

WESTERN ROCK LOBSTER

Eureka 3D Marine Seismic Survey



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Acronyms and Abbreviations

Name	Description
AMP	Australian Marine Park
CAES	Catch and Effort System
CPUE	Catch per unit of effort
DPIRD	Department of Primary Industries and Regional Development
EMBA	Environment that may be affected
EP	Environment Plan
KEF	Key Ecological Feature
NOAR	nodes on a rope
OA	Operational Area
OBN	Ocean bottom node
SRL	Southern rock lobster
SWMR	South west marine region
TACC	Total allowable commercial catch
WCRLMF	West Coast Rock Lobster Managed Fishery
WRL	Western rock lobster

1 INTRODUCTION

Pilot Energy Pty Ltd (Pilot) is proposing to undertake the Eureka three-dimensional (3D) marine seismic survey (hereafter referred to as the Eureka 3D MSS) in Exploration Permit WA-481-P, Production Licence WA-31-L, and an area of open acreage, which are located on the mid-west coast of Western Australia (WA), in the northern Perth Basin. The purpose of the Eureka 3D MSS is to collect 3D geophysical data about the underlying rock types to inform oil and gas exploration.

The western rock lobster (WRL) (*Panulirus cygnus*) has been identified as a key receptor to the proposed activity in the Operational Area (OA) and in the Environment that May Be Affected (EMBA) (Figure 1-1).

This report presents a summary of the information on the WRL collated from the Environment Plan (EP).

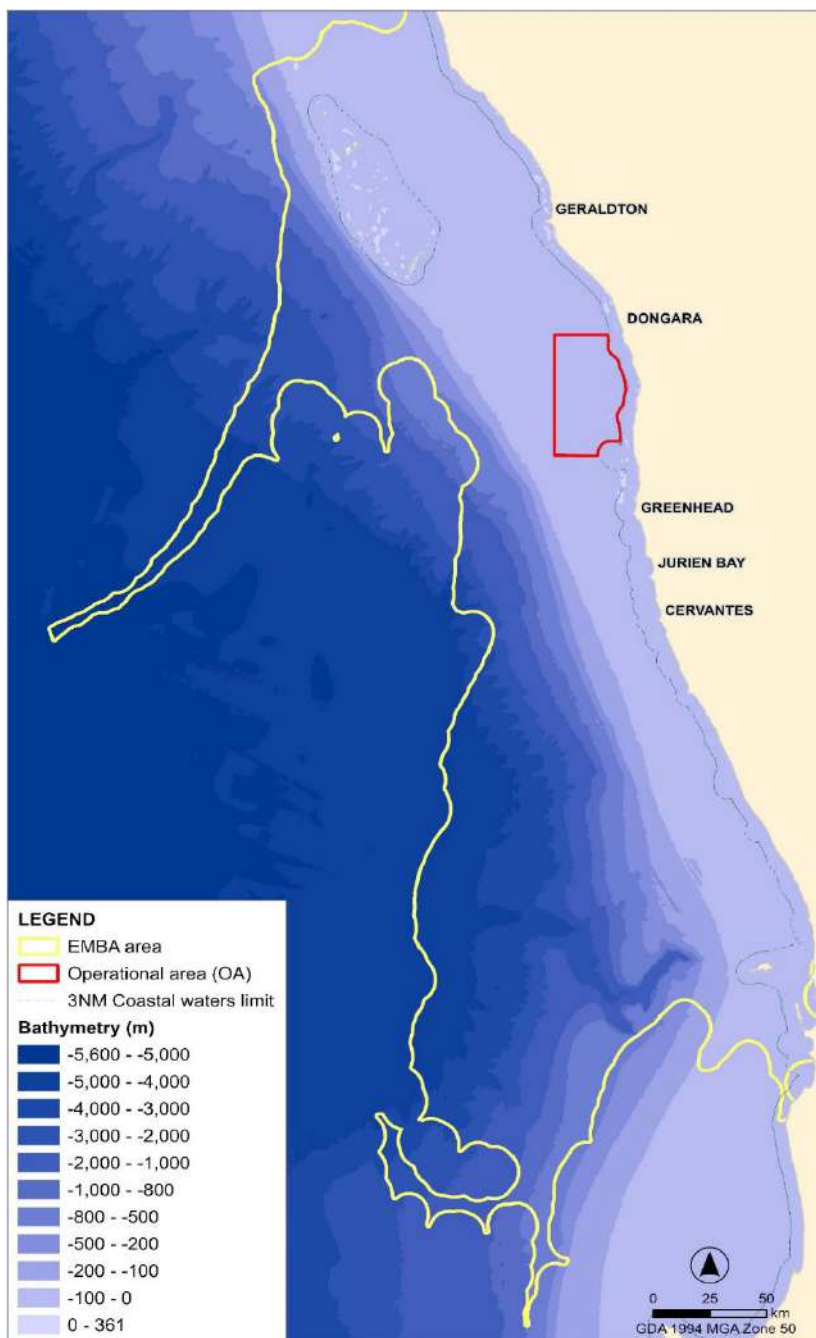


Figure 1-1: OA and EMBA for the Eureka 3D MSS

2 KEY ECOLOGICAL FEATURES

Key ecological features (KEFs) are the parts of the marine ecosystem that are considered to be of importance for a marine region's biodiversity or ecosystem function and integrity (DoEE n.d.). KEFs have been identified by the Australian Government on the basis of advice from scientists about the ecological processes and characteristics of the area. KEFs are not Matters of National Environmental Significance (MNES) and have no legal status in their own right. However, they may be considered as components of the Commonwealth marine area.

The western rock lobster KEF is located within the Eureka 3D MSS OA (Figure 2-1).

