Final report

Bremer Canyon
Emerging Priorities Project EP2

Occurrence and distribution of marine wildlife in the Bremer Bay region

Phil Bouchet, Jessica Meeuwig, Christine Erbe,
Chandra Salgado-Kent, Rebecca Wellard, Charitha Pattiaratchi

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Supported by the Australian Government's
National Environmental Science Programme

Project EP2: Surveying marine life in the canyons off Bremer Bay.

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1. Introduction

Approximately 70 kilometres south-east of Bremer Bay (119.4°E, 34.4°S) off southern Western Australia's coast lies a group of submarine canyons that incise the continental slope, plunging to depths of more than 1,000 metres. Charismatic pelagic organisms such as cetaceans, sharks, seabirds and squid are known to concentrate in high abundance above these features. In particular, the canyons are the site of the largest reported seasonal aggregation of killer whales (*Orcinus orca*) in the Southern Hemisphere, with over 100 identified individuals in the local population, many of which are regularly sighted. Existing data suggest that the majority of killer whale encounters occur west of the Bremer Marine Park, around the heads of the Knob and Henry Canyons. It is unclear, however, whether this area represents a discrete and unique killer whale hotspot or whether the park may support other aggregations, be they from separate individuals or the same animals frequenting the hotspot. Furthermore, the mechanisms underpinning ocean productivity in these otherwise relatively oligotrophic waters remain largely unresolved.

Under the National Environmental Science Programme (NESP) Emerging Priorities scheme, the Minister for the Environment and Energy, the Honourable Josh Frydenberg MP, committed $AUD 100,000 in research funding to the Marine Biodiversity Hub (MBH) to:

- Convene a scientific workshop that would enable a group of selected experts from a variety of institutions to synthesise existing data around the distribution, abundance, diversity and behaviour of marine wildlife in the Bremer hotspot and identify critical knowledge needs (Meeuwig *et al.* 2016);
- Develop an appropriate sampling plan for addressing some these gaps;
- Collect empirical data in the field accordingly and within a short timeframe.

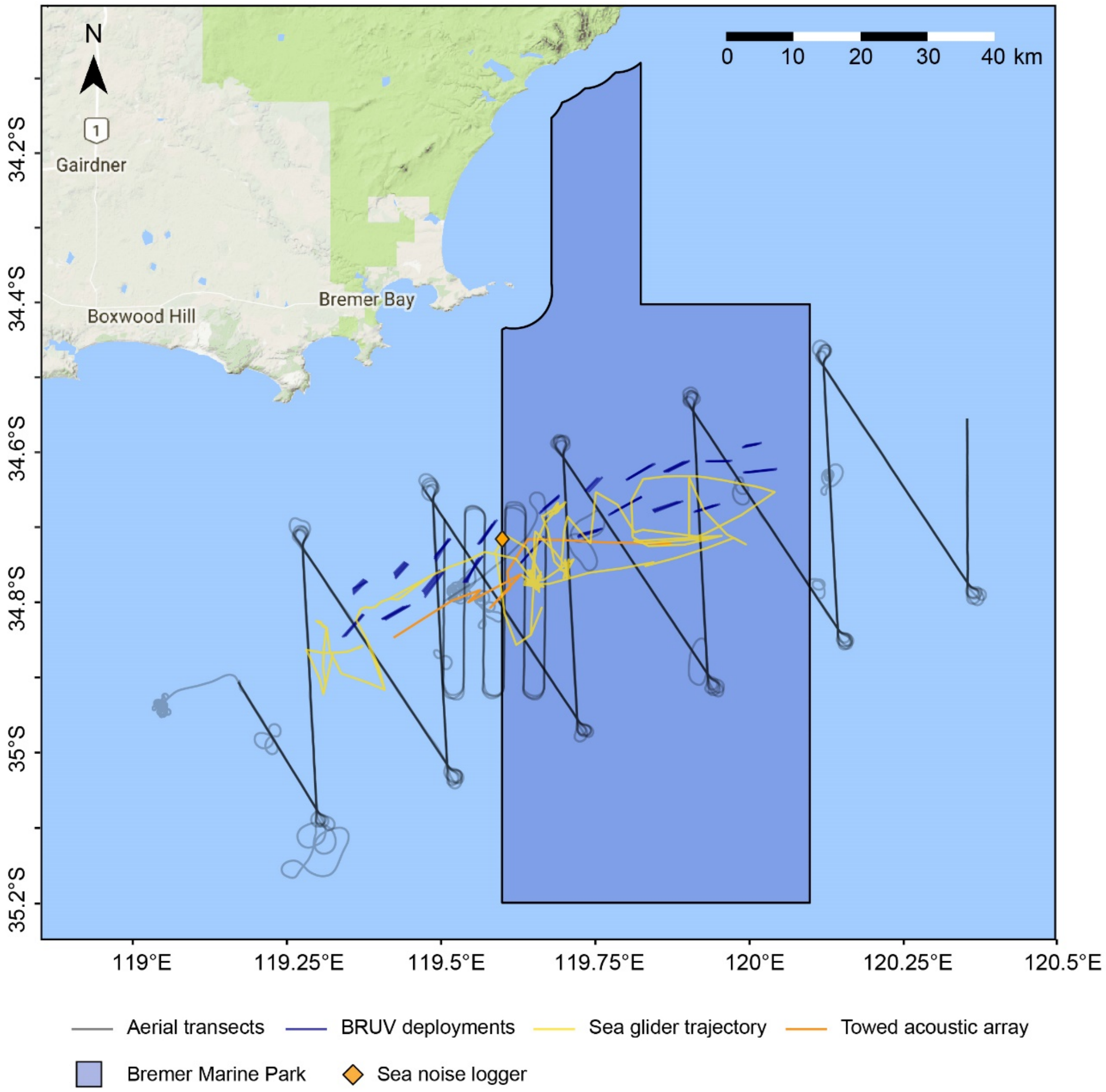
Meeuwig *et al.* (2016) capture the outcomes of the workshop (held October 25, 2016 at the University of Western Australia) in a separate report, and provide both a thorough overview of current knowledge on physical and biological processes in the Bremer ecosystem, as well as further background information on the rationale behind the project. The expert consultation process identified two priority information gaps of relevance to the needs of the Minister. These related to (i) the regional distribution of cetaceans throughout the Bremer sub-basin, and (ii) the identification of adequate engagement and communication tools for assisting decision-making.

Between February and April 2017, the Bremer Marine Park and surrounds were accordingly surveyed using a combination of sampling platforms (see subsequent sections for details). These activities were supported by an additional contribution of $AUD 50,000 from Parks Australia, $15,000 from the Ian Potter Foundation, and an in-kind contribution from the Integrated Marine Observing System (IMOS). This report builds on Meeuwig & Turner (2017) and summarises the results of the Bremer Canyon NESP EP2 Project ('Occurrence and distribution of marine wildlife in the Bremer Bay region'). The data acquired will not only help prioritise future research but will also support policy and management decisions with respect to the Bremer Marine Park, as well as the Albany Canyon group and adjacent shelf break, which are both identified as Key Ecological Features in the South-West Marine Bioregional Plan.

2. Research activities

2.1. Overview of survey effort

A multidisciplinary survey of the Bremer Marine Park was undertaken in 2017 in a collaborative effort between the University of Western Australia (Marine Futures Lab), Curtin University of Technology (Centre for Marine Science and Technology), the Marine Information and Research Group (MIRG) Australia and IMOS. Sampling involved a combination of aerial visual transects, deployments of drifting mid-water baited remote underwater video systems (stereo-BRUVS), passive acoustic recordings, and water profiling using a deep-diving autonomous underwater vehicle (Seaglider) (**Figure 1**).



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2.2. Pelagic baited video surveys

Methods

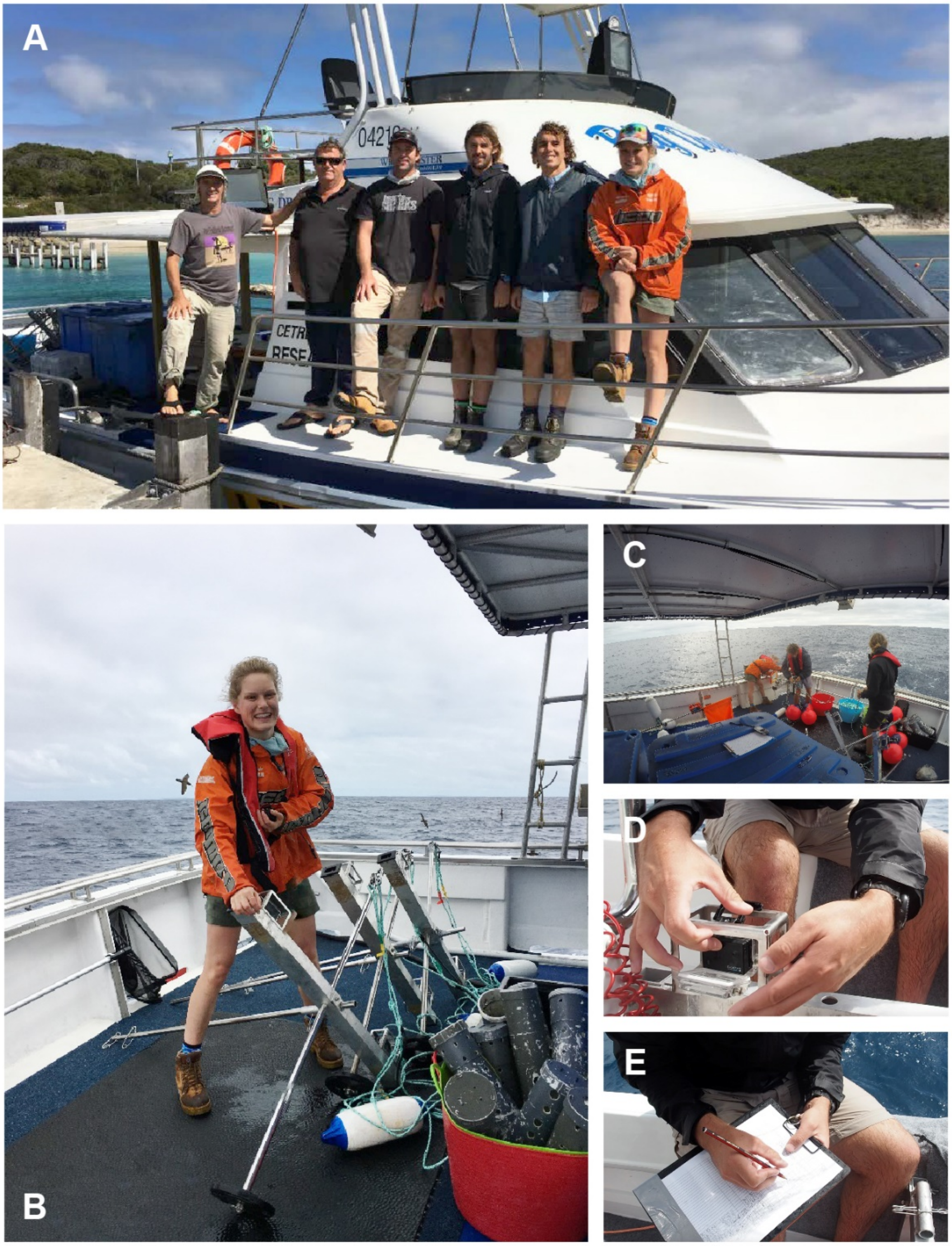
A team from the University of Western Australia's Marine Futures Lab collected video imagery from 100 mid-water stereo-BRUVS deployments over a period of ten days between February 27, 2017 and March 08, 2017 (**Figure 2**). Mid-water stereo-BRUVS provide a cost-effective, non-invasive tool for sampling and monitoring deep ocean environments, and have been used extensively for establishing scientific baselines in other West Australian marine parks (Letessier *et al.* 2013, Letessier *et al.* 2014, Bouchet & Meeuwig 2015). Sampling proceeded with 20 sets of 5 camera pairs, tethered on a longline and set adrift at sites located both within and westward of the Bremer Marine Park, primarily along the continental shelf break and over canyon heads (**Figure 1**). Image processing and analysis were completed at the University of Western Australia using SeaGIS software EventMeasure, as per established protocols (Bouchet *et al.* 2018). All detected animals were identified to the lowest possible taxonomic level, their relative abundance recorded (as MaxN[1]), and body (fork) lengths measured using epipolar geometry (Gibson *et al.* 2016) whenever conditions (e.g. turbidity) allowed. Records of feeding behaviour or interactions between congeners were logged as appropriate.

Results

A total of 14 taxa were observed, including large predators such as killer whales (*Orcinus orca*), bronze whaler (*Carcharhinus brachyurus*) and blue sharks (*Prionace glauca*), as well prey species like the cock-eyed squid (*Histioteuthis miranda*) (**Table 1 & Figure 3**). Large schools of mackerels and jacks were also encountered, in addition to small juveniles of unidentifiable species. Unique skin marks, likely gained during mating, were visible on female blue sharks. Sharks exhibited a fairly widespread distribution, and were seen on multiple transects inside and outside the park. By contrast, the only BRUV-based sighting of killer whales was at the head of the Knob canyon, approximately 18 km (9.8 nm) west of the park boundary (**Figures 5 to 11**).

