Attachment for Question 4. (Blue Whale Study Inc EPBC Permit application 2009)

A. The equipment and methods used to comply with the EPBC Act Regulations

The equipment and methods proposed are described below.

Satellite tagging:
Satellite tagging of individual whales is the only method available for providing information on actual movements, including long-range migration paths, and fine-scale movements within special areas eg feeding or breeding areas.

In 2005, with DEH approval, we used tag darts designed and built by the Australian Antarctic Division, and attached by Dr Nick Gales. Darts were ~16cm long x 1.5cm x 1.5cm, and were fired by pneumatic gun. They implanted into the whale, penetrating to their full length into skin, blubber and underlying fascia, with a stopping plate which leaves only a short length, and the transmitting antenna, protruding from the skin. Each dart has sharp cutting edges which make a clean entry slit, minimising tissue trauma. Several short recurved barbs prevent the dart working loose, until natural healing processes bring about the rejection of the entire device. Darts are coated with a slow-release antiseptic agent, gentomycin, which is released from a matrix of non-toxic methacrylate, thus minimising the possibility of infection. Darts are kept in sterile containers until use.

During April 2005, four adult blue whales were successfully satellite tagged in the Bonney Upwelling in collaboration with Dr Gales. These tags gave valuable short-term (max. 19 days) movement data as the whales foraged through their continental shelf feeding area, confirming conclusions about foraging movements reached from aerial survey data. One whale gave a particularly interesting result as it left the Bonney Upwelling feeding area and headed south to the Sub-tropical Convergence (STC), an oceanic region where Soviet whalers illegally killed many blue whales during the 1960s. A report of the satellite tagging in April 2005 (Gill, 2005[1]) was sent to DEH.

However, tags deployed by us in 2005 and by Dr Gales in other regions did not transmit data for long enough to show migration routes north to tropical wintering areas, a major objective of this methodology. Dr Gales believes that the tags were retained well by the animals, but that their antennae or other hardware may have been damaged. The tag design has been refined by Dr Gales and we intend to resume this project in the next 12 months or so. The tags we propose to use are slightly longer than those used in 2005 and thus implant deeper. We recognise that this research is invasive, and considerable thought has been given to ethical aspects of tag design. Our co-investigator on this project, Dr Gales, is a very experienced marine mammal vet and zoologist, who considers the degree of impact of penetration is minimal on the scale of an adult blue whale, a massive animal typically of more than 100 tonnes. Dr Bruce Mate of Oregon State University has been tagging blue whales for 12 years using tags of the length we propose to use, and in his experience blue whales show no response to attachment, and from subsequent photo-ID there is no evidence that such tags have any deleterious effect on blue whales.

[1] Gill, P.C. 2005. Blue whale satellite tagging, Bonney Upwelling, April 2005. Report to Department of Environment and Heritage, Canberra.

Suction-cup attachments:

Suction-cup tag attachments are a relatively recent innovation in cetacean research, allowing attachment of logging devices to whales without the need for invasive penetrative attachment. Such attachments are appropriate for short-term deployments, over a time scale of hours rather than weeks or months (which unfortunately requires penetrating attachments). Tools may include time-depth recorders (TDRs) (e.g Baird et al.,2002[2]), temperature and salinity recorders, inertial motion recorders (which record the animal's three-dimensional movements), acoustic recorders (which record sounds made by the whale or others nearby), and video cameras (e.g. National Geographic's Crittercam) which directly record hitherto unknowable aspects of ecology and behaviour.

Suction-cup attachment requires the same level of close approach as satellite tagging, as the tag must be physically attached using a 5m handheld pole. However, no physical wound is incurred by the whale. Tags are retrieved when the cups' suction is broken; the tags then float to the surface and emit a VHF radio signal which is tracked until recovery.

We successfully suction-cup tagged seven blue whales during March 2007 in collaboration with John Calambokidis and Greg Schorr of Cascadia Research (USA), experts in this attachment method. These tags gave 27 hours of dive data, which when integrated with simultaneous oceanographic and prey data, has provided extremely valuable insights into blue whale foraging behaviour unique to the Bonney Upwelling ecosystem. This data forms a major part of Margie Morrice's PhD.

We intend to repeat this work (probably in March 2010 and 2011), again in collaboration with Cascadia Research, as it is important to repeat tagging under a range of environmental conditions as blue whales are likely to be highly adaptable to changing conditions, though it is not known how they will adapt to climate change in this important feeding ground. We are using this data to model blue whale fine-scale feeding habitat, to complement large-scale habitat studies we are currently writing up.

Tissue biopsy:

This method is now in universal use as a standard tool for analysis of population structure in cetaceans (e.g. Hoelzel, 19933), by allowing DNA extraction which throws light on issues including paternity, kinship, the degree of relatedness between populations and individuals, and the assessment of genetic distance between populations. It also allows the determination of lipophilic toxic contaminant loads in whale blubber.

Biopsy involves an approach to within ~30m of the whale, so that the biopsy dart can be fired from a modified .22 rifle (Paxarm system) at the whale's flank. The biopsy tip is a cylinder of sterilised stainless steel about 1cm wide x 2cm long, with a cutting lip and small recurved prongs within the cylinder to retain a small amount of tissue. The entire dart itself weighs less than 200g, rebounds from the whale upon impact and floats until recovery. In a Canadian study, the response of blue whales to biopsy was categorised as either 'no response' (78%) or 'low response' (22%), indicating that they are not significantly affected by biopsy darting (Gauthier and Sears, 1999[4]).

