Science Review Report – Workshop 1

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**Primary Industries and
Regional Development**

GOVERNMENT OF
WESTERN AUSTRALIA

Western
ROCK
LOBSTER
World leading sustainable fishery

Background

In early 2018 Western Rock Lobster (WRL) requested to work collaboratively with the Department of Primary Industries and Regional Development (DPIRD) to undertake a prudent independent peer review of the science and modelling associated with the West Coast Rock Lobster Managed Fishery. While the fishery has annual reviews of the stock assessment and associated annual indices as part of their Marine Stewardship Council (MSC) certification and harvest strategy, the last review of the stock assessment modelling was conducted in 2011 (de Lestang et al. 2012), just after the change in management from input to output controls. Since this time, the fishery has settled into its new quota management system and has seen an increase in the legal biomass of lobsters. This increase has resulted in pressure to raise the TACC. While the TACC setting is not a part of this independent peer review, the stock assessment modelling will eventually form the basis of these calculations and confidence in the science and modelling resulting from the peer review will assist in TACC decision making. Therefore, it is important to ensure that the modelling is accurate and that the quality of advice from the modelling is appropriate. This is particularly relevant given concern has been expressed by some commercial fishers that they are observing different catchability and lobster behaviour compared to their historical experiences. Their view is that the modelling may be optimistic and are concerned by the consequences of overestimating the legal biomass. In order to review the modelling of the western rock lobster resource, a two-phase process was adopted. The first was a science review that would collect observations and concerns of the fishers, which would then be followed by a review of the stock assessment modelling that could focus in on the fisher concerns.

This report summarises the proceedings and outcomes of the science review which culminated with the West Coast Rock Lobster Science Review Workshop 1, held on the 6th April 2018 at the Western Australian Fisheries and Marine Research Laboratories.

Science Review Process

The process for the science review was broken down into two main phases. A "coastal tour" of major ports within the fishery, conducted by Western Rock Lobster (WRL), to canvas industry's opinions regarding status of the fishery (see Appendix 1). This was augmented with a number of emails by fishers posing specific issues they wished to have clarified at the subsequent workshop. Phase two was a science review workshop held on 6th April 2018 at the DPIRD offices in Hillarys. The review was organised by DPIRD in collaboration with the WRL. The workshop consisted of presentations by Drs Simon de Lestang and Jason How from DPIRD and Dr Tim Langlois from UWA (see Appendix 2) and was attended by 33 participants (see Appendix 3). Questions were allowed throughout the presentations, with additional time provided in the afternoon of the meeting for concerns to be raised by participants. All of the questions, concerns and discussion has been included in this report. These discussions informed the drafting of the terms-of-reference for the modelling review (Workshop 2) to be held on 31 May and 1 June 2018.

Science Review Presentations

The science presentations outlined a number of key factors used in the stock assessment. These were:

- Data sources collected and used in the assessment of the fishery
- Atypical observations being reported by fishers
- Factors affecting data sources and causing biases in perception
- An assessment of catch rates throughout each main area of the fishery, focussing on the relationship between puerulus (post-larval) recruitment and subsequent undersize lobster abundance
- A review of the heat wave that impacted the coast in the summer of 2010/11 (and to a lesser extent in 2011/12 and 2012/13)
- A description of the integrated stock assessment from which the annual assessments are made (as well as a description of two draft models being developed to compare with the integrated model)
- The outcomes of the modelling focussing on where the stock is currently considered to be
- Associated current and future research projects

Questions raised during science presentations

A number of questions or discussion points were raised during the science presentation. These, and the associated responses were captured and are outlined below.

What is the relationship between lobster growth rate and temperature?

Density, temperature, sexual maturity and habitat have been shown to affect lobster growth rate. Generally however, juvenile growth rate will increase with temperature, though interplay between the aforementioned factors does make it a more complex issue. A paper on this has recently been accepted for publication (de Lestang 2018).

Could a lack of juveniles in an area affect the settlement of puerulus?

We are currently investigating potential cues for puerulus settlement. For example does noise associated with other lobsters trigger settlement? However, in aquaria puerulus are often ingested by larger lobsters. This cannibalistic behaviour would suggest that a lack of juvenile lobsters would not result in reduced settlement owing to reduced predation rates. Work overseas has indicated that settlement is triggered by water depth and certain types of algae. Additionally, studies have shown that puerulus and post puerulus lobsters are not gregarious for one to two years after settlement.