No difference in mean taxonomic richness per deployment was detected between sites located inside and outside the Bremer Marine Park (TR_{IN} = 1.62 ± 0.58 SD vs. TR_{OUT} = 1.85 ± 0.53 SD). Similarly, no differences were observed in the proportion of longlines on which animals were present (χ^2 2x2 contingency test on families with sufficient sample size, namely *Carangidae*, *Carcharhinidae*, *Clupeidae*, and Juveniles), nor in the mean total abundance per deployment (TA_{IN} = 6.77 ± 4.81 SD vs TA_{OUT} = 9.68 ± 12.0 SD; p=0.62; t-test on $\log_{10}$ values of TA). The marginally greater mean total abundance outside the park resulted from high numbers of small clupeids (herrings). Example footage from the stereo-BRUVS can be viewed at https://youtu.be/jktW3t-xsv8. When placed in a wider national context, the Bremer Marine Park exhibits intermediate levels of species diversity and biomass, though it supersedes all other parks sampled to date within the South-west network (i.e. Perth Canyon and Geographe) (**Figure 4**).

[1] MaxN is calculated as the maximum number of individuals of a given species in a single frame, and is a conservative estimate of relative abundance that avoids the double counting of individuals.



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Family	Species	Common name	Where	MaxN	LME	LMI	LMA
Carangidae	*Naucrates ductor*	Pilot fish	In	14	478	304	753.9
	Trachurus novaezelandiae	Yellowtail horse mackerel	In	32	152.3	126.7	194.8
	Carangidae sp.	Jacks, mackerels and scads	In / Out	150	44.4	7.3	336.5
Carcharhinidae	*Carcharhinus brachyurus*	Bronze whaler (copper) shark	In / Out	19	2136	1518	2817
	Prionace glauca	Blue shark	In / Out	14	2526	1857	3443
	Carcharhinidae sp.	Requiem sharks	In	1	-	-	-
Clupeidae	*Clupeidae sp.*	Herrings and sardines	In / Out	198	157.7	19.7	824.7
Delphinidae	*Orcinus orca*	Killer whale	Out	2	-	-	-
Echeneidae	*Remora remora*	Suckerfish (remora)	In	2	-	-	-
Histioteuthidae	*Histioteuthis miranda*	Cock-eye squid	In / Out	9	393.5	243.4	867.7
Monacanthidae	*Monacanthidae sp.*	Leatherjackets	In	1	19.2	19.2	19.2
Scombridae	*Scomber australasicus*	Blue mackerel	In / Out	202	318.4	112.6	892.5
	Thunnus maccoyii	Southern Bluefin tuna	In	2	1001	1001	1001
Unidentified	*Juveniles sp.*	Juvenile fishes	In / Out	145	13.6	5.2	49.1

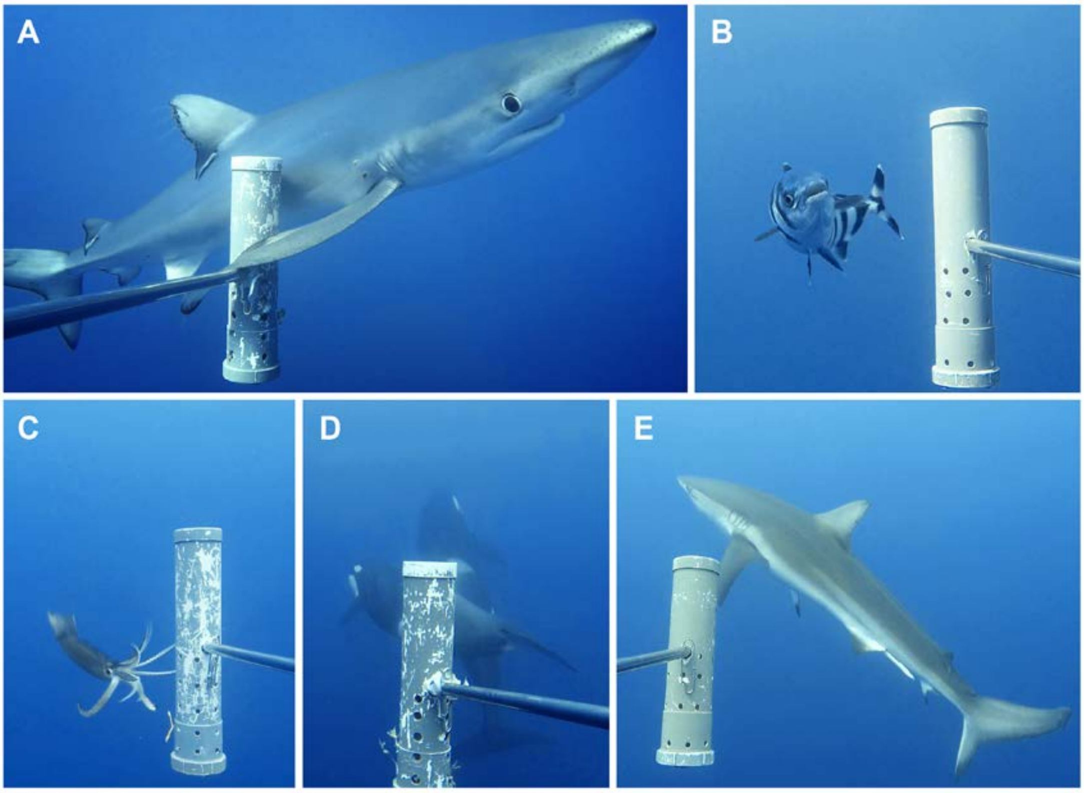
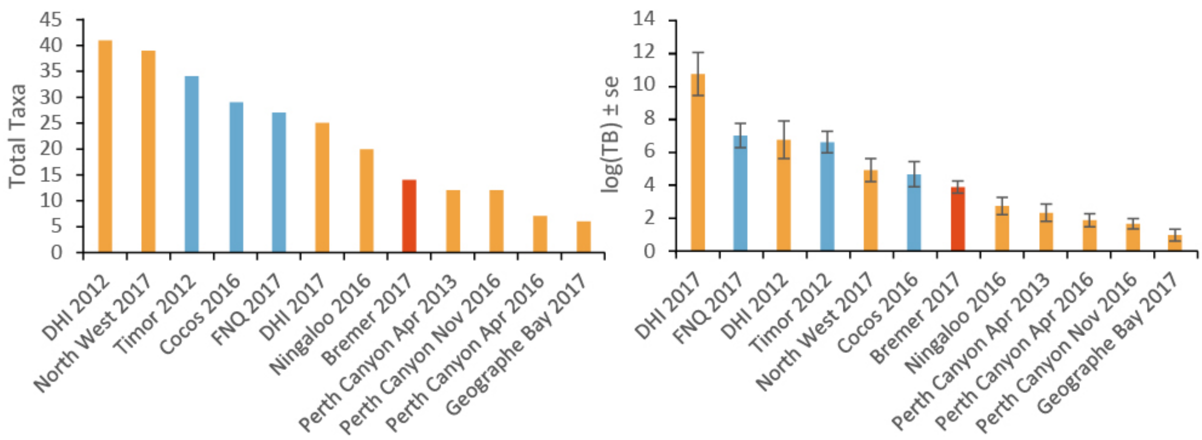


Figure 3. Example species detected on mid-water video systems within the Bremer Marine Park and surrounds, including the **(A)** blue shark, *Prionace glauca*; **(B)** Pilot fish, *Naucrates ductor*; **(C)** Cock-eyed squid, *Histioteuthis miranda*; **(D)** Killer whale, *Orcinus orca*, and **(E)** Bronze whaler shark, *Carcharhinus brachyurus*. Photo credits: Marine Futures lab, University of Western Australia.



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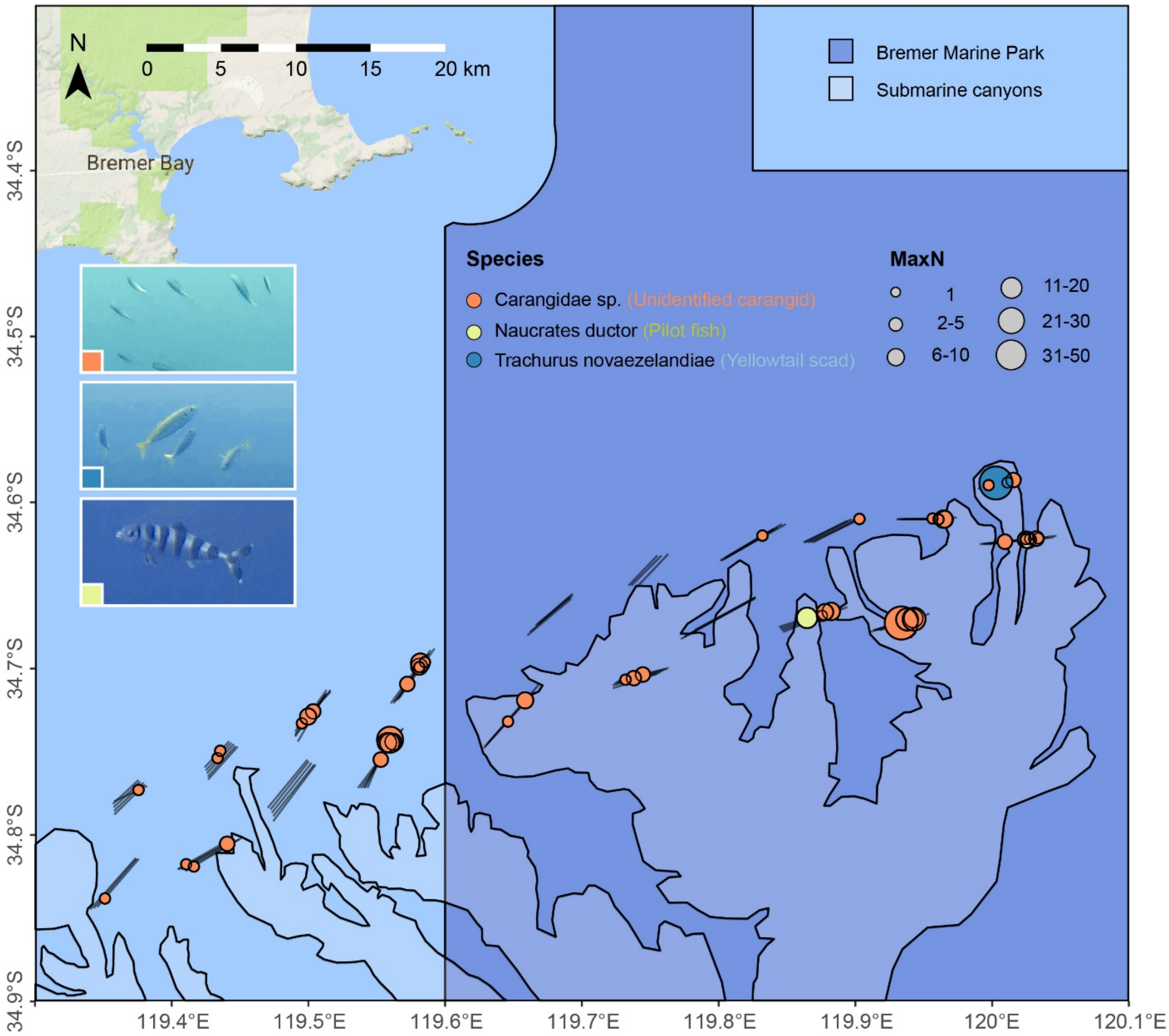

