Department of Conservation
Te Papa Atawhai

Applicant Information Form 12a
Holding, taking, importing, exporting marine mammals for research purposes

The Department recommends that you contact us to discuss the proposed activity prior to completing the application forms:

Permissions Advisor (Support)
Phone: +64 3 371 3700
Email: permissionschristchurch@doc.govt.nz

Please provide all information requested in as much detail as possible. Applicants will be advised if further information is required before this application can be processed by the Department.

This form must be completed when applying for permits to hold, take, import, export marine mammals for research purposes ONLY. If you wish to hold, take, import, export marine mammals for reasons other than research please fill in Form 12b, available on the DOC website.

Please note that simple research permit applications should be lodged at least 30 working days prior to a permit being required. Complex applications may require longer.

Once you have filled in your application form, please complete this checklist to ensure that all components of your application are complete. This will help prevent any possible delays in the processing of your application.

- ☐ Legal status (company/trust/inc society) registration number (if not an individual)
- ☐ All appropriate application forms
- ☐ Written consultations (if applicable)
- ☐ Supporting information and detail including maps as required in activity forms
- ☐ Have you read and accept the section regarding the liability of the applicant for payment of fees.
- ☐ If Animal Ethics Committee Approval has been obtained, provide details and attach copies.
- ☐ **Have you signed your application?**

All efforts in putting together a detailed application are greatly appreciated and will allow the Department to effectively and efficiently process your application.

A. Applicant Details

Applicant Name (full name of registered company or individual, student or university)	Leigh Torres, Oregon State University						
Legal Status of applicant (tick)	**Individual X**		**Registered Company**		**Trust**		**Incorporated Society**
Other (please specify full details)							
Please supply the company, trust or incorporated society registration number:							
If an individual please supply your date of birth (this is a unique identifier for you): [redacted]							
Trading Name (if different from Applicant name)							
Postal Address (of Applicant)	[redacted]						
Street Address (if different from Postal Address)							
Phone	[redacted]		**Website**	https://mmi.oregonstate.edu/gemm-lab			
Contact Person and role	Leigh Torres, PI						
Phone	[redacted]		**Cell Phone**	[redacted]			
Email	Leigh.Torres@oregonstate.edu						
Contact Person and role	Dawn Barlow, Co-PI						
Phone			**Cell Phone**	[redacted]			
Email	dawn.barlow@oregonstate.edu						

B. Title of Research Project

Response of blue whales and krill to climate change: Synthesis of Acoustics, Physiology, Prey, and Habitat In a Rapidly changing Environment (SAPPHIRE)

C. Details of Proposed Activity

☐ **X** Take ☐ Hold ☐ Import ☐ **X** Export

NB please tick all applicable activities

D. Applicants/Key Researchers

List the names and institutional affiliations of all the key individuals involved with the research. List any convictions or offences, of any of the applicants or key researchers, against the MMPA 1978 or any other Act involving the mistreatment of animals.

Leigh Torres, Ph.D., Associate Professor, Marine Mammal Institute, Oregon State University
Dawn Barlow, Ph.D., Postdoctoral Scholar, Marine Mammal Institute, Oregon State University
K.C. Bierlich, Ph.D., Postdoctoral Scholar, Marine Mammal Institute, Oregon State University
Holger Klinck, Ph.D., Director, K. Lisa Yang Center for Conservation Bioacoustics, Cornell University
Kim Bernard, Ph.D., Associate Professor, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University
C. Scott Baker, Ph.D., Associate Director, Marine Mammal Institute, Oregon State University
Rochelle Constantine, Ph.D., Professor, School of Biological Sciences, University of Auckland
Emma Carroll, Ph.D., Professor, University of Auckland
Dave Lundquist, Ph.D., Technical Adviser Marine, Marine Species Team, New Zealand Department of Conservation
Mike Ogle, Technical Adviser Marine, Marine Species Team, New Zealand Department of Conservation
Callum Lilley, Principal Compliance Advisor, New Zealand Department of Conservation

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E. Description of Proposed Research

- Abstract

Provide an abstract of the proposed research project, emphasising the research objectives and the manner in which such activity involves the taking, import or export of marine mammals.

The South Taranaki Bight (STB) region is critically important habitat for a genetically distinct population of pygmy blue whales (Barlow at al. 2018). This unique population is present in the STB year-round, and our previous research has highlighted the potential impacts of changing ocean conditions on critical life history processes including feeding and reproduction (Barlow et al. 2023). However, in the face of climate change, critical knowledge gaps remain regarding how blue whales and their prey, krill, will respond. Through the SAPPHIRE project, we will collect data on krill availability and quality, and blue whale occurrence, behavior, and physiology in the STB. This approach enables us to examine how changing ocean conditions affect the availability and quality of krill, and thus impact blue whale body condition, endocrinology, and foraging and reproductive effort. More specifically, our objectives are to:

A. Assess the mechanistic response of krill to variable environmental conditions through controlled experiments and field collections,
B. Document the physiological response of blue whales to changes in environment and prey,
C. Describe relationships between environmental conditions and blue whale foraging and reproductive behavior, and
D. Integrate these components to develop novel Species Health Models (SHM) to predict prey and predator population response to rapid environmental change.

Our methods to achieve these objectives include the deployment of two hydrophones to monitor blue whale feeding and breeding calls for three years, and vessel-based survey effort during three consecutive summer field seasons (January-February 2024, 2025, 2026) to collect data on the availability and quality of krill, the distribution and behaviour of blue whales, blue whale body condition measured via unoccupied aircraft systems (UAS; drone), and tissue biopsy and faecal samples for genetic and hormone analysis. Through the SAPPHIRE project, we will develop a framework for understanding the health impacts of environmental change on krill and blue whales, which can in turn inform management decisions based on relevant health thresholds in the face of climate change.