Since going to quota and opening the fishery to year round fishing, some fishermen are known to heavily target the IBSS locations right before DPIRD sample. This would not have happened in the past when the fishery was closed over the breeding season. This is likely to affect IBSS catch rates. How do you account for this in the model?

Tag returns show that some IBSS sites are heavily fished. However, these sites are representative of deeper water breeding grounds. There is no reason to assume these sites are being fished any more

intensively than the rest of the fishery. Catch rates from the IBSS therefore are representative of the entire fishery and a good proxy for abundance. However, should the fishing on the IBSS grounds be more intensive than other deep water breeding areas, then the index would be an underestimate of the broader breeding grounds. This could result in a more conservative management of the breeding stock.

Fishers are concerned about the fact that they can now keep setose. Will this have repercussions for the breeding stock?

This is one of the benefits of a quota system and of fishing at relatively low harvest levels. When management regulations result in large number of lobsters being left on the ground, fishers can take more of what's in their pots without risking the state of the breeding stock.

Discussion: The importance of commercial monitoring and the meshed pot program for the assessment of the stock was highlighted and it was noted that it requires considerable industry assistance. This elicited some discussion regarding why some commercial monitoring trips weren't undertaken on some fishers boats and why meshed pots aren't being recorded to the same level they were previously.

It was noted by a fisher that commercial monitoring staff don't want to go out in bad weather and that is why they are not getting on as many boats to monitor. The same fisher also said that they are now too busy to complete a meshed pot. This was rebuked by another fisher who stated that it doesn't take that much more time and fishers should take a more active role in collection of data for research. A different fisher mentioned that they go earlier on the days when monitoring staff are out so that they can record the undersize abundances from a greater number of pots than just the single meshed pot. The CEO of the WRLC said that they are committed to getting access to more research data from fishers and wanted to explore ways to attain this. A suggestion of extra quota was suggested but was dismissed as neither DPIRD nor WRLC had quota to give away in return for research participation.

Fishers in the Jurien Bay area have changed fishing behaviour in recent years, from concentrating on the shallow waters, to now focussing effort in the deep offshore waters and the whites. Could the changes in shallow and deep water total catch and catch rates in Jurien Bay, be reflecting a change in fishing effort location, rather than a change in biomass location, as suggested by the scientists?

This proposed change in fishing location effort will have impacted the total catch in deep and shallow water, and explains why the majority of total catch now comes from deep water. However, catch rates take into account the number of pots fishing in each location. Catch rates have increased across both deep and shallow water, but the increase has been far greater in the deep water. This suggests that biomass in deep water is at a historical high level and that while biomass in both shallow and deep water has increased, this increase has been greatest in deep water.

Discussion: Modelling showed that the Abrolhos Islands were not as impacted as other northern locations after the heat wave. It was suggested that this may be related to the relatively warmer waters of the islands, and that the ecosystem there may be more resilient to heatwaves as a result. However, it was mentioned that the islands have experienced a substantial change in floral habitat after the heatwave, from "cabbage weed" to what has colloquially been termed "scary weed", which is a green filamentous algae.

Could the fact that the model is not predicting the recent downturn catch rates in Kalbarri since the heatwave be a result of later than average winter storms delaying puerulus settlement in this area?

Late winter storms could explain this variation from the model. If this is the case, next year we should see a massive increase in undersize. However, the residual plot suggests the puerulus-undersize model has over estimated undersize catch rates each year since the heatwave, with the exception of one very low catch year.

Fishing efficiency has increased substantially since the fishery began, especially in the 90's when technological advancements meant technology such as GPS were readily available for use by fishers. Where the model has backdated estimates of catches, what fishing efficiency has been used?

There has historically been extensive amount of research on fishing efficiency with five papers having been published on this subject (see de Lestang et al., 2012 for a review on historical fishing efficiency). Fishing efficiency is estimated by the model and is year and area dependent. The main contrast used by the model to estimate fishing efficiency since the early 1990s is the difference between commercial catch rates and those from fishery independent surveys in similar areas. For the pre-1090s period the model uses the outcomes from previous analysis to inform fishing efficiency.

Could the poor relationship between puerulus settlement and recruitment of juveniles at the Abrolhos Islands be an indication of the carrying capacity of the species?

Yes, this suggests that carrying capacity impacts juvenile numbers more than levels of puerulus settlement we record.

Where is the significant growth in biomass from 2007 to 2010 coming from? We as fishers are not seeing this level of growth on the ground. We came off a low level of recruitment around this time, so the model is saying the existing biomass doubled in weight over this period. We don't believe this possible.