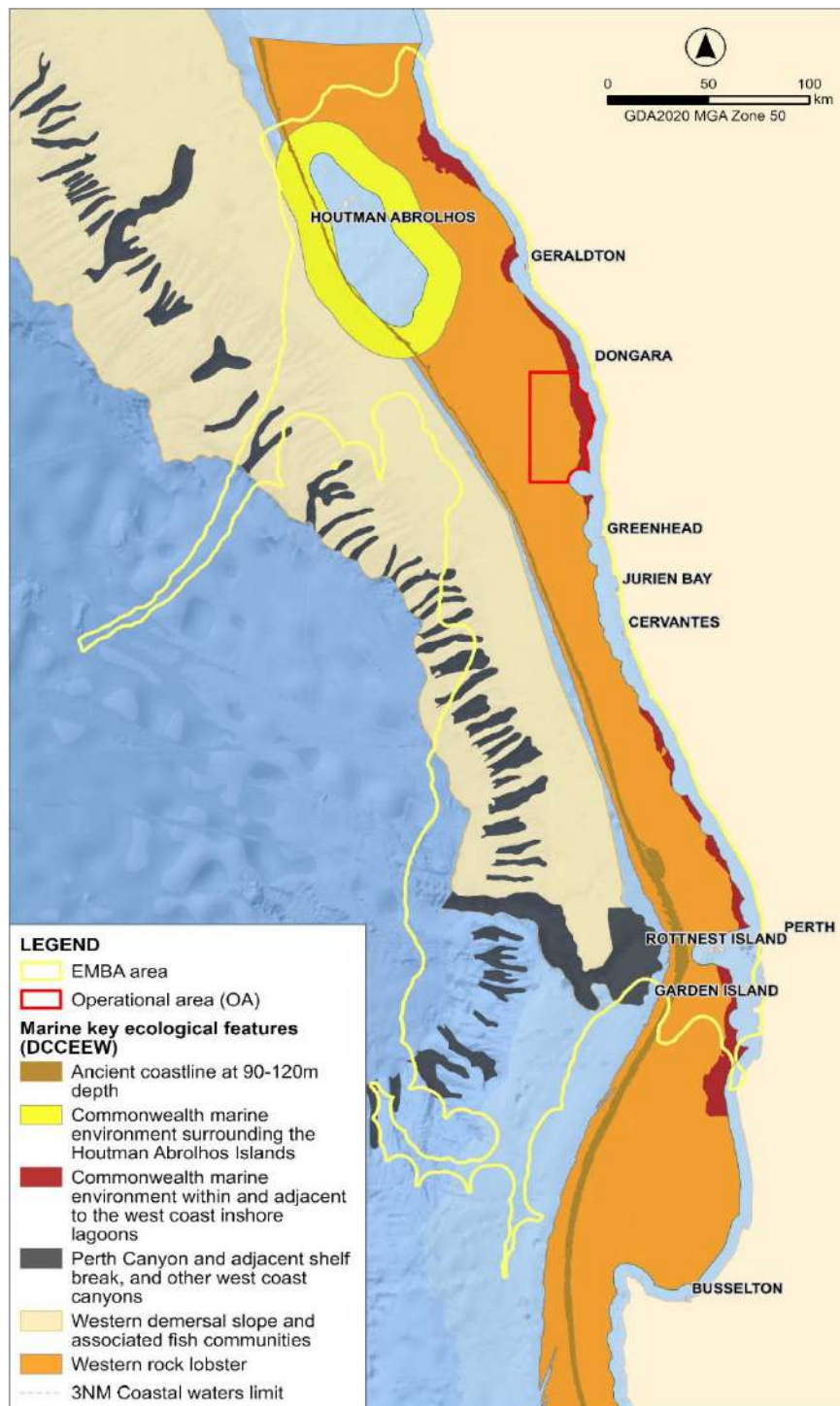


Figure 2-1: KEFs overlapping the OA and EMBA

3 THE WESTERN ROCK LOBSTER

Within the South-west marine region (SWMR), western rock lobsters can be found north of Cape Leeuwin to a depth of 150 m (DSEWPaC 2012). The western rock lobster is the dominant large benthic invertebrate in the bioregion. The species plays an important trophic role, as both predator and prey, and is a highly valued recreational and commercial fishing target. The lobster significantly reduces the densities of a diverse variety of invertebrate prey (e.g., epifaunal gastropods), and is a key prey for many species, particularly during the post-larval puerulus phase (MacArthur et al., 2007). Spawning and egg hatching occurs at depths below 40 m in spring/summer, whereafter the phyllosoma get transported offshore into the Indian Ocean via the LC (Figure 3-1). The phyllosoma life stage lasts 9 to 11 months, spreading the species' larvae throughout the southeastern Indian Ocean, aggregating at depths 50 to 120 m (Hayes et al. 2008). Late phyllosoma larvae metamorphose into a post-larval puerulus beyond the edge of the continental shelf, after which they swim towards shallow inshore reefs. The lobsters stay in these reefs for three to four years, before migrating out to deeper waters to spawn, completing the life cycle (MacArthur et al. 2007).

While inhabiting the inshore reefs, the lobsters are valuable prey for a large range of species, including octopus, cuttlefish, baldchin groper, blue groper, dhufish, pink snapper, wirrah cod, breaksea cod and Australian sea lions (Hayes et al. 2008). Due to the vulnerability and high biomass of lobster, the species is a critical trophic pathway for many inshore species. Western rock lobsters are also directly targeted by commercial and recreational fishers; however, recent catches have declined. Further information regarding the commercial fisheries focused on western rock lobster is provided in Section 6.

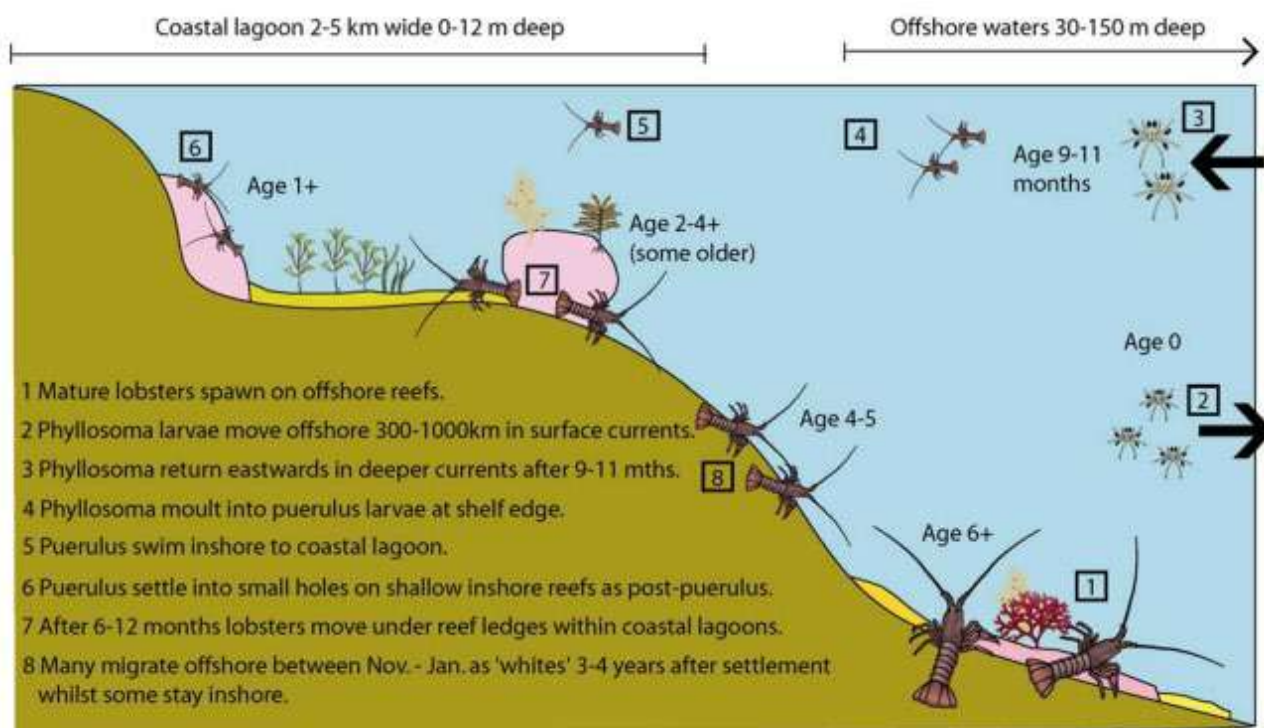


Figure 3-1: Western rock lobster life cycle (Source: parksaustralia.gov.au)

4 TIMING OF BIOLOGICAL SENSITIVITIES

Several biological sensitivities related to the phenology of marine fauna including the WRL are expected to occur within the OA and EMBA. The timing of the Eureka 3D MSS is expected to overlap with the peak commercial fishing season for WRL (February) and the period of WRL puerulus settlement Table 4-1.