Barlow DR, Torres LG, Hodge KB, Steel D, Baker CS, Chandler TE, Bott N, Constantine R, Double MC, Gill P, Glasgow D, Hamner RM, Lilley C, Ogle M, Olson PA, Peters C, Stockin KA, Tessaglia-Hymes CT, Klinck H (2018) Documentation of a New Zealand blue whale population based on multiple lines of evidence. Endanger Species Res 36:27–40.

Barlow DR, Klinck H, Ponirakis D, Branch TA, Torres LG (2023). Environmental conditions and marine heatwaves influence blue whale foraging and reproductive effort. Ecology and Evolution, 13(2): e9770.

- Duration of Proposed Research

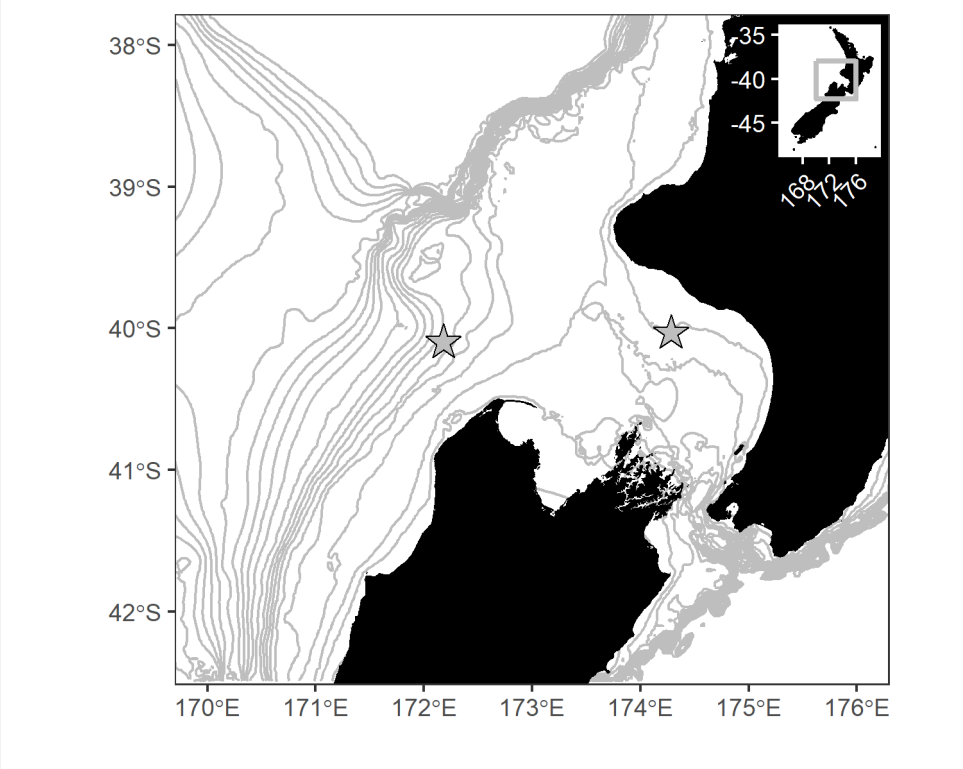
Provide a detailed description of the overall duration of the proposed research.

Fieldwork will be conducted between 15 January and 5 March, 2024, during which time we will conduct a three-week vessel-based survey and deploy two hydrophones. Vessel-based surveys will be repeated during the same window in 2025 and 2026, and the hydrophones will be recovered to retrieve and replace batteries and data storage, and then re-deployed to record for the following year. In January 2027, the hydrophones will be recovered, and opportunistic data collection on blue whales may occur during this period if they are observed.

- Location of Proposed Research

Provide a detailed description of the overall location of the proposed research. Supply a map detailing the location if appropriate.

This research effort will focus on the South Taranaki Bight (STB) region between the North and South Islands of Aotearoa New Zealand (see map below). If too few blue whales are found in the STB region (as may occur during marine heatwaves) we would need to survey areas adjacent to the STB as shown by the extent of the map below. Two hydrophones will be deployed to monitor for blue whale vocalizations, with one placed offshore in the western portion of the study region, and the second one within the STB (approximate locations denoted by stars in the map below).



- Species Name and Status

Provide a list of all the species (common and scientific names) involved in the research activities. Describe the status and factors that affect the species i.e., incidental bycatch, pollution etc.

Pygmy blue whale (*Balaenoptera musculus brevicauda*); New Zealand Threat Classification Status: Data Deficient; Threatened by historical whaling depletion, vessel strikes, and habitat and noise disturbance.

Antarctic blue whale (*Balaenoptera musculus intermedia*); New Zealand Threat Classification Status: Data Deficient; Threatened by historical whaling depletion, vessel strikes, and habitat and noise disturbance.

*Bryde's whale (*Balaenoptera edeni*); New Zealand Threat Classification Status: Nationally Critical; Threatened by historical whaling depletion, vessel strikes, and habitat and noise disturbance.

*Fin whale (*Balaenoptera physalus*); New Zealand Threat Classification Status: Data Deficient; Threatened by historical whaling depletion, vessel strikes, and habitat and noise disturbance.

*Sei whale (*Balaenoptera borealis*); New Zealand Threat Classification Status: Data Deficient; Threatened by historical whaling depletion, vessel strikes, and habitat and noise disturbance.

