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## **Submission to the Senate Inquiry on the impact of seismic testing on fisheries and the marine environment**

### **Terms of Reference**

The impact of seismic testing on fisheries and the marine environment

- a. the body of science and research into the use of seismic testing;
- b. the regulation of seismic testing in both Commonwealth and state waters;
- c. the approach taken to seismic testing internationally; and
- d. any other related matters

### **About Our Industry**

Established in 2004, Southern Rocklobster Limited (SRL), serves as the national peak body working to further the interests of the Australian Southern Rock Lobster Industry. SRL's member organisations are the South Australian Rock Lobster Advisory Council, the Tasmanian Rock Lobster Fisherman's Association, the Victorian Rock Lobster Association and the Australian Rock Lobster Exporters Association. The membership base covers all of the Southern rock lobster harvesters and exporters in Australia accounting for a GVP of \$250AUD million at the wharf. The Southern rock lobster fishing fleet is comprised of approximately 300 vessels with product being exported by approximately 25 facilities across all three harvesting States.

### **Background**

Research into the potential for noise in the marine environment to harm aquatic organisms has historically focused on marine mammals such as whales and dolphins, along with some

investigations into economically important fish species. The effects of sound on marine invertebrates has only received attention comparatively more recently.

In 2010, following a seismic survey conducted in the Bass Strait, fishermen in the Bass Strait Central Zone Scallop Fishery reported large scale mortalities and poor-quality scallops, with a reduction in the commercial harvest of scallops from 2278 tonnes in the 2009/2010 season to only 454 tonnes in the 2010/2011 season. The industry estimated that 24,000 tonnes worth AU\$70 million were lost, which represented a catastrophic loss for the industry considering its 3,000-4,000 tonne annual total allowable catch worth nearly AU\$7 million.

The loss raised concern amongst the Southern Rock Lobster industry, which has important fisheries that overlap areas of seismic survey interest within the Bass Strait and throughout Victorian, South Australian and Tasmanian waters.

Globally, rock lobster fisheries are some of the most valuable single species fisheries, with annual production of 80,000-100,000 tonnes worth US\$2.0-2.4 billion (FAO).<sup>1</sup> Australia accounts for a considerable proportion of these totals, producing over 10,000 tonnes worth nearly AU\$ 670 million annually<sup>2</sup>. This catch is comprised largely of the Western Rock Lobster (59%) and the Southern Rock Lobster (28%).

At the time of the 2010 survey, few studies into the effects of aquatic noise in general, or seismic signals in particular, on marine invertebrates had been conducted. This lack of available evidence on the potential impacts of seismic signals on scallops and other invertebrates highlighted a need to better understand the effects of seismic signals on economically important marine invertebrate fisheries.

In response to this need, a research project investigating the impacts of exposure to seismic signals on the commercial scallop (*Pecten fumatus*) and the Southern Rock Lobster (*Jasus edwardsii*) was undertaken by researchers from IMAS and Curtin University's Centre for Marine Science and Technology. The focus of this study was to expose adult scallop and lobster to seismic air gun signals in a field setting and measure the physiological and behavioural impacts over acute and chronic time scales. The research was supported by with the Fisheries Research and Development Corporation (FRDC), through our Industry Partnership Agreement and co-funded with the University of Tasmania's Institute for Marine and Antarctic Studies (IMAS).

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<sup>1</sup> Food and Agriculture Organization of the United Nations (2019) Fishery Commodities Global Production and Trade. FAO, Rome. Accessed 6/11/2019 <http://www.fao.org/fishery/topic/16140/en>

<sup>2</sup> Australian Bureau of Agricultural and Resource Economics (2019) Australian fisheries and aquaculture statistics 2017 – Production. ABARES, Canberra. Accessed 11/11/2019 [http://www.agriculture.gov.au/abares/Documents/research-topics/fisheries/AustFishAquacStats\\_2017\\_Production\\_v1.1.0.xlsx](http://www.agriculture.gov.au/abares/Documents/research-topics/fisheries/AustFishAquacStats_2017_Production_v1.1.0.xlsx)

This submission summarises the research conducted at IMAS into the effect of seismic surveys on marine invertebrates. The information presented here is based on the work described in these publications:

- Day, R.D.; McCauley, R.D.; Fitzgibbon, Q.P.; Hartmann, K.; Semmens, J.M. (2019) Seismic air guns damage rock lobster mechanosensory organs and impair righting reflex. *Proceedings of the Royal Society B* 286:20191424 [doi:10.1098/rspb.2019.1424](https://doi.org/10.1098/rspb.2019.1424)
- Day, R.D.; Fitzgibbon, Q.P.; Gardner, C. (2019) The impact of holding stressors on the immune function and haemolymph biochemistry of Southern Rock Lobster (*Jasus edwardsii*). *Fish and Shellfish Immunology* 89:660-671 [doi:10.1016/j.fsi.2019.03.043](https://doi.org/10.1016/j.fsi.2019.03.043)
- Day, R.D.; McCauley, R.D.; Fitzgibbon, Q.P.; Hartmann, K.; Semmens, J.M. (2017) Exposure to seismic air gun signals causes physiological harm and alters behaviour in the scallop *Pecten fumatus*. *Proceedings of the National Academy of Science of the United States of America* 114:E8537-E8546 [doi:10.1073/pnas.1700564114](https://doi.org/10.1073/pnas.1700564114)
- Fitzgibbon, Q.P.; Day, R.D.; McCauley, R.D.; Simon, C.J.; Semmens, J.M. (2017) The impact of seismic air gun exposure on the haemolymph physiology and nutritional condition of spiny lobster, *Jasus edwardsii*. *Marine Pollution Bulletin* 125:146-156 [doi:10.1016/j.marpolbul.2017.08.004](https://doi.org/10.1016/j.marpolbul.2017.08.004)
- McCauley, R.D.; Day, R.D.; Swadling, K.M.; Fitzgibbon, Q.P.; Watson, R.A.; Semmens, J.M. (2017) Widely used marine seismic survey air gun operations negatively impact zooplankton. *Nature Ecology & Evolution* 1:0195 [doi:10.1038/s41559-017-0195](https://doi.org/10.1038/s41559-017-0195)
- Day, R.D.; McCauley, R.D.; Fitzgibbon, Q.P.; Semmens, J.S. (2016) Seismic air gun exposure during embryonic development does not negatively affect spiny lobster *Jasus edwardsii* larvae (Decapoda:Palinuridae). *Scientific Reports* 6:22723. [doi:10.1038/srep22723](https://doi.org/10.1038/srep22723)
- Day, R.D.; McCauley, R.D.; Fitzgibbon, Q.P.; Hartmann, K.; Semmens, J.M. (2016) Assessing the impact of marine seismic surveys on southeast Australian scallop and lobster fisheries. Fisheries Research and Development Corporation, University of Tasmania, Hobart, FRDC 2012/008. <http://www.frdc.com.au/Archived-Reports/FRDC%20Projects/2012-008-DLD.pdf>