Table 4-1: Timing of WRL sensitivities relevant to the OA and EMBA

Sensitivity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Proposed Eureka 3D MSS timing												
WRL puerulus settlement ¹												
WRL commercial fishing season												

Hatched cell = peak period

Source: = Bellchambers et al. 2012

5 SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

5.1 Protected areas

The OA does not overlap with any Australian Marine Park (AMP), or any WA State protected marine areas, however, the EMBA overlaps the following AMPs with corresponding Commonwealth protected areas: Abrolhos AMP, Perth Canyon AMP, Two Rocks AMP, Jurien AMP, and the South-west Corner AMP (Figure 5-1).

Important habitat usage areas for the western rock lobster have been identified in the following state and commonwealth protected areas:

- The Abrolhos AMP – important habitat
- Two Rocks AMPs – important habitat and breeding grounds
- South-west Corner AMP – key foraging area

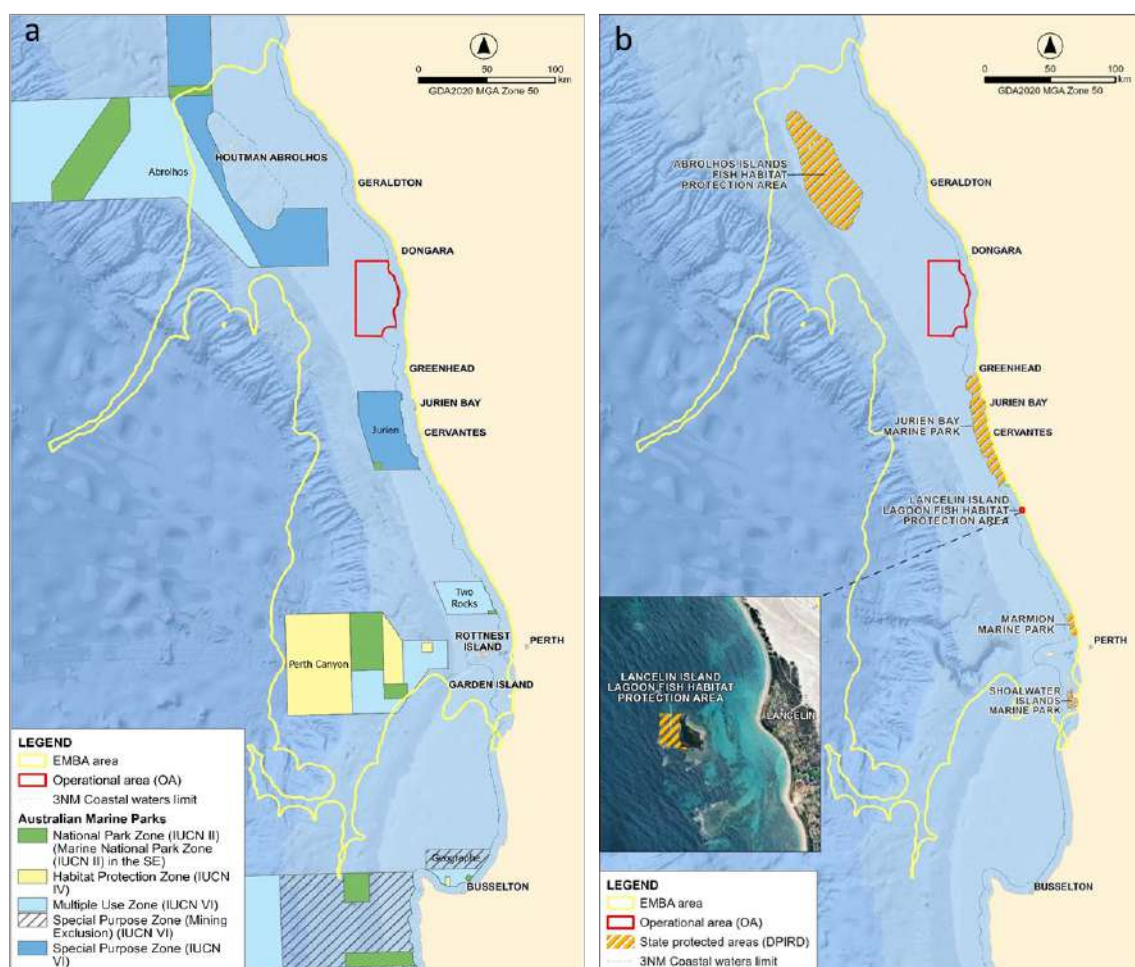


Figure 5-1: Overlap of the OA and EMBA with a) Commonwealth protected areas, and b) State protected areas

6 WEST COAST ROCK LOBSTER MANAGED FISHERY

The WCRLMF covers WA State waters between Exmouth and Cape Leeuwin, and out to the extent of the AFZ. The fishery targets the western rock lobster (*Panulirus cygnus*) throughout their geographic range along the lower west coast of WA, using baited traps/pots (Newman et al. 2023). Historically, the WCRLMF has been Australia's largest and most valuable single species wild capture fishery (de Lestang et al. 2016).

The WCRLMF is managed in three spatial areas: Zone A (Abrolhos Islands area), Zone B (north of 30° S) and Zone C (south of 30° S). In 2010/11, the fishery transitioned to an output-based system in response to a downturn in recruitment (Caputi et al., 2014), implementing a transferable quota system to control the annual total allowable commercial catch (TACC) in each zone while maximising economic yield (DPIRD 2014; Newman et al. 2023).

Analysis of Catch and Effort System (CAES) data shows that fishing effort (i.e., annual vessel counts) over the ten-year period between 2012 and 2021 ranged between Shark Bay and the Capes region, with most vessels recorded in nearshore waters between Geraldton and Perth, as well as around the Abrolhos Islands (Figure 4-1). Vessel counts were greatest off the Geraldton coast (226–300 and 301–375 vessels), followed by the Abrolhos Islands (226–300 vessels) and Perth coast (151–225 vessels).

Spatial fishing intensity is known to correlate with areas of suitable limestone reef habitat, with proximity to ports along the coastline and at the Abrolhos Islands. Additionally, since the implementation of a 50% catch share between management Zones A and B to combine with Zone C in 2015, spatial catch variability has reduced by dispersing effort across the fishery (de Lestang et al. 2016).

The movement of WCRL may also influence fishing effort. Juvenile, newly moulted WRL (or 'whites') migrate west from coastal reefs across sandy habitats to deeper offshore breeding grounds (Bellchambers et al., 2017), while a smaller number migrate north following the continental shelf (de Lestang et al. 2016). While there is substantial inter-annual variability in north-ward movement between latitudes 27° S and 30° S (de Lestang et al. 2016), this may contribute to the concentrated fishing effort in the northern areas of the fishery.

The OA overlaps with 1,575 km² (or 1.94 %) of the area of WCRLMF fishing effort over the ten-year period (Figure 4-1). CAES blocks within the OA recorded between three and 300 vessels.

