BEFORE THE ENVIRONMENTAL PROTECTION AUTHORITY
AT WELLINGTON

IN THE MATTER	of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 ("the Act")
AND	
IN THE MATTER	of the applications by Trans Tasman Resources Limited (TTR) for marine and discharge consents to recover iron sand under sections 20 and 87B of the Act and
BETWEEN	**Trans- Tasman Resources Limited** Applicant
AND	**The Environmental Protection Authority** EPA
AND	**Kiwis Against Seabed Mining Incorporated (KASM)** Submitter

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STATEMENT OF EVIDENCE BY DR LEIGH TORRES ON BEHALF OF
KIWIS AGAINST SEABED MINING INCORPORATED
Dated 23rd January 2016

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STATEMENT OF EVIDENCE OF LEIGH TORRES

INTRODUCTION

1. My name is Leigh G. Torres.

2. I hold a PhD in Marine Ecology (Duke University, 2008), a Master's of Environmental Management (Duke University, 2001), and a Bachelor of Arts in Communication and Environmental Science (American University, 1997).

3. I am currently an Assistant Professor in the Department of Fisheries and Wildlife at Oregon State University (USA). I lead the Geospatial Ecology of Marine Megafauna Laboratory (GEMM Lab) within the Marine Mammal Institute. The GEMM Lab focuses on the ecology, behavior and conservation of marine megafauna including cetaceans, pinnipeds, seabirds, and sharks. Our research is diverse and global, and we use advanced and innovative methods to describe the distribution, behavior, health and ecological patterns of marine megafauna to provide effective management options that will reduce space-use conflicts with human activities in the marine environment.

4. I have conducted research on the ecology marine mammals since 1996. My expertise are in spatial ecology (understanding species distribution patterns and their environmental drivers) and foraging ecology (understanding feeding patterns and ecological correlates). I have applied my knowledge and skills to a variety of research projects on a diversity of species and habitats, including bottlenose dolphins in Florida, southern right whales and sperm whales in New Zealand, gray whales in the northeastern Pacific, bottlenose dolphins in New Zealand, and blue whales in New Zealand.

5. I have the following experience with blue whales in the South Taranaki Bight: In 2013 I published a paper in the New Zealand Journal of Marine and Freshwater Research hypothesizing the existence of a blue whale foraging ground in the South Taranaki Bight (STB) region of New Zealand. This hypothesis was based on:

   (1) recent opportunistic and marine mammal observer (on seismic surveys) sightings of blue whales in the STB,

   (2) historical sightings of blue whales in the STB from Soviet and Japanese whaling records,
   (3) stranding records of blue whales around New Zealand, and

   (4) oceanographic studies in the STB documenting regional upwelling events, that cause high productivity, and lead to large aggregations of a known blue whale prey item in the Southern Hemisphere, the krill *Nyctiphanes australis*.

   Soon after this publication, I organized and led a brief field research effort to prove that blue whales use the STB region as a foraging ground. Over five days of survey work in January 2014, we recorded ten sightings of blue whales of an estimated 50 individual whales, including a mother/calf pair. We frequently observed blue whale foraging behaviour and we captured, observed and recorded their krill prey in high densities. Our observations and data collection during this limited field effort in the STB proved the hypothesis that the STB is a blue whale foraging ground. Since this time, I have been working closely with the New Zealand Department of Conservation, the Bioacoustic Research Program at Cornell University (New York, USA), and the Cetacean Conservation and Genomics Laboratory (CCGL) at Oregon State University to collect the comprehensive data needed to understand the ecology of this population in order to inform management efforts that will lead to effective regulations of human activities in the region. In order to describe the significance and extent of this foraging ground, the primary objectives of our research have been to determine:

a. The spatial and temporal extent of the blue whale foraging area in the STB region.

b. The number (abundance) of blue whales using STB region as a foraging ground.

c. The rate of persistent use of the STB region as a foraging ground by individual blue whales.

d. The population identity and connectivity of these blue whales.

In January 2016, I led a 3 week research expedition in the STB to collect data to address these objectives. During this 2016 field season, five hydrophones were deployed across the STB region that will record blue whale vocalizations for at least one full year, providing data on blue whale behavior and distribution patterns. Additionally, during 10 vessel days in the STB region, almost 1,500 miles were surveyed collecting blue whale distribution, identity, and habitat data.

Data from the 2014 and 2016 field season are now being analyzed by the GEMM Lab and collaborators, and preliminary findings are discussed below.

I also worked at the National Institute of Water and Atmospheric Research, Ltd (NIWA) in Wellington as a post-doc (2008-2010) and a marine ecologist (2010-2014), during which time I worked on a variety of marine species research projects within New Zealand waters. This work includes contracts by TTR to provide reports on the current knowledge of marine mammals in the South Taranaki Bight (near the proposed mining site), and to generate habitat models of three marine mammals species considered threatened in the STB (southern right whales, Maui/Hector's dolphins, and killer whales). Early drafts of this later report contained preliminary information of blue whale foraging in the STB that I deemed pertinent for TTR to be aware of, but this section of information was considered irrelevant by TTR and removed from the report upon request by TTR.

PURPOSE AND SCOPE OF EVIDENCE

6. KASM has asked that I prepare the following evidence in regard to direct and indirect effects of noise, sediment plume, and vessel traffic caused by the proposed mining operations on the health and population viability of blue whales in the South Taranaki Bight (STB) region through disturbance and habitat avoidance, loss of foraging opportunities, decreased or disturbed prey availability, vessel strikes, communication masking and increased stress due to elevated noise, and displacement from critical habitat.

7. In preparing this evidence, I have reviewed the application itself and the peer reviews provided by Hegley 2015, Marico Marine 2015, MacDiarmid et al 2015 (scale of marine ecological effects), MacDiarmid et al 2015 (zooplankton communities), Cawthorn 2015, The EPA Key Issues Report 2016, Cahoon et al 2015, Bradford-Grieve and Steven 2015, Torres et al 2015, De Beers mining perspective, Findlay 1996.

    a. National Marine Fisheries Service. 2016. Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-55, 178 p.

    b. Cotte, C. and S. Yvan. 2005. Formation of dense krill patches under tidal forcing at whale feeding hot spots in the St. Lawrence Estuary. Marine Ecology Progress Series 288:199-210.

    c. Baker, C. S., B. L. Chilvers, S. Childerhouse, R. Constantine, R. J. C. Currey, R. H. Mattlin, A. Van Helden, R. Hitchmough and J. Rolfe. 2016. Conservation status of New Zealand marine mammals, 2013. Department of Conservation.

8. I have read the Code of Conduct for Expert Witnesses Environment Court's Consolidated Practice Note (2014). In so far as I express expert opinions, I agree to comply with that Code. In particular, except where I state that I am relying upon the specified evidence of another person as the basis for any expert opinion I have formed, my evidence is within my sphere of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions which I express.

SUMMARY OF EVIDENCE

9. The following sets out a summary of key points found in my evidence:

- The South Taranaki Bight (STB) is important habitat for blue whales, particularly as a foraging area. While we currently have incomplete knowledge about the spatial and temporal distribution of blue whales near the proposed mining site, the available data (sightings and acoustic detections) indicate that blue whales use this region regularly throughout the year. Furthermore, genetic, behavior, acoustic and sightings data indicate that blue whales in the STB region may be part of a distinct New Zealand population of whales.

- Blue whales in the STB region feed on a euphausid krill, *Nyctiphanes australis*, which aggregate in the area based on nutrient and light availability that influence phytoplankton productivity. Blue whales have high energetic demands and must find dense aggregations of their prey and feed efficiently in order to survive and be reproductively viable. The expected sediment plume from the mining operations may impact the distribution and availability of *N. australis*, thus reducing the foraging ability and efficiency of blue whales.

- Cetaceans (whales and dolphins) are highly sensitive to ocean noise, as sound is their primary sensory mode with acoustics informing their foraging, communication, and navigation behaviors. Blue whales produce and receive low frequency sounds, some of which can travel hundreds of kilometers to transfer information. Evaluation by TTR regarding noise impacts from mining operations on low frequency marine mammals (baleen whales) is poor, misleading, and disregards the potential to disturb blue whale behavior, distribution and physiology (stress levels). Noise produced by the mining operations may directly disrupt blue whale foraging, cause blue whales to move out of important feeding areas, interfere with blue whale communication causing loss of feeding or mating opportunities, cause changes in vocal behavior patterns with subsequent energetic consequences, and induce increased physiological stress that compromises blue whale health. All of these responses by baleen whales to elevated noise have been scientifically demonstrated elsewhere; it would be imprudent to allow such potential impacts on a newly documented, distinct New Zealand population of blue whales.

- Vessel traffic across the STB region will increase due to the proposed mining operation. While collision risk may be minimal during mining operations due to low vessel speeds, large vessels will travel at higher speeds to and from the mining area from major ports (New Plymouth, Whanganui), which will pose a collision risk to whales. Baleen whales, particularly blue whales, are at risk of injury and death from vessel strikes worldwide.

- The mitigation plan is incomplete in my opinion, as there is no offshore sampling based on an assumption of limited spatial impact by mining operations.

- The cumulative impacts of all anthropogenic activities in the STB region must be considered. Blue whales have extreme energy demands, and each disturbance to their feeding opportunities and success rate can impact their viability and reproductive capacity. Added noise, habitat impacts, prey disturbance and vessel density in the STB by the mining operation would add physiological and behavioral consequences and burdens to blue whales already living within an impacted and compromised ecosystem.

BLUE WHALES IN THE SOUTH TARANAKI BIGHT

10. Torres (2013) hypothesized the presence of a blue whale foraging ground in the STB region based on (1) recent opportunistic and marine mammal observer (on seismic surveys) sightings of blue whales in the STB, (2) historical sightings of blue whales in the STB from Soviet and Japanese whaling records, (3) stranding records of blue whales around New Zealand, and (4) oceanographic studies. Through dedicated field research efforts in Jan/Feb 2014 and Jan/Feb 2016 this hypothesis has been proven correct, and important data on the ecology of this population has been collected. Our field methods have included:

    - Vessel survey effort to document presence and absence of blue whales.
    - Oceanographic data collection (temperature, salinity, fluorescence, thermocline depth) to link blue whale distribution with habitat use.
    - Hydro-acoustic surveys to assess the distribution and density of prey.
    - Behavioral observation and data collection during blue whale sightings.
    - Collection of photo-identification data of individual blue whales to estimate regional abundance, residency patterns, and individual-based movement patterns.
    - Tissue biopsy sampling for analysis of genetics, stable isotopes, and reproductive and stress hormone levels.
    - Fecal sample collection to assess prey species genetically, and reproductive and stress hormones.
    - Unmanned Aerial System (A.K.A. 'drone') overflights of whales to determine body condition and conduct behavioral observations.
    - Deployment of a 5-unit hydrophone array across the STB region to continuously record low frequency sounds for a one year period. These units were refurbished (battery and hard-drive replacement) in July 2016; therefore data presented below is for the Jan-July 2016 period.