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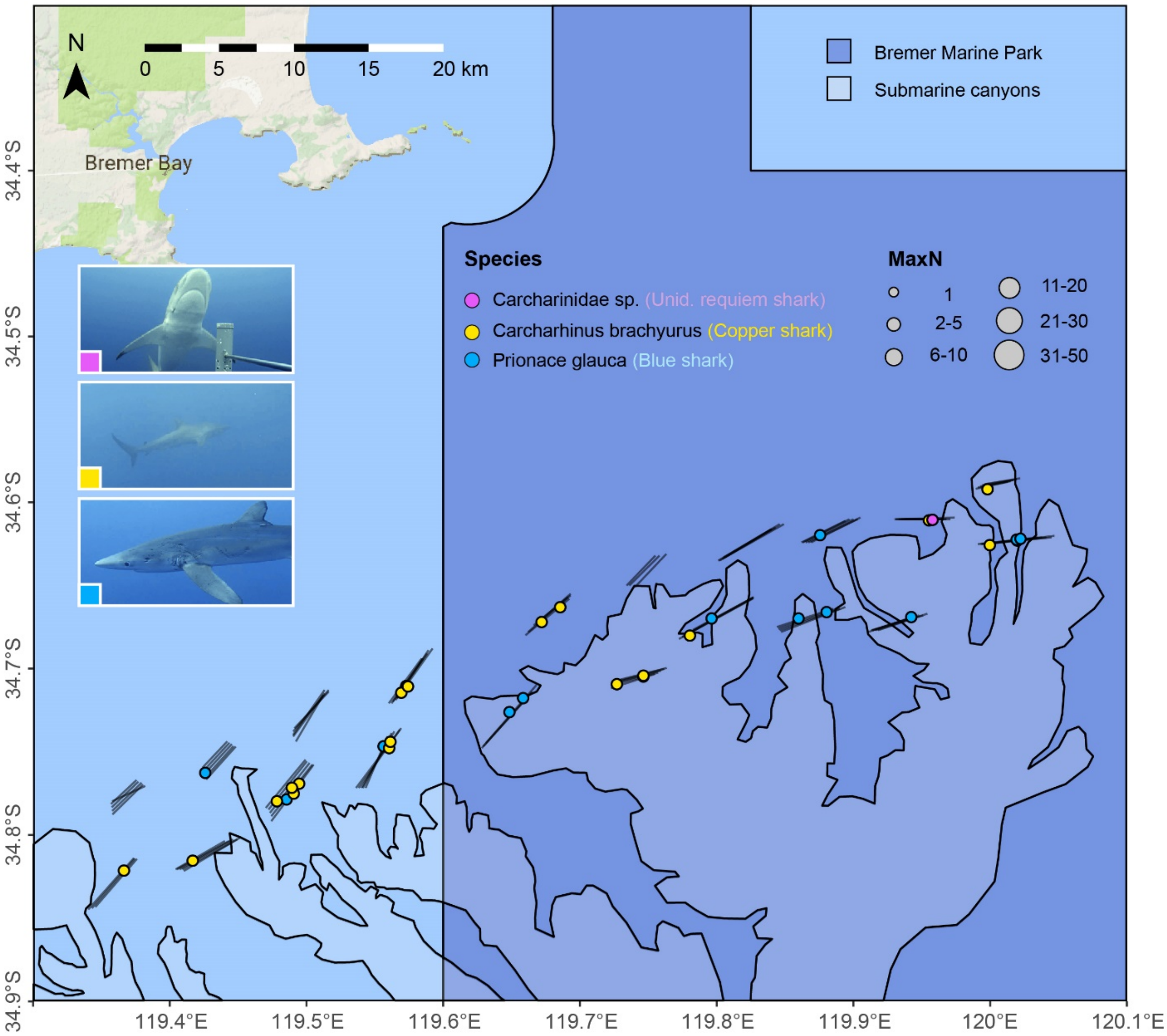

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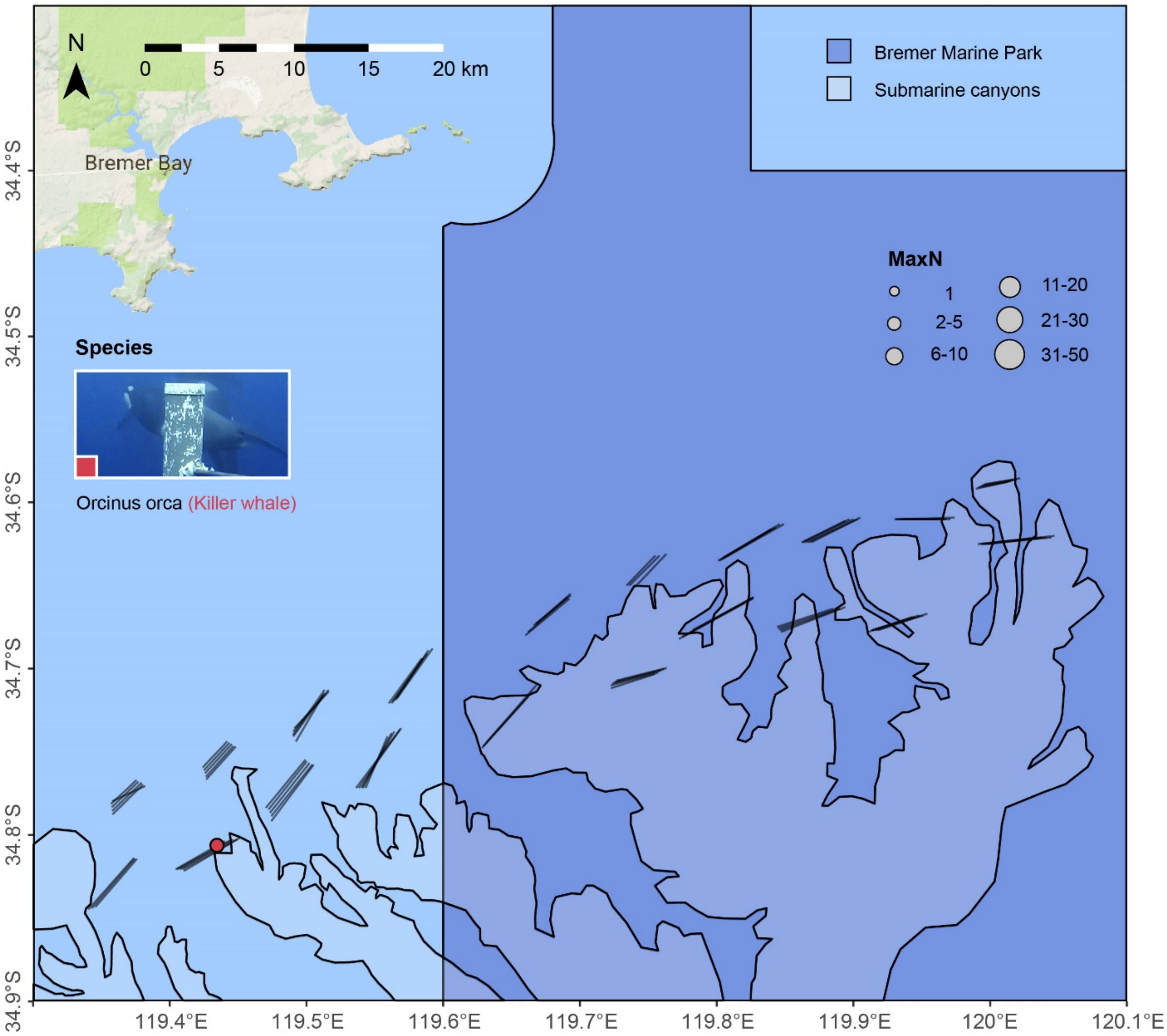

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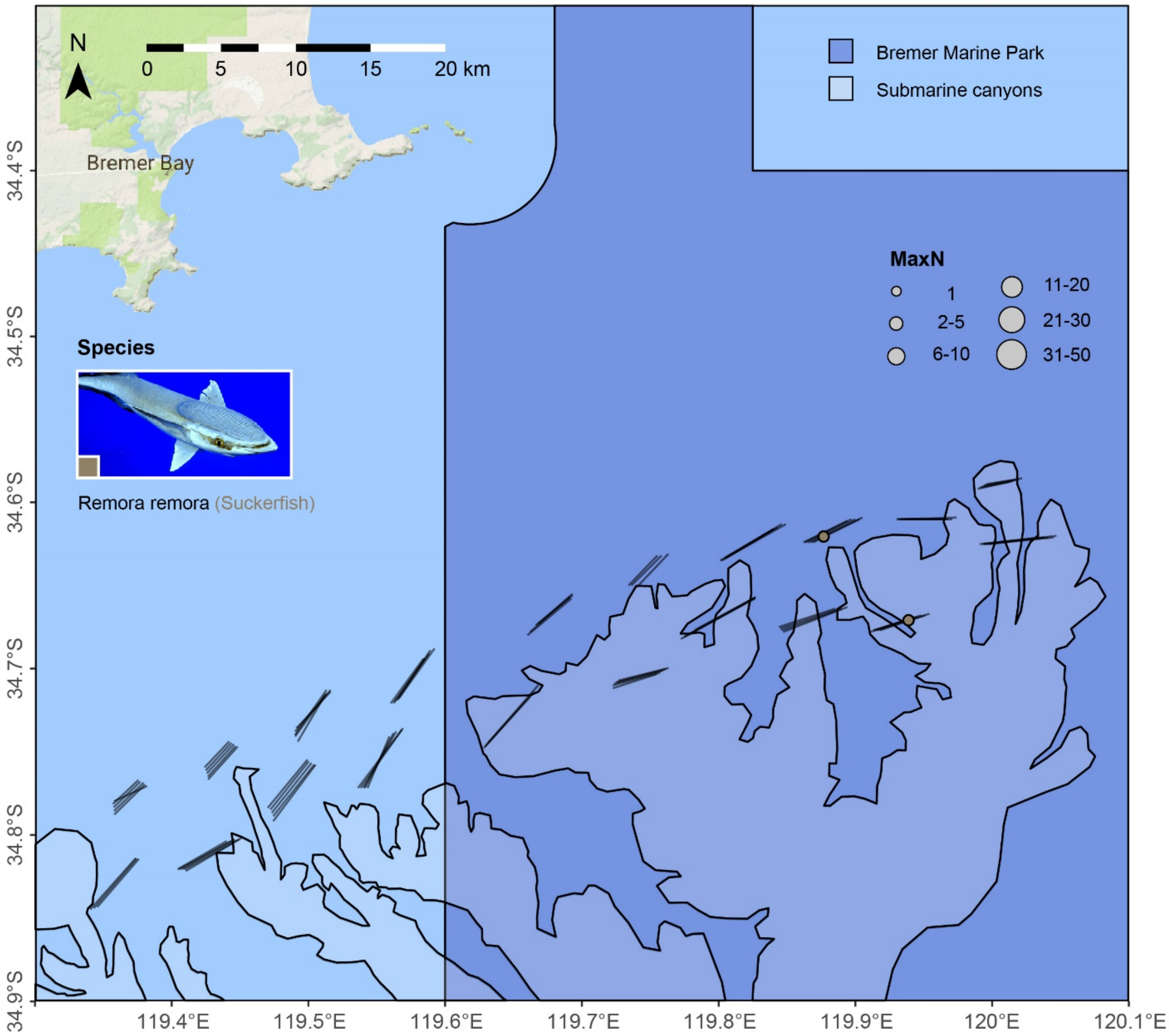

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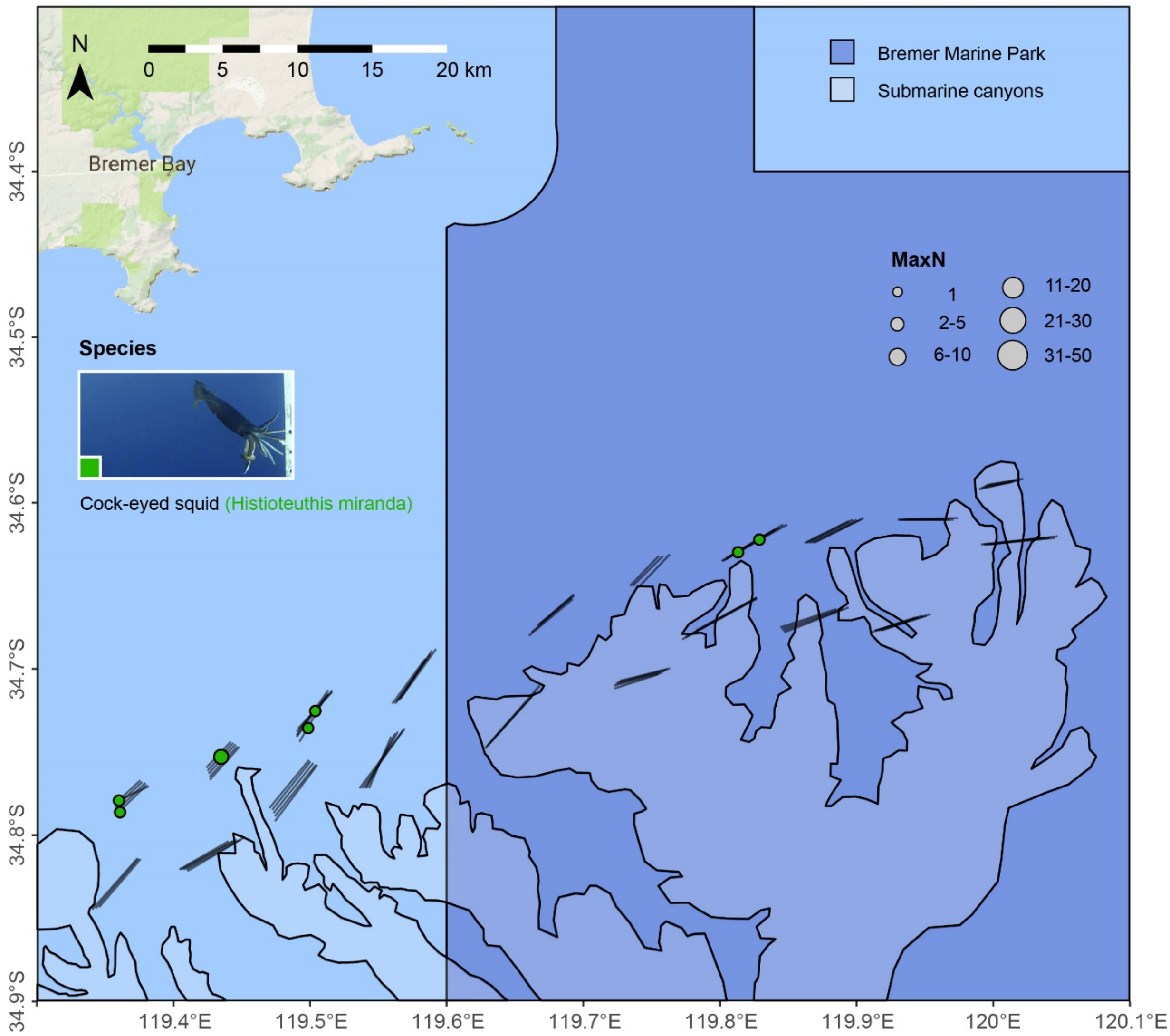