Monthly patterns in fishing effort (the sum of fishing vessels above confidential limits) followed a consistent seasonal trend. Average monthly effort over the ten-year period was greatest in the summer from December to May, peaking in February, with a corresponding reduction in winter from June to November (Figure 4-2). The 2020 season was excluded from the average due to trade limitations and disruptions caused by COVID-19.

The WCRLMF management structure enables export market demand to drive temporal fishing effort. Since 2013, the commercial season has run for 12-months beginning 15 January, giving fishers with individual catch limits (i.e., transferable quotas) an incentive to increase economic efficiency and the flexibility to fish when the market price for lobsters is high. Asia is the primary export market for WRL, with almost all catch exported to China, together with Hong Kong, Taiwan, and Japan (Newman et al. 2023). Fishing effort reflects export prices and typically peaks shortly after the annual quota is renewed around Chinese New Year in January/February (Figure 4-2).

External economic factors may also influence monthly fishing effort. For example, in 2020 catch effort was substantially reduced during the peak seasonal fishing period in January and February, reflecting the Chinese ban on Australian imports and the crash in export demand due to COVID-19.

Catches of WRL are also limited by sea and weather conditions (Newman et al. 2023), which are generally more favourable in the summer, as shown in Figure 4-2. Historically, seasonal catches of WRL have also been greater in December/January due to the higher catchability of the 'whites' phase, as well as in March/April when undersize WRL moult into legal size (de Lestang et al. 2016). Fishing effort and catch are typically lower in winter, due to more rough weather days, lower catchability, and many females starting to mate and therefore becoming illegal for capture (de Lestang et al. 2016).

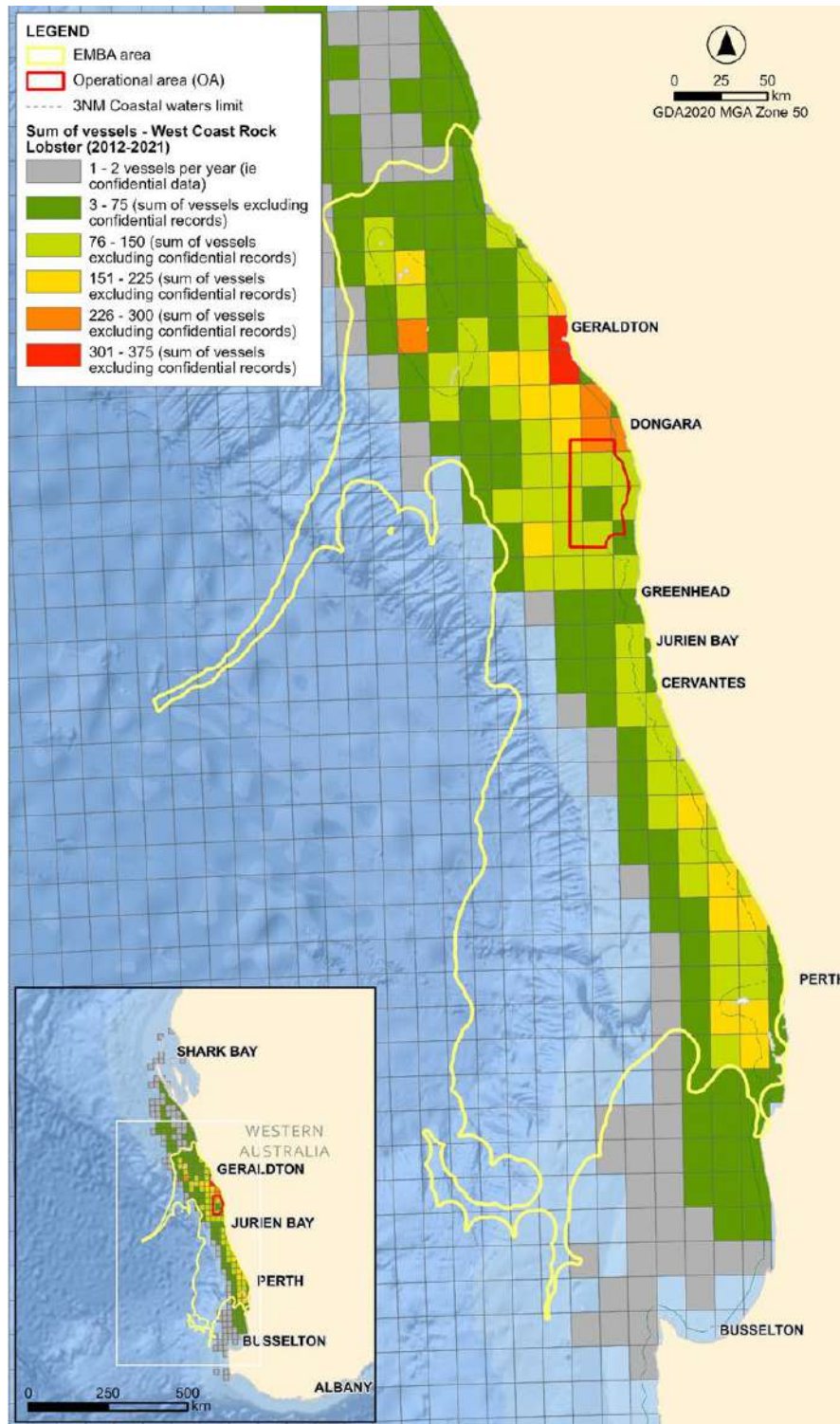


Figure 6-1: Spatial distribution and sum of annual vessel counts (excluding confidential records) in 10 x 10 nm CAES blocks recorded in the WCRLMF for 2012–2021 combined