11. In addition to these data, collaborators from around New Zealand have contributed blue whale sightings data and photographs, which we have combined where appropriate with our analyses efforts. Included in these supplementary data are high-confidence sightings from the Department of Conservation marine mammal sighting database and sightings recorded by marine mammal observers during seismic survey operations in the STB. Analysis of these by myself and collaborators is still underway. The results presented below are preliminary but accurate.

<u>Presence and distribution:</u>

12. To date we have 387 blue whale sightings reported in New Zealand waters since 1980. Of these sightings, 240 have been recorded in the STB region (10 during our 2013 survey, 22 during our 2016 survey; 85 from a Todd Energy seismic survey in 2013; 60 from a PGS

seismic survey in 2016; 5 from an OMV seismic survey in 2011; and miscellaneous other sightings).

13. Due to uneven survey effort across the STB region or through an annual cycle, it is difficult to draw conclusion based on these sighting data regarding the spatio-temporal distribution patterns of blue whales. Figure 1 illustrates the monthly distribution of blue whales sightings in the STB. While a clear peak in sightings is evident during the spring and summer months (Oct, Nov, Jan, Feb, Mar) this could also be due to the distribution of survey effort during these months of relatively favorable weather. The drop in reported sightings during the December – a period when many groups take holiday – is potential evidence of this influence of survey effort.

14. Figure 2 illustrates the spatial distribution of these blue whale sighting data across the STB region, with current oil and gas operations and the proposed mining area identified. The sightings are color-coded by month, yet should not be interpreted as an indication of temporal distributions patterns. Rather, these groups of sightings represent dedicated survey effort in a specific area during a clustered period. This evidence demonstrates that when survey effort is conducted in the STB region, aggregations of blue whales – likely foraging – often occur and are recorded. Minimal survey effort, either scientific or during seismic survey operations, has occurred in the eastern region of the STB (Figs. 3 and 4). Therefore these sightings data provide incomplete knowledge of the potential for blue whale occurrence near TTR's proposed mining site and emphasizes the value of standardized survey effort across the region.

15. One blue whale sighting has been reported in close proximity to the proposed mining area (in purple circle in Fig. 2). This sighting was of three blue whales, in 79 m deep water, is 13.5 km from the boundary of TTR's mining area, and was reported by a fishing vessel on 19-Sep-2013.

16. TTR's proposed mining area is between 22 and 36 km from coast and in waters between 20 and 42 m deep. Of the 387 reported blue whale sightings in New Zealand, 10 blue whale have occurred in waters less than 45 m (Fig. 5), and 126 have occurred within 40 km of shore (Fig. 6). These findings indicate that the nearshore location of the proposed mining site does not mean that the area is not blue whale habitat.

17. Results from our acoustic monitoring efforts in the STB region are able to fill some of the knowledge gaps of blue whale spatio-temporal distribution. The green stars in Figure 2 represent the deployment locations of our five hydrophones (Marine Autonomous Recording Units (MARU) developed by the Bioacoustic Research Program at Cornell University: http://www.birds.cornell.edu/page.aspx?pid=2713). The MARU number is indicated above each green star. The distribution of the MARUs was determined to obtain broad coverage across the STB region, avoid areas of strong currents and high trawling effort, and maintain proximity to allow acoustic triangulation of acoustic signals. All MARUs were deployed between 22 and 26 Jan 2016 and recovered on 30 June or 1 July 2016. Each MARU recorded at a 2 kHz sampling rate with a high-pass filter at 10 Hz and a low-pass filter at 800 Hz. MARU 2 is located 18.8 km from the boundary of TTR's proposed mining site, in 67 m of water.

18. In the approximately five months of acoustic data, the New Zealand blue whale call type was detected at each of the surveyed sites within and surrounding the STB region (Fig. 8). This

blue whale call type is distinct to the New Zealand region and has not been recorded elsewhere (McDonald 2006, McDonald *et al.* 2006, Miller *et al.* 2014, Brownell Jr *et al.* 2016); this acoustic finding provides further evidence that these blue whales comprise a distinct New Zealand population. Percent monthly presence for each MARU site was normalized for recording effort by dividing the number of days containing the New Zealand blue whale call type by the number of recording days analyzed within the month:

$$\text{Percent Monthly Presence for Each MARU Site (\%)} = \frac{Number\ of\ days\ per\ month\ w/acoustic\ presence}{Number\ of\ days\ analyzed\ per\ month} \times 100$$

19. High detection rates of the New Zealand blue whale call type are evident at all MARU sites (Table 1), ranging from 85 to 100% daily detection. All surveyed sites had 100% acoustic presence during March, April, and May 2016. The daily acoustic pattern of blue whale acoustic presence (Fig. 9) at MARU 2 illustrates reduced daily presence during the late January and early February period of 2016. This pattern is also evident at MARU 3. This gap in detections in the eastern STB coincides with our vessel based survey effort in Jan/Feb 2016 (Fig. 5) when we also did not record any visual sightings of blue whales in eastern areas of the STB. During this period in Jan/Feb 2016 very warm ocean temperature conditions occurred the New Zealand region caused by an El Niño cycle. Figure 10 compares two SST satellite images within the STB and west coast region of New Zealand that were surveyed in Jan-Feb 2014 and again during Jan-Feb 2016. The plot on the left describes ocean surface conditions in 2014 and illustrates how SST primarily ranged between 15 and 18 ^{o}C. By comparison, the panel on the right depicts the sea surface conditions encountered during the 2016 field season, and a stark difference is apparent: during 2016, SST ranged between 18 and 23 ^{o}C, barely overlapping with the 2014 field season conditions. The target prey of blue whales in this region, *N. australis*, tend to aggregate in pockets of nutrient-rich, cool water. During the 2014 field season, most blue whales were encountered in an area where SST was about 15 ^{o}C (within the white circle in the left panel of Fig. 10). During 2016, virtually no cool water was anywhere and blue whales were mainly observed off the west coast of Kahurangi shoals in about 21 ^{o}C water (within the white circle in the right panel of Fig. 10. (NB: the cooler water in the Cook Strait in the southeast region of the right panel is a different water mass than preferred by blue whales and does not contain their prey.) I believe that it was due to these anomalously warm ocean conditions that no blue whale sightings were detected visually or acoustically in the eastern portion of the STB during late January and early February 2016.

20. It appears there is a persistent level of blue whale acoustic presence within and surrounding the STB region; future analysis of subsequent hydrophone deployment data will elucidate if there is a seasonal pattern as well as inter-annual variability of acoustic presence. It is important to note that only male blue whales produce this call (as a mating strategy), therefore the presented occurrence patterns of acoustic presence in the STB region are an underestimate of the whole population. While a high level of acoustic occurrence was detected, the analysis to determine the distance between the acoustic sensors and the calling whales has not been completed yet. Blue whale populations around the world produce calls that are low in frequency and high in intensity, and these sounds can propagate hundreds of kilometers (Table 2). In order to derive information on blue whale proximity to the proposed mining site from the acoustic data, we estimated the received level (RL) of the 'best quality' representative New Zealand blue whale call recorded on MARU 2. We determined the transmission loss (TL) of this call based on the assumption that the source level (SL) of New Zealand blue whale calls are similar to southern hemisphere

pygmy blue whales (Table 2). We then applied this TL value into a cylindrical spreading transmission loss calculation (Urick 1967) to estimate the range (km) that this whale may have been during this closest approach (the 'best quality' call). Based on this method we determined that this blue whale was within a 1 kilometer radius of the recording site MARU 2. This proximity provides further evidence that blue whales occur close to the proposed mining site and where impacts are likely to occur (e.g., from the sediment plume, elevated noise). While this result is preliminary, it is a conservative and reliable estimate of distance between the hydrophone and the calling blue whale. As our acoustic analyses continues we will continue to gain a greater understanding of blue whale occurrence across the STB region.

Residency and Population Information

21. In 2014, we photo-identified 21 individual blue whales over seven vessel survey days in the STB region. Two individuals were sighted more than once, and one mother-calf pair was observed. In 2016, 26 more individuals were identified over 11 more survey days, including three individuals that were seen on multiple occasions and four mother-calf pairs. This effort brings us to 47 individual blue whales identified in the STB by our research efforts over the course of two field seasons. A discovery curve showing the cumulative number of identified does not appear to asymptote or stop increasing, indicating that we have not yet identified most or all the individuals in this population (Fig. 11).

22. In addition to our team's survey effort, we have compiled blue whale photos and sighting data contributed by collaborative research groups and individuals throughout New Zealand in an effort to build a comprehensive photo-ID catalog and sighting record. The photos we are working with span from 2004-2016, and include multiple locations. For the STB, we have a total of 51 photo-identified individual blue whales when we include photos contributed by our collaborators. For all of New Zealand, our catalog now consists of 95 unique individuals, and we expect that this number will increase with more data collection efforts.

23. Of the 95 identified individuals, there have been 5 photo-ID matches between years and locations:

    - One whale was sighted in the Cook Strait in 2008 (data courtesy of Nadine Bott) and in Kaikoura in 2013 (data courtesy of Whale Watch Kaikoura);
    - One whale was photographed in 2013 in the STB (data courtesy of Todd Energy Survey) and in the same region by our team in 2016;
    - One whale was seen off of Westport in 2013 by the Australian Antarctic Division's research cruise (data courtesy of Mike Double) and by our team in the STB in 2016;
    - One whale was photographed in the Cook Strait in 2013 (data courtesy of Nadine Bott) and in the STB by our team in 2016;
    - One whale was seen in the Hauraki Gulf in 2010 (data courtesy of Rochelle Constantine), in STB in 2014 by our team, and off of Kaikoura in 2016 (data courtesy of Whale Watch Kaikoura); each time this whale was observed it was seen with a different calf.

24. These re-sightings of individuals span across 3, 5, and 6 years demonstrating reoccurrence of individual blue whales in New Zealand waters over multiple years. Additionally, these repeat sightings of individual blue whales range across New Zealand coastal areas including the Hauraki Gulf, the Cook Strait, the STB, off Westport, and off Kaikoura.

25. Additionally, photographs of these blue whales observed in New Zealand waters were matched to blue whale photo-id catalogs from Australia, including 272 images of 174 individual blue whales, to assess connectivity between the two regions. These catalogs were contributed by the Australian Marine Mammal Centre (Bonney Upwelling 2012, East Coast Australia 2014) and The Blue Whale Study (Bonney Upwelling 1998-2011). No matches were made between any whale observed in New Zealand and observed in Australian waters, suggesting minimal connectivity between these populations, which is yet another indication that blue whales in New Zealand form a distinct sub-population.

26. We compared mitochondrial DNA haplotypes from four regions in the Southern Hemisphere (Southeast Pacific Chilean coast, Australia, Southern Ocean, New Zealand) and find the New Zealand population to be differentiated from the Southeast Pacific Chilean pygmy and Southern Ocean Antarctic blue whale population but not from the Australian pygmy population. We also used microsatellite genotypes in a Bayesian cluster analysis to assign individuals to populations based on their allele frequencies. In a comparison of the Southern Ocean and New Zealand, STRUCTURE analyses identified two distinct populations, supporting the differentiation between these two recognized subspecies.