This growth is a result of a reduction in the number of animals being fished, leaving a larger biomass on the ground, and the growth of this biomass. Yes, catch rates have more than doubled and we are interpreting this as an increase in biomass which is supported by the fishery-independent surveys in deep water.

But the fishery's catch rate only doubled because the fleet halved. 20 years ago you were forced to fish right next to each other, now you rarely see another fisher. We are not seeing this 50% increase in biomass that the model describes.

Catch rates do not double purely as a result of the fleet halving. This would only happen if pots were fished right next to each other. The relationship between size of the fleet and catch rates is not linear. Catch rates increased because the fleet went from harvesting 70-80% to 30% of legal biomass, leaving behind an additional ~50% to grow and carry over biomass to the following year. Over the time period 2008 - 2013 (five seasons) the fishery caught ~ 14 000 t less lobsters than was predicted from the historic puerulus-catch relationship, this represents a marked increase in residual biomass.

Is weight gain dependent on size?

It is both size and sex dependent. Smaller animals moult more frequently and the weight gain is more dramatic relative to their original weight. Large females do not grow as fast as large males, which moult more regularly.

Where is the department getting information on undersize catch rates, because there is no longer anywhere to enter it on our catch return forms?

We get this information from meshed pot surveys and commercial catch monitoring. We would like to change reporting procedure so we can capture this information directly from fishers also.

Is high grading affecting growth rates?

The larger biomass could be stunting growth through competition for food, habitat etc. As high grading has become common we have tracked damaged animals in the IBSS. We haven't seen a marked increase in damage in lobsters captured in the IBSS since the transition to quota management.

Could fish damage be affecting growth rates? We see an increase in damage and moralities from fish in multi day pulls, which have become more popular since going to quota.

We need to look at the post release mortality of lobsters, especially if there is fish damage, and the effect of multi-day pulls on mortality rates.

Is high grading accounted for in the model?

We do not adjust for size specific high grading in the model, rather we apply a uniform high grading percentage for the month which is estimated from commercial monitoring data and CDRs. However, the length frequencies from the model and the IBSS match, so we appear to be removing the right proportions of different grades.

A 5 year old animal can be 80 mm in Fremantle, but only 75 mm in the islands, is this due to greater nutrient levels in the cold water?

It's not due to nutrients; it is mainly a result of the effect of temperature on metabolic rate. Lobsters are poikilothermic, i.e. having a body temperature that varies according to the surrounding temperature, therefore their metabolic rate is dependent on the temperature of the water around them. Lobsters in the warmer waters, e.g. the Islands, reach sexual maturity faster, and at a smaller size, due to their increased metabolic rate. Once lobsters reach sexual maturity their growth rate slows. Animals in the colder waters in the south take longer to reach sexual maturity, and therefore have a higher growth rate for longer, resulting in them being larger.

Suggestion from fisher: Instead of using the purpose built casitas to capture juveniles, you could just use a modified pot and pull at night. A pot with meshed up ends, but open side to allow them to enter, produces large catches of undersized lobsters, especially if pulled at night time.

Industry Forum

Rapid Biomass Increase

During the industry forum concerns were again raised regarding the significant increase in biomass in the model from 2007 to 2010. Fishers felt that this increase was exaggerated and not what they were witnessing on the ground. They believed the model was interpreting their increase in catch rate as an increase in biomass, when in reality their catch rates had only increased due to a reduction in the fleet and increased efficiency. This created a lack of confidence in the models from fishers. DPIRD agreed that the relativity of commercial catch rates has changed over time, due to a range of

factors that have either increased (e.g. pot size, less pot competition etc.) or decreased (bait usage, targeting specific grades) catch rates (other than simply biomass). It is important therefore to recognise that the modelling uses information from a range of studies on fishing efficiency as well as the contrast in catch rates from commercial fishing to those from the IBSS. DPIRD further explained that confidence in modelling should also come from the fact that three models, all using different sources of data, were showing the same level of exploitation. Using various models, operating under different assumptions and using different inputs, is a rigorous way to test model outputs. The fact that all three models are telling the same story provides confidence in the results. Industry was not completely convinced by these arguments, and this concern has been expressed in the fourth term of reference (see Terms of Reference).