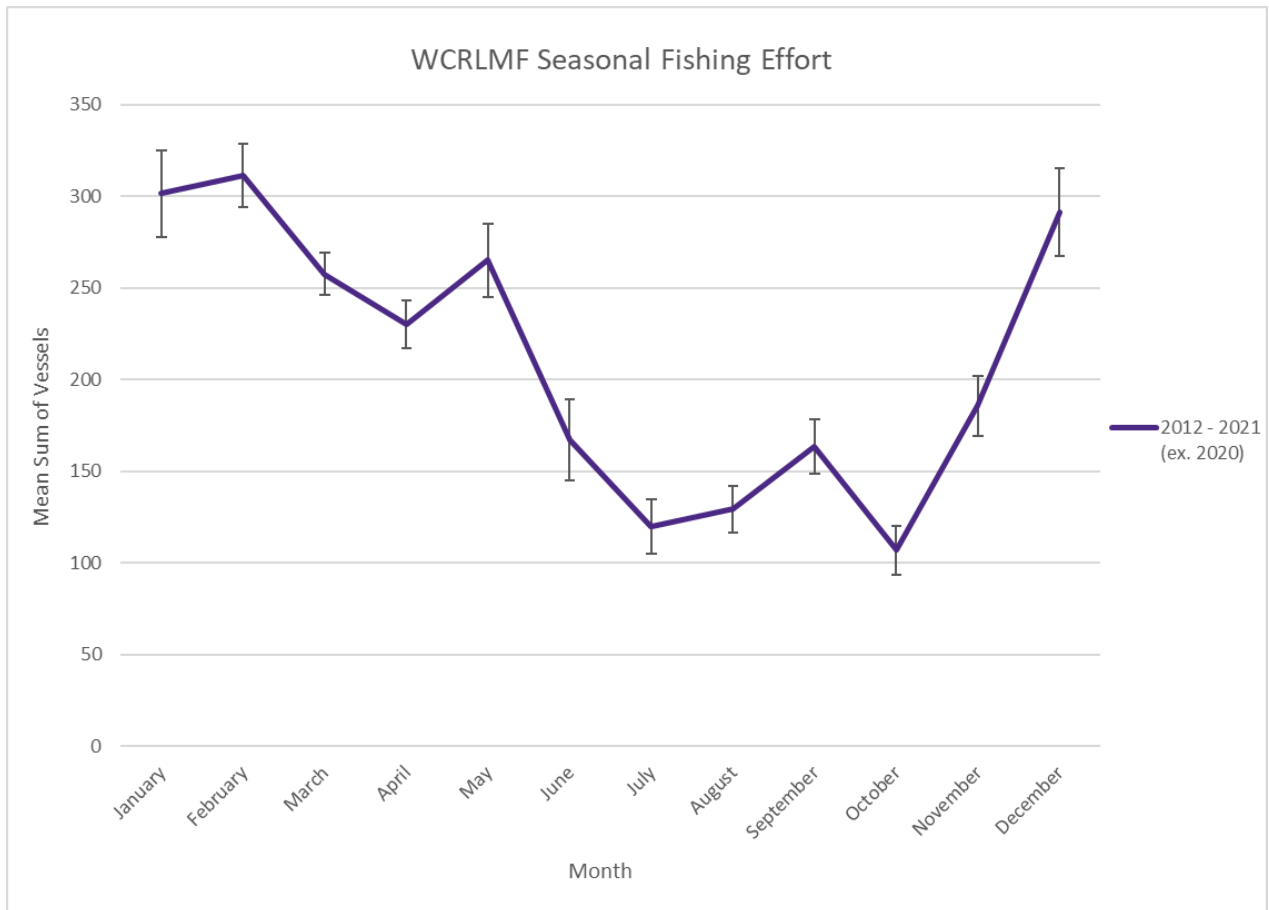


Figure 6-2: Mean monthly sum of vessels (excluding confidential records) in 10 x 10 nm CAES blocks recorded in the WCRLMF for 2012–2021 combined, excluding 2020

7 UNDERWATER SOUND – SEISMIC OPERATIONS

Different animals are sensitive to different sound frequencies, which are measured in Hertz (Hz) and kilohertz (kHz). Therefore, if an animal is sensitive to a particular frequency range, a sound in that frequency range will seem louder to that animal than to a different animal which is less sensitive to those frequencies. This can make a considerable difference to how loud a sound is perceived to be and any resultant impact to the animal.

7.1 WRL sensitivity and sound exposure thresholds

Research undertaken by Day et al. (2016a, 2016b) in Australian waters, exposed captive southern rock lobster (SRL) (*Jasus edwardsii*) to multiple passes of a seismic source element in 10-12 m water depths. Maximum received sound exposures were 209-212 dB re 1 μ Pa PK-PK, 186 to 190 dB re 1 μ Pa²·s per-pulse SEL, and SELcum of 192 to 199 dB re 1 μ Pa²·s. Exposed and control lobsters were housed in a laboratory for up to a year post-exposure to allow monitoring of longer-term impacts. The findings of the study were published in a report, as well as several scientific articles. These are summarised below.

Mortality

- Exposure to seismic sound did not result in any mortalities to adult lobsters (Day et al. 2016a, 2016b).

Righting time and statocysts damage

- Airgun exposure caused damage to the righting reflex and statocysts in SRLs (Day et al. 2019). Following exposure equivalent to a full-scale commercial array (3100 in³) passing within 100–500 m, lobsters showed impaired righting and significant damage to the sensory hairs of the statocyst. Reflex impairment and statocyst damage persisted for at least 365 days post-exposure and did not improve following moulting. For this study, maximum measured received noise levels were 209-213 dB re 1 μ Pa (PK-PK).
- In a group of lobsters with pre-existing statocyst damage (assumed to be caused by exposure to high levels of anthropogenic noise), seismic exposure did not cause further statocyst damage, nor was there an increase in righting time (Day et al. 2020).

Stress

- Increased tail gape (an indication of stress) was present in the summer experiments only, which may be a result of higher temperatures exacerbating a stress response (Day et al. 2016a, 2016b).

Haemolymph physiology and nutritional condition

- Examination of the impact of seismic acoustic exposure on the haemolymph physiology and nutritional condition of this species and found no effect of seismic exposure on 24 haemolymph biochemical parameters, hepatopancreas index or survival. However, this study did report evidence of a chronic negative impact on immune competency for up to 120 days post-exposure, a potential immune response to infection after 365 days post-exposure; and chronic impairment of nutritional condition 120 days post-exposure (Fitzgibbon et al. 2017). These authors concluded that the biochemical haematological homeostasis of rock lobster is reasonably resilient to seismic acoustic signals; however, exposure may negatively influence the rock lobster's nutritional condition and immunological capacity. The impact of these results at an ecological level is not known.

Larvae

- Day et al. (2016a, 2016b) found no effects on the mortality, abnormality, competency, or energy content of lobster larvae after exposure of early embryonic stages to seismic exposure. In this study, egg-bearing female southern rock lobsters (*Jasus edwardsii*) were exposed to signals from three airgun configurations, all of which exceeded SEL of 185 dB re 1 μ Pa²·s (209-212 dB PK-PK). Lobsters were maintained until their eggs hatched and the larvae were then counted for fecundity, assessed for abnormal morphology using measurements of larval length and width, tested for larval competency using an established activity test and measured for energy content. Overall, there were no differences in the quantity or quality of hatched larvae, indicating that the condition and development of spiny lobster embryos were not adversely affected by airgun exposure. Day et al. (2016a, 2016b) detailed that the results suggest that embryonic spiny lobster are resilient to airgun signals and highlight the caution necessary in extrapolating results from the laboratory to real world scenarios or across life history stages.

Eggs

- Increased mortality, delayed development or abnormal development to the egg mass carried by any 'berried' females, if present, or larvae produced from those eggs, is highly unlikely. The condition or development of eggs carried by female lobsters at the time of exposure, even at close proximity directly beneath the seismic source, were not affected (Day et al. 2016b). However, these eggs were in an early embryonic developmental stage, just after extrusion and prior to eye development, and were thus entirely soft tissue with no large internal density differences. Later spiny lobster larval developmental stages have developed sensory systems including arrays of pinnate setae along the flagella of the antennae and mechanosensory statocyst organs which they may use for navigation during the critical onshore migration and settlement phase. As such, the experimental results found here may not necessarily be the same for spiny lobsters exposed later in development (including later stage embryos and larvae) and is an area which requires further research to determine the potential impacts of seismic surveys on lobster populations.

The significance of the seismic exposures and whether the sub-lethal effects, such as increased righting times, may have wider ecological implications (e.g., ability to feed, avoid predators and resist disease) warrants further consideration.