27. Genetic analysis: Tissue samples collected in the STB during our research effort (10 in 2014, 10 in 2016) were analyzed along with 15 previously collected samples (from 1994-2014) held at the New Zealand Cetacean Tissue Archive (NZCeTA): 12 from beachcast animals around New Zealand, and skin samples collected from two live animals in Cook Strait and one in the Hauraki Gulf. Total genomic DNA was extracted from the skin tissue of these samples to assess haplotype frequencies (see Sremba *et al.* 2015, Torres *et al.* 2015 for methodological details). To assess population structure, we first tested for mtDNA haplotype differentiation between STB and NZCeTA samples, and then between the pooled New Zealand samples and three other collections: the Antarctic form from the Southern Ocean (n=183, Sremba *et al.* 2012), the 'pygmy' form from Chile (n=113, Torres-Florez *et al.* 2014), and the 'pygmy' form from Australia (n=89, LeDuc *et al.* 2007, Attard *et al.* 2015) populations.

28. Sequencing of the mtDNA control region resolved six haplotypes, five previously described by LeDuc et al. (2007) and one previously undescribed (Table 3). For both the STB and NZCeTA samples the majority of the individuals were haplotype 'd' (72% STB; 71% NZCeTA; Table 3). There was no significant difference in mtDNA haplotype frequencies between the two New Zealand collections (FST = 0.00, p = 0.63). Comparison of the haplotype frequencies from the pooled New Zealand collection to the Southern Ocean and Chilean collections showed highly significant differences for both FST and ΦST, but there was no significant difference between the New Zealand collection and the Australian collection (Table 4).

29. Genetic analysis determined New Zealand blue whales to be most genetically similar to Australian 'pygmy' blue whales, yet we also identified a new haplotype and found no photo-identification matches to individual Australian blue whales despite a large number of photographs assessed. A larger genetic sample size is needed to better assess the degree of isolation or interchange between what seem to be distinct demographic units. The lack of mtDNA differentiation between Australian and New Zealand blue whales, with no photographic matches, may result from (1) a relatively recent isolation between populations, or (2) ongoing genetic connection on breeding grounds with assortment through fidelity to feeding grounds. These sighting and genetic results suggest that New Zealand pygmy blue whales may comprise a distinct population.

Behavior

30. Of the 32 blue whale sightings we have made in the STB region during research cruises in 2014 and 2016, the primary behavior state of six was confirmed foraging behavior. Another 21 sightings were of unknown behavior state, but recorded as 'possible forage'. Two sightings were documented as travel behavior, and three sightings were of social behavior. We have also documented five mother-calf pairs, including capturing nursing behavior through non-invasive UAS observations[1].

31. Additionally, of the 60 sightings reported recently by marine mammal observers aborad the PGS seismic survey, 8 have been mother-calf pairs. Furthermore, the prevelence of New Zealand blue whale call type detected through acoustic analysis of the hydrophone data indicate that breeding behavior occurs in the STB region. Only male blue whales produce this call type as mating strategy to attact female mates. These behavioral observations, group composition records, and acoustic detections indicate that the STB region could be an important foraging, nursing and breeding region.

Health

32. We have not fully assessed our visual records and fecal samples collected at blue whale sightings in the STB region (photos and UAS video, hormone analysis) for health assessment. However, during the 2016 survey, one blue whale with a deformity was observed on 26 January and again on 3 February. The whale has a large depression (concave area) behind the blow hole, and on the animal's right side under this depression is a large bump (Fig. 12). The cause of these deformities is currently unknown but could be due to malnutrition, an injury such as caused by a ship strike, or an illness such as a tumor. The rest of the whale's body appeared to be in good condition, implying that malnutrition is unlikely to be the cause. A tissue biopsy sample of this individual was collected (not at the tumor site) and could be analyzed for anomalous proteins and carcinomas. Additionally, Olson *et al.* (2015) noted in their study of New Zealand blue whales that, "The body condition of the whales that we observed in January and March 2013 appeared poor; the whales were thin with vertebral processes pronounced in comparison to the surrounding tissue. The skin of these whales and of those photographed during the other months and years in New Zealand appeared in poor condition, with numerous scars from lesions and cookie cutter shark (Isistius sp.) bites. All 31 photo-identfiied blue whales were similar in appearance."

[1] (https://www.youtube.com/watch?v=9hpfVmP0hJ4).

Table 1. Percent daily occurrence of the New Zealand blue whale call type at each surveyed site within and surrounding the South Taranaki Bight, New Zealand.

Surveyed Site	# Recording Days Analyzed	# Days Acoustic Presence	Percent Daily Presence
MARU 1	156	154	98.7%
MARU 2	157	138	87.9%
MARU 3	157	133	84.7%
MARU 4	159	151	95%
MARU 5	159	159	100%

Table 2. Examples of source levels, population specific bandwidths, and approximate detection ranges of a few representative blue whale populations in the southern hemisphere.

Blue Whale Population	**Source Levels**	**Population Specific Bandwidth**	**Approximate Detection Range**
Antarctic blue whales: Western Antarctic Peninsula	189 ± 3 dB re: 1 µPa at 1 m (*Širović et al. 2007*)	25-29 Hz (Sirovic *et al.* 2007)	Up to 200 km (*Širović et al. 2007*)
Pygmy blue whales: eastern Indian Ocean population	179 ± 2 dB re: 1 µPa at 1 m (Gavrilov et al. 2011)	20-75 Hz (Gavrilov et al. 2011)	50-200 km (Gavrilov and McCauley 2013)
Antarctic blue whales: Southwestern Indian Ocean	179 ± 5 dB re: 1 µPa at 1 m (Samaran et al. 2010b)	17-30 Hz (Samaran *et al.* 2010b)	70-180 km (Samaran *et al.* 2010a)
Pygmy blue whales: Southwestern Indian Ocean	174 ± 1 dB re: 1 µPa at 1 m (Samaran et al. 2010b)	17-50 Hz (Samaran et al. 2010b)	40-50 km; up to 150 km (Samaran et al. 2010a)

Table 3. Number of blue whale individuals by mitochondrial DNA haplotype for each dataset and the combined New Zealand dataset (STB = Samples collected in STB during research surveys; NZCeTA = other New Zealand samples). One beachcast sample from the NZCeTA collection and one sample from the STB failed. Haplotype codes follow Leduc et al. (2007) except where noted in the text.

	STB	NZCeTA	Total
haplotype d	13	10	23
haplotype e	1	2	3
haplotype ii	2	1	3
haplotype mm		1	1
haplotype r	1		1
new haplotype	1		1
Total	18	14	32

Table 4: Results of pairwise comparisons of mitochondrial DNA haplotype (FST) and nucleotide (ΦST) diversity between New Zealand and three other southern hemisphere blue whale populations: Southern Ocean, Chile coast and Australia (LeDuc et al. 2007 and Attard et al. 2015 (n=89)). The mtDNA haplotypes from 35 New Zealand individuals was used for these comparisons.

	Sample size	# haps	# haps shared with NZ	FST	P value	ΦST	P value
Southern Ocean	183	52	2	0.221	< 0.001	0.31	< 0.001
Chile coast	113	19	2	0.265	< 0.001	0.348	< 0.001
Australia	89	14	4	0.016	0.101	0.007	0.215

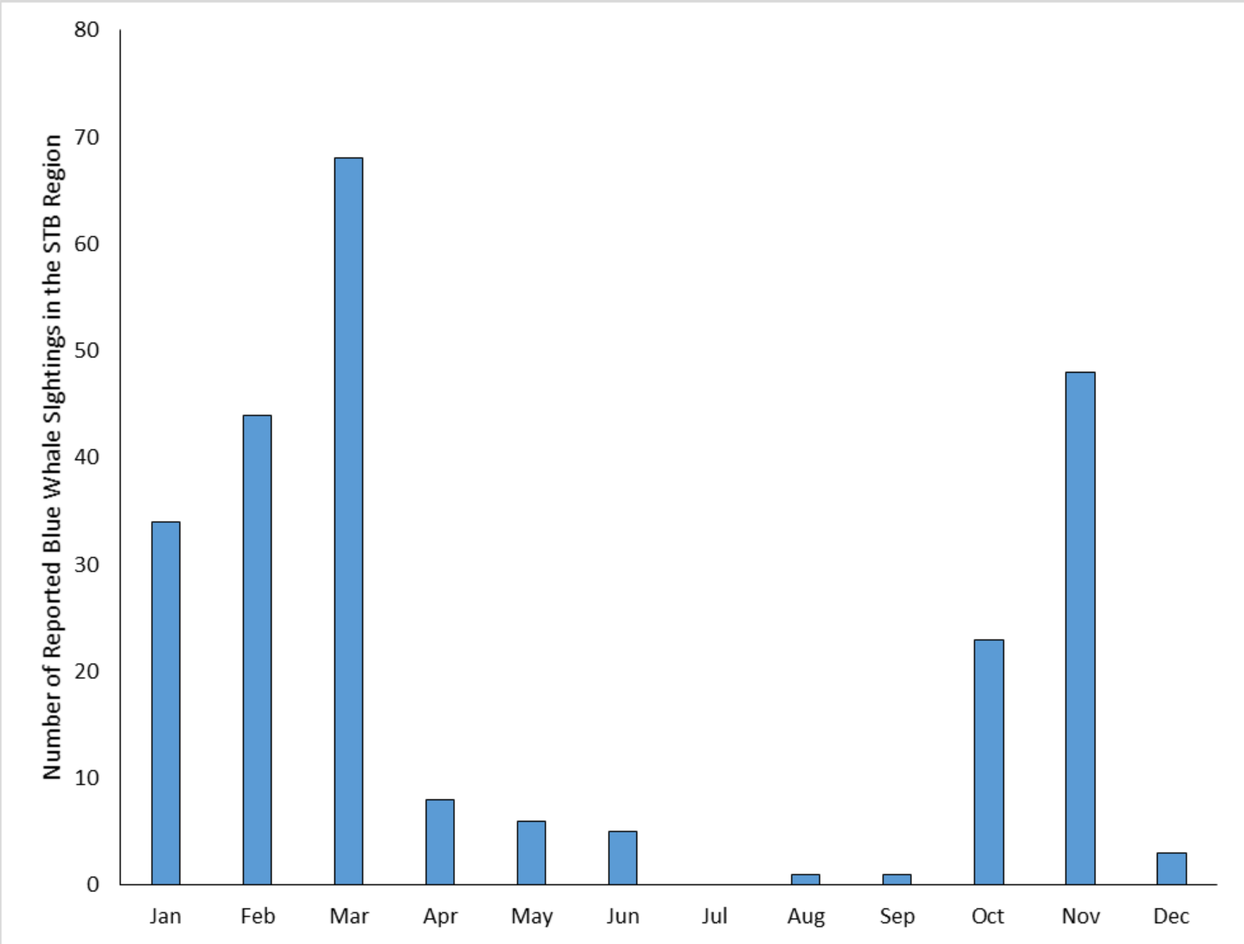


Figure 1. Monthly distribution of blue whales sightings in the STB. While a clear peak in sightings is evident during the spring and summer months (Oct, Nov, Jan, Feb, Mar) this could also be due to the distribution of survey effort during these months of relatively favorable weather. The drop in reported sightings during the December – a period when many groups take holiday – is potential evidence of this influence of survey effort.