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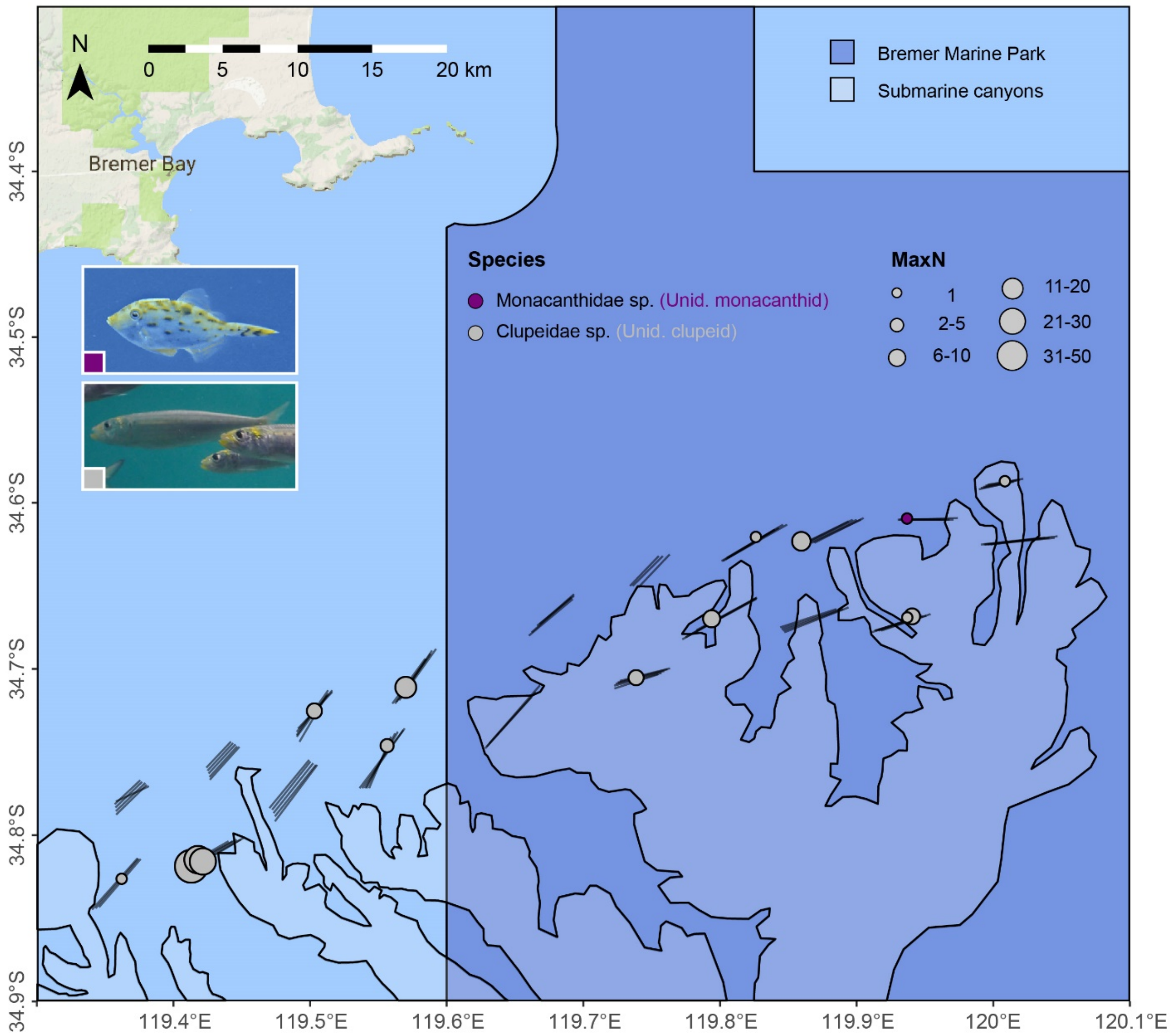

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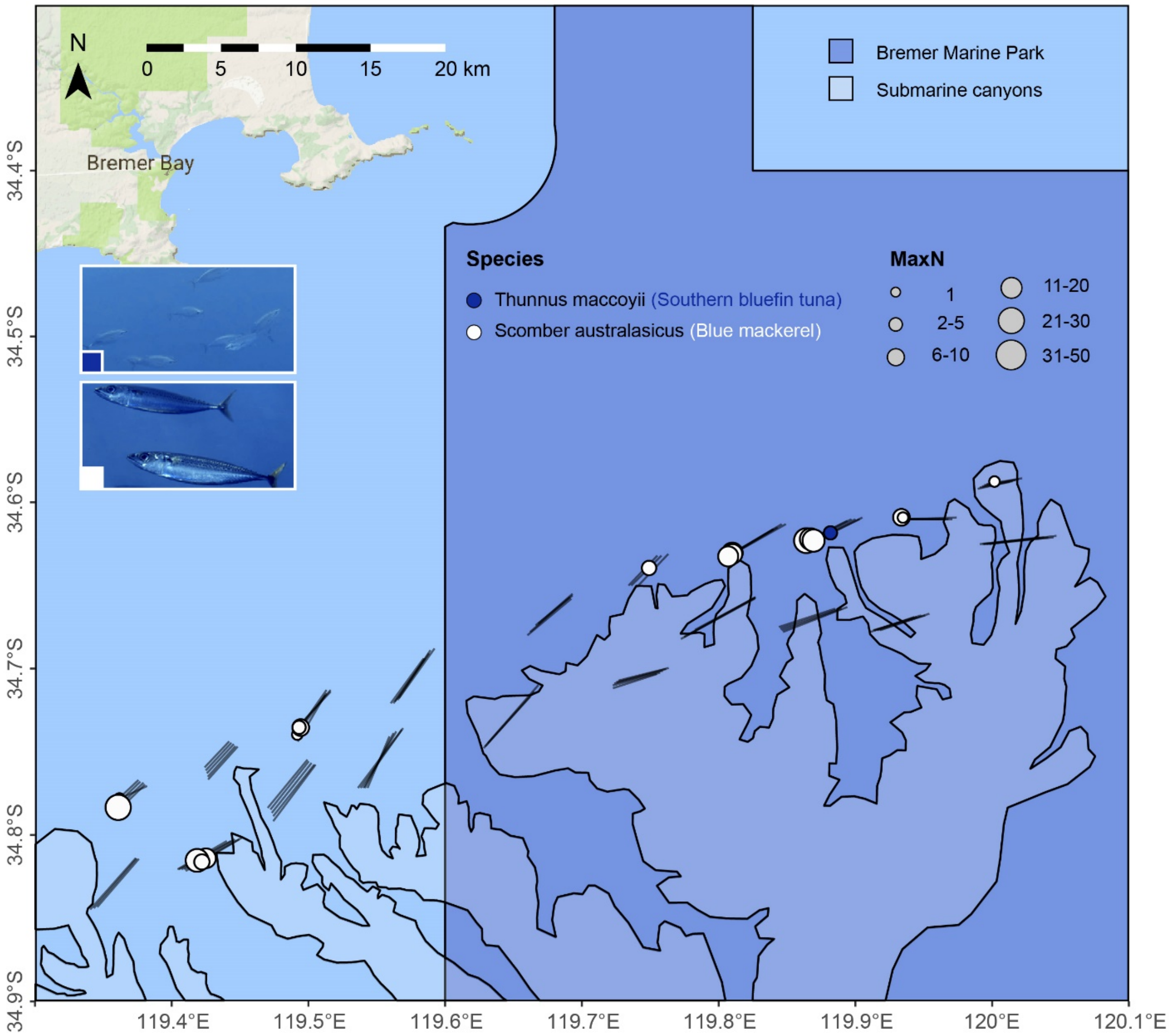

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2.3. Aerial transects

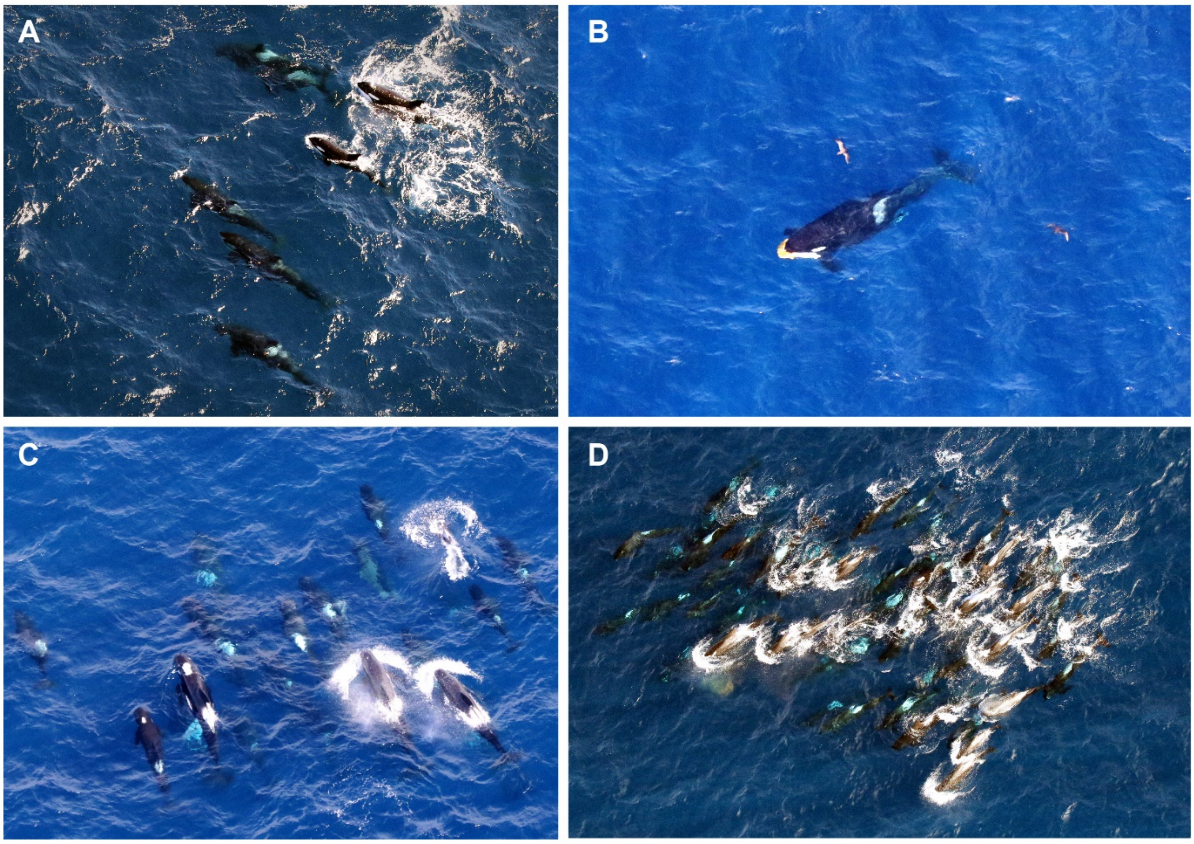
<u>Methods</u>

A series of six aerial visual surveys were undertaken between March 16, 2017 and March 23, 2017 aboard a twin-engine over-head wing Cessna 337 aircraft fitted with bubble windows (chartered from Norwest Air Work Pty Ltd). Transects were designed to cover a large section of ocean both within and outside the Bremer Marine Park, following a zigzag/sawtooth pattern. Additional search effort was also expanded around the known killer whale aggregation site west of the park, using denser parallel transects oriented North to South. Transects were flown at a constant altitude of 305 m (1,000 feet) and a speed of 222 $km.h^{-1}$ (120 knots) following previous studies (e.g. Salgado Kent *et al.* 2012). Onboard personnel included a pilot and a team of two experienced marine observers (led by Rebecca Wellard, Curtin University), who remained acoustically separated and independently logged sightings of all megafauna species observed during the flight. Ancillary data recorded with each detection consisted of GPS positions, estimates of confidence in species identification (certain, probable, guess), as well as any available information on animal numbers, behaviour, group size, group composition (presence of calves or sub-adults), swim direction, and sighting cue. Observers used clinometers (Suunto PM-5/360PC) and compass boards to record relative vertical and horizontal bearings to animals, allowing their true positions to be calculated post-survey after taking account of the aircraft's angle of drift. All sighting details were recorded on an Olympus digital recorder for post-flight data entry by the team leader.

Surveys were conducted in 'passing mode' (i.e. allowing no deviation from the flight path), however a 'racetrack' procedure was implemented to maximise data collection opportunities around killer whales. When the species was detected in reasonable proximity to the flight path, the aircraft circled back to re-survey the last segment of transect, allowing observers to gather as much information as possible (Hiby 1999, Hammond *et al.* 2013).