*Humpback whale (*Megaptera novaeangliae*); New Zealand Threat Classification Status: Migrant; Threatened by historical whaling depletion, vessel strikes, and habitat and noise disturbance.

*Southern right whale (*Eubalaena australis*); New Zealand Threat Classification Status: Recovering; Threatened by historical whaling depletion, vessel strikes, and habitat and noise disturbance.

*Minke whale (*Balaenoptera bonaerensis*); New Zealand Threat Classification Status: Data Deficient; Threatened by vessel strikes, habitat and noise disturbance, whaling.

*Sperm whale (*Physeter macrocephalus*); New Zealand Threat Classification Status: Data Deficient; Threatened by historical whaling depletion, vessel strikes, and habitat and noise disturbance.

*Killer whale (*Orcinus orca*); New Zealand Threat Classification Status: Nationally Critical; Threatened by habitat and noise disturbance.

*Pilot whale (*Globicephala spp.*); New Zealand Threat Classification Status: Not Threatened (*G. melas*), Data Deficient (*G. macrorhynchus*); Threatened by habitat and noise disturbance, whaling.

*False killer whale (*Pseudorca crassidens*); New Zealand Threat Classification Status: Naturally Uncommon; Threatened by fisheries interactions, habitat and noise disturbance.

*Hector's dolphin (*Cephalorhynchus hectori hectori*); New Zealand Threat Classification Status: Nationally Vulnerable; Threatened by fisheries interactions, habitat and noise disturbance.

*Maui's dolphin (*Cephalorhynchus hectori maui*); New Zealand Threat Classification Status: Nationally Critical; Threatened by fisheries interactions, habitat and noise disturbance, disease.

*Bottlenose dolphin (*Tursiops truncatus*); New Zealand Threat Classification Status: Nationally Endangered; Threatened by fisheries interactions, habitat and noise disturbance.

*Beaked whale *spp.;* New Zealand Threat Classification Status: Data Deficient for all species that may be observed/sampled, with the exception of Gray's beaked whale listed as Not Threatened. Threatened by habitat and noise disturbance.

**These species will only be opportunistically approached for photo-identification, drone overflight, and biopsy sampling to collect information for other DOC-supported research programs. If individuals from these species groups are observed during our field operations and conditions are favourable and individuals are cooperative, then photographs, drone data, and biopsy samples will be collected.*

- Sample Size

Provide sample size for each species, method of sampling and location.

During two previous field seasons of a similar duration and following similar protocols (2016 and 2017), we photo-identified an average of 35 unique individual blue whales, conducted 16 UAS flights over blue whales, and collected 17 tissue biopsy samples and 9 faecal samples each year. Our knowledge of blue whale distribution in the region and familiarity with these methods (particularly UAS operations) has improved greatly since those field efforts, and we therefore anticipate comparable or greater sample sizes for the SAPPHIRE project. Specifically, our proposed sampling method and target sample sizes in each year (2024, 2025, and 2026) are detailed below. Sampling effort will be focussed on the STB region. If too few blue whales are found in the STB region (as may occur during marine heatwaves) we would need to undertake sampling in areas adjacent to the STB as shown by the extent of the map (above).

Photo-identification: collected via digital SLR photographs during vessel surveys, expected sample size of up to 100 unique individuals per year.

UAS flights: collected via DJI Inspire 2 or similar small, quadcopter UAS; expected sample size of up to 50 flights over blue whales per year.

Tissue biopsies: collected via rifle or crossbow, expected sample size of up to 50 samples per year for blue whales. We anticipate very low sample sizes (< 10) from any other species, which would only be collected opportunistically for ongoing projects by DOC and other scientific collaborators.

Faecal samples: collected via fine-mesh dip net, expected sample size of up to 30 samples per year.

Suction cup tagging: collected via CATS tags deployed from a small vessel via a carbon-fibre pole or UAS, anticipated sample size of up to 8 deployments per year.

In the event that the research team is having trouble locating blue whales during fieldwork, there is the potential to conduct aerial surveys to spot blue whale aggregations and direct subsequent vessel-based surveys to areas of higher blue whale density. While this effort may not be necessary at any stage of the project, if flights are conducted, no more than three surveys will be flown each field season.

- Proposed Methodology

Provide a detailed description of the methodology proposed ie aerial/boat/drone surveys, photo-identification, biopsy sampling, etc. Include a brief description of any statistical modelling used to justify sample size. Clearly indicate the actual or estimated age (i.e., neonate, pup/calf, juvenile, adult), size, sex and reproductive condition of the animals at the time of taking.