Low Catch Rate Zone

Industry were especially concerned about biomass in an area of perceived low catch rates, in a shallow water area south of Dongara. This area was considered very good ground for many years, and supported a fleet of approximately 50 boats. However, industry now claims that the area has such low catches no more than one boat ever fishers here, and despite this reduction in pressure the stock has never come back. Fishers believe that this 'dead zone' is not associated with the 2011 heat wave, as catches have been very low in this area for around 25 years. There was some conjecture among fishers regarding the extent of this 'dead zone', but generally it was thought that inshores catches are extremely low from Green Head to Dongara and below average from Wedge Island to Jurien Bay. The majority of fishers agreed that Lancelin south has a very strong inshore fishery. A second area of low catch rates, in Kalbarri, was also discussed. Industry believes catches in this area decreased dramatically after the 2011 heatwave and is yet to recover. This situation in Kalbarri was supported by data shown by DPIRD. However, concern was expressed that even the areas near the mouth of the Irwin river, an area of presumed historically high puerulus settlement and juvenile recruitment, had not recovered. Industry was concerned that the model can't explain these trends, and it was felt that until this is better understood, the TACC should not be increased. The department assured industry that their concerns about these low catch zones are being investigated. These areas are the focus of an FRDC funded collaborative project, run by DPIRD and The University of Western Australia. The aims, outcomes, and some preliminary results of this project were presented by Dr Tim Langlois (UWA) during the workshop. The department was confident that this project will identify the processes underpinning these patterns in catch rates and fishers were generally satisfied with this research.

Industry's lack of confidence in the model outputs led them to question the quality of the input data. Some fishers were concerned that catch data is no longer representative of biomass, as under a quota system fishers are now able to modify their behaviour in response to low catch rates. It was acknowledged by many from industry that catch rates can vary significantly between years and locations. In years and areas of low catches fishers will modify their behaviour and effort to maximise their catch, often by moving to more productive areas. For example Kalbarri fishers are known to fish Dongara when Kalbarri catch rates are low. The model, therefore, rarely receives data on low catches rates. Industry believes this may result in the model receiving positively biased data. DPIRD responded that this is accounted for in the model as it has a high spatial and temporal complexity (11 areas and 11 time-steps each year). The movement of effort from one area to the next is accounted for and low catch rate areas are taken into account. Furthermore the model contains information from independent surveys (IBSS), which is standardised for efficiency and occurs whether catch rates are good or not. However, some industry members were unconvinced, and this concern is captured in the sixth term of reference (see Terms of Reference).

Increased Whites Migration Exploitation

In addition to moving longitudinally along the coast in response to low catch rates, fishers are also known to change their effort between targeting deep water whites and shallow water reds. It was highlighted that in recent years the deep water whites have been particularly targeted. Industry expressed concerns that these kinds of changes in fishing behaviour may not be adequately captured by the model, and questioned what effect concentrating effort on the deep water whites may have for the fishery as a whole. DPIRD explained that variation in fishing effort and location is captured within the model. The model is constructed with two depth zones across its 11 'areas' and effort is apportioned to each of these according to the statutory catch and effort returns (currently catch disposal records; CDRs) received from industry. If the current trend of the industry is greater effort focused on the whites, DPIRD proposed that this could only be positive for overall biomass. The whites migration is very likely the height of a lobster's juvenile mortality as they march long distances across open sand with little protection from predators. Therefore, taking extra lobsters during this period is likely to have less of an impact on overall biomass than taking resident reds. It was acknowledged that this migration is an important stage in the life cycle of a lobster, and so enough biomass must make it through this migration to ensure the longevity of the stock. However, current migration data indicates that this is not a problem as there is still a large number of lobsters migrating, including undersize lobsters, and these are spreading across the fishery. This is reflected in increased abundance in the fishery-independent survey in deep water.

Modeling of Migration

How the model incorporates migration rate and direction was also questioned by industry. DPIRD explained that the model uses tag data to account of migration. The model tracks the movement patterns of tagged lobsters and uses this to allocate a proportion of migrating animals to each of the 11 model areas. These proportions are updated as additional data becomes available from tag returns. By incorporating fishing effort with recruitment and migration rate from tag returns, the model is able to calculate the net flow of animals, and therefore biomass, in each area. However, industry raised concerns about a possible disconnect between settlement and recruitment into the fishery, and how this would impact the models estimate of migration. Fishers are concerned that there are certain areas within the fishery, for example the 'dead zone', where puerulus is high but catch rates are still low. In these areas fishers believe puerulus settlement is not indicative of recruitment into the fishery three to four years later, as the model assumes, due to unknown processes that are not accounted for within the model. As a result the model would be overestimating migration into the deep water in these areas. DPIRD clarified that if unknown processes are impeding recruitment into the fishery, the model would use these data to derive the "puerulus to recruit" relationship used in the model. Therefore this pattern would be replicated within the model.