<u>Results</u>

A total of 62 sightings were made in 25 hours of effort (**Figure 12**), with four cetacean species reliably identified: the killer whale (*Orcinus orca*), the long-finned pilot whale (*Globicephala melas*), the sperm whale (*Physeter macrocephalus*) and the bottlenose dolphin (*Tursiops sp.*). More than two-thirds of sightings (70%) consisted of single animals or pairs, although several larger groups of pilot whales and bottlenose dolphins comprising between 10 and 60 individuals were also seen. Killer whales were encountered seven times during the week, with group sizes varying from 1 to upwards of 30 individuals. Of these seven encounters, two were inside the Bremer Marine Park boundaries, and the remaining five outside (**Figure 13**). Individuals were seen travelling in most cases (n=6, 85.7%). The remaining sighting, a group of more than 30 animals, including at least two calves, was observed feeding with long-finned pilot whales and bottlenose dolphins. It remains unclear whether killer whales were feeding upon or with these species. The distribution of both pilot and sperm whales was fairly widespread throughout the region, with the latter recorded on virtually every transect. Young calves were present in 11% of cetacean groups, and rarely exceeded a total of number of two. Several unidentified sharks and cetaceans were also recorded.



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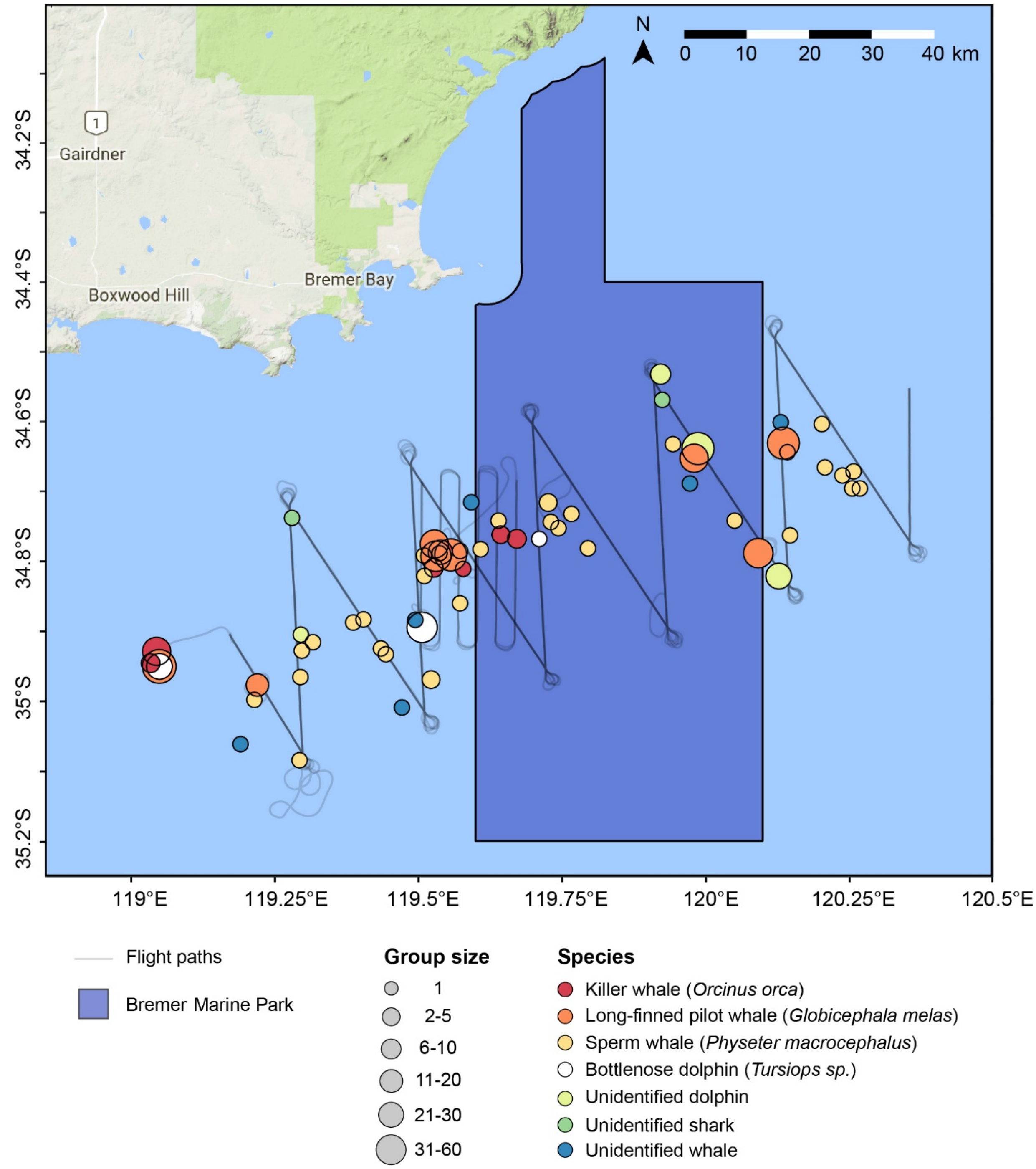

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2.4. Acoustic monitoring

Methods

Curtin University's Centre for Marine Science and Technology (CMST) has a long history of conducting passive acoustic monitoring around the Australian continent. Between February 2015 and February 2016, long-term acoustic observations were made at the edge of the continental shelf south of Bremer Bay, using two autonomous sound recorders deployed on the seafloor (**Figure 1**). One of these recorders was designed to operate at low frequencies characteristic of large baleen whales, and had a duty cycle of 300-s active intervals followed by 600-s of sleep time. The other, an SM2+ model from Wildlife Acoustics, targeted higher frequencies more appropriate for toothed whales and dolphins, and had a much higher sampling rate of 192,000 samples per second, recording approximately 960s every 30 minutes. A towed acoustic array was also deployed from the *R/V Whale Song* on February 7, 2016 during a transit journey in the Southern Ocean. The analysis of these datasets was commissioned under the NESP EP2 Project and is fully described in Gavrilov & Erbe (2017). In addition to this, 129 acoustic recordings of killer whales have been collected since 2014 in the context of Rebecca Wellard's PhD research, eight of which were obtained in 2017 (**Table 2**). The acoustic recordings from 2017 are subject to ongoing analysis.

Table 2. Summary of acoustic recordings of killer whales *Orcinus orca* obtained during the 2017 field season. Courtesy of Rebecca Wellard.

Date	Duration (min:sec)	Device used
01-Apr-2017	*20:00*	SoundTrap
03-Apr-2017	*12:06*	Hand-held hydrophone
03-Apr-2017	*19:00*	Hand-held hydrophone
03-Apr-2017	*05:41*	Hand-held hydrophone
03-Apr-2017	*03:45*	Hand-held hydrophone
03-Apr-2017	*04:53*	Hand-held hydrophone
03-Apr-2017	*07:19*	Hand-held hydrophone
03-Apr-2017	*08:39*	Hand-held hydrophone

Results

Vocalisations from four species of baleen whales were detected on the low-frequency logger, namely from Antarctic blue (*Balaenoptera musculus intermedia*), pygmy blue (*Balaenoptera musculus brevicauda*) (**Figure 14**), fin (*Balaenoptera physalus*) and humpback (*Megaptera novaeangliae*) whales. 'Spot calls', likely produced by southern right whales (*Eubalaena australis*) (Ward *et al.* 2017), were also heard. Only a few instances of whistles and echolocation clicks produced by toothed whales could be found in the data returned by both the high-frequency recorder and the towed array. The source of these sounds could not be readily identified due to the limited bandwidth and duration of available recordings, although it is likely that whistles and click trains belonged to killer and sperm whales respectively (Madsen *et al.* 2002, Wellard *et al.* 2015). The majority of large cetaceans visited the study area from late autumn to late spring, leaving the Bremer sub-basin or staying away during the summer and early autumn. The seasonality of toothed whale presence could not be determined at this stage and will require year-round monitoring with high-frequency instruments. Nightly fish choruses were heard every month of the year from at least three different but unidentified fish species.

Full details are given in Gavrilov & Erbe (2017).

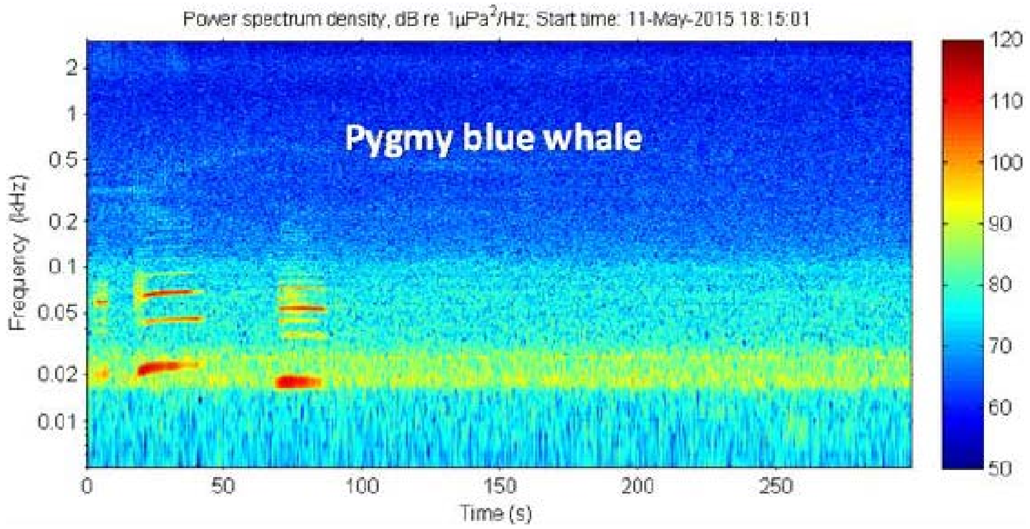


Figure 14. Example spectrogram showing pygmy blue whale calls recorded on the low-frequency logger deployed in the Bremer region. Source: Gavrilov & Erbe (2017).

2.5. Biopsy and tagging

Methods

Researchers from MIRG Australia spent 26 days in the offshore Bremer sub-basin between late February 27, 2017 and April 03, 2017. Vessel-based operations allowed the collection of photographic data and tissues samples from large megafauna. A small tender was deployed on six of those days (weather permitting), with the aim of deploying low impact minimally percutaneous external-electronics transmitter (LIMPET) satellite tags to track the fine-scale movements and residency patterns of killer whales, as well as yield insight into various activities such as foraging behaviour.

Results

Killer whales were encountered on 14 of the 26 days (53.8%), and approximately 20 hours were spent following adult individuals (**Figure 15**). Five biopsies were collected during the same time period, bringing the total number of killer whales sampled in the region since 2014 to 33. Several previously undocumented animals (including calves) were identified photographically and the relevant images added to the Project ORCA catalogue, available here. No suitable tagging opportunities arose due to challenging sea conditions. Renewed efforts will be made to deploy the tags in 2018.

Sightings of other cetacean species were also logged. Sperm whales *Physeter macrocephalus*, mostly solitary adult males, were observed on 15 days (57.7%), though bigger groups of up to 40 individuals were also encountered. Two biopsy tissue samples were taken (**Figure 16**).

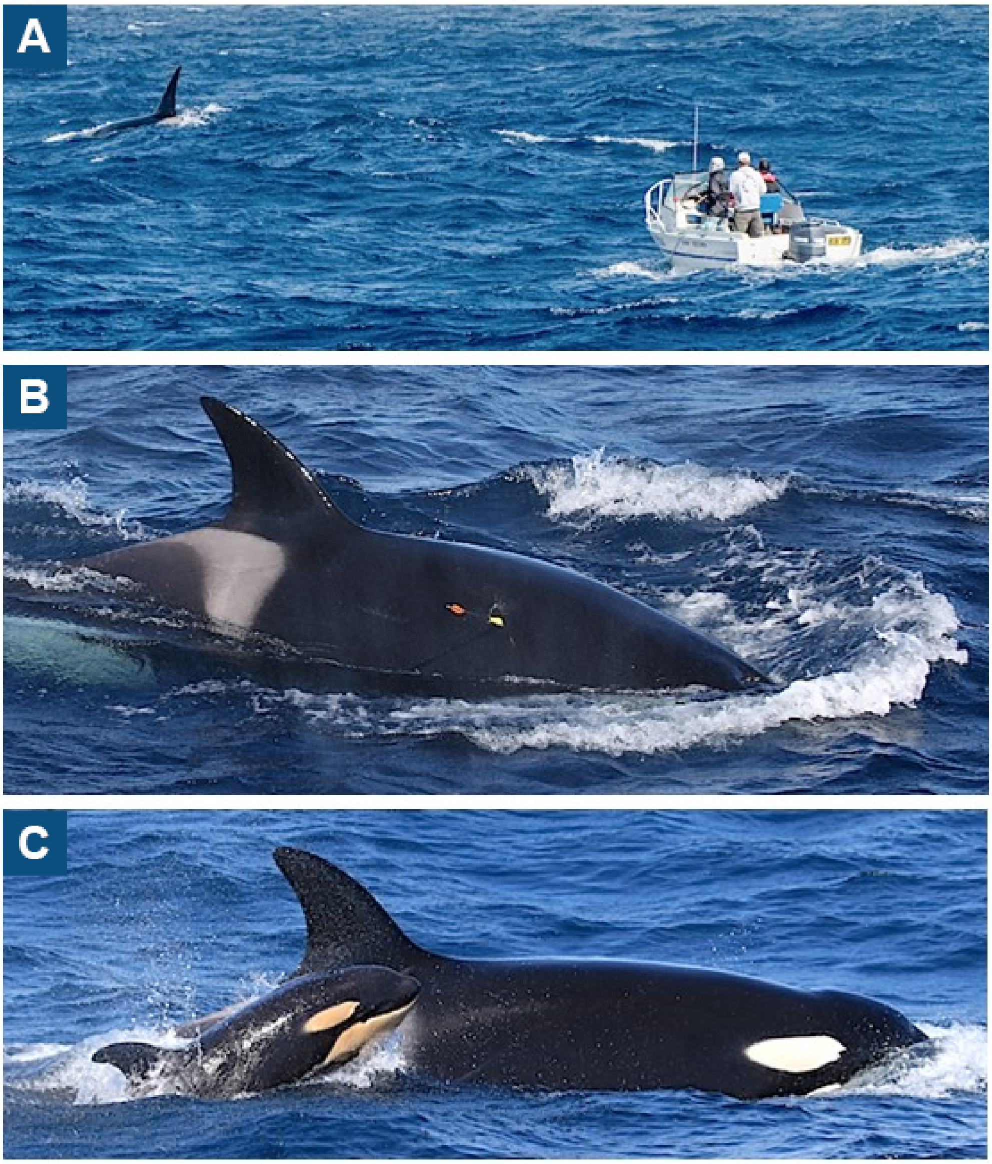


Figure 15. Tagging and biopsy sampling of killer whale *Orcinus orca*. **(A)** Research team approaching an adult male. **(B)** Successful collection of a tissue sample in the Hood Canyon on March 19, 2017. **(C)** Adult killer whale and calf.

