Breaking the Silence: 
how our noise pollution is harming whales
To humans, the world beneath the waves may seem a quiet place. To the animals that live there, it is anything but. Numerous marine species use sound to communicate and navigate across distances from centimetres to hundreds of kilometres. Indeed, because the underwater world can be limiting to other senses such as vision, taste and smell, sound is often the primary way for marine species to communicate and learn about their environment. This is especially true for whales.

All porpoises, dolphins and whales use sound to communicate with each other; to say “here I am” and to ask “where are you?” to keep social groups together, to find and attract potential mates. All dolphins and some whales, such as sperm whales, use sound to navigate and find their prey in the form of natural sonar, called echolocation: they emit a series of clicks and analyse the echoes that rebound off their surroundings.

Porpoises and dolphins emit high-pitched squeaks and whistles, at times highly complex and varied, and the largest whales generate deep, sonorous noises that, in the case of blue whales, are the loudest sounds produced by any living thing – so loud that they can travel across hundreds of kilometres of ocean.

Or, at least, they could. Over the past century, and even more in recent decades, the ocean has become a much noisier place. Explosives, pile-drivers, drilling, dredging, and airgun blasts used in seismic surveys for oil and...
gas exploration are driving up the volume, all against the backdrop of a never-ending, steadily-growing, drumbeat of noise generated by an ever-increasing global shipping fleet.

**For a blue whale that was born 70 years ago, its ‘acoustic bubble’ – the distance over which its vocalisations can travel and the vocalisations of others can be heard – has shrunk from 1,600 kilometres at its birth to just 160 kilometres today.**

Both right and blue whales have been found to increase their vocalisations in the presence of sound sources within their vocal range, presumably to make themselves heard, while a 2012 study found a correlation between shipping noise and chronic stress in some whales. Extreme noise can even be fatal; time after time, the use of powerful forms of military sonar has been associated with mass strandings and deaths in several whale species.

Around the world, the issue of underwater noise and its effects on marine life is the subject of increasing attention and concern, including from the likes of the International Maritime Organization, the Convention on Migratory Species, and the United Nations. Back in 2004, the Scientific Committee of the International Whaling Commission stated that “there is now compelling evidence” of the threat posed by man-made noise to marine mammals; last year, the Convention on Biological Diversity ratcheted up the concern, describing underwater noise as “a global issue that needs addressing.”

Yet around the coast of Australia, port developments, shipping growth, oil and gas exploration and naval exercises continue to be conducted, while Australian government and industry action fails to keep pace with our increasing knowledge of the risks noise pollution poses to these magnificent creatures.

Noise in the ocean is causing whales stress, making it harder for them to hear, and forcing them to ‘shout.’ It is excluding them from important habitats and may even be killing them.

**It is time we dialled down the volume. This report details some ways in which we can.**
whales & noise around Australia

The map shows important areas for whales around Australia and noise pollution in these areas.

Kimberley
Home to west coast humpback whale nursery. The gas hub at James Price Point is off the agenda for now but the waters of offshore coral atolls - the Rowley Shallows, Browse Island and Scott Reef, which host many different species of whale and dolphin - are all subject to oil and gas exploration and production.

Pilbara
Increased shipping from major north-west ports of Dampier and Port Hedland as mining products are exported, as well as further industrial, coastal and offshore development, may impact migrating humpback whales and inshore dolphin populations along the Pilbara coast.

Ningaloo
Offshore oil and gas drilling and construction, as well as further seismic surveys threaten the iconic waters of the Ningaloo Reef World Heritage Area, where humpback, blue and sperm whales can be found.

Perth Canyon
One of only three recognised blue whale feeding areas in Australian waters, sperm and beaked whales also feed here. Southern right whales migrate through the area. Under threat from seismic surveys used in oil and gas exploration.

Great Barrier Reef
Construction of new industrial ports and massive predicted increases in shipping traffic associated with coal exports will bring increased noise pollution to the Great Barrier Reef, home to dwarf minke whales, snubfin dolphins and critical nursing and breeding grounds for humpback whales.
A constant backdrop of noise: As much as 90 per cent of the world’s cargo is transported by sea, and the total amount is increasing continually. From 1980 to 2009, the global merchant fleet almost doubled in capacity, and now totals over 50,000 cargo and container ships, bulk carriers and oil tankers.