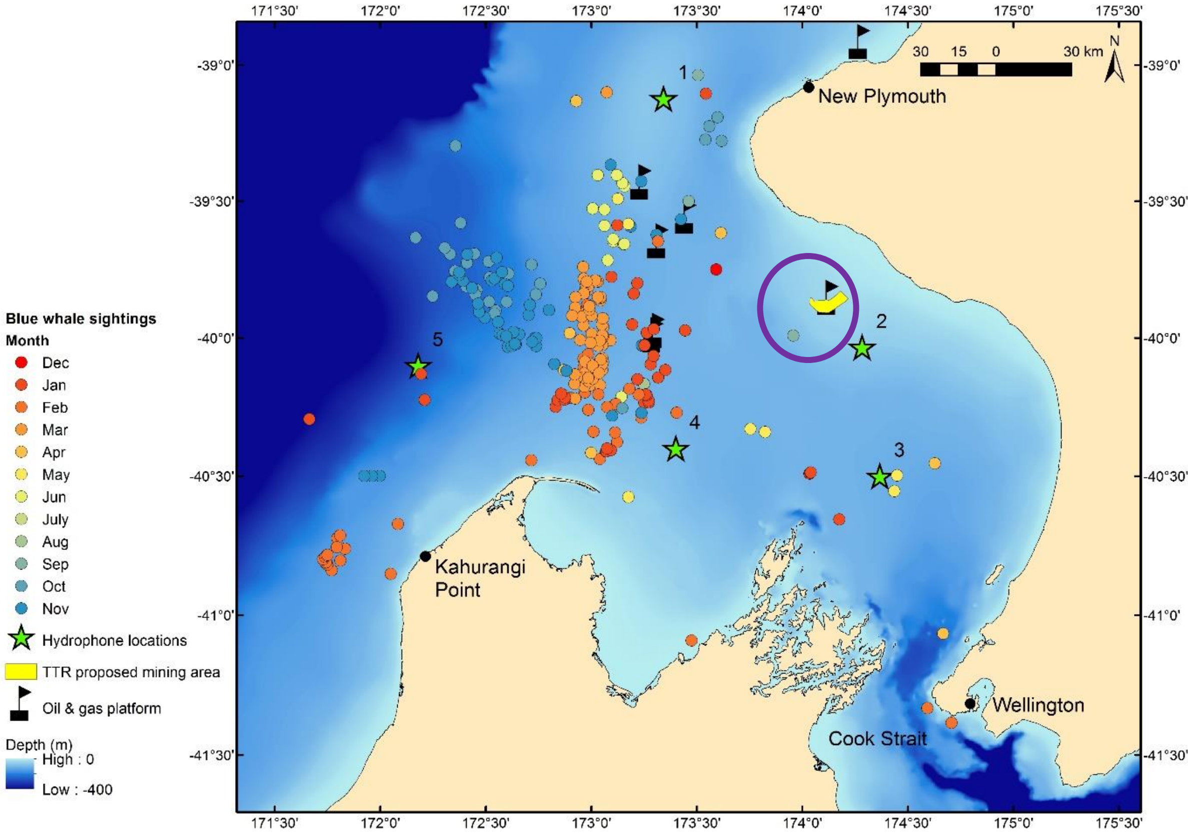


Figure 2. Spatial distribution of these blue whale sighting data across the STB region, with current oil and gas operations and the proposed mining area identified. The sightings are color-coded by month, yet should not be intepreted as an indication of temporal distributions patterns. Rather, these groups of sightings represent dedicated survey effort in a specific area during a clustered period. The green stars represent the deployment locations of the five hydrophones and each hydrophone identifcation number is indicated above each green star. Purple circle highlights the closest blue whale sighting to the proposed mining site reported (13.5 km).

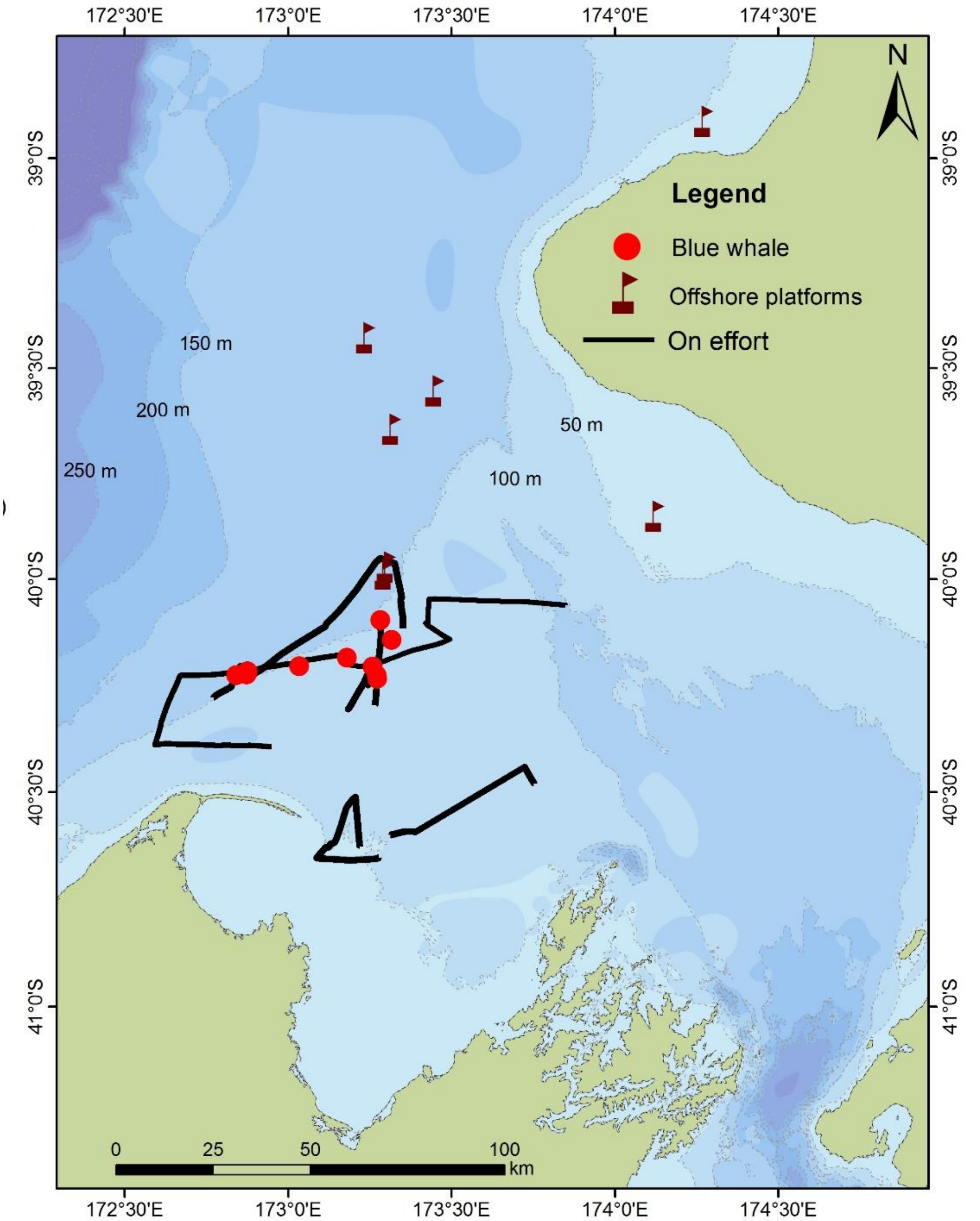


Figure 4. Distribution of dedicated blue whale survey effort and blue whale sightings in the STB region by my research group in Jan/Feb 2014.

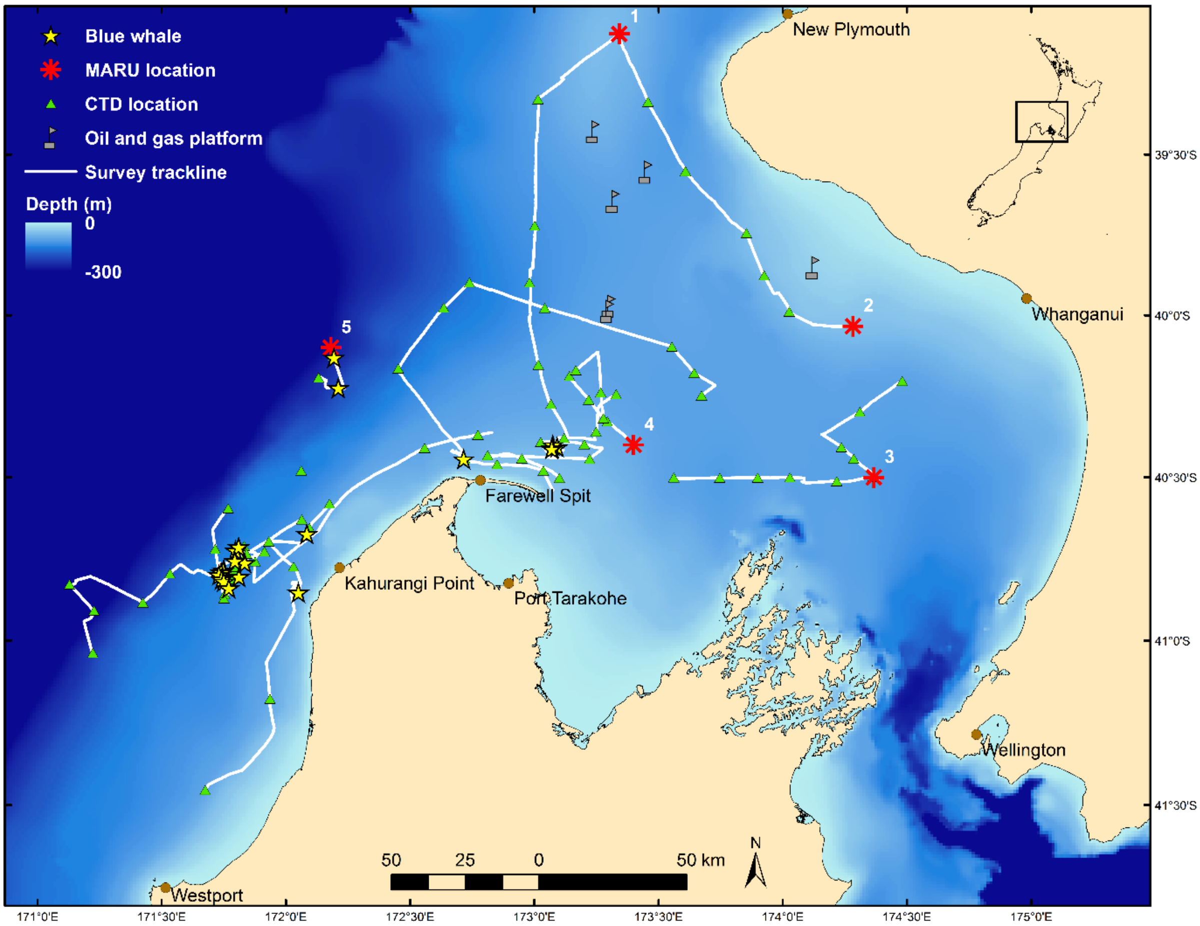


Figure 5. Distribution of dedicated blue whale survey effort and blue whale sightings in the STB region by my research group in Jan/Feb 2016. Note: strong El Niño conditions with annomonously high ocean temperatures in the STB conincided with this survey period, which likely caused blue whale occurence patterns to shift mainly toward the offshore region of the STB.