Day et al. (2020) reported that some of the control lobsters used in the experiments were collected from a marine reserve and were found to have a high level of pre-existing impairment to statocysts similar to that induced by the seismic exposure experiments. The source of the damage in the lobsters in this study could not be ascertained, but the soundscape comparisons of the collection sites showed that the noisy site had a 5-10 dB greater level of noise, equivalent to a 3-10 times greater intensity, in the 10-700 Hz range than was found at the remote collection site. Therefore, this statocyst impairment was considered to be the result of long-term exposure to shipping noise. The lobsters with pre-existing statocyst damage showed no significant differences in righting times between control and exposed lobsters; however, as a group these lobster had the slowest right times of all experiments. It is unclear why exposure to the seismic surveys did not cause additional damage to the statocysts in these animals. Monitoring of the lobster population at the same reserve where the lobsters with pre-existing statocyst impairment were taken from showed that the rock lobster population within the reserve was thriving and at carrying capacity (Green & Gardner, 2009; Kordjazi et al. 2015). Therefore, the levels of statocyst impairment reported in the Day et al. (2016a) study appear to not be impacting on the survival of this lobster population. However, it should be noted that these lobsters were not subject to any fishing pressure and the same aquatic noise that damages the lobster statocysts may also reduce the level of predation they face.

Day et al. (2021, 2022, 2023) examined the potential impacts of seismic surveys on the larval stages of SRL to determine whether early development and recruitment may be affected. Lobster puerulus (post-larval stage) and juveniles were held in baskets and exposed to multiple passes of a seismic source element in 10-12 m water depths. Maximum received sound exposures were 203-219 dB re 1 μ Pa PK-PK, 181 to 190 dB re 1 μ Pa²-s per-pulse SEL, and SEL_{cum} of 201 to 205 dB re μ Pa²-s, comparable to Day et al. (2016a) (Day et al. 2021, 2022, 2023). Lobster puerulus were randomly assigned to control (not exposed to airgun signals) or E0 (exposed to airgun signals at a nominal range of 0 m from the sail line), and juveniles were assigned to control, E0 and E500 (exposed to airgun signals at a nominal range of 500 m from the vessel sail line). The findings of the study are as follows:

- Righting was significantly impaired for all exposure treatments immediately after exposure, indicating that the range of impact extended to at least 500 m from the source (maximum range tested in the study).
- Although exposure did not result in any elevated mortality for puerulus or juveniles, increased righting times likely indicated impaired predator avoidance and defence, which may therefore result in indirect mortality as a result of seismic exposure.
- Puerulus and juvenile E0 treatment lobsters did not show the capacity for recovery, while juvenile E500 lobsters recovered from impairment after the first moult, providing evidence of a range threshold for recovery
- Intermoult period was significantly increased in E0 juvenile lobsters, and appeared to be increased in puerulus, while juvenile E500 treatment lobsters show a moderate, non-significant increase in moult duration

- Increased intermoult duration suggested impacted development and potentially slowed growth, and physiological stress.

Impairment resulting from close range (0 m) exposure appeared to be persistent, as previously reported in adults, whereas juveniles exposed at a more distant range (500 m) showed recovery, indicating that exposure at a range of 500 m may not cause lasting impairment to righting (Day et al. 2022, 2023).

Unpublished research conducted by DPIRD Fisheries Research (de Lestang et al. in prep), has investigated the medium- and long-term effects of seismic exposure on wild western rock lobster, *Panulirus cygnus*. Two hundred and ten wild caught lobsters were tagged with spaghetti tags and held in aquaria for 10 days prior to being transported to the seismic survey location. One hundred of these lobsters were exposed at a depth of ~5 m, to an 80 in³ sleeve gun array, with an operating pressure of 2000 psi. The treatment lobsters were held in a line of eight or nine plastic baskets (four lobsters per basket), with the seismic source towed at a depth of 2 m over the middle of the line. Therefore, the minimum exposure range for lobsters in the baskets in the centre of the line was ~3 m. Sound exposure levels received by the treatment lobsters were not measured, as a hydrophone was deployed in the centre of the survey area, ~2 km away from the treatment location. An additional 100 control lobsters were held in the same conditions 5 nm away, well outside the survey area. All lobsters were tagged and released in fished areas. Upon release the animals righting reflex and release behaviour was tested. The treatment group had significantly greater righting time, greater limb loss, and exhibited overall poorer release behaviours, such as drifting, while the control group exhibited more active release behaviours. Recapture rates of the two experimental groups were modelled to obtain estimates of mortality over time. Preliminary results indicated a ~30% (15-45% CI) reduction in recapture rates of exposed animals, compared with the control animals, after one month at liberty, then no difference thereafter (<706 days). These results may indicate an initial 30% increase in mortality of the exposed animals within the first month post exposure, but equally it could be indicative of a behavioural reaction - i.e., a reluctance by exposed lobsters to enter a pot. Any acute mortality may indicate increased predation rates as a result of reduced defence capabilities associated with longer righting times and less active release behaviours. Further research, involving a larger sample size, is necessary to establish the robustness of these findings, particularly given the extremely close exposure ranges (minimum of ~3 m) for the treatment lobsters, which is not reflective of a typical 3D marine seismic survey.

7.2 Impacts to rock lobster

7.2.1 Eggs and larvae

For this impact assessment the sound exposure thresholds for mortality/potential mortal injury (PMI) to fish eggs and larvae from Popper et al. (2014) were applied and consider both PK and SEL_{24h} metrics (Table 7-1). The thresholds were based on limited data and were selected on the basis that Popper et al. (2014) note that they are likely to be conservative. While research generally suggests limited impacts to plankton beyond approximately 10 m distance from seismic sources, the precautionary Popper et al. (2014) thresholds for larval mortality / PMI have been selected to indicate the magnitude and extent of potential impacts from acquisition of the survey.

Table 7-1: Maximum predicted distances (R_{max}) to mortality/PMI thresholds in the water column for fish eggs and larvae, and zooplankton

Sound exposure threshold	R_{max} distance (km)
210 dB re 1 $\mu\text{Pa}^2\cdot\text{s}$ (SEL _{24h})	0.06
207 dB re 1 μPa (PK)	0.27

As shown in Table 7-2, the maximum distance (R_{max}) to mortality/PMI thresholds for fish eggs and larvae, and zooplankton, applying the single pulse (PK) threshold from Popper et al. (2014) was 270 m.

Any potential mortality/PMI impacts to zooplankton communities have to be assessed in the context of natural mortality in these populations. Any mortality or mortal injury effects to zooplankton (including fish eggs and larvae) resulting from seismic noise emissions are likely to be inconsequential compared to natural mortality rates, which are very high—refer discussion above.

7.2.2 Adult lobsters

7.2.2.1 Sound pressure

A range of sound exposure levels from 202 dB re 1 μ Pa PK-PK to 213 dB re 1 μ Pa PK-PK were applied in the acoustic modelling study for benthic invertebrates. Sound levels of 209–212 dB re 1 μ Pa PK-PK thresholds are potentially associated with some level of sub-lethal effects. As shown in Table 7-2, at a sound exposure threshold of 209 dB re 1 μ Pa PK-PK, the maximum predicted $R_{\max}$ distance was 167 m. The maximum predicted $R_{\max}$ distance associated with the 213 dB re 1 μ Pa PK-PK level for sub-lethal effects and chronic mortality (Day et al. 2017) was 103 m.