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[2] Baird, R.W., J.F. Borzani, M.B. Hanson and P.L. Tyack. 2002. Diving and night-time behaviour of long-finned pilot whales in the Ligurian Sea. *Marine Ecology Progress Series* 237: 301-305.

[3] Hoelzel, A.R. 1993. Genetic ecology of marine mammals. *Symposia of the Zoological Society of London* 66: 15-32.

[4] Gauthier, J. and R. Sears. 1999. Behavioral response of four species of balaenopterid whales to biopsy sampling. *Marine Mammal Science* 15: 85-101.

During March-April 2007 we worked with collaborators Dr Luciana Möller and Dr Kerstin Bilgmann of Macquarie University, collecting biopsy samples to contribute to an Australia-wide analysis of blue whale population genetics. While the 22 samples we have collected over the last few years have been a valuable contribution to this work, we still require many more samples so will be working with the Macquarie Uni researchers again in 2009 and beyond.

Photo-identification:
Photo-ID is now in common use as an effective tool for the individual identification of cetaceans throughout the world. It involves approaching to a distance less than 50m and using a telephoto lens to photograph natural markings on the animal's flanks. Natural markings include pigment patterns, scars, deformities, and dorsal fin shape. Blue whales have distinctive patterns of mottled pigment on their flanks which permit photo-ID (Sears *et al.*, 1990[5]). If possible both flanks are photographed, then animals are left alone. Photo-ID is conducted during tagging and biopsy work so that these become 'known' animals. It is the least invasive of the methods proposed in this application and will be used if possible whenever blue whales are encountered.

Catalogues of identified individuals are compiled and matches searched for between areas and seasons. This gives important information on movements between areas, residence periods within areas, association patterns between individuals, and life history characteristics such as calving intervals, longevity, etc. At the Biennial Marine Mammal Conference in Cape Town in December 2007 we helped initiate a co-operative Southern Hemisphere blue whale photo-ID program, collaborating with researchers from Western Australia, New Zealand, South Africa, Chile and the USA.

The Blue Whale Study has a small catalogue (approx 60 records) but a major aim over the next few years is to significantly increase the size of our catalogue. Already from a limited number of IDs we have a resight with the Perth Canyon, WA and a Bonney Upwelling resight over 7 years. As our catalogue grows we expect the number of resights between areas and seasons to contribute significantly to our understanding of blue whale movements and habitat occupation.

B. Steps taken to minimise disturbance to whales

As can be seen from section A, the research methods proposed involve varying degrees of disturbance. For all of the proposed methods except photo-ID, it is necessary to approach blue whales to within 50m, and for methods involving the physical attachment of tags, it is necessary to approach to within 5-6m. Clearly, any close approaches carry the potential for disturbance of the target animals, and especially given the Endangered status of blue whales, we recognise our responsibility to ensure that the work is conducted with the minimum impact on the whales. Photo-ID is unlikely to have any effect on whales, while tissue biopsy is widely regarded as having minimal effects on whales. Attachment of tags of various kinds has potential for additional disturbance. Suction cup attachment is regarded as benign in terms of physical damage to whales, with disturbance resulting only from the necessity for very close approach, and the ensuing brief physical contact.

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[5] Sears, R., J.M. Williamson, F.W. Wenzel, M. Bérubé, D. Gendron and P. Jones. 1990. Photographic identification of the blue whale (*Balaenoptera musculus*) in the Gulf of St. Lawrence, Canada. *Reports of the International Whaling Commission* (Special Issue 12): 335-342.

Satellite tagging involves the highest level of invasive disturbance currently used in non-lethal whale research. Not only is a very close approach necessary, but the device must be forcefully implanted into the whale from close range. However, blubber is a tough, resilient tissue, and we believe that the entry wound quickly heals around the tag. Whales often carry wounds resulting from combat with other whales, or from bites of predatory sharks or killer whales, and appear very capable of healing minor wounds quickly. The satellite tags we have used employ biologically inert materials impregnated with antibiotics. There is no evidence of lasting tissue damage in satellite tagged blue whales which have been subsequently observed and photographed off the USA west coast. The research team is keen to monitor the impacts of our work on the whales, and will routinely keep written and video records of the proposed research activities.

We recognise that close approaches by our small research vessel will constitute one of the major disturbing effects on the whales. We and our collaborators are some of the most experienced small boat operators around whales in the world, with extensive experience in reading large whale behaviour. This vast pool of experience is one of the greatest assets of this program and will allow us to minimise numbers of approaches required for successful operations.

In summary, we believe that effects of these research methods on blue whales will be minor and transitory, and greatly outweighed by the benefits gained.

C. The objectives and purposes of the action(s)

The objectives and purposes of the methods proposed have already been touched on in Questions 8 & 10. Our objectives are to throw light on unknown aspects of the biology, ecology, migrations, and genetics of blue whales and other species that occur in the Bonney Upwelling and other feeding grounds, and if possible, in tropical breeding grounds to which they migrate. The purpose of gaining this knowledge is twofold: to add to the body of scientific knowledge concerning these species, for its intrinsic scientific value; and to provide this information for use in guiding management decisions for the longterm protection and recovery of blue whales and other associated species, and for the longterm protection of habitat critical to their survival.