Pot Size Changes

The issues associated with multiple day pulls of mesh pots were mentioned. Industry conceded that may fishers leave their meshed pots for up to a week, and that this probably creates biases within the data obtained. The Department noted that two day pulls did not appear to be a problem, but beyond this it was very likely that the quality of the data would be compromised from animals exiting pots. With more meshed pot data the Department would be able to better measure this reduction in catch rate, however the current low level of participation makes this calculation difficult. Several other issues regarding catch standardisation were also discussed. Industry questioned how the Department was going to control for different pot sizes when interpreting catch rate data, especially in light of the recent changes to pot dimension regulations. The Department agreed that having multiple pot sizes in

operation within the fishery does make the interpretation of catch rate data more problematic. The new large 1 m by 1 m pots are likely to have a notable effect on catch rates, and ideally the Department would like to calculate a correction factor for these pots compared with the traditional pots. Fishers stressed that in addition to new pots being larger, there are many variations in pot construction that could be impacting the comparability of catch rate data, such as straight sides compared to the traditional sloped sides. However, the Department insisted that calculating any more than one correction factor would be too finer scale, and a lack of replication would diminish confidence in the calculation. One correction factor to adjust catches from large pots would capture an average of the various configurations of these pots, and would ensure the comparability of catches from these pots and traditional sized pots.

Provision of Research Data

Industry asked the Department whether they were comfortable with the amount of tagging data driving the migration model. Based on both the model outputs and sheer numbers of tags released (approximately 60,000 over the last three years), the department was happy with amount of tagging data used in the model. However, the department did mention that more monitoring data would be beneficial. This type of data is very valuable, as it allows them to see exactly what's coming up in a pot, providing extra detail on lobster sizes, condition, and reproductive state. The importance of the data collected during the IBSS was stressed, as these surveys remove biases associated with commercial catch such as escape gaps and fishing efficiency. The department would like to see more independent surveys, and even suggested that they could be run by industry, similar to the meshed pot program. However, a lack of industry participation was highlighted. In a recent pot salting trial run by the department, where commercial fishers' pots were salted with tagged lobsters, less than 10% of fishers notified the department of the captured tagged lobster. The department also mentioned a continuing decline in meshed pot data due to very few fishers participating in the program. In a recent request for additional participation in the meshed pot program, the department received no interest from fishers. Several fishers present at the meeting mentioned that they participate in the program, and encouraged others to do the same, claiming that it really only takes "a couple of extra minutes" and is "easy".

Despite the above stated issues with standardizing catch data from industry, the department was very happy with the type of data being collected. The move from catch and effort statistics (CAES) to daily CDR has been very beneficial, as the department now receives daily, rather than monthly, catch information, more regularly and at a finer temporal and spatial scale. While paper CDR forms are still in use, the majority of fishers now use the mobile application FishEye to report CDR. Industry generally thought that FishEye, as well as other department reporting apps such as the tag return app, work very well. However some issues were discussed regarding the reporting of catch data and several ways to improve the quality of data reported were suggested. Both industry and DPIRD agreed that including the ability to record information on undersized lobsters, setose, tar spots and spawners would be beneficial to management. The department indicated that they would have more confidence in these data if it were recorded on a voluntary basis, as if compulsory it was likely that some fishers would not record lobster the condition accurately. It was concluded that the department would look into adding a voluntary section on lobster condition to the CDR form for next season. Industry also suggested that the department make the blocks on the CDR forms smaller, to increase the spatial resolution of data. It was acknowledged by both industry and DPIRD that there is an issue with fishers under reporting the number of pot lifts per day, due to repulling pots; i.e. they may fish 120 pots, but after the initial pull, they go back and re-pull the first 50, meaning a total of 170 pot lifts not 120 as reported. The department explained that this would cause the model to

overestimate efficiency. They explained that there is in fact a "session" feature in the app to address this issue, where fishers can refer to a group of pots as one session, and those pots that are re-pulled can be logged as a second session. The department agreed that the use of this feature needs to be better explained to fishers. Fishers also brought several issues with the tag return app to the department's attention. The app only accepts carapace length measurements to the nearest millimeter. Industry would like to see the app modified so that decimal places may be recorded. Additionally fishers reported issues recording the release of a tagged lobster. While the application has a "release" option, there appears to be an issue with the software, and the program will not accept this input. DPIRD agreed to rectify both of these issues with the tag return app.