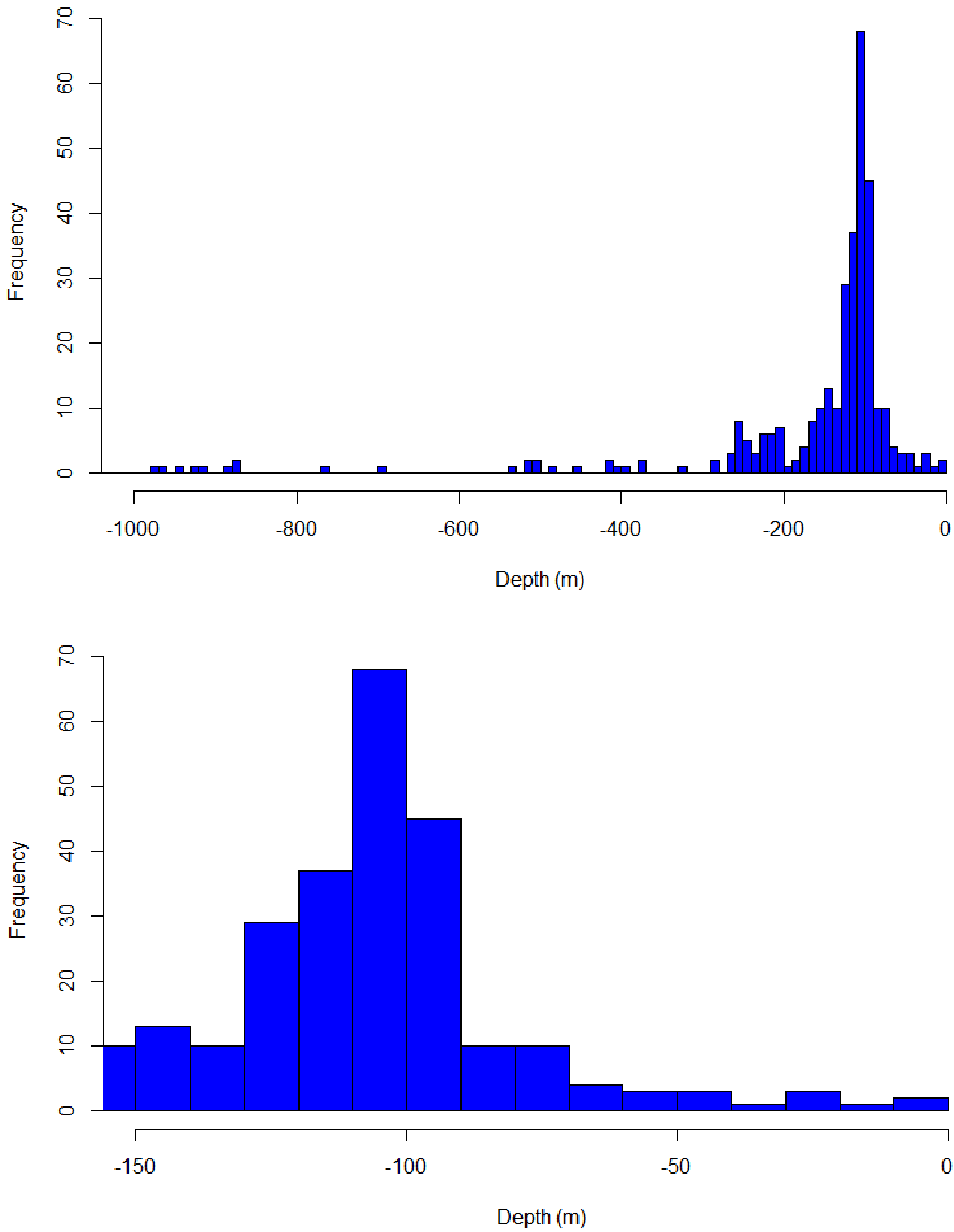


Figure 6. Frequency histogram of blue whale sightings in New Zealand waters by depth from 0-1000 m (top panel) and 0-150 m (bottom panel).

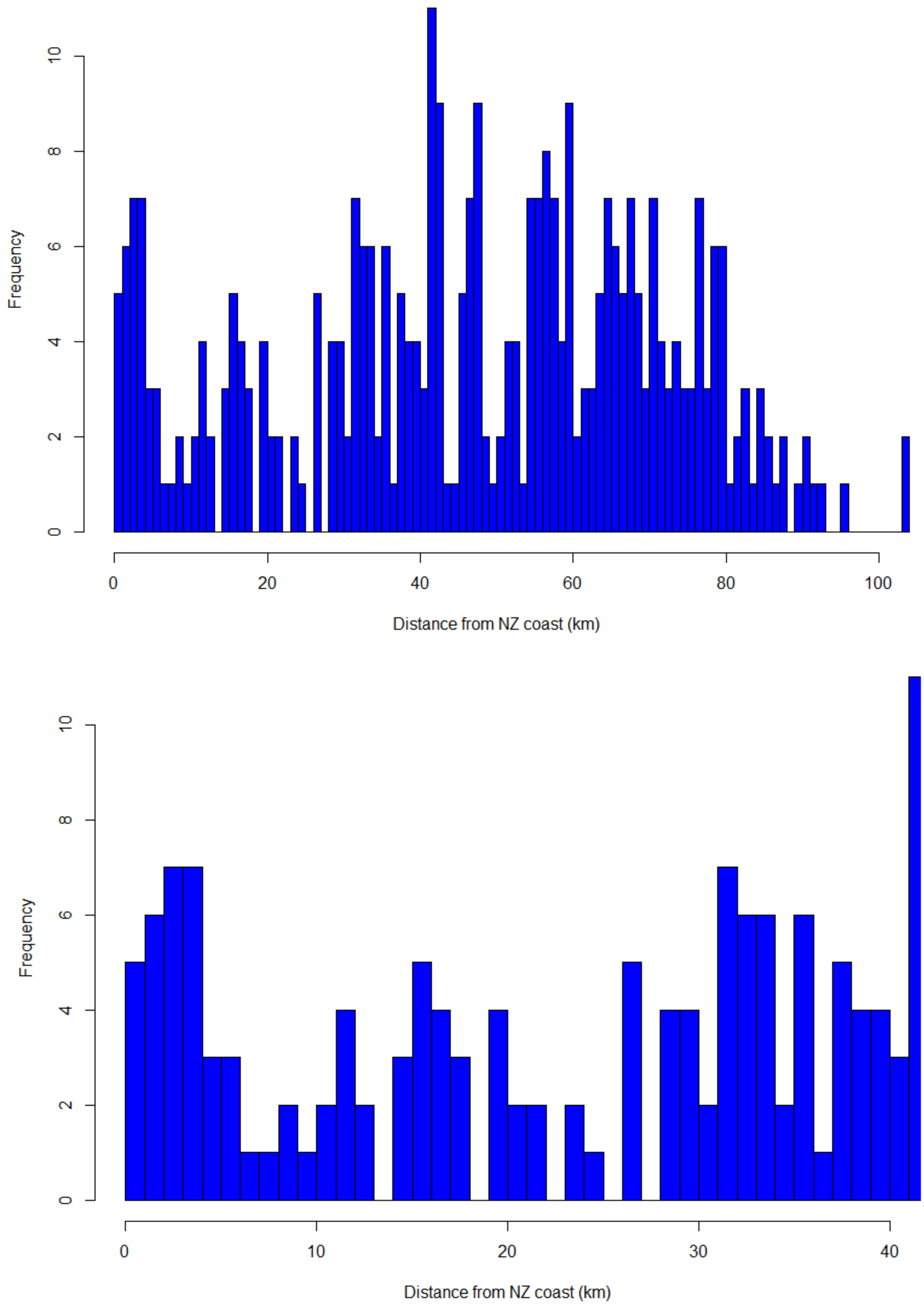


Figure 7. Frequency histogram of blue whale sightings in New Zealand waters by distance from New Zeaalnd coast from 0-100 km (top panel) and 0-40 km (bottom panel).

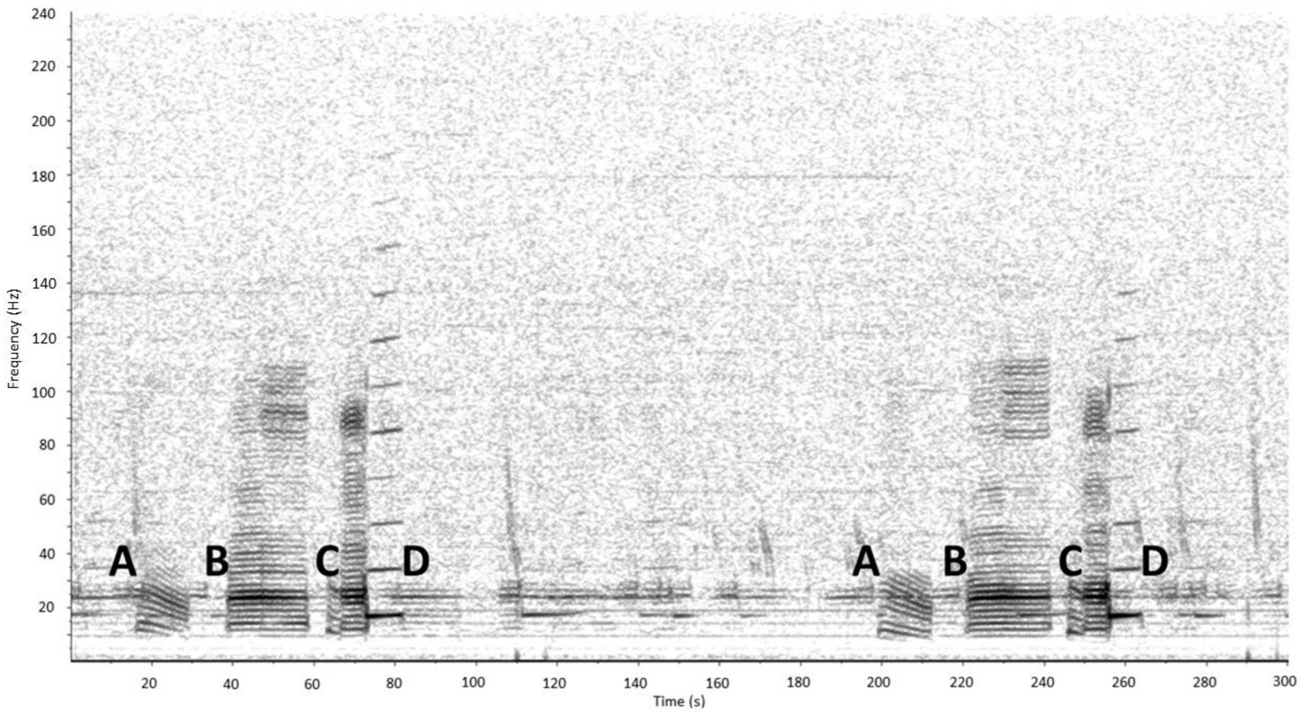


Figure 8. Example spectrogram of the New Zealand blue whale call type recorded at surveyed site MARU 2 on April 22nd, 2016. The call type consists of four parts (A-D), and is often repeated as shown.