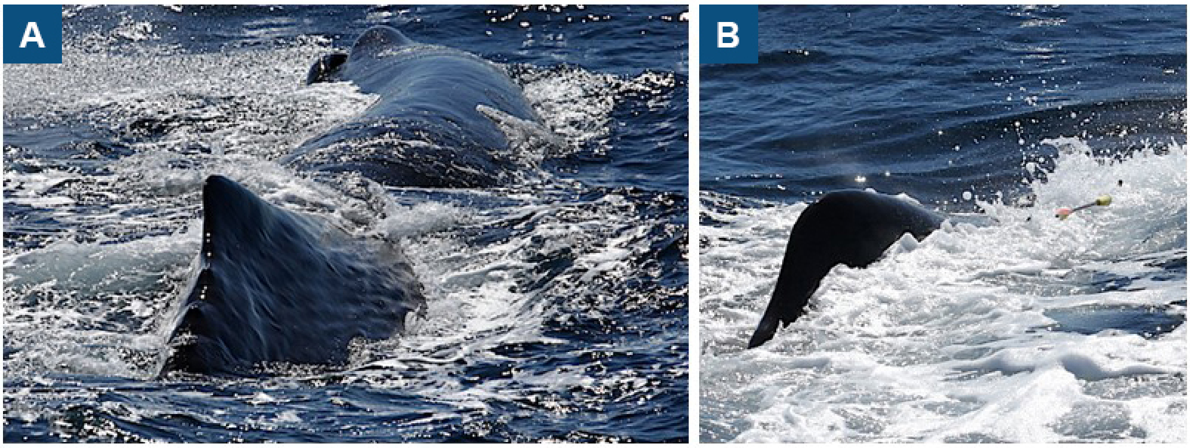


Figure 16. Biopsy sampling of sperm whale *Physeter macrocephalus*. **(A)** Adult sperm whale breathing at the surface. **(B)** Biopsy dart bouncing off the animal's back following tissue collection.

Several squid species have been observed and sampled in the Bremer Canyon in the past, the most common being the small-bodied cock-eyed squid *Histioteuthis miranda*, which was also observed on mid-water BRUVS. One dead giant squid specimen, possibly *Architeuthis dux*, was also retrieved (**Figure 17**). While the cause of death was unknown, there have been accounts of killer whales feeding on squid off southwest Western Australia (Wellard *et al.* 2015) and elsewhere (Hanson & Walker 2014).

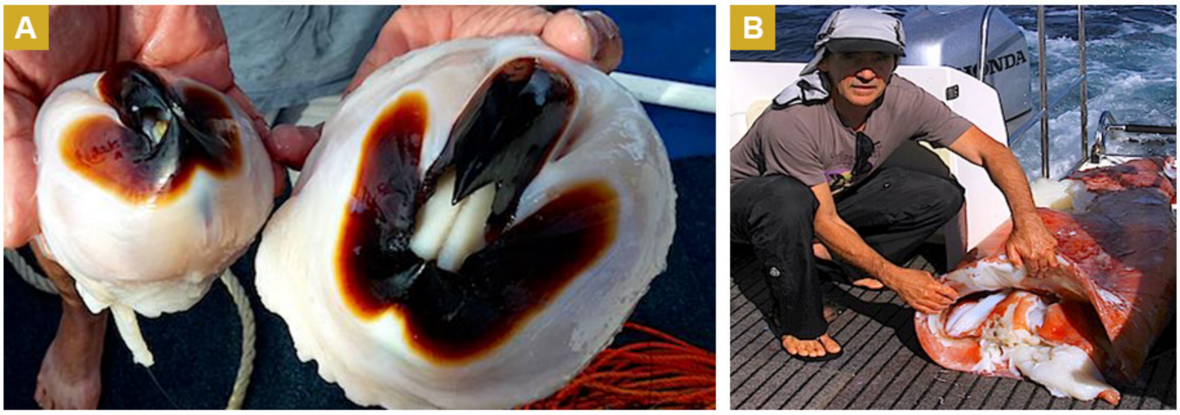


Figure 17. Possible giant squid *Architeuthis dux* specimen. **(A)** Giant squid beaks. **(B)** Researcher John Totterdell holding the squid's mantle.

2.6. Oceanographic sampling

<u>Methods</u>

An autonomous underwater vehicle (Seaglider) was deployed on March 11, 2017 to improve understanding of the dominant oceanographic processes at play in the Bremer region and the likely physical drivers of megafauna aggregations. The glider was equipped with a Seabird-CTD, WETLabs BBFL2VMT 3-parameter optical sensor and a Seabird Oxygen sensor

(Pattiaratchi 2007), and was launched west of the Knob Canyon, navigating eastward along the continental slope over a 6-week period (**Figure 18**). Over 150 dives to depths nearing 1,000 metres were completed, with continuous measurements of water temperature, salinity, dissolved oxygen, and other biogeochemical parameters taken along repeat, sawtooth transects crossing the Henry, Hood and Bremer canyons. This survey was only the second of its kind for the area and built upon the results of a previous mission conducted by the IMOS in 2013. The glider data can be downloaded from the [Australian Ocean Data Network](#).

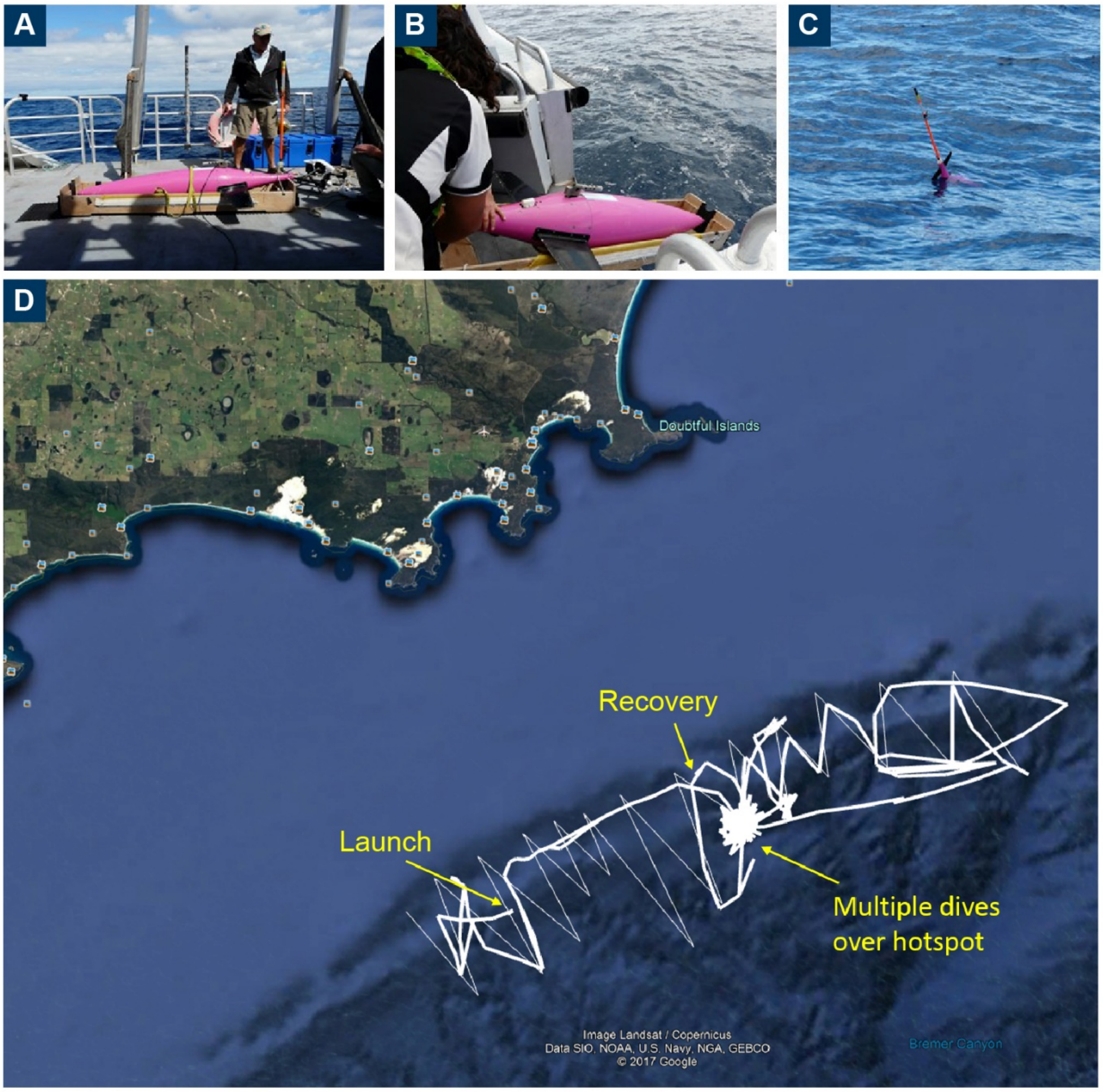


Figure 18. 2017 Seaglider mission in the Bremer sub-basin. **(A to C)** IMOS Seaglider pictured before, during and post deployment. **(D)** Spatial trajectory of the glider between March 11, 2017 (deployment) and April 13, 2017 (retrieval).

Results

Substantial variation in both temperature and salinity was apparent within the top 100-200 m of the water column, indicating the presence and interaction of different water masses in addition to the warm, lower-salinity Leeuwin Current (**Figure 19**).

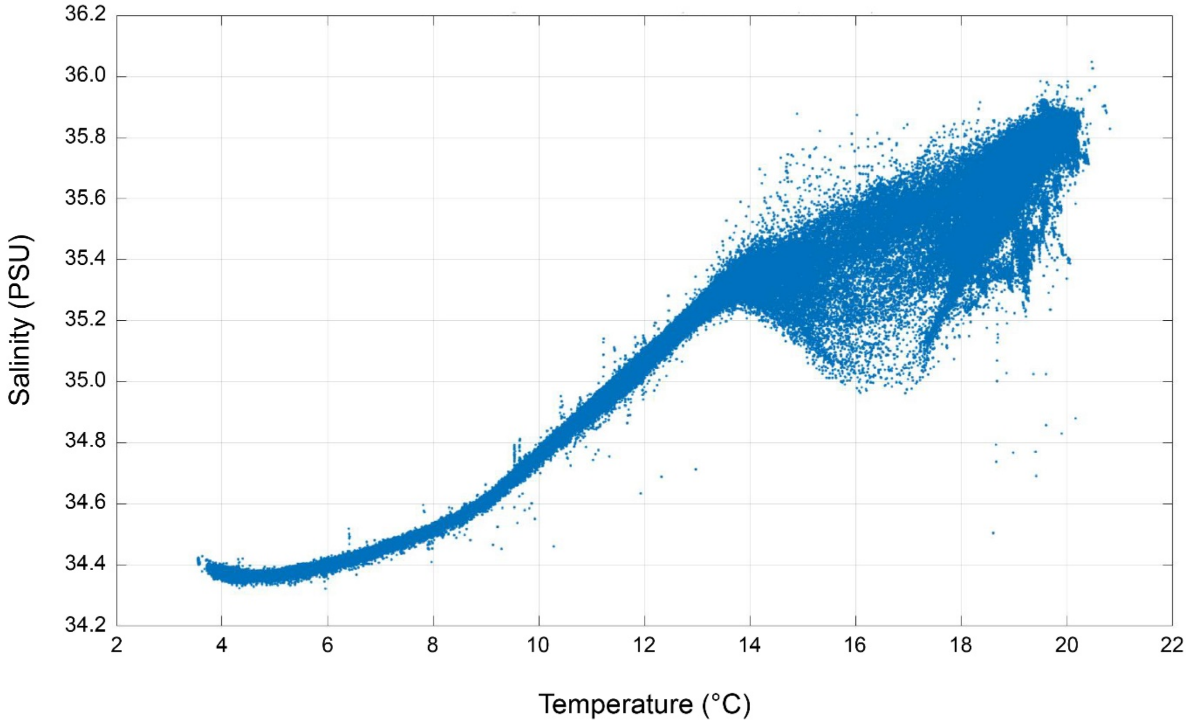


Figure 19. Temperature-Salinity diagram for the Bremer sub-basin derived from Seaglider measurements taken between March 11, 2017 and April 13, 2017.