Email Questions

A list of questions were emailed to the Council and Department prior to the workshop. These were read aloud and answered as a part of the industry forum.

1.   What was the rationale and methodology used in changing the method that the puerulus collection data is now presented, with sites now aggregated.
To stop people focussing too closely at a single site. As it is now this provide a more general picture for a region. The individual sites are used in the modelling and will be shown at the workshop.

2.   Is the puerulus data still available as it was presented in the past and not corrupted with other sites, in particular the Seven Mile and Alkimos collectors?
We record the data individually at the collector level. The main use of the collated data is to show industry.

3.   Has the data collected for each year and each statistical block in the fishermen's returns since output control started been collated?
Yes. This is what we use in the model and will be shown at the workshop.

4.   Has the breeding stock survey work in A and B zone detected a reduction in the proportion of large males? The opening of the season in the spring breeding season has resulted in fishermen targeting areas where males congregate when there is a high price for large sized lobsters.
No. Since we started taking max-size and setose females the proportion of large males has not declined.

5.   How is the now accepted dead ground areas reflected in the model used to calculate the biomass of lobsters in the fishery?
This is a focus of the workshop.

6.   Has data from other areas of the shallows been collated to determine if other areas are now affected in the shallows?
This is a focus of the workshop

7.   For the last few seasons in the summer fishery, in the A-B zones an increasing percentage of the catch is being taken over the edge of the continental shelf in depths between 80 and 100 fathoms. The past summer saw around 40% of the total AB quota being taken in 6 weeks in this very deep water. In the previous years of input control even with the discovery of the outside Big Bank run fishery, nothing approaching this percentage of the catch was taken. This obviously has greatly reduced the catch required to be taken from mainly the middle ground, as mostly the shallows now

produces very little. How has this major alteration in fishing pressure been incorporated into the model?

It is directly taken out of the migrating deep-water not the shallow water. The integrated model replicates this behaviour.

8.   Does the model take into account the summer fishing at the Abrolhos where large amounts of the total island catch is taken in the deep water over the edge?

Yes the integrated model does.

9.   A limited amount of tagging has been carried out over the years by the Department. Has this been collated, and if so can it show the growth rates for each area, and in specific depths?

We have tagged more animals than any other fishery in Australia; over 226 000 lobsters. We have used this for a number of research areas including growth. The results from the latest growth work were presented at the last coastal tour which detailed growth by area and decade.

10.   Has any tagging been conducted on smaller (40-60 mm) animals? If so again has this data been collated to be able to show growth rates for different areas and depths? Also does this show any significant migrations for these small animals?

Yes. See above. Yes significant migrations have been shown. These data were presented at the last coastal tour.

11.   What data does the Department use to calculate the abundance of stock on the ground? Are all available data sources are used in a range of models; Integrated model, biomass dynamics model and tag-recapture model?

Explained at the coastal tour and detailed during the workshop.

12.   Does the Department have data on the number of pots used in the fishery and the number of days fished to catch the quota in each area? Has this data been collated to determine if the effort to catch the annual quota has changed since the beginning of output control?

Yes from the CDR. Presented at the coast tour.

13.   Does the Department still use catch per pot lift to estimate abundance?

Yes. CPUE from commercial fishers and IBSS are used. These data are standardised to account for biases such as soak time, high grading, escape gaps, etc..

14.   How has the model been able to assess the much lower effort on most of the middle ground, particularly in the summer "Whites season"?

The model is separated into shallow and deep (<20 fm>). It does not specifically separate the middle ground from other areas.

15.   How does the model allow for the great increase in technological effort in recent years? This includes:

i)   shared data (existing fishermen purchasing data from retiring fishermen),

ii)   a consistent increase in the technology available to fishermen, including sounders running 3D ground plotting data, compensated for pitch, roll and heave,

iii)   use of much larger pots with the capacity to catch up to 3 times more than the old standard pot in the very deep water run.

iv)   Ability of large capable boats and experienced fishermen to exploit the remote areas in the

north of the fishery.

v)   use of 2 and 3 pots per rope in the deep water, construction of much larger boats with the ability to operate in very adverse weather, and hold vastly more catch in high quality tanks, which allows fishermen to catch more lobsters per day against the alternative of having to stop pulling when the capacity of the boats tanks is reached.