### **Physiological Effects of Seismic Testing on Southern Rock Lobster (*Jasus edwardsii*)**

IMAS research into the impact of seismic surveys on the Southern Rock Lobster as part of the FRDC 2012/008 project focused on the physiology and reflex behaviour, with studies conducted using adult lobsters. The experimental field-exposures in this work were carried out in the winters of 2013 and 2014 and the summer of 2015. In the former two studies, berried (egg-carrying) females were used. The lobsters in these studies were sampled over

acute and chronic time scales, with sampling conducted over a range of 0, 2, 14, 120 and up to 365 days in the experiments.

After the lobsters were exposed to signals from an air gun at a field site off the coast of Tasmania representative of lobster habitats, they were brought back to IMAS and assessed for several reflex behaviours commonly used in the lobster industry to assess health status, such as the time taken to right themselves after being placed on their dorsum or “back” and how well they could hold their tail up. They were also sampled for haemolymph (the crustacean equivalent to blood), which was tested for a range of biochemical parameters using a panel similar to the familiar blood tests doctors give patients in their annual check-ups. Finally, the lobster’s mechanoreceptor organ, the statocyst, which gives them a sense of balance and functions as the equivalent to the human inner ear, was analysed to determine whether it was damaged following exposure. A sub-set of berried females were also maintained until their eggs hatched to determine whether the embryos were affected by exposure.

The results from these experiments constitute the most comprehensive assessment of the impacts of aquatic noise and seismic exposure, in particular, to be performed on a marine invertebrate to date. It was found that the embryos were resilient to exposure, with seismic exposure having no negative impact on the resultant larvae. While this finding was positive for the long-term sustainability of the fishery, as any evidence of undermining larval recruitment would have been a dire finding, it is important to note that this investigation was limited to exposure as an embryo and not during larval stages.

Adult lobsters did not have any mortality following exposure and showed little response in terms of their haemolymph biochemistry in any of the experiments. There was some evidence of reduced nutritional condition in lobster exposed to air gun signals, which suggested a reduced ability to either acquire or process and digest food compared to lobsters not exposed. A potentially more serious finding was the impact to the number of haemocytes (blood cells) in the exposed lobsters, which was found to steadily decrease over time post-exposure, reaching a low at the 120 days post-exposure sampling point. Decreases in cell numbers suggest an unsustainable chronic stimulation of the immune response system leading to a suppressed capacity for immune function.

Lobsters exposed to air gun signals showed an increase in the time taken to right themselves, a finding that corresponded with damage to the mechanosensory organ responsible for detecting gravity and body position. This damage, and the righting impairment, was persistent in all experiments, lasting up to 365 days post-exposure after lobsters had undergone moulting, which would be expected to facilitate regeneration of damage. Interestingly, the impact was only observed in lobsters collected from a remote site off the southern coast of Tasmania. In lobsters collected from the Derwent River, which

sees a high level of traffic from large ships, lobsters showed pre-existing damage to their mechanosensory organs and seismic exposure was not found to further this damage.

In summary, the results of this study found that although seismic surveys appear to be unlikely to result in immediate mortality, there are concerns over the alteration of several important aspects of lobster biology, such as immune function, nutritional condition and sensory systems. Until the full scope of these impacts and their ecological effects can be more thoroughly investigated, caution must be taken against extrapolating these results to situations not within the scope of the study, such as potential impacts on the fishery.

### **The Consultation Process**

An increasing number of mining, gas and petroleum related developments overlap spatially with the interests of the Southern rock lobster industry. It is challenging to engage with and respond to the increasing quantity of proposals being put forward by titleholders. The levels of consultation employed by titleholders is inconsistent and often inadequate. Our organisation is not compensated for the significant time and labour required for consultations. The current arrangement is not sustainable for our industry in the future.

It is not sufficient for proponents of major developments to expect industry associations, or those fishers affected, to have responsibility and dedicate the time required to investigate and review complex environmental reports within short time frames. These reports may not even address the interests of professional fishers, or the links between their activities and the environment.

It is the view of the Southern rock lobster industry that the decision making process for mining, gas and petroleum project proposals must require proponents to demonstrate that their consultation and negotiation strategies engage appropriately with us. This consultation process must address and where possible mitigate environmental and access issues.

Our industry believes that the duty to consult lies solely with the titleholder. The provision of information alone does not constitute appropriate and meaningful consultation.

**For any further information please contact Tom Cosentino, SRL Executive Officer on the details provided at the opening of this submission.**

**Ends**