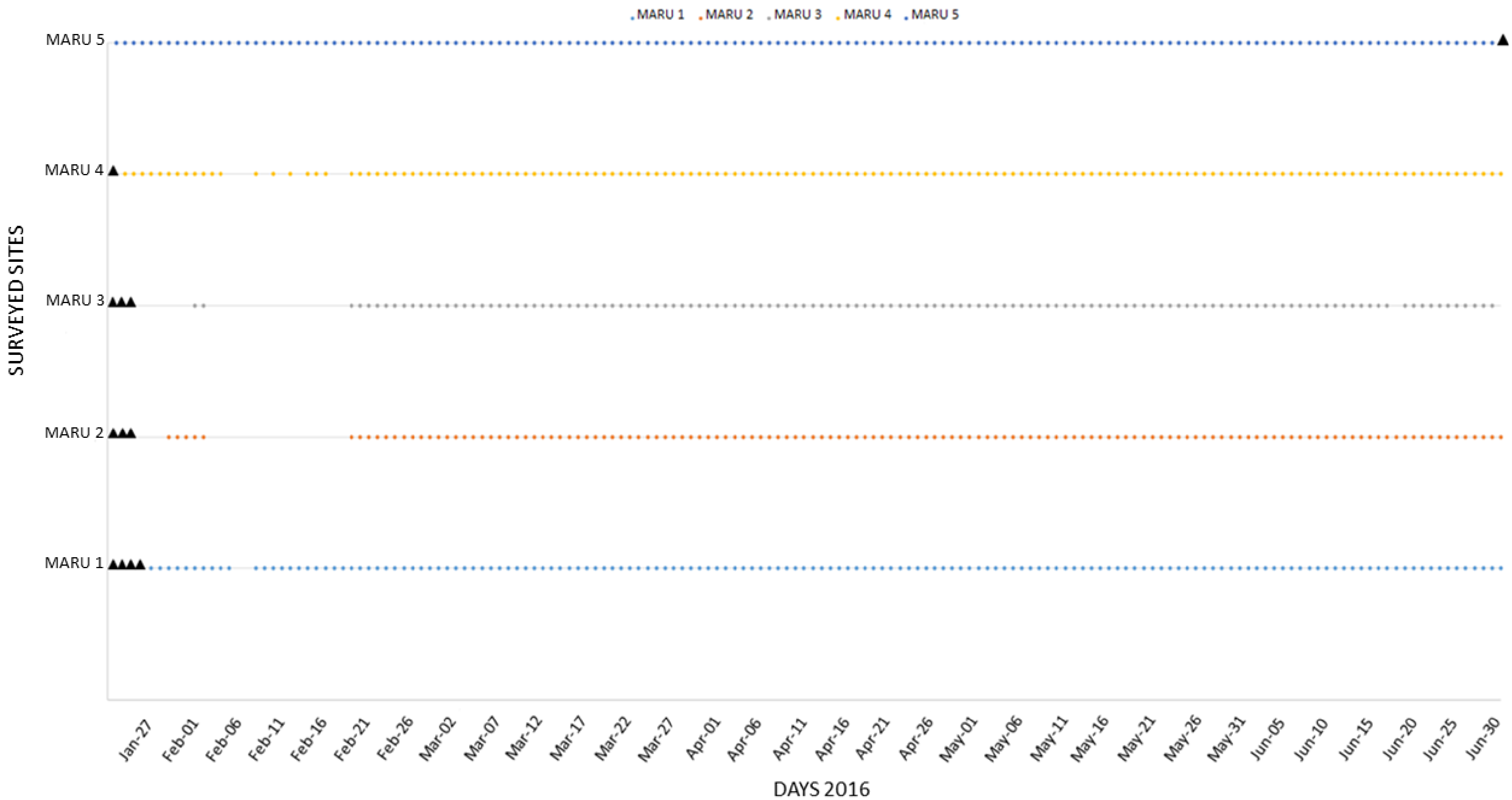


Figure 9. Daily acoustic presence of the New Zealand blue whale call type at all five MARU survey sites. Colored dots indicate presence; black triangles indicate no data were collected at select survey sites during January 23rd (MARU 1-4), January 24th (MARU 1-3), January 25th (MARU 1-3), January 26th (MARU 1), and June 30th (MARU 5).

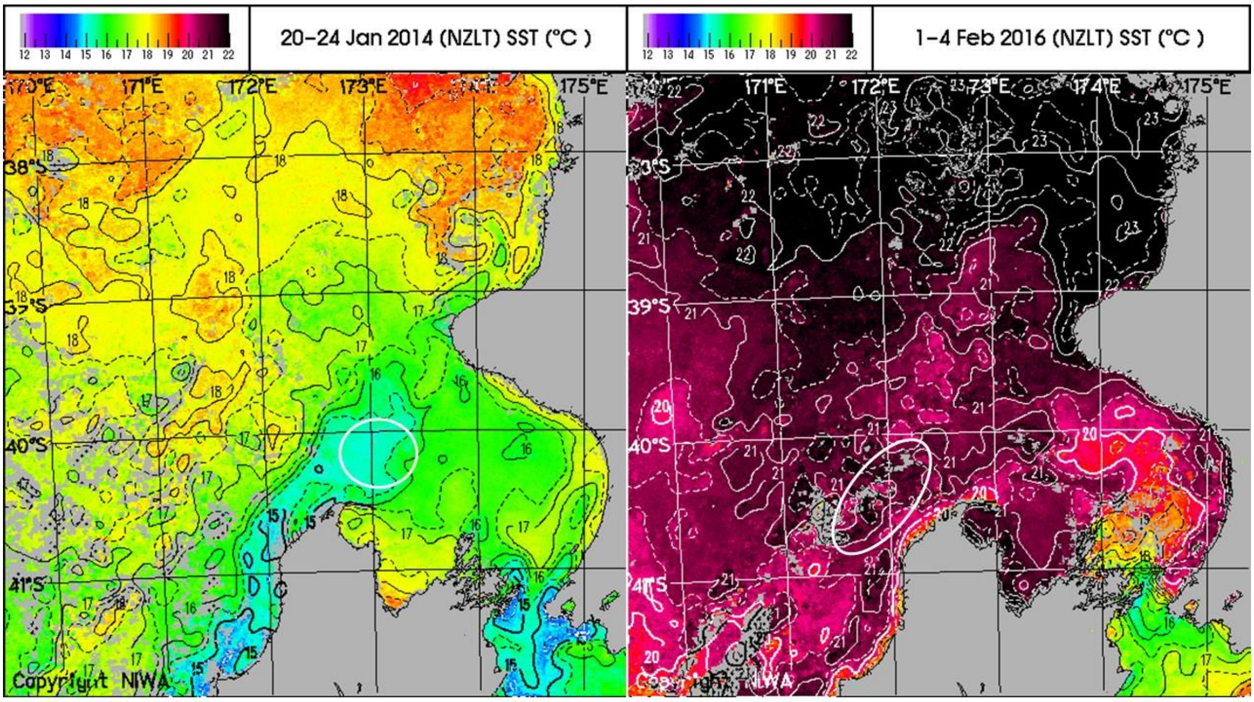


Figure 10. A comparison of satellite images of sea surface temperature (SST) in the South Taranaki Bight region of New Zealand between late January 2014 and early February 2016. The white circles on each image denote where the majority of blue whales were encountered during each field season.

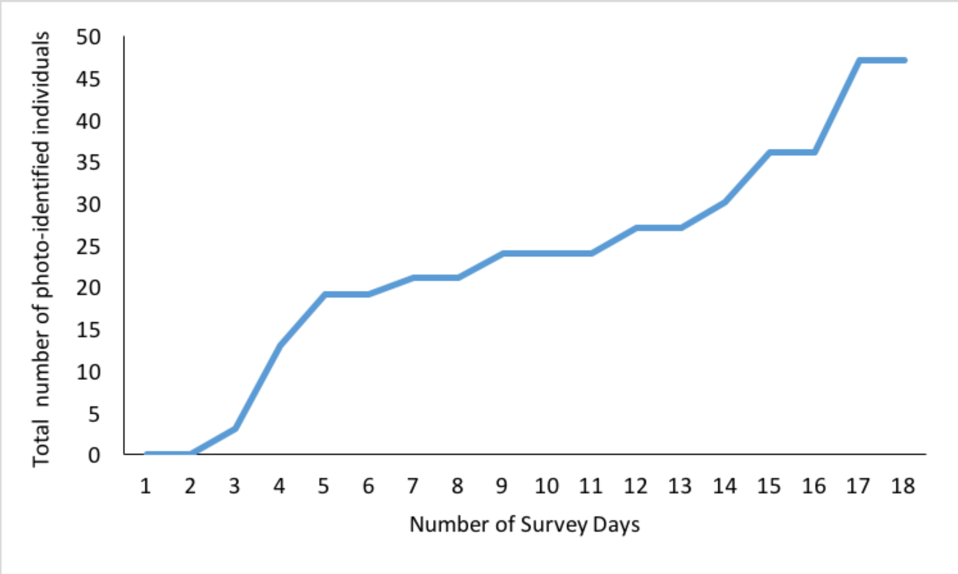
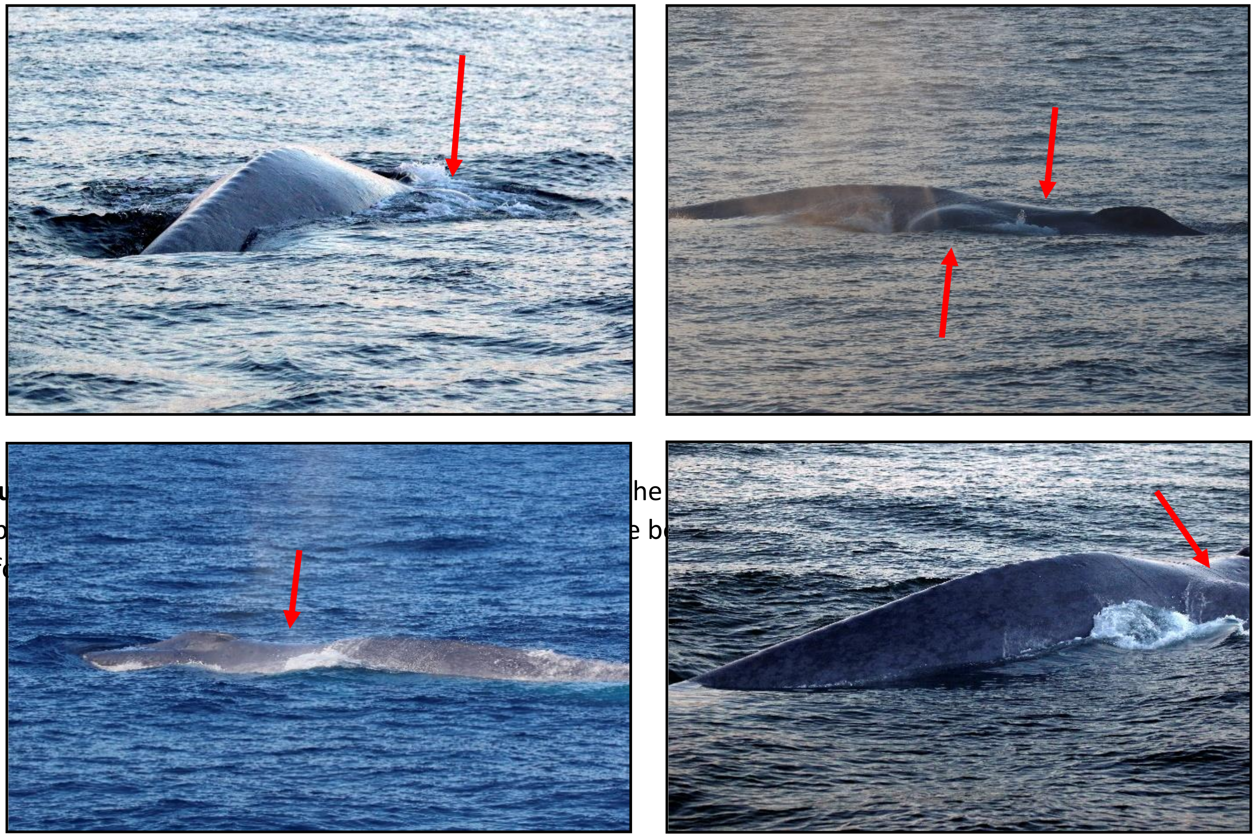