The use of comparative indices of catch rates between commercial fishers and independent surveys. If commercial fishers are becoming far more efficient in an area then there will be a divergence between catch rates. The model conducts this comparison at 7 different locations. We have just published a paper on this and presented it at the conference in Maine.

The following questions were provided after the workshop and hence were not directly answered during the industry forum. The answers are provided below for completeness in addressing industry concerns.

1.   Lack of lobster between Dongara and Wedge Island inside 15 fathoms.
This was a focus of the workshop (see Industry Forum - Low Catch Rate Zone).

2.   Edge volume is larger in December, January and February, however there are very few lobsters under 76 mm. There was previously large volume cacker runs through this area.
This was addressed during the workshop (see Slide 27 of Appendix 4 for summary)

3.   There are significantly fewer undersized lobster north of Dongara to Flat Rocks.
This was a focus of the workshop (see Industry Forum - Low Catch Rate Zone).

4.   Less boats are fishing Fresh Water area since catch numbers have declined in recent years – meaning the lack of lobsters is not due to overfishing.
This was a focus of the workshop (see Industry Forum - Low Catch Rate Zone).

5.   There are more pot lifts per vessel, however there are significantly less pots in the water since quota began.
Effort is incorporated into the modeling process (see slides 75, 91 and 96 of Appendix 3 for details)

6.   We now have 12 month fishing where previously it was 7.5 months with A Zone boats able to fish A/B Zones at any time of the year. Previously A Zone was only fished 15 March to 30 June. A Zone boats could only fish B Zone 15 November to 14 March. Was there a change in the modelling to reflect these changes?
The integrated model is structured in such as a way as a change to the model structure was not required. The catch and effort from these periods and locations was therefore just ascribed to the existing 11 model areas and 11 timesteps.

7.   We now fish August/September/October handling spawning female lobster, catching the same females repeatedly. Is this affecting the viability of the spawn and survival rates of the spawning females?
Damage is monitored during the IBSS and no increase in damage has been recorded.

8.   High grading of catch means repeatedly catching the same lobster, is this affecting survival rate?

Discard mortality was quantified previously (Brown and Caputi 1983, 1986). This mortality rate is applied to high graded lobsters and hence is accounted for in the model

9.   Does model allow for larger pot volumes (1m x 1m pots) and multiple day pulls?
This was a discussed during the Industry Forum (see Pot Size Changes).

10.   Has the model changed to allow for advancement in technology i.e. larger boats, larger holding capacity, 3D mapping, secure communications, 24 hour GPS location and computer plotting systems.
This was a discussed in reference to email questions (#15) during the Industry forum (see above).

11.   Lower fishing pressure in November/December (end of quota period) when whites are migrating allow more lobster to get to the edge and move into other zones. This would affect the modelling for each zone. Fishermen have found that A Zone seems to be improving per pot lift whereas B Zone is decreasing.
This was a discussed during the Industry Forum (see Modeling of Migration).

Conclusions

The presentations and discussions during the science review were mutually beneficial, and a number of existing concerns were resolved during this process. However, there were some outstanding issues which industry and the Department request the review panel to address. These were formulated into a terms of reference (TOR) at the conclusion of the review. These TOR will be the focus for the review of the modeling on the Western Rock Lobster Resource.

Terms of Reference

1.   Appropriate levels to set the threshold and limit reference points (MSC definitions)?

     ● Threshold: Maximum Sustainable Yield

     ● Limit: Point of Recruitment Impairment

2.   Review and assess the three models and determine their appropriateness

3.   Are three models to assess the fishery necessary or should they be reduced / modified (is there a more efficient process)?

4.   What is seen while fishing is not reflective of the growth of biomass in the models. Are the models having difficulty assessing this index?