Vessel-based surveys will be conducted during three-week field seasons in the summers of 2024, 2025, and 2026. This field effort will involve trackline survey effort to observe and record the presence of blue whales, and any other cetacean sightings. Survey effort will be guided in part by predictive models of blue whale distribution (Barlow & Torres, 2021), to direct survey effort to areas of higher probability of blue whale presence. The vessel-based survey effort may also be aided by aerial spotter planes that may locate blue whales and report their position to the vessel team to minimize search time (see below for details). Vessel-based survey effort will be conducted on days with suitable weather conditions (Beaufort Sea State < 5). The vessel will be the *R/V Star Keys*, which Is 19.2 m in length, with a flying bridge situated 3.8 m above the waterline. The vessel has been successfully used for blue whale data collection in the past, and will be operated by skilled and experienced skipper and crew. Surveys will be conducted at speeds of 8-10 kt, with trained marine mammal observers on the port and starboard sides of the vessel's flying bridge to maximize observational area. At all blue whale sightings, survey effort will be suspended, and the date, time, and location recorded. The whale(s) will be slowly approached for behavioural observation (between 100 and 30 m) and further data collection (i.e., photo-ID, UAS flights, biopsy and faecal sample collection). If weather conditions allow, a smaller rigid hull inflatable boat (RHIB; ~ 5 m in length, equipped with a 100 hp outboard engine and good manoeuvring capability) will be launched from the main research vessel to manoeuvre closer to the whales for further data collection. This smaller vessel may approach within 10 m of a whale for tissue biopsy sample collection (see details below). During all vessel survey operations, a Simrad EK80 echosounder will be operated to collect detailed information on the distribution, depth, and density of krill aggregations. Krill will also be collected via a Bongo net in areas of blue whale foraging activity (but not within 100 m of whales), and opportunistically in areas of dense krill aggregations, to obtain information on the quality of blue whale prey

We will attempt to capture photo-identification images of the left and right flanks of each blue whale we observe, whenever possible, using digital SLR cameras and fitted with zoom lenses (100-400 mm). This effort will sometimes necessitate the research vessel to approach within 50 m of the whale. Photo-identification data will be used to link all other data streams (UAS flights, biopsy and faecal samples) to the unique individual sampled. Furthermore, these data will be used to determine re-sightings of individuals, match to individuals previously photographed in the STB and other areas of New Zealand and catalogues for other regions of the Southern Hemisphere (e.g., via the International Whaling Commission's Southern Hemisphere Blue Whale Catalogue), and contribute to ongoing population monitoring to obtain abundance and trend estimates for the New Zealand blue whale population. Photographs will be collected for blue whales of all sex, age, and reproductive classes.

If conditions allow, a UAS will be launched from the research vessel and flown above the whale(s) at a height > 20 m to capture videos of behaviour and imagery to be used for photogrammetric analyses. These images will be used to assess body condition and health of the whales through measurements of length and girth that can be used to estimate pregnancy and nutritive state, complementing other data collection methods. The UAS will be battery powered with minimal noise, operated by a skilled, experienced, and licensed (USA FAA Part 107) pilot, and always flown within visual sight. During UAS operations, the research vessel will not approach the whales any closer than necessary to fly the UAS,

to minimize disturbance to the whales. UAS flights will be conducted over blue whales of all sex, age, and reproductive classes.

After a reasonable amount of effort is spent on photo-identification and UAS operations, tissue biopsy sampling will be undertaken by skilled and experienced Department of Conservation staff under the DOC standard operating procedure “SOP for Remote Biopsy of Cetaceans” (DOC-3207548). Blue whales exhibiting consistent behaviour patterns conducive to safe and effective biopsy sampling will be approached. Samples will be collected via a Paxarms modified air rifle or crossbow fitted with a lightweight biopsy dart (cutting head size ~ 7mm diameter, 20mm length). The biopsy effort will be paired with simultaneous photo-identification effort to identify sampled whales. Following standard protocols, biopsy samples will be stored in sterile containers and frozen at -20 ºC until genetic, hormone, and stable isotope analyses. Skin tissue samples will be sub-sampled, and a portion of the tissue will be curated within the New Zealand Cetacean Tissue Archive (NZCeTA) at the University of Auckland. The remaining skin tissue will be analysed at the University of Auckland (by Drs. Carroll and Constantine) for DNA profiling and analysis. The blue whale blubber tissue will be exported to the Cetacean Health and Life History Program at NOAA’s Southwest Fisheries Science Center for hormone analyses to measure the stress, reproductive, and nutritive state of the sampled blue whales. Any remaining tissue after hormone analyses can be re-imported to New Zealand. A sub-sample of skin tissue will be analysed by the Stable Isotope Analytical Facility at NIWA, Wellington. Blue whale biopsy samples will not be collected from calves but will be collected from juveniles and adults of all sex and reproductive classes. For any other species sampled opportunistically, only adults will be biopsied (all sex and reproductive classes). Additionally, if any species besides blue whales are to be sampled, the remote biopsy protocol will be modified according to the DOC SOP (e.g., reduced cutting head size for smaller delphinid species).

A fine-mesh (500 µm) dip net attached to a telescoping pole will be used to collect faecal samples from surface waters opportunistically when faecal material is observed. The faecal plume is approached after the whale has left the area and from behind the whale’s path of movement, to minimize disturbance. Samples will be stored in sterilized plastic jars, frozen, and exported to the Marine Mammal Institute at Oregon State University where they will be processed for prey genetics and hormone analyses. Faecal samples will be collected opportunistically from blue whales of all sex, age, and reproductive classes.