Figure 11. Discovery curve of the cumulative number of individual blue whales identified in the South Taranaki Bight during all scientific vessel surveys conducted by our research team during January and February of 2014 and 2016.



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Evaluation of proposed mining impacts on blue whales

Risk of vessel strike through increased vessel activity:

33. I believe that with every increase in anthropogenic activity in the STB region, the risk of vessel strike of a blue whale increases. There will be an increase in vessel traffic across the STB region due to the proposed mining operation, as acknowledged by the IA reports. While collision risk may be minimal during mining operations due to low vessel speeds, large vessels (floating storage and off-loading vessel, bulk carrier export vessel) will travel at higher speeds to and from the mining area from major ports (New Plymouth, Whanganui). This vessel traffic is a concern as it will pose a collision risk to whales. Baleen whales, particularly blue whales, are at risk of injury and death from vessel strikes worldwide (Van Waerebeek *et al.* 2007, Irvine *et al.* 2014), particularly as vessels get bigger, faster, and more prevalent across our oceans.

34. We are now confident the STB region is an important area for blue whales, but remain unclear about their spatio-temporal distribution patterns. Through continued data collection and analysis our understanding of distribution patterns will improve. Such information will help inform vessel traffic management and speed regulations that have been shown to reduce lethal injury to whales (Vanderlaan and Taggart 2007, Vanderlaan *et al.* 2008). The larger and faster the vessel is, the more threat it poses to large baleen whales because of the inability of whales to detect and evade an oncoming vessel (Nowacek *et al.* 2004). With TTR's proposed mining, more large vessels will be trafficking across the STB regularly, which will pose added risk to the blue whale population that is already maneuvering around high vessel traffic in the STB region, as illustrated by Marico (2015). TTR's IA has no mention of regulating vessel speed or routes to or form the mining site in order to reduce the risk of vessel strikes.

35. While Cawthorn et al. (2015) documented no blue whale sightings during their aerial surveys near the proposed mining site, it is important to recognize the minimal survey effort conducted by this study for TTR. Marine mammal sightings are often rare events, simply due to their inherent low prevalence and sightability, which often necessitates increased effort in an area to get a true sense of occurrence patterns.

Risks posed by increase noise due to proposed mining activities:

36. Cetaceans (whales and dolphins) are highly sensitive to ocean noise, as sound is their primary sensory modality, with acoustics informing their foraging, communication, and navigation. The acoustic range of blue whales is between 10-100 Hz, with long distance communication occurring below 50Hz (Fig. 8 and Table 2). TTR's evaluation of noise impacts from the proposed mining operations on low frequency marine mammals (baleen whales) is poor and misleading, and overlooks the potential to disturb blue whale behavior, distribution and physiology (stress levels).

37. To begin with, Hegley (2015) performed no actual assessment of the ambient noise levels at the mining site. Their evaluation of ambient noise was conducted at another location (Lyttelton Port) for only 15 minutes. Ambient ocean noise is highly site specific with sound propagation patterns highly dependent on local patterns of water temperature, benthic substrate, and bathymetry (Estabrook *et al.* 2016). Furthermore, ambient ocean noise is highly variable

temporally, with strong diel and seasonal patterns (Estabrook et al. 2016). None of these factors are considered in Hegley's (2015) evaluation of ambient noise at the proposed mining site, which they use to assess the level of potential disturbance to marine mammals. Hegley (2015) postulates that noise caused by mining activities will be less than the ambient noise levels, and therefore not impact marine life, yet the applied level of ambient noise is completely inappropriate, and leads to misguided assumptions.

38. Additionally, Hegley's (2015) proposed level of ambient noise at the proposed mining site of 132dB is derived from the sound of one vessel passing within 100 m of the acoustic receiver in Lyttelton Port (approximately 158dB re 1µPa) and then extrapolated based on vessel traffic in the STB within 10 nm of the mining site (Marico 2015). Again, this is a poor extrapolation because vessel noise is dependent on ship type, the number of ships in the region, and regional environmental characteristics - none of which are considered by Hegley (2015). Hegley (2015) makes the false assumption that all vessel traffic within 10 nm of the proposed mining site will have the same sound characteristics of this one vessel measured in a different area. Secondly, Hegley (2015) provides no information of how they derived their estimate of 132dB.

39. The IA claims, 'As identified in the last paragraph of Section 4.9.2, since the submission of Hegley (2015) report, TTR have obtained studies and reports provided to De Beers Marine from the Institute for Maritime Technology (South Africa). These reports provide empirical data of the level of noise generated by crawler operations. These reports demonstrate that the levels of low frequency noise produced by vessels of the off-shore mining industry are essentially the same as merchant vessels.' The Hegley (2015) report acknowledges the lack of information available on the noise generated from dredges or suction dredge. Hegley (2015) relies entirely on information derived from Reports 36 and 38, which are based on a study conducted prior to 1995 (actual dates not given) and presumably not with the equipment that will be used by TTR considering technology advancement over the past 20+ years. An on-site assessment of the noise levels to be produced by the equipment that will actually be used by TTR, such as the crawler (or SSED), FPSO, tug, and gas turbine generator, were not conducted and therefore the actual noise levels to be expected in the proposed mining site have not be evaluated or described adequately.

40. Furthermore, the Hegley (2015) estimate of the crawler's combined sound power level of 117dB re 20µPa, which equates to an underwater level of approximately 172dB re 1µPa at 1m, and does not include sound produced by the cutter head. Additionally, it's important to note that multiple sound generating activities will occur simultaneously, increasing the noise level produced; the operation and noise generated by the pumps, hydraulics, motors, drill, generators, etc. will not be in isolation. This cumulative level of noise to be generated was not evaluated by Hegley (2015).

41. The limited information of the sound source levels of the equipment and activities expected at the proposed mining site provided by Hegley (2015) is presumably from Report 38 (though not actually referenced in Hegley 2015). Table 1 in Report 38 provides noise levels from a variety of machinery tested prior to 1995, which produced sounds between 145 and 155 dB that are in the low frequency range that directly overlaps the hearing and communication range of blue whales (See Fig. 8 and Table 2). Report 38 does provide frequency spectrums of drills, crawler and

chains, all of which also show that the highest noise levels (dB) will be in the low frequency range where blue whales hear and communicate. So, while TTR purport minimal noise contribution by their mining equipment based on an unreliable study, the IA does acknowledge that noise will be produced and elevated in the low frequency band used by blue whales.

42. Moreover, the sound propagation estimates by Hegley (2015) – "From this, the noise from the dredge operation has been predicted at typically 130dB at 200m, 121 bD at 500m, 115dB at 1lm, and 108dB at 2km" – provides no information on how this transmission loss was calculated (how these numbers were derived), which includes no information on local sound propagation conditions that will impact the distance sound will travel (because these local conditions were never measured, as described above). TTR must conduct noise assessment at the site, so local ambient noise conditions can be measured and a representative transmission loss model can be generated.

43. Therefore, the assessment form 1995 is a poor indication of the noise that may be derived from the machinery operation at the proposed mining site in the STB. Hegley (2015) provides very questionable characteristics of the sounds to be produced by the crawler. I do not believe that TTR have address the EPA's concerns with regard to noise effects. The provided reports do not "provide empirical data on the level of noise generated by crawler operations". The referenced study was conducted over 20 years ago. Moreover, what evidence is available (Table 1 from Report 38) of the noise characteristics of the machinery that may be used indicates that there will be elevated noise in the low frequency range of blue whales. Additionally, TTR claim that noise produced by their operations will be similar to 'merchant vessels', which, even if this is a true statement, is harmful to blue whales, as large vessel traffic produces low frequency sounds that have been shown to impact the behavior of baleen whales (Parks *et al.* 2007, Parks *et al.* 2011, Rolland *et al.* 2012). This overlap in noise range between large vessels and blue whales is exemplified in Figure 13, 14 and 18 of the Hegley (2015) report. Furthermore, Figure 13 from Hegley (2015) illustrates the increased sound level at the low frequencies used by blue whales. (This type of sound spectrum should be provided for all operations proposed by TTR's mining operations.) Yet, there is an important distinction between vessel noise and the proposed mining operation noise: persistence of the sound source. A vessel will move through an area, but the mining operation will be a permanent source of noise for 35 years. Such a persistent source of noise will likely have significant impacts on blue whale distribution (Goldbogen *et al.* 2013), habitat use patterns (Williams *et al.* 2014), and health (Rolland et al. 2012). The fact that the primary range of expected noise emission is in the hearing range of blue whales is very concerning, especially considering that the relative and cumulative contribution to local ambient noise condition has not been considered.