5.   Is spatial variation in recruitment been accurately captured in the model and has it changed temporally?

6.   Is the current data collection sufficient for the management of the fishery?

Appendix 1: Coastal Tour Locations and Dates

Monday 26 March 2018 in DONGARA
3.00pm – 5.00pm
Southerly Tavern, Dongara

Monday 26 March 2018 in GERALDTON
6.30pm – 8.30pm
Sirocco Bar, Ocean Centre Hotel

Tuesday 27 March 2018 in KALBARRI
5.00pm – 7.00pm
Kalbarri Hotel

Wednesday 28 March 2018 in JURIEN BAY
4.00pm – 6.00pm
Sandpiper Tavern & Pizzeria

Thursday 29 March 2018 in LANCELIN
2.30pm – 4.30pm
Lancelin Inn Hotel

Wednesday 4 April 2018 in FREMANTLE
3.30pm - 5.30pm
Fremantle Sailing Club

Appendix 2: Agenda

West Coast Rock Lobster Science Review

Workshop 1

8.30 a.m. Friday, 6 April 2018

39 Northside Drive, Hillarys

Meeting Chair - Matt Taylor, WRL CEO

0830	Arrive and Registration
0900	Welcome/Apologies/Introduction/Background/Purpose
0915	Science Presentation

- Model inputs, assumptions and biases

Presenter: Dr Simon de Lestang and Dr Jason How

1030 - 1050	Morning Tea
1050	Science Presentation

- Model inputs, assumptions and biases

Presenter: Dr Simon de Lestang and Dr Jason How

1230 - 1300	Lunch
1300	UWA Research Presentation

- Low catch rates in the shallow water areas at the centre of the fishery

Presenter: Dr Tim Langlois

1400	Industry Forum
1530 - 1545	Afternoon Tea
1545	Formation of Terms of Reference for Model Review (Workshop 2)
1700	Meeting Close

Please note - Questions and comments are encouraged and welcomed during the science presentation sessions throughout the day. In the event that a question cannot be sufficiently answered immediately it will be addressed in the Industry Forum session at 14.00.

Appendix 3: Attendees & Apologies

Attendees

No	Name	Organisation
1	Kim Colero	Chair, WRL
2	Terry Lissiman	Deputy Chair, WRL
3	Nic Sofoulis	Director, WRL
4	Clay Bass	Director, WRL
5	Linda Williams	Director, WRL
7	Matt Taylor	CEO, WRL
8	Clare Robinson	Communications & Research Officer, WRL
9	Katherine Chow	Finance & Administration Officer, WRL
10	Simon de Lestang	Scientist, DPIRD
11	Jason How	Scientist, DPIRD
12	Graeme Baudains	Principal Management Officer, DPIRD
13	Carli Telfer	Fisheries Management Officer, DPIRD
14	Laura Orme	Fisheries Management Officer, DPIRD
15	Tim Langlois	Research Fellow, UWA
16	Sam Koncurat	Industry Representative
17	Basil Lenzo	Industry Representative
18	Jim Waters	Industry Representative
19	Peter Stanich	Industry Representative
20	Clinton Moss	Industry Representative
21	Jarred Groom	Industry Representative
22	Mark Ralph	Industry Representative
23	John Fitzhardinge	Industry Representative
24	Roy McVeigh	Industry Representative
25	Fedele Camarda	Industry Representative
26	Greg Cole	Industry Representative
27	Jim Penn	Scientist
28	Mark Rossbach	DPIRD
29	Eric Barker	DPIRD
30	Nick Caputi	Scientist, DPIRD
31	Emma-Jade Tuffley	DPIRD & UWA
32	Michael Brooker	UWA
33	Jessica Kolbusz	UWA

Apologies

Name	Organisation
Robbie Wuillemen	Industry Representative
Peter Prideaux	Industry Representative
James Paratore	Industry Representative
Nino Paratore	Industry Representative
Peter Bailey	Director, WRL
Robbie Glass	Director, WRL
Justin Pirrottia	Industry Representative
Peter Hammond	Director, WRL
Peter Cooke	Independent Director, WRL
Karen Brown	Independent Director, WRL

References

Brown, R. S., and N. Caputi. 1983. Factors affecting the recapture of undersized western rock lobster Panulirus cygnus George returned by fishermen to the sea. *Fish. Res*. 2:103–128.

Brown, R. S., and N. Caputi. 1986. Conservation of recruitment of the western rock lobster (Panulirus cygnus) by improving survival and growth of undersize rock lobster captured and returned by fishermen to the sea. *Can. J. Fish. Aquat. Sci*. 43:2236–2242

de Lestang, S., Caputi, N., How, J., Melville-Smith, R., Thomson, A. and Stephenson, P. 2012. Stock Assessment for the West Coast Rock Lobster Fishery. *Fisheries Research Report No. 217*. Department of Fisheries, Western Australia. 200pp.

de Lestang, S. 2018. Could warming oceans and increased lobster biomass rates be affecting growth rates in Australia's largest lobster fishery? *Bulletin of Marine Science*. https://doi.org/10.5343/bms.2017.1100