If survey conditions are excellent and blue whales are displaying consistent, predictable behaviour patterns, and photo-identification, biopsy sampling, and UAS flights are successful, then we may initiate effort to place non-invasive, short-term tags on blue whales for fine-scale behavioural data collection. We will use multi-sensor bio-logging tags from Customized Animal Tracking Solutions (CATS), which contain multiple high-resolution sensors to measure tri-axial acceleration (pitch, roll, yaw), pressure, acoustic recordings, and video footage. The tags attach to the whale using suction cups and will be deployed via one of two methods. Traditionally, tags have been deployed from a small rigid hull inflatable vessel via a ~6-7 m carbon-fibre pole (requiring vessel approach to within < 3 m of the whale) to carefully place the tag on the flank of the blue whale. Alternatively, recent studies have demonstrated successful deployment of CATS tags via UAS, which minimizes the potential disturbance caused by close vessel approach (Wiley et al. 2023). While we have previously deployed CATS tags on baleen whales via pole, the UAS deployment method shows greater promise for success while minimizing disturbance to the whales, and is therefore our preferred method. The UAS, equipped with a suction cup tag and drop attachment system, hovers at an altitude of approximately 45 m waiting for the blue whale to surface. When the whale surfaces, the drone operator descends the drone and approaches the whale from the rear. When positioned approximately 2-7 m over the area between the whale’s blowhole and dorsal fin, the operator triggers a remote release system, uncoupling the tag from the UAS. The remote release system consists of a servo-pin release and GHz radio receiver and transmitter and is configured to allow a single operator to pilot the drone and activate the release system. Upon contacting the whale’s back, the tag attaches via the suction cups. Encounter times are less than 10 minutes per flight, but multiple attempts (up to 5 flights) may be necessary to successfully deploy a tag. The attachment duration of the tags is short-term (typically < 24 hours). Once the tag detaches from the whale, typically within a day, it floats at the surface and will be located via satellite and VHF radio technologies and recovered. The fine-scale, multi-sensor data collected by these tags enable detailed reconstruction of the whale’s underwater movements, yielding detailed insights into their foraging behaviour and energetics. Tagging will only be initiated if the whale(s) exhibits consistent and expected behaviour at the time of observation and appears in overall good health. Tags will only be deployed on adults, of all sex and reproductive classes.

Two underwater acoustic recorders (hydrophones) will be deployed in the STB under a marine consent issued by the EPA (application concurrent to this permit application), to record blue whale calls in the region over three full years (February 2024-January 2027). The hydrophones will be the “Rockhopper” units designed by Cornell University’s K. Lisa Yang Center for Conservation Bioacoustics (Klinck et al. 2020), which can record for a full year (duty-cycled at 50%). The Rockhopper is a digital audio recording system contained in a positively buoyant 43 cm glass sphere, which is deployed on the seafloor using an iron weight anchor. A hydrophone mounted to the Rockhopper will record acoustic data, which is stored on internal electronic storage media. After a year-long deployment, each Rockhopper will be sent an acoustic command from the research vessel to release itself from the anchor and float to the surface for recovery. Thus, the iron anchor will be left behind, but will dissolve over time, with a negligible effect on the surrounding environment. One Rockhopper will be deployed in the western part of the study region (40.09981 ºS, 172.18057 ºE), and the second will be deployed within the STB (approximately at 40.03328 ºS, 174.28328 ºE) (see study area map figure). Specifically, the units will be deployed in carefully selected locations with minimal current flow and a low bottom-contacting trawl footprint. These measures are carefully taken to minimize potential interactions with fishing activity, as well as to avoid displacement or possible loss of the Rockhoppers. Furthermore, the units will be located outside of oil and gas operational areas (e.g., rigs or floating production, storage, and offloading units). The Rockhoppers will initially be deployed during vessel-based fieldwork in 2024. Subsequently, they will be recovered and re-deployed during vessel-based fieldwork in 2025 and 2026. Finally, the units will be recovered during a specific mission in January 2027 to retrieve the third year of acoustic data. While the primary objective of the hydrophone deployment is to record blue whales, the Rockhoppers record across a broad frequency range and are capable of robustly recording the STB soundscape (frequency and intensity of sounds from physical, biological, and anthropogenic sources) and the occurrence patterns of most vocal marine mammals known to occur in the region, excluding only the ultrasonic vocalizations of the smallest odontocetes. Acoustic data will therefore be collected across all sex, age, and reproductive classes for any vocal marine mammal species present in the vicinity.

Aerial surveys will follow pre-determined tracklines covering up to 300 nm of trackline distance in a flight. Tracklines will be decided based on predicted blue whale habitat suitability and weather, to maximize potential blue whale encounters in favourable observation conditions. Aerial surveys will be conducted in small aircraft with high wings and windows that bulge out, and trained observers will scan the water for cetaceans. The aircraft will fly at a consistent height of 1000 feet (305 m) above the water, and hold a constant speed of 100 kt. The efficacy of this aircraft and survey methodology (flight height, speed, distance, coverage) was demonstrated in March 2023, when Mike Ogle (DOC Technical Adviser Marine) conducted an aerial survey of the STB and successfully located blue whales in areas of high predicted habitat suitability. As the blue whales were clearly identifiable using these methods, time spent over the whales, and any related potential disturbance to the animals, was minimized. Aerial surveys will be conducted over blue whales of all age and reproductive classes. The location and group size of any cetaceans other than blue whales encountered during aerial surveys will be recorded as well, and will likewise be conducted for animals of all age and reproductive classes.

Barlow DR and Torres, LG (2021). Planning ahead: Dynamic models forecast blue whale distribution with applications for spatial management. Journal of Applied Ecology, 58(11): 2493-2504.

Klinck, H., D. Winiarski, R. C. Mack, C. T. Tessaglia-Hymes, D. W. Ponirakis, P. J. Dugan, C. Jones, and H. Matsumoto. The Rockhopper: A Compact and Extensible Marine Autonomous Passive Acoustic Recording System. Global Oceans 2020: Singapore – U.S. Gulf Coast, 2020.

Wiley, D. N., Zadra, C. J., Friedlaender, A. S., Parks, S. E., Pensarosa, A., Rogan, A., Shorter, A., Urban, J., Kerr, I. (2023). Deployment of biologging tags on free swimming large whales using uncrewed aerial systems. Royal Society Open Science, 10(4), 221376.