44. In addition to the IA's unfounded claims that minimal noise will be added to the environment, the IA also makes false and misguided assumptions of no impact of added noise in the environment to marine mammals. Ocean noise around the world has been increasing for decades due to industrial activities including vessel traffic, seismic survey operations and mining activities, and sonar (Hildebrand 2009), with significant impacts to cetaceans (Tyack 2008, Clark *et al.* 2009). Evidence shows that blue whales worldwide have already shifted their frequency of communication over the past five decades, and raising ocean noise is a hypothesized cause (McDonald *et al.* 2009). The IA states that, "…whales would seek to avoid the specific areas

within the project area where iron sand extraction activities are occurring due the noise and disturbance effects." Such avoidance ***is*** an impact on whales – termed habitat displacement – and can have significant consequences if animals are missing important feeding or mating opportunities, especially if this impact is persistent over time.

45. There are many levels of impacts of noise on marine mammals, starting with behavioral response (habitat displacement), masking of sounds so that animals cannot communicate effectively, long-term physiological impacts such as elevated stress levels that may compromise immune systems, temporary threshold shifts that is reversible hearing loss, and permanent threshold shift where hearing is permanently damaged.

46. Examples of impacts of industrial noise on baleen whales:

- Di lorio and Clark (2010) showed that blue whales change their vocal behavior during seismic survey operations by calling more frequently to compensate for elevated ambient noise conditions. Such increased calling can have energetic consequences for cetaceans (Holt *et al.* 2015).
- Melcon *et al.* (2012) found that blue whales were less likely to produce calls when mid-frequency active sonar was present. These results demonstrate that anthropogenic noise, even at frequencies above the blue whales' sound production range, has a strong probability of eliciting changes in vocal behavior.
- Rolland et al. (2012) demonstrated the first evidence that exposure to low-frequency ship noise is associated with chronic stress in whales. The study found that reduced ship traffic in the Bay of Fundy, Canada, following the events of 11 September 2001, resulted in a 6 dB decrease in underwater noise with a significant reduction below 150 Hz. This noise reduction was associated with decreased baseline levels of stress-related fecal hormone metabolites in North Atlantic right whales.
- Parks et al. (2011) documented changes in calling behavior by individual endangered North Atlantic right whales with increased background noise. Right whales responded to periods of increased noise by increasing the amplitude of their calls.
- Richardson *et al.* (1986) showed that bowhead whales began to orient away from an airgun array when 7.5 km away. Whales were displaced by about 2 km. In general, bowhead whales exhibited avoidance reactions when they received seismic pulses stronger than about 160 dB r e: 1 µPa.
- Goldbogen et al. (2013) showed that low source level mid-frequency sonar significantly affected blue whale behavior, especially during deep feeding modes. When a response occurred, behavioral changes varied widely from cessation of deep feeding to increased swimming speed and directed travel away from the sound source. Sonar-induced disruption of feeding and displacement from high-quality prey patches could have significant and previously undocumented impacts on baleen whale foraging ecology, individual fitness and population health.

47. The impact of noise generated by the proposed mining activities on blue whales has not been adequately evaluated. Unlike purported by TTR's IA, such displacement from habitat is not inconsequential because habitat avoidance can have consequences: animals that avoid noisy environments may also lose foraging opportunities. If this happens once, consequences may be

minor, but with the proposed 35 years of mining operations such an impact on the ambient noise environment could have long-term and significant impacts on blue whale distribution patterns and therefore access to feeding opportunities. Blue whales have the largest energetic demands of any animal (Williams *et al.* 2001, Acevedo-Gutierrez *et al.* 2002), therefore access to productive feeding areas with dense aggregations of prey is critical to their survival and reproduction rates. If habitat displacement occurs, blue whales may be forces to feeding in lower quality areas, compromising their health and reproductive rates.

48. Additionally, added noise to the ocean environment by mining activities can increase acoustic masking. Acoustic masking can cause inefficient and potentially lost communication between individuals. Increased ocean noise can cause animals to call louder, requiring greater energy demands, or animals may be unable to hear signals from conspecifics regarding feeding and mating opportunities. Furthermore, even if whales remain in an area of increased noise in order to have access to feeding opportunities, their foraging behavior and success may be compromised, as demonstrated by Goldbogen et al. (2013).

49. In addition to behavioral responses to ocean noise, there is rising evidence of physiological impacts of ocean noise on baleen whales. Evidence has shown that many mammal species, including humans, show physiological stress responses to chronically noisy environments, and these responses can impact health and susceptibility to illness (Evans *et al.* 1998, Stansfeld and Matheson 2003, Ising and Kruppa 2004). Through the analysis of fecal hormone levels, it has been demonstrated that northern right whales have a significant correlation in stress response with increased ambient ocean noise levels (Rolland et al. 2012). Therefore, we must be vigilant regarding added noise in the ocean environment because each increase contributes to the behavioral and physical consequences to ocean animals, including blue whales.

Risks associated with increased sediment plume:

50. The sediment plume and optical models of the proposed mining region in the IA indicate that the impacts of the mining activities will be low-level and confined to a small area. However, I see no evidence of model simulation of mining activities and plume production over the proposed 35 year mining period. If the mining activities were planned to be an acute, one-time event, I agree that the ecosystem would quickly recover from such a minor impact. Yet, with prolonged mining activity over 35 years, this sediment plume may not dissipate but rather persist in the STB region due to a continual source, and likely spread, via currents and wind to areas outside the modeled proposed mining area region.

51. Such long-term, persistent increase in sediment in the water column of the STB is likely to have impacts on ecosystem productivity through reduced light penetration and subsequent change to the zooplankton community, including *Nyctiphanes australis* (krill), the target prey item of blue whales in the region (Torres 2013, Torres et al. 2015). With increased sediment in the water column dense patches of *N. australis* – needed by blue whales to survive – may be less numerous, more difficult to detect, and occur in unusual areas that reduce availability to whales.

52. Furthermore, zooplankton sampling conducted in February 2015 presented by MacDiarmid et al. (2015) shows that euphuasiids *(*like *N. australis)* occurred near the proposed mining site, in

an eastwardly direction (See Fig. 3.2 in MacDiarmid et al. 2015). This direction is also the direction of expected sediment plume flow. Therefore, we can expect that even with the minimal sediment transport predicted by TTR reports, the distribution and abundance of euphuasiids near the mining site may be impacted. Furthermore, as discussed by MacDiarmid et al. (2015), zooplankton sampling has occurred across the STB in the 1970s and 80s. These studies are summarized in Torres 2013:

"*Studies have documented large concentrations of zooplankton, including elevated biomass of* N. australis*, linked to these upwelling plumes due to enhanced primary productivity (Foster and Battaerd 1985) (Bradford and Chapman 1988, James and Wilkinson 1988, Bradford-Grieve et al. 1993). All of these studies found* N. australis *concentrations most abundant downstream of the upwelling area to the north and east (Fig. 1). Unfortunately, the majority of zooplankton sampling sites in these studies occurred between the upwelling area and south of 39'50°S, and no long-term records of the zooplankton community in the STB have been made. Therefore, no empirical data are available on the variation in zooplankton composition throughout the entire STB region or temporally. However, Bradford and Chapman (1988) found the greatest biomass of* N. australis *at the northern and eastern limits of their sampling area and illustrated increasing wet weight toward the north. Furthermore, the STB area has the most extensive zooplankton biomass of all coastal regions in New Zealand (Bradford and Roberts 1978) and a study of the euphausiid community in nearby Cook Strait found* N. australis *to be the dominant species with year-round presence (Bartle 1976)."*

53. These studies suggest an important biomass of *N. australis* in the STB with an unknown distribution (spatially or seasonally), yet the studies that do exist show increasing abundance toward the proposed mining site. Although we have incomplete knowledge on where blue whales forage in the STB region, sighting and acoustic records indicate that it is likely that blue whales forage near the TTR proposed mining site. Therefore, habitat disturbance that impacts prey availability for blue whales in this area should be considered and avoided.

54. Hence, this statement in Section 4.8.1.1 of the IA is complete speculation based on false assumptions and little evidence on the distribution of blue whales and their prey, and should be considered suspect: "In addition, the extent of the area where suspended sediment concentrations will be above 2 mg/L as a result of the project (being the level which would cause some disturbance to the feeding and foraging activities of blue whales) represents only 0.2% of the known foraging area of blue whales – excluding the shallower areas of the STB. As such, MacDiarmid et al. (2015a) concludes that any displacement or impacts on blue whale feeding would be negligible."

Comments on the proposed marine mammal management plan:

55. The mitigation plan is incomplete in my opinion, as there is no offshore sampling based on an unfounded assumption of limited spatial impact by the proposed mining operations. I believe that monitoring of impacts should include at least one study site or transect that is offshore of the proposed mining site. TTR and regulators should be aware of potential environmental change across the whole region. Furthermore, it would be best for much of the proposed mitigation plan to be carried out prior to this permitting process as the data to be collected

would serve to fill many of the knowledge gaps that are being highlighted, such as ambient noise conditions, sound propagation, and sediment flow.

CONCLUSION

56. Evidence is mounting that blue whales regularly occur in the STB region for foraging and breeding opportunities, and that these animals may be part of a distinct New Zealand population of blue whales. No doubt that many questions remain regarding this population of blue whales, but based on the data presented above, it is clear that blue whales occur year round in the STB region, show fidelity to New Zealand waters across many years, and use the region for feeding, nursing and breeding. Ongoing data collection and analysis will continue to reveal more detailed patterns of blue whale space use and movement patterns.

57. TTR's minimal and deficient evaluation of acoustic impacts on the STB environment and marine life demonstrate a dismissive attitude toward the potential effects of their proposed mining operations on marine mammals in the region, including blue whales. Additionally, the marine mammal surveys conducted on behalf of TTR by Cawthron (2015) were a minimal and insufficient exercise in data collection. It appears that TTR have attempted to avoid complete discussion of impacts on marine mammals through incomplete collection and presentation of data. A more adequate assessment of impacts on marine mammals would include extensive marine mammal visual and acoustic surveys across the region and seasons, examination of whaling and stranding records, assessment of the soundscape and sound source levels of equipment to be used, and a seasonal and regional study of the prey (zooplankton and fish) communities.

58. It is naive to think that a 35 year mining project within the STB region will not impact this population of blue whales, through elevated noise within their frequency range, habitat displacement, vessel impacts, and prey disturbance. While the degree of impact is unknown, we can expect repercussions if the mining project proceeds. Our evidence indicates that blue whales in the STB region likely form a local New Zealand population. Therefore, activities that pose unknown and possible risks to this recently documented blue whale population should be avoided. Furthermore, the cumulative impacts of anthropogenic activities in the STB region on blue whales must be considered. Although seabed mining operations like this proposal could be considered "just another drop in the bucket", the bucket will overflow someday, causing blue whales and the STB ecosystem to suffer consequences that cannot be reversed. Finally, when considering regulation of human impacts on natural ecosystems, I believe it is important to recognize the innate right of animals, such as blue whales in this case, to live in their natural habitat without disturbance, to feed without compromise, and to communicate without disruption.

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