seeks to draw from the findings of the first workstream to adapt existing (finfish-based) fisheries management evaluation tools, such as FISHE and FishPath, to better meet the specific needs of crustacean fisheries management.

The third workstream focuses on identifying existing data gaps and exploring low-cost data collection solutions suitable for different crustacean-producing regions around the world. Data-gaps, and limited data-collection capacities are some of the biggest obstacles for effective management. Where data are available, the fourth workstream puts them to work by developing and employing a flexible crustacean-centered size-structured assessment model. The proof of concept will assess Bohai Sea mantis shrimp *(Oratosquilla oratoria)*, but will look to adapt to other crustacean fisheries soon after. Both workstreams will be significant steps in improving the stock assessment capacity for crustacean fisheries, hitherto underrepresented in fisheries monitoring programs worldwide.

A fifth and final workstream focuses on science communication. The task force is in the process of developing a webinar series to instigate a broad-based discourse of the global impacts of crustacean fisheries. The first few webinars will paint a big picture, answering the basic questions of "how many are there?", "how important are they?", and "how are they managed?". The webinar series will then narrow down in scope to address specific challenges pertaining to climate change, marine protected areas (MPAs), stock enhancements, and other important topics.

Through the many workstreams and (most directly) through the webinar series, the Crustacean Task Force hopes to reach out to inspire more young scientists, students, fisheries managers, and anyone interested to take part in the exploration of better scientific and management strategies for crustacean fisheries as "global fisheries". As these crustacean fisheries are bound to become more important to ocean sustainability in the era of climate change, there is a clear need for greater international collaborations to address the various environmental, economic, and local livelihood impacts of crustacean fishing. The Crustacean Task Force is eager to take bold steps in this direction.

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Plastics in the western rock lobster fishery

From: Katrina Bornt

The world's oceans have become vastly polluted with plastic debris over the last century. Contributions from fishing industries remain unknown at global and regional scales. This study is the first to document plastic fishing gear used and lost in a commercial fishery in Western Australia (WA). Here we focus on the highly profitable Western Rock Lobster (WRL; *Panulirus cygnus*) commercial fishing industry, WA's most valuable fishery and Australia's most valuable single species wild capture fishery. We will interview WRL commercial fishers to find the types and quantities of plastic fishing gear used and lost during their fishing operations. Plastic ropes, floats, bait baskets, pot necks are made from a variety of synthetic polymers such as high/low density Polyethylene, Polypropylene and Polystyrene. Millions of marine organisms die annually from being entangled in plastics or by ingesting them. Plastics may also leach harmful toxins into the environment, which can bioaccumulate in food webs. Data from interviews include quantitative (e.g. plastic product types, quantity, durability, gear loss estimates) and qualitative (e.g. gear type preferences, perspective). I will be estimating the plastics used and lost in a highly significant fishery. Ultimately, our results will produce important information for governments and industries to make evidence-based decisions on the issue of plastic pollution in the world's oceans. The information provided by this research could also be used in the development of industry solutions such as plastic-free technologies and gear loss mitigation strategies.

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Hindsights from a Retired Canadian Fishery Scientist

From: Robert Miller

Eleven fishery scientists employed by the Canada Department of Fisheries and Oceans (DFO) in Nova Scotia were interviewed about their role in providing fishery management advice. They represented 250 person-years during four decades in more than 20 finfish and shellfish fisheries.

The purpose of this note is to share hindsights with scientists and fishery managers in fishery regulatory agencies. Interviewees commented on the manuscript, but this version is colored by my successes and failures with fisheries for six shellfish species over my career.

Carrots and Sticks

DFO fishery scientists and their support staff spend more than one-half their time assessing the health of fish stocks and recommending acceptable levels of fish removal using either catch limits and/or restrictions on the type and amount of fishing effort. Learning established methods or developing new ones can be interesting work. However, once the methods are mastered and assessments repeated a few times they can evolve to drudgery. Even in repetition, considerable effort is required to collect, archive, analyze, and interpret data; then to present results in oral and written reports, undergo peer review, and revise the reports. However, if scientists' advice is used to improve the sustainability of fish stocks and the livelihood of fishers and their communities, then science staff are more likely to maintain their enthusiasm.