- Justification of Proposed Research

Describe why this work is necessary, clarify if it has been done before and if so why it needs to be repeated. It is especially important to identify and justify all procedures, which have the potential to

cause pain or distress to the animal(s), and details of the steps to be taken to avoid or minimise the pain or distress.

Ocean ecosystems are experiencing significant and rapid impacts of climate change, yet the cascading effects on marine organisms are largely unknown and understudied. It is therefore critical to understand how rapid environmental change will impact the availability and quality of key prey species, and consequently how these changes will impact predator health and population resilience. The goal of the SAPPHIRE project is to identify and describe the impacts of environmental variation on the physiology of krill, a crucial marine prey species, and blue whales, a model marine predator, to enhance our ability to understand and predict species response to climate change. The STB is a uniquely well-suited study system for this project, as the New Zealand blue whale population is present within the region year-round, relying on the habitat for both feeding and reproduction.

Vessel-based surveys for blue whales were conducted in the STB 2014, 2016, and 2017, including photo-identification, biopsy sampling, UAS flights, and oceanographic and prey data collection. These data aided in the documentation of the New Zealand blue whale population, which was previously undescribed, and yielded insights into their habitat use patterns and the oceanographic drivers of krill in the region. However, no such comprehensive data collection effort has taken place since 2017. As such, the status and trend of this blue whale population remain unknown, thereby hindering management decisions such as revision to their “Data Deficient” threat classification status until further data are collected. While previous research on blue whales in the STB has focused on population documentation and understanding distribution and habitat use patterns, the SAPPHIRE project focuses on population health. Through the SAPPHIRE project, we will develop a framework for understanding the health impacts of environmental change on both krill and blue whales, which can in turn inform management decisions based on relevant species and ecosystem health thresholds. Furthermore, the outputs of SAPPHIRE will be well-suited for the design and testing of dynamic management approaches. Finally, the SAPPHIRE project will harness the iconic status of blue whales to inform society about the significant impacts of climate change on the oceans, so that publicity and regulatory action based on this flagship species can enhance awareness and motivate societal change.

Of all our proposed data collection methods, we expect that the only operations that may cause temporary or minor disturbance or pain to the whales is from close vessel approaches, tissue biopsy collection, UAS operations, and suction cup tag deployment. Any potential disturbance effects will be minimized using operating procedures described in the risk mitigation section below. Tissue biopsy collection takes a small plug of skin and blubber from the whale’s dermis, and is necessary for this project as biological analyses of these tissues will provide sex identification, population genetics, hormone concentrations including indications of stress levels and pregnancy rates, and stable isotope descriptions of the whales’ trophic ecology. Morphometric data collected via the UAS flights will provide quantitative information on the body condition (i.e., nutritive state, pregnancy status, any injuries or abnormalities), as well as the behaviour, of the whales. Data collected via the suction cup tags will enable quantification of foraging rates and the energetic costs of foraging to blue whales under variable environmental and prey conditions. The information provided by the tissue biopsy samples, UAS flights, and suction cup tags is therefore critical to our ability to meet project goals of health assessment of this blue whale population relative to environmental variability. Any biopsy samples that are opportunistically collected from other species besides blue whales will be used to enhance the sample size and data coverage for other projects supported by DOC and scientific collaborators, providing a valuable opportunity to contribute to ongoing research, particularly on rarely observed species. Additionally, all tissue samples will be contributed to the New Zealand within the New Zealand Cetacean Tissue Archive (NZCeTA) at the University of Auckland, so they can contribute to the greater understanding about the biology and conservation of these species.

Throughout all data collection, concerted effort will be made to minimize any distress or pain to any animals involved in the study. Specific measures that will be taken to minimize risk to both the whales and the researchers are discussed in greater detail below in the Risk Mitigation section.

- Risk Mitigation

Outline what steps you will take to limit or mitigate any potential adverse impacts the proposed research may have. Impacts include any aspect that may affect the health and safety to the animal, or to members of the public; adverse effects on public relations, or any loss or destruction of cultural or historic resources.

Research efforts will be conducted in favourable weather conditions (BSS < 5) to 1) avoid health risks to researchers and crew, 2) improve data collection efficiency and accuracy, 3) minimize disturbance to whales through more conservative and accurate vessel manoeuvrability.

At all times, if whale(s) demonstrate “avoidance” behaviour of the research vessel(s), then all pursuit activities will be suspended for that whale(s). Avoidance behaviour is classified here as displaying one or more of the following behaviours: short surfacing intervals, evasive surfacings relative to the vessel’s position, or change of behaviour state to fast travel away from the research vessel.

To minimize disturbance to the animals, the research vessel will not approach a whale(s) at high speed and will make all attempts to approach from a rear-flank position at a “matching” speed. We will also make all efforts to maximize the approach distance to the whale(s) that will allow data collection (we will not approach any closer than necessary for behavioural observation from the vessel or via the UAS, photo-identification or biopsy collection, or deployment of suction cup tags). During fieldwork, sampling will be conducted in an order from least to most invasive (UAS, photo-identification, biopsy sampling, suction cup tagging). This approach will allow us to minimize the time spent in close proximity to the whale(s) and forego more invasive sampling if the whale(s) react at any point.