Table 7-2: Maximum predicted distances ($R_{\max}$) to effect thresholds for benthic crustaceans at the seafloor

Sound exposure threshold (PK-PK)	$R_{\max}$ distance (m)	Water depth (m)
213 dB re 1 μ Pa	103	40
212 dB re 1 μ Pa	121	50
210 dB re 1 μ Pa	136	30
209 dB re 1 μ Pa	167	50
202 dB re 1 μ Pa	292	15

At received noise levels of 209 dB re μ Pa (PK-PK), the maximum predicted $R_{\max}$ distance for sub-lethal impacts to crustaceans is approximately 167 m, and therefore there is the potential for some crustaceans to experience sound levels that could result in some low-level, sub-lethal effects (e.g., impairment of reflexes, damage to statocysts and reduction in numbers of haemocytes). These sub-lethal effects could result in a reduction in fitness to some individuals, but Day et al 2016a and 2016b showed that exposed and control lobsters housed in a laboratory for up to a year post-exposure did not show increased levels of mortality. In addition, the OA covers only a very small area occupied by the Rock Lobster population so logically only a small proportion of the population could experience these sub-lethal effects. Therefore, impacts at a population level due to reduced fitness would be unlikely.

7.2.2.2 Particle motion

At the seafloor interface, crustaceans and bivalves are subject to particle motion stimuli from several acoustic or acoustically-induced waves. These include the particle motion associated with an impinging sound pressure wave in the water column (the incident, reflected, and transmitted portions), substrate acoustic waves, and interface waves of the Scholte type. However, it is unclear which aspect(s) of these waves is/are most relevant to the animals, either when they normally sense the environment or their physiological responses to loud sounds, and as such there is not enough information to establish similar criteria and thresholds as done for marine mammals and fish. Including recent research, such as Day et al. (2016a, 2016b, 2017), current literature does not clearly define an appropriate metric or identify relevant levels (pressure or particle motion) for an assessment. This includes the consideration of what particle motion levels lead to a behavioural response, or mortality. Therefore, at this stage, authoritative thresholds to inform the impact assessment are not defined. However, levels can be determined for pressure metrics presented in literature to assist the assessment (Koessler & McPherson 2023; Appendix E).

As described above, for crustaceans, a PK-PK sound level of 202 dB re 1 μ Pa (Payne et al. 2008) is considered to be associated with no impact, and therefore applied in the assessment. Additionally, for context, the PK-PK sound levels determined for crustaceans in Day et al. (2016b), 209–212 dB re 1 μ Pa, are also included.

Reef exclusion zones

Noting the maximum distance to no effect for western rock lobster was 292 m, based on the conservative 202 dB re 1 μ Pa PK-PK threshold level from Payne et al. (2008), Pilot has proposed seismic source exclusion zones of 300 m around Leander Reef, Big Horseshoe Reef and around a further 13 unnamed reef areas in water depths shallower than 12 m. The seismic source will not be operated within 300 m horizontal distance of the 12 m contour of Leander Reef and Big Horseshoe Reef or within 300 m horizontal distance of the 12 m contour of the other unnamed reef areas within the eastern part of the ASA (Figure 7-1).

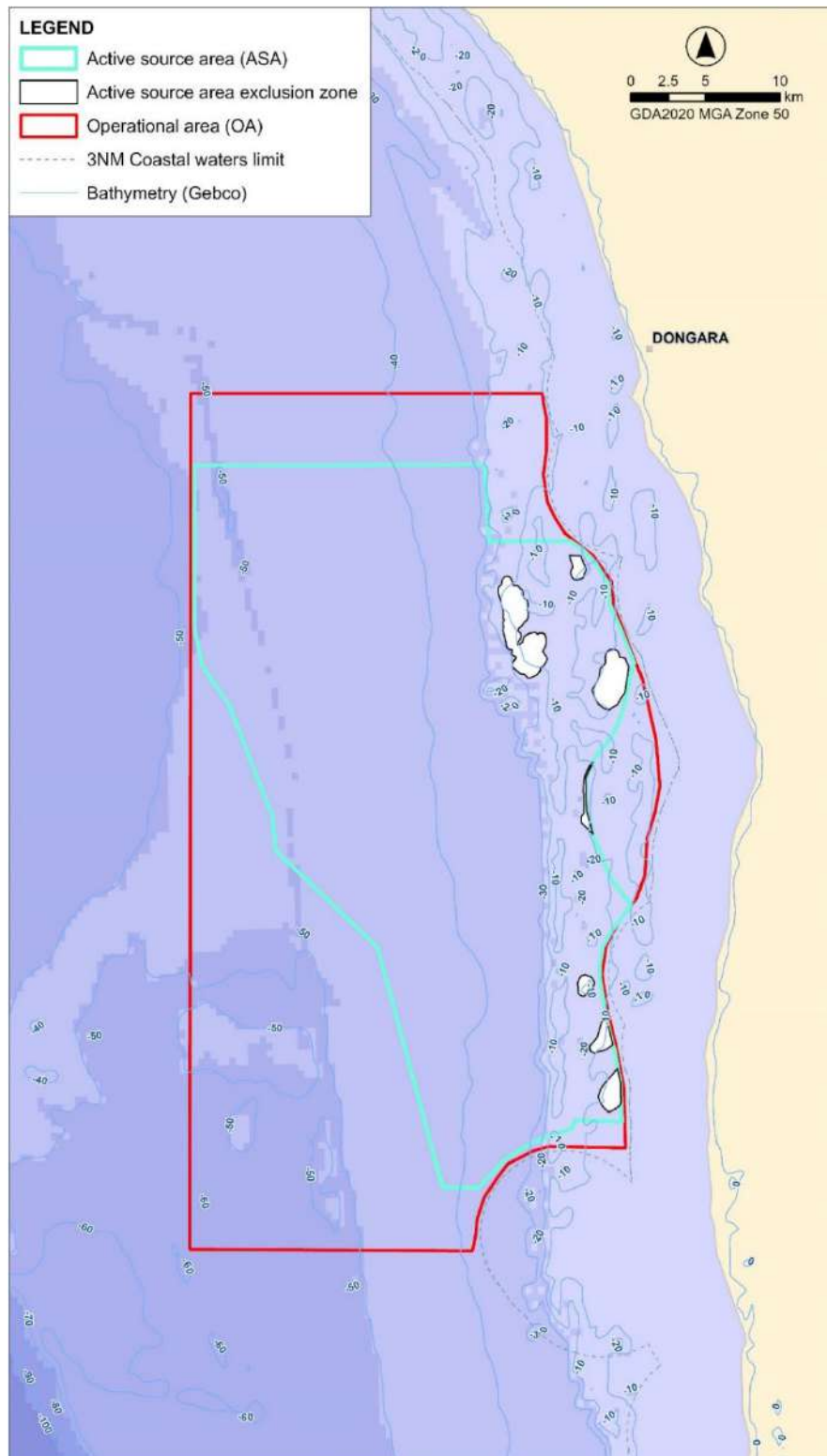


Figure 7-1: Proposed seismic source exclusion zones

7.3 Impacts to WCRLMF

Increased sound levels associated with seismic acquisition may modify the behaviour, local abundance and distribution of fish species, and therefore affect commercial fisheries catch rates within the Active Source Area and in adjacent waters. Additionally, seismic acquisition has the potential to affect commercial fisheries via displacement or exclusion of fishers from areas where they normally operate for all or part of the period during which the survey is being acquired.