Dissolved oxygen concentrations were also elevated between 100 m and 600 m depth (**Figure 20**). Water parameters stabilised below this layer, reflecting values characteristic of the deeper, westward-flowing Flinders Current. The highest concentrations of chlorophyll occurred at depth, though periodic mixing (e.g. from storms) allows productivity to reach surface layers in some areas. This was particularly apparent over the known killer whale hotspot at ca. 119.6°E (**Figure 21**). Chromophoric dissolved organic matter (CDOM) readings in the canyon system were very low (< 2 ppb) (**Figure 20**), indicating minimal hydrocarbon concentrations at the time of sampling.

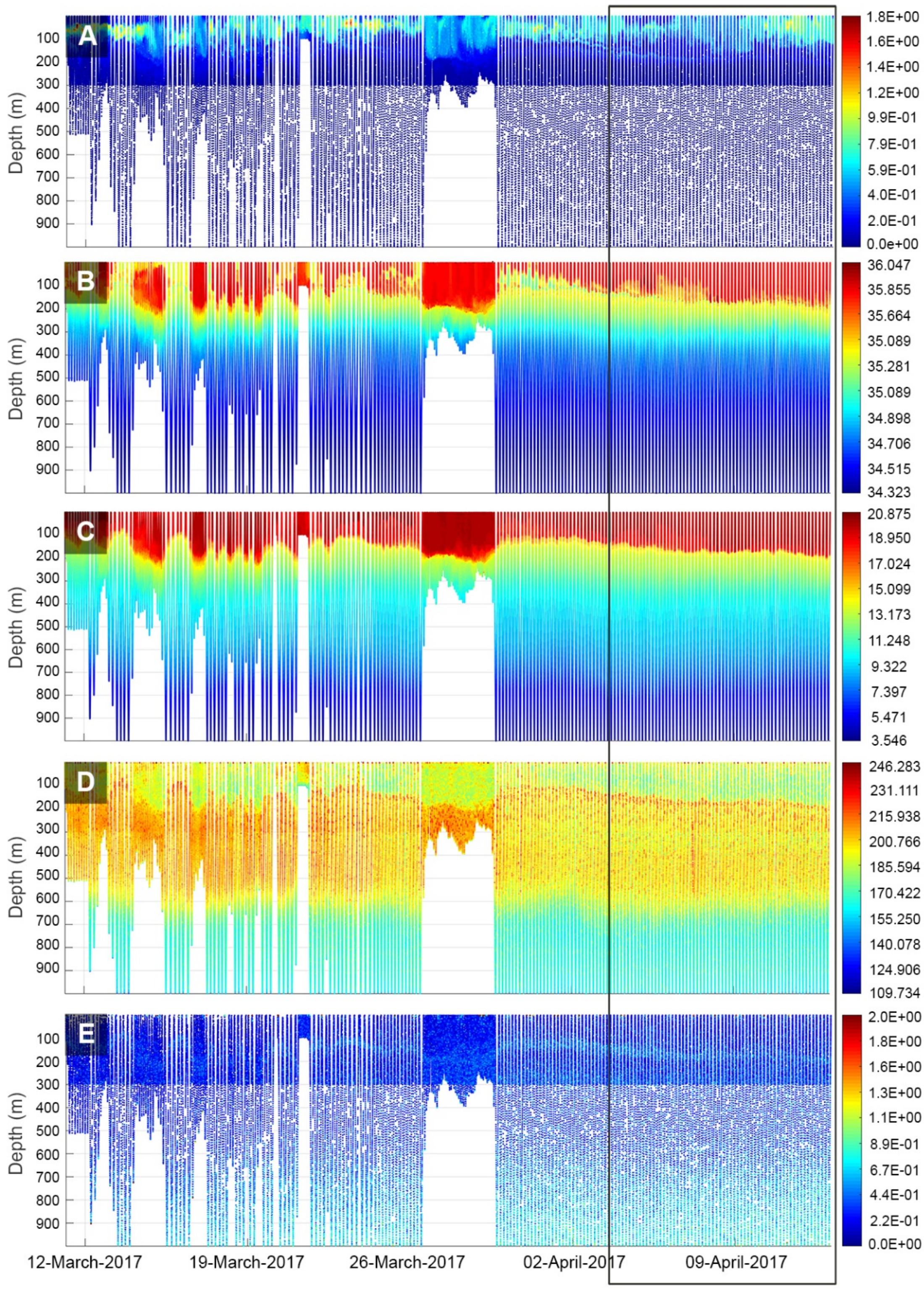


Figure 20. Time series plots of **(A)** Chlorophyll-a (mg.m^{-3}), **(B)** Salinity (PSU), **(C)** Temperature (°C), **(D)** Dissolved oxygen (µmol.L^{-1}), and **(E)** Chromophoric dissolved organic matter (ppb) for the Bremer sub-basin, derived from Seaglider measurements taken between March 11, 2017 and April 13, 2017. The black box marks the period during which sampling occurred within the known killer whale *Orcinus orca* hotspot (see **Figure 21**).

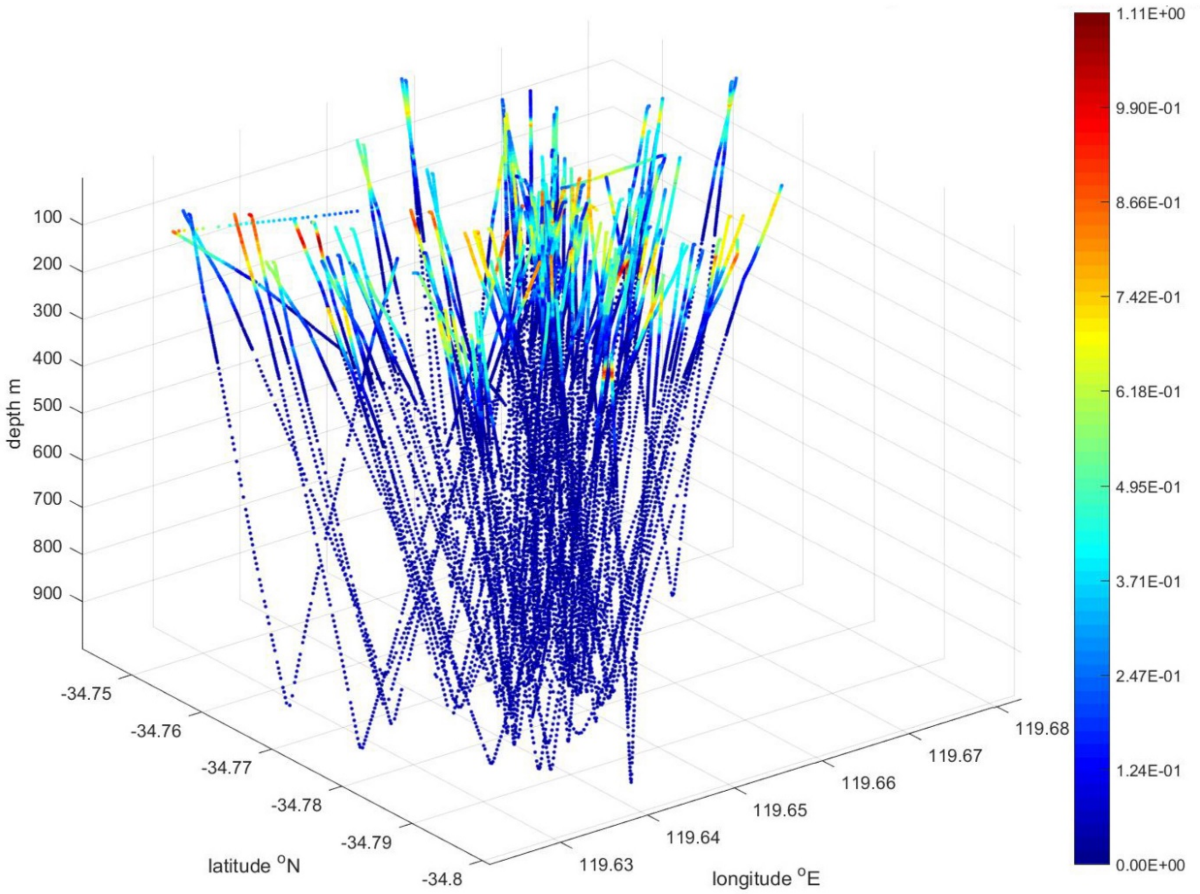


Figure 21. Three-dimensional plot of Seaglider dives showing the vertical distribution of chlorophyll-a (in mg.m^{-3}) within the known killer whale *Orcinus orca* hotspot over the Henry Canyon.

2.7. Modelling of killer whale habitat preferences

Methods

As part of her PhD research, Rebecca Wellard (Centre for Marine Science and Technology, Curtin University) has been collecting opportunistic information on killer whales every austral summer since 2014 on-board the Naturaliste Charters commercial ecotourism vessels. Trips have so far covered an area of ca. 4,000 km^2, concentrating on the heads of the Knob and Henry Canyons (119°35.55E; 34°44.30S) where animals have been repeatedly seen to aggregate. In that time, 77 days have been spent at sea, totalling 621 hours of effort and 265 cetacean encounters, of which 183 were with killer whales. Additional sightings were made during (i) non-systematic boat-based surveys undertaken in March-April 2017 aboard the *RV Big Dreams* chartered by MIRG Australia (see section 2.5), and (ii) aerial surveys flown as part of this project during the same period (see section 2.3). Field protocols were very similar across methods, with observations recorded in dual passing and closing modes (see section 2.3).

These data underpinned the development of a statistical model relating killer whale occurrence in the Bremer sub-basin to a number of ecologically relevant habitat variables, including depth, sea surface temperature, and chlorophyll-a concentration as a proxy for primary productivity. The model was built by a team from Curtin University using generalised estimating equations (GEEs), an extension of generalised linear models (GLMs) which allows for residual autocorrelation and therefore lends itself to the analysis of repeated measurements and other forms of correlated data, such as those collected on platforms of opportunity.

Full methodological details are given in Salgado Kent *et al.* (2017).

Results

The density of killer whale groups was greatest approximately 38 km from the coast, over seafloors lying in 800-1,000 m depth (**Figure 22**).

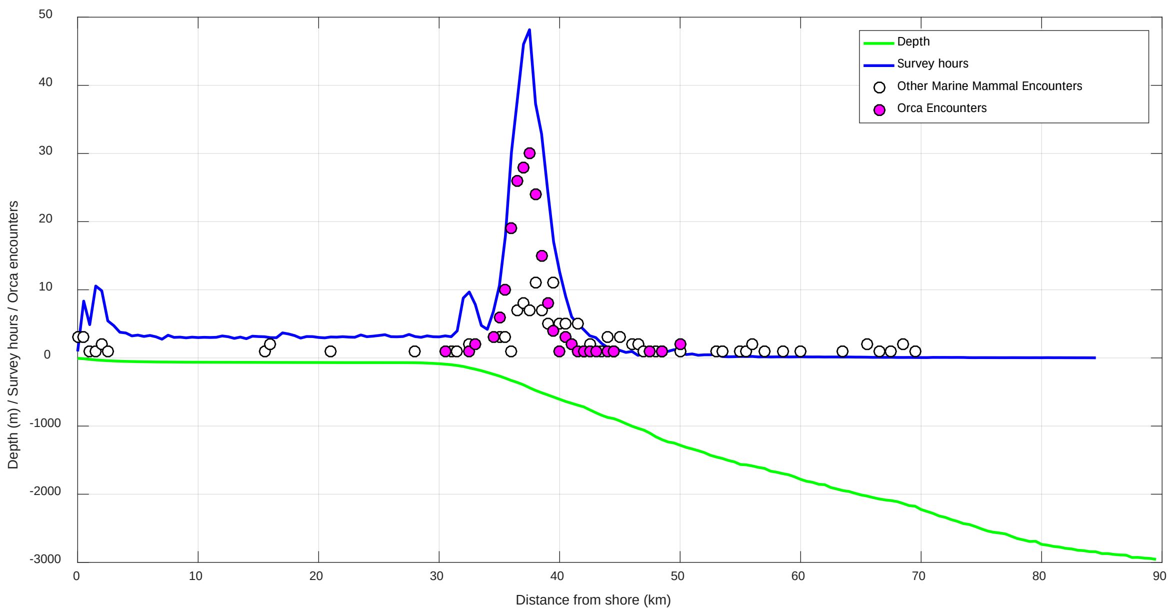


Figure 22. Distribution of killer whale *Orcinus orca* (pink circles) and other marine mammal (white circles) encounters as a function of distance from shore, and in relation to regional bathymetry and effort for vessel surveys (2015-2017) and aerial surveys (2017). Source: Salgado Kent *et al.* (2017).