Using photo-identification methods, concerted effort will be made to avoid repeated biopsy sampling of the same whale(s) to minimize stress to individual whales. Protocols for biopsy sampling will reduce the risk to whales by 1) using the appropriate cutting head size for the animal being sampled (e.g., ~ 7 mm diameter, 20 mm length for blue whales), 2) sterilising biopsy dart tips prior to shooting the animal to minimize risk of infection, 3) aiming for the left or right flank of the body near the dorsal fin region, and 4) using the rifle’s velocity control valve and appropriate charges to balance the need to obtain and retain samples and minimize the animal disturbance. Sterilisation procedures in the field include flame sterilization of tweezers and scalpel blades between samples to reduce contamination or rinsing with 70% ethanol and wiping carefully to remove any visible bits of tissue. Additionally, the protocol below will be followed at the end of every day:
Rinse the plastic dart bodies with water and wipe with ethanol. Clean the metal dart cutting heads:

(a) In a small tin plate or in a pot, rinse the dart heads in water and use a small scrubbing brush (e.g., toothbrush) to remove all visible tissue. Be sure to check inside the tip of the dart where the barbs are to ensure there is no tissue remaining.
(b) Rinse the dart tips again with clean water and then empty water from the tin plate/pot.
(c) Sharpen and reset the dart cutting heads using specialized tools.
(d) Put the dart heads back into the tin plate/pot, squirt with ethanol, and flame sterilise
(e) When the dart tips have cooled, use sterile tweezers to pick up clean dart tips and put them in clean small plastic bags. Seal the plastic bags so that the dart tips remain sterile until they are ready to be used.

The UAS will only be operated in safe weather conditions (wind < 20 kt) and at a safe height above the whale(s) to avoid behavioural disturbance (> 20 m above whales). However, we will also ensure that the UAS will be always operated at altitudes below 120 m to avoid any chance of interference with aircrafts, in compliance with CAA regulations. Additionally, the UAS will be operated within visual limits and during daytime only to minimize chance of accidents. The UAS will be kept away from all possible other (non-research) vessels in the area by > 500 m (unless the vessel approaches us during operation). The UAS will not be flown within the vicinity of oil and gas facilities including rigs and floating production, storage and offloading units (FPSOs) and will only be operated outside restricted areas. The UAS will not be flown within 1 km of shore, or within 4 km of any aerodrome (in compliance with CAA regulations). We will use small, lightweight quadcopter UAS platforms, weighing less than 5 kg. The operator will be Oregon State University Postdoctoral Scholar Dr KC Bierlich, who holds a FAA Part 107 US Commercial Drone Pilot License and has completed over 500 UAS missions for research purposes, including flights over blue, gray, humpback, minke, and killer whales, and bottlenose dolphins.

Suction cup tagging of blue whales will only be initiated if weather and sea state conditions are excellent, and the whale(s) is exhibiting predictable, consistent behavioural patterns. For pole-based tag deployment the blue whale(s) will be approached with a rigid hull inflatable vessel from a rear-flank position at a “matching” speed, and the tag will be deployed on the whale’s flank via careful placement using a carbon-fibre pole. Given the risks of close approach (< 3 m) to the whale and use of the deployment pole, all researchers in the tagging vessel will be required to wear helmets for protection. UAS-based tag deployments will only be conducted by FAA-licensed drone pilots who are experienced UAS pilots and well-practiced in necessary manoeuvres. Such training will include several (> 20) practice deployments on floating inanimate objects before attempting to tag whales. No long-term impacts to whale health (e.g., injury, skin deformity) have been documented from suction cup tag deployments. Furthermore, suction cup tags are not expected to provide substantial drag, since the suction cups slide off if substantial drag is placed on them. While there may be short-term (< 1 min) behavioural reactions to tag deployment (i.e., sinking, acceleration), no long-term impacts of suction cup tagging on the health or behaviour of cetaceans have been documented (Johnson et al. 2009). During tag deployment, any behavioural reactions to tagging of the target individual will be noted and recorded by video where possible. In cases when reactions are prolonged (e.g., more than ~1 minute), we will attempt to remain with tagged individuals long enough to document their return to normal behaviour and reaction durations will be recorded and reported. Following deployment and monitoring for any behavioural response, the tagged whale will then be left by the vessel to minimize disturbance for the duration of the tag attachment. Mother/calf pairs will not be tagged. Tagging operations will be led by Dr Leigh Torres, who has experience manoeuvring small research vessels for safe and successful CATS tag deployment on baleen whales, Mike Ogle, who is experienced in deploying suction cup tags on cetaceans in New Zealand, and Dr KC Bierlich, a licensed UAS pilot with extensive experience flying over whales (> 7 years) as described above, who has specific tag-deployment experience.

Aerial surveys will only be conducted if the field team is not able to consistently locate blue whales during vessel-based fieldwork. Should the pre-determined tracklines pass directly over areas where blue whales are located, the horizontal distance to the blue whales may be as little as 0 m, while the vertical distance will be the flight height of 1000 feet (305 m). Because of the fast survey speed (100 kt), any encounter time with blue whales will be minimal, and mostly the blue whale locations will simply be recorded while the survey continues along the trackline (“passing mode”). In the event that the observer deems it necessary to break from the trackline for closer approach to the whales, e.g., to confirm species identification, obtain a group size estimate, or collect aerial photographs, the entire encounter will be limited to 20 minutes or less, and the closest approach distance will be limited to 150 m or greater. Aerial surveys will be conducted by Mike Ogle, Dr. Leigh Torres, and Dr. Dawn Barlow, all of whom are experienced in these aerial survey methods and protocols for minimizing disturbance to the animals.

No impacts to cultural or historic resources are anticipated (see iwi consultation below). However, we will collect small tissue samples from blue whales and opportunistically from other cetacean species, which are considered taonga by iwi. A sub-sample of these biopsy samples will remain in New Zealand within the New Zealand Cetacean Tissue Archive (NZCeTA) at the University of Auckland.