In 2010-11, more than 4,000 cargo ships made more than 27,000 port calls in Australia, an increase of 2.3 per cent a year over the previous five years. Add to that the thousands upon thousands of fishing, research, recreational and other vessels in the world – in Australia alone, the total number of recreational boats has been estimated to be over 900,000 - and it is clear that the ocean is now teeming with motorised traffic, all of it making noise that permeates through the water below.

Small boats and pleasure craft produce higher-pitched noises that travel shorter distances through the ocean but, because of their high concentrations in relatively small areas, can dominate in near-shore environments. High concentrations of small vessels can mask killer whale communications over 10 kilometres.

Medium sized ships such as tugboats and research vessels often deploy large and complex propulsion systems, including noisy bow thrusters. And larger merchant vessels generate deep engine sounds that can travel across large distances. In Cape Cod Bay on the east coast of the United States, noise pollution created...
primarily by shipping traffic has shrunk the ‘acoustic bubble’ of right whales – the distance over which whale calls can travel and be heard - by 80 per cent.6

Researchers have found that those whales have been forced to increase the volume and frequency of their calls to defeat the cacophony of vessel noise. When shipping traffic in that area was greatly reduced in the aftermath of the September 11, 2001 attacks, scientists noted a sharp decrease in stress-related hormones in whale faeces. They wrote that “this is the first evidence that exposure to low-frequency ship noise may be associated with chronic stress in whales”.

A growing problem: Australia boasts 106 listed ports – the ninth most in the world – which host an abundance of pleasure craft and a constant influx and egress of commercial shipping.8 And shipping traffic is projected to increase significantly in Australian waters, including waters that are among the most sensitive ecologically and of greatest importance to whale populations. For example, ship traffic in the Great Barrier Reef region – a critical area for nursing and breeding humpback whales – already makes close to 4,500 port calls, much of it exporting Queensland’s mineral and coal deposits.

According to an economic analysis by the Queensland government, that may rise to 6,100 port calls a year within 10 years. Other studies suggest the total may be even higher, perhaps as much as 7,500 annually – a massive increase in ship traffic and noise in a vital area for whales.9

A large problem with available solutions: It seems likely that the loudest 10 per cent of vessels contribute the great majority of ocean noise from shipping – according to some estimates between 48 and 88 per cent.10 Much of this is generated by inefficient propeller design and function; improvements in propeller design for new ships and adjustments to the flow of water into propellers on existing ships, could result in substantial noise reductions.

The International Maritime Organization has recommended that countries identify their noisiest vessels, although progress remains slow, and they have also established design standards for more energy efficient (and therefore quieter) new ships.

Meanwhile, some shipping companies have instructed their ships to reduce speed during transit for fuel efficiency reasons, an act that also reduces both the risk of collisions with whales and noise pollution – it has been calculated, for example, that the total acoustic footprint for the world’s cargo fleet at 12 knots would be 34 per cent of that at 14 knots.11
Using sound to probe the sea bed:
Exploring the sea bed for oil and gas deposits almost invariably involves the use of seismic testing. Essentially, a seismic or seafloor survey involves directing a high energy sound pulse into the sea floor and measuring the pattern of reflected sound waves. The main sound-producing elements used in oil and gas exploration are airgun arrays, which are towed from marine vessels. Such arrays are almost unfathomably loud; Cornell University researcher Christopher Clark has stated that, by lowering hydrophones (underwater microphones) into the water, he can hear “seismic exploration activity off the north coast of Brazil ... 2,000 miles away in the middle of the Atlantic Ocean, the same way I can hear one off west Africa or Canada or the west coast of Ireland. And it’s not for a week, it’s for months.”¹²

Not surprisingly, there is plenty of evidence that whales do not respond favourably to such invasions of their acoustic world. Some responses may be subtle: for example, bowhead whales have been seen to remain in the area of seismic testing, but to dive for shorter periods and demonstrate lower respiration rates than bowheads not exposed to seismic noise; humpback whales off Western Australia have been seen to execute course and speed changes to avoid close contact with active seismic surveys.¹³

In areas of oil and gas