Peak numbers were recorded in water temperatures ranging from 19.4 to 22.1°C and chlorophyll-a concentrations between 0.05 and 0.5 mg.m^{-3}, although these conditions also coincided with those in which more intense sampling effort took place. Results indicated that chlorophyll-a may have a relatively strong influence on killer whale occurrence, with sightings increasing in areas of higher primary productivity. Model predictions over the extent of the Bremer sub-basin (i.e. ca. 130 km longitudinal range along the shelf edge) revealed that the heads of the Bremer, Henry and Pallinup Canyons exhibited productivity levels expected to be associated with killer whale presence (Salgado Kent *et al.* 2017) (**Figure 23**).

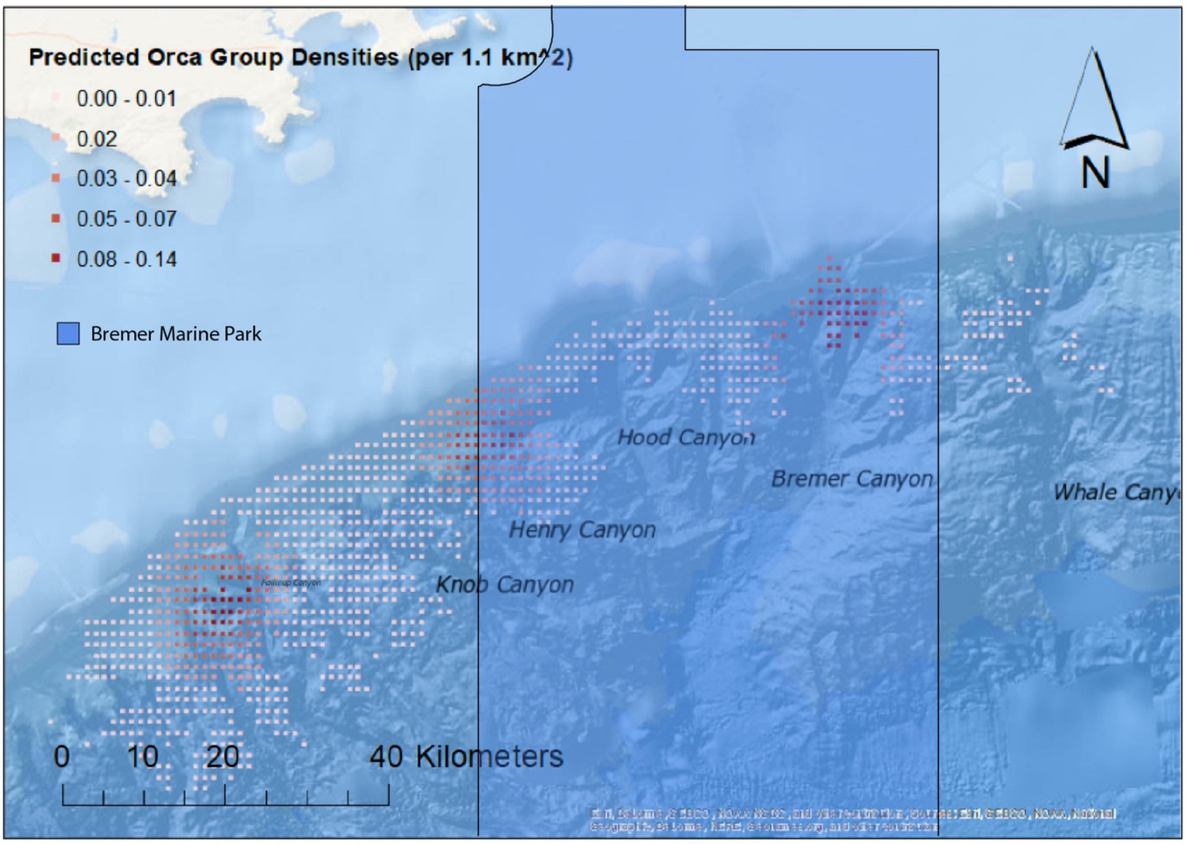
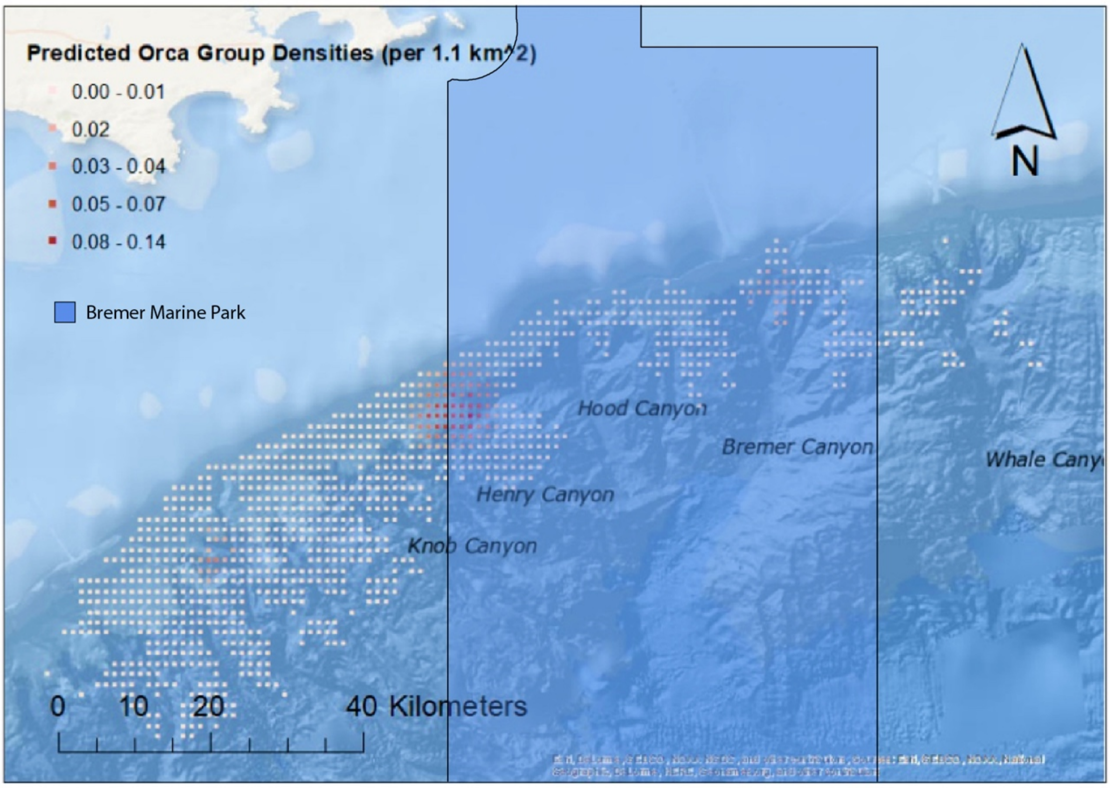


Figure 23. Predicted relative density of killer whale *Orcinus orca* groups (corrected for km transited by the vessel) throughout the Bremer sub-basin. Adapted from: Salgado Kent *et al.* (2017).



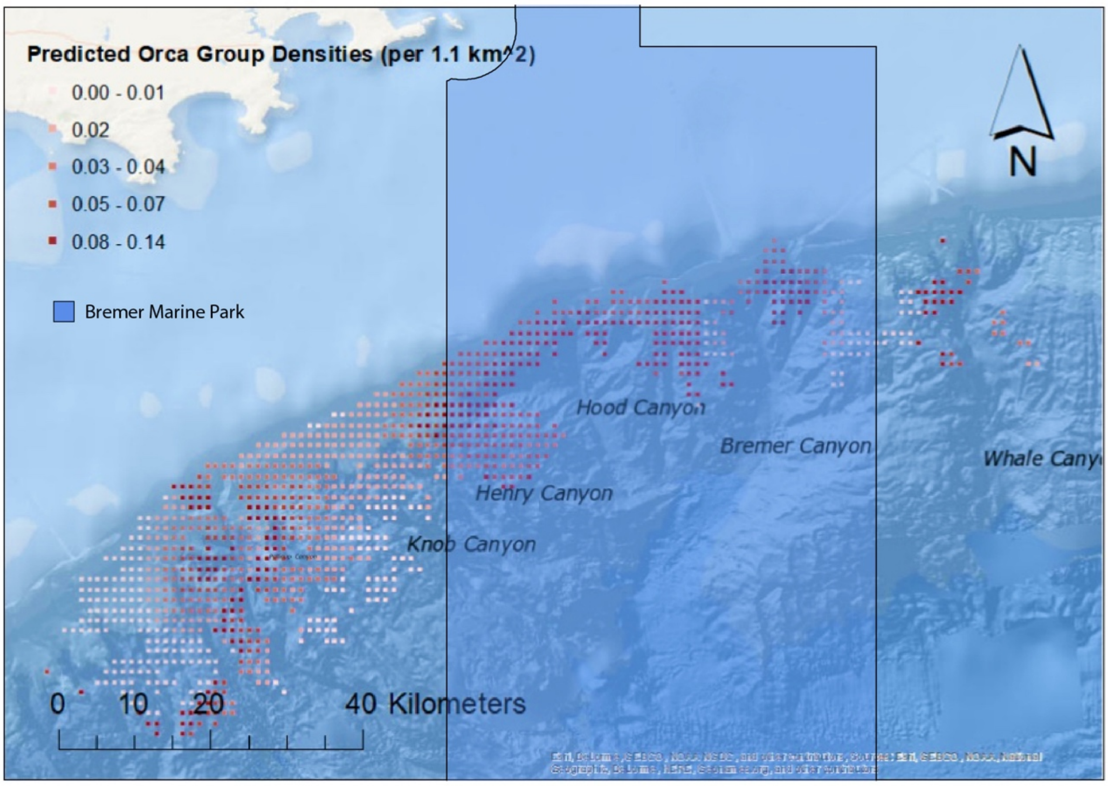


Figure 24. Lower (top) and upper (bottom) bounds from 95% confidence interval predictions of killer whale *Orcinus orca* groups (corrected for km transited by the vessel) throughout the Bremer sub-basin. Adapted from: Salgado Kent *et al.* (2017).

3. Outreach and communication products

The following communication outputs/activities were produced/occurred as part of this project:

- Project summary webpage published on the Marine Biodiversity Hub website.
- Briefing on the field work provided to the Member for O'Connor, who highlighted the research in Parliament on March 22, 2017.
- Publication of the Project Orca Photo ID Catalogue, which now includes new individuals encountered during this programme.
- Video compilation of best footage from the mid-water stereo-BRUVS.
- Plain English summaries (x5) promoting the project goals, methods used and ecological values of the Bremer region to the wider public.
- 3-page document (designed jointly with Parks Australia) summarising the results of the aerial survey programme.
- A web application showcasing the results of the aerial survey programme.

4. Publications and datasets arising from this project

Publications & reports

- **Bouchet PJ, Wellard R, Erbe C, Meeuwig JJ. 2018.** Aerial visual survey of cetaceans and other megafauna in the Bremer Marine Park and surrounding areas. Short communication produced for the NESP Marine Biodiversity Hub and Parks Australia, 4 p.

- **Meeuwig JJ, Turner J. 2017.** Bremer Canyon Progress Report - NESP Emerging Priorities Project EP2 (Spatial distribution of marine wildlife in the Bremer Bay region). Report prepared for the NESP Marine Biodiversity Hub, 18 p. Available from https://goo.gl/Nj3uaU

- **Meeuwig JJ, Turner J, Bouchet PJ. 2016.** Bremer Canyon Science Workshop Report - NESP Emerging Priorities Project EP2. Report prepared for the NESP Marine Biodiversity Hub, 27 p. DOI: 10.13140/RG.2.2.25891.35364

Datasets & metadata records

- Aerial visual survey of cetaceans and other megafauna in the Bremer Marine Park and surrounding areas (NESP Emerging Priorities EP2). Available from: http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=7526a44e-dea3-496c-81f4-776d908e2923

- Passive acoustic recordings of marine megafauna within the Bremer Marine Park and adjacent areas (NESP Emerging Priorities EP2). Available from: http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=ae6bf482-4f8a-4501-9401-035a165c2427

- Pelagic baited camera (stereo-BRUVS) survey of the Bremer Marine Park and adjacent areas (NESP Emerging Priorities EP2). Available from: http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=a18994fa-2879-4b46-97e4-b399bf847b43

- Spatial distribution of killer whales (*Orcinus orca*) in the Bremer Marine Park and adjacent areas (NESP Emerging Priorities EP2). Available from: http://catalogue.aodn.org.au/geonetwork/srv/eng/metadata.show?uuid=dca17ddc-9cae-4de0-8dbe-4d8141be5886. Please note that a peer-reviewed publication is currently in preparation based on the results from this work (Contact Prof. Christine Erbe at Curtin University for further information).

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