We will follow the ethos of transparency and provide permitting, funding, and media agencies with research updates on fieldwork, as deemed appropriate or necessary.

Johnson, M., de Soto, N. A., & Madsen, P. T. (2009). Studying the behaviour and sensory ecology of marine mammals using acoustic recording tags: a review. Marine Ecology Progress Series, 395, 55-73.

F. Other

Is there any further information you wish to supply in support of your application?

G. Consultation Undertaken

Some applications require consultation with whānau/hapū/iwi (local Māori), and other interested parties. Please contact the nearest Department of Conservation office to discuss what is required. Written expert views, advice or opinions concerning your proposal may also be attached to support the application. Attach any proof of consultation to the application.

In order to assist consultation please discuss how you believe the research may have an impact on cultural values and measures you will take to mitigate their effects. An example is discussing the research with local Maori.

Our previous blue whale research in the STB region in 2014, 2016 and 2017 was conducted in consultation with, and support from iwi from the northwest of the South Island, Te Atiawa, Ngati Rarua and Ngati Tama, which are represented here by the umbrella organization Mana Whenua Ki Mohua. Support or no objection for the project was also expressed by lower western North Island iwi Ngāti Raukawa and Taranaki Whanui. The STB region neighbors over 20 iwi jurisdictions, and given the increased recognition of the need for broader iwi engagement, we made substantial efforts to consult with all iwi groups to discuss our research plans and understand their cultural values and information needs.

Iwi consultation began in June 2023, soon after we received notice of the funding award to conduct the research project. Mike Ogle (DOC staff) discussed our proposed work with Mana Whenua Ki Mohua at a hui at Onetahua marae, and they expressed support for our research efforts and importance of the work. Additionally, iwi around the top of the South Island (Ngati Apa, Ngati Rarua, Ngati Kuia) were contacted by DOC as part of the permit process with no objections received.

Consultation with iwi from the Taranaki and Whanganui regions have consisted of multiple emails and virtual meetings via Zoom were conducted between September and December 2023 between Leigh Torres (project lead) and iwi representatives from Ngāti Ruanui, Ngāruahine, Taranaki, Ngaa Rauru, and Te Rūnanga o Ngā Wairiki Ngāti Apa. In these discussions we presented the purpose for the project (understanding impacts of climate change on marine animals and ecosystems) and the project methods and specific objectives. We also discussed the importance of whales as taonga to iwi across Aotearoa, and iwi interests in marine knowledge in the STB region and current concerns, such as wind energy development and seabed mining. We also described the many ways we plan to engage with iwi throughout the project, including meetings, outreach materials and workshops, and research progress reports and presentations.

Once in Aotearoa New Zealand in January 2024, our research team was invited to a hui at the Tu Tahi Church near Whanganui to meet iwi members and representatives and discuss our research efforts. On January 24th, Leigh Torres, Dawn Barlow, and KC Bierlich drove from Wellington to the Church for this hui, which was a very positive and informative meeting. We discussed our previous research on blue whales in the Aotearoa, our personal connections to Aotearoa, our commitments to engagement with local communities and conservation efforts, and our plans for current research. We also listened and learned about tikanga, cultural connections and history with taonga, and iwi interests in marine ecosystems.

We are committed to continuing engagement with iwi throughout the project to ensure that their mātauranga can be integrated with our research objectives and findings. We believe that the findings derived from our research efforts, which include minimal impact on blue whales considered taonga, will be highly valuable to iwi as they face the impacts of climate change. Our work will provide insights on how the marine ecosystem in Aotearoa, from krill to large whales, will respond to anticipated environmental change. We also plan to integrate mātauranga provided to us through conversations and engagement with iwi to better understand the history of this ecosystem, as well as local observations and concerns. We believe that through integration of mātauranga and our novel data collection, we will empower iwi to make informed decisions regarding human activities in Aotearoa's marine environment. We aim to engage with both tangata whenua and DOC environmental managers throughout the SAPPHIRE project so that our knowledge gained about how changing ocean conditions will affect the health and reproduction of blue whales can be most effectively and appropriately applied to protect and conserve these taonga animals and their critical habitat in the STB.

More specific details on the completed and ongoing iwi consultations to-date are outlined below:

The proposed project was presented to Mana Whenua Ki Mohua, the umbrella organisation for three iwi of Golden Bay: Te Atiawa, Ngati Rarua and Ngati Tama. The monthly meeting was held at Onetahua Marae, Golden Bay. The project was presented by Mike Ogle (DOC Technical Adviser Marine) and Ross Trotter (DOC Operations Manager). Minutes from the meeting with Mana Whenua Ki Mohua on 12th June 2023 are copied and pasted here from their records:

> **Te Papa Atawhai – Mike Ogle and Ross Trotter, Marine Mammal Mahi**
> Blue whale work is being continued from the 2014 study and the research shows that the whales whakapapa to Aotearoa, although there is still a deficiency in the data. The proposal is to continue the research for another 3 years. The surveys will be similar, using drones to ascertain condition and biopsies to enable information on whakapapa and ascertain stress levels on the individuals. The difference from the last proposal is the researcher would like to use suction caps with trackers on to increase the amount of data being able to be collected. The research is also looking at climate change impacts especially marine heat waves. Mike believes the process is reasonably gentle having used the same suction caps on Hectors Dolphins. He is at the hui to ask what MKM thinks of the proposal. MKM whanau said they support this proposal.