Managers may view publishing study results in science journals as entertainment for scientists and be reluctant to allocate time and resources. However, managers should not only allow publication, they should insist on it. Anonymous reviewers critique papers submitted for publication and will reject a paper if the author fails to demonstrate a knowledge of related research. Reading and absorbing volumes of scientific literature is hard work, very hard work. Yet, it is to the employer's advantage that their scientists know how problems in his/her field are resolved internationally. Managing a shrimp, crab or lobster fishery in Australia, Norway, and the U.S. has common problems. Exposing our work to a diverse audience can be a humbling reminder that we have lots to learn, including that we didn't even know what we didn't know. Whereas peer review is the stick, the carrots are the excitement of solving problems, adding to the knowledge in one's field, and gaining the respect of peers. Employing scientists with sound research skills also gives the employer in-house expertise which can, on short notice, be directed to unanticipated problems.

Sharing the Gospel

Scientists are motivated to share results of their work with fishers, fishery managers, colleagues, and the general public. Science is a competitive profession and most practitioners have healthy egos. We like to discuss our results publicly and dislike being censored. Sometimes science managers, fishery managers, or politicians misrepresent peer-reviewed science advice. Fishery scientists accept that other considerations can take precedent over science advice. However, in the interest of open government, and in giving the taxpayer what they pay for, we would like to see an honest presentation of the decision process.

Fishery managers deserve special attention. For lack of homework, many didn't understand science methodology, and were unaware of management options used elsewhere. Fishery scientists presented stock assessments to fishery management advisory committees, usually chaired by a fishery manager. The chair could allow verbal abuse of scientists and agree with committee members in opposing unpopular science advice. This could lead to watered down or rejected advice.

Dollars and Sense

Targeting funding closely to fish stock assessments is a counter-productive use of funds and fishery science staff. Testing the many assumptions in stock assessment models (e.g. age-specific rates of natural and fishing mortality, growth rates, rates of egg production, selectivity of sampling gear, frequency and location of sampling, accuracy of catch reporting) should be accommodated as they are important to the accuracy of model outcomes.

Generating frequent advice on catch quotas can be a consuming and mind-numbing chore. Where possible the author favors input regulations that adjust fishing effort only as required by new developments rather than catch quotas "because it is that time again". In Canada a major fishery for lobster has been managed by input regulations for 150 years.

More Science

A requirement for developing measurements of success for each new regulation would obligate stakeholders to clearly document and test for the intended outcomes of management decisions. These outcomes could be social (e.g. increased access for new license holders), economic (better seasonal match of supply to demand), scientific (e.g. double stock egg production), or administrative (e.g. lower cost of enforcement).

Science advice always includes elements of uncertainty and is often challenged. In response to these challenges the fishing industry and management agency could sign a contract to implement an alternative regulation for a fixed time. At the end of the contract period stakeholders would review the results and choose to revert to the original regulation, continue with the new, or develop a third option. Of course, the objective of the change needs to be clearly stated and the methods of measurement chosen.

Change over time is the usual method of measuring response to a different regulation; however, applying the new regime to a portion of the stock in one or more experimental management areas and comparing results to an unchanged regime would be difficult to sell to stakeholders, but a more rigorous test. Agriculture and forestry scientists insist on having experimental areas in the field.

Summary

Recommendations: the fate of science advice is transparent; publication in science journals is required; research peripheral to stock assessment is supported; objectives of each new management measure are stated and success measured; management options can be explored by experimentation; fishery managers adopt more rigorous standards of professionalism.

In DFO such large cultural changes may require re-building of the organization structure.

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The Lobster NEWSLETTER

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