Parry & Gason (2006) undertook a statistical analysis of catch per unit effort (CPUE) data collected over nearly 30 years in the Victorian southern rock lobster fishery (in southwest Victoria) that showed no influence of historical 2D and 3D MSS activity. Analyses looked at short-term (weekly) and long-term variations (up to seven years) in CPUE to determine whether changes were correlated with the MSS. The surveys occurred in water depths ranging from 10 m to 150 m. The study included surveys occurring during the SRL spawning period as well as during the lobster fishing season and so would have interacted with adult lobsters and larvae in the same way that the proposed Eureka 3D MSS may. This study found no evidence that catch rates were affected in the weeks or years following the surveys; however, Day et al. (2016a) suggest that catch rates would have had to decrease by around 50% for this study to detect a result.

7.4 Impacts to protected area values and management

Protected areas and their WRL conservation values that could be affected by seismic sound from the Eureka 3D MSS are summarised in Table 7-3.

Table 7-3: Protected areas potentially directly or indirectly affected by the Eureka 3D MSS

Protected area	Conservation values that may be affected by the survey	Impacts from survey
Commonwealth protected areas		
Abrolhos AMP	Important rock lobster habitat	The impact assessment for environmental receptors provided throughout this section demonstrates that the survey will not have significant impact on the values of the area for migration, feeding, resting, and breeding/nesting. Pilot has adopted a 'zoned' approach to the Eureka 3D MSS and will implement control measures to avoid impacts to migrating cetaceans.
Key ecological features		
Commonwealth marine environment within and adjacent to the west coast inshore lagoons KEF	Important nursery area for western rock lobster	The marine environment within and adjacent to the west coast inshore lagoons KEF is located within the Eureka 3D MSS OA
Western rock lobster KEF	Important area for western rock lobster	The western rock lobster KEF is located within the Eureka 3D MSS OA.

8 INTERACTIONS WITH COMMERCIAL AND RECREATIONAL FISHING ACTIVITIES FOR WRL

Consultation with stakeholders identified concern over the loss of access to fishing grounds (displacement) and interference with fishing gear (e.g., entanglement).

Recreational fishers onboard charter and private vessels operating off the WA coast and around the Abrolhos Islands typically target large pelagic and west coast demersal scalefish species. There were 59 licenced tour operators active in 2019/2020 (Newman et al., 2021a), though only 1-2 licences per year in waters within the OA. It is likely that some activity by recreational fishers will occur within the OA, though this is expected to be short-term and intermittent. This may be impacted by the recent extension to banned fishing periods for demersal scalefish, which overlaps with the period of the survey; however, there is no information to advise how long this extension may apply for. It will be necessary for areas in the immediate vicinity of the survey vessel and towed array to be prohibited to recreational and commercial fishing vessels in accordance with maritime regulations relating to safety of navigation. However, only minor disruption to fishing activities is expected for fishers who may set their fishing gear for several hours and/or who are mobile and can move away from the survey vessel whilst still fishing (for example rock lobster and octopus fishers). This is because the survey vessel will be travelling at a slow speed (4.5 knots) and occupies a small space relative to the broader survey area which will remain open to fishing activity.

9 SEABED DISTURBANCE TO WRL

9.1 Ocean bottom nodes

Shallower areas of the OA may be better acquired using ocean bottom node (OBN) technology. The nodes have flexible placement and retrieval options including autonomous vehicles, nodes on a rope (NOAR) and commercial divers. The nodes would be placed on the seabed at the start of the survey and collected at the end of the survey timeframe. The placement and retrieval of these small, lightweight nodes on the seabed has the potential to cause minor physical damage to benthic habitats.

OBNs may be placed on the seabed in water depths shallower than ~12 m. Nodes are expected to be placed in a grid of 250 m x 250 m, which would result in the deployment of approximately 2,500 nodes. The Node Survey Area where equipment will be deployed covers approximately 119 km². The shallow waters of the OA partially overlap with the Commonwealth marine environment within and adjacent to the west coast inshore lagoons KEF, and the OA is entirely within the Western rock lobster KEF.

The temporary placement and retrieval of nodes on the seabed may result in negligible impacts to biota as a result of physical disturbance and elevated turbidity. However, given the localised area where the equipment will be placed and their small footprints, no significant impact to the values of the Commonwealth marine environment within and adjacent to the west coast inshore lagoons and Western rock lobster KEFs will occur.

9.2 Accidental loss of solid objects and unplanned anchoring

During normal operations, the survey vessel will tow an underwater seismic source and a series of streamers (minimum of six) with a maximum length of ~7 km, at approximately 4.5 knots (8 km/h). The seismic source will be towed at a depth of 6 – 7 m beneath the sea surface, and streamers will be towed at a depth of ~7 m below the sea surface. Should a seismic streamer become detached from the survey vessel or drag on the seabed it has the potential to cause minor physical damage to benthic habitats. However, the streamers are fitted with streamer recovery devices (SRDs) (i.e., pressure-activated, self-inflating buoys) that are designed to bring the equipment to the surface if lost accidentally. As the equipment sinks, it passes a certain water depth at which point the buoys inflate and bring the equipment back to the surface. Once at the surface the survey or support vessel will recover the streamer where practicable and safe to do so.

Under normal operations, no anchoring will be undertaken by the survey and support/chase vessels within the OA. Unplanned anchoring could occur in the event of an emergency to maintain the safety of the vessel and crew. Anchoring may result in localised disturbance to the benthic environment in contact with the anchor and anchor chain or inadvertently anchoring over shipwrecks, pipelines, other oil, and gas subsea infrastructure, or set fishing gear (i.e., rock lobster pots,).

The extent of disturbance will depend on the nature of the seabed and the area disturbed.

9.3 Accidental oil spill

In the event of a fuel spill, surface slicks and plumes of entrained hydrocarbons can cause a localised reduction in water quality in surface waters, which at specific thresholds and exposure hours may have toxic effects on marine fauna and flora. Potentially affected biota includes plankton, fishes, and invertebrates (including rock lobster). Acute or chronic exposure to an oil spill through surface contact and/or ingestion can result in toxicological risks. The presence of an exoskeleton (e.g., crustaceans such as rock lobster) will reduce hydrocarbon absorption through the surface membrane but invertebrates with no exoskeleton and larval forms may be more vulnerable to impacts from pelagic hydrocarbons.

The Western rock lobster KEF could be contacted by dissolved and entrained oil at biologically relevant thresholds. It is possible for this KEF to be contacted by dissolved oil from just north of Geraldton to approximately 100 km south of Cervantes. Entrained oil could affect a greater portion of the Western rock lobster KEF with possible contact extending approximately 200 km north of Geraldton to approximately 150 km south of Perth at concentrations greater than 10 ppb. However, for both dissolved and entrained oil fractions only a small portion of the KEF between these northern and southern points could be contacted by dissolved oil at concentrations greater than 10 ppb. The area of the KEF that could be contacted by oil is very small relative to the size of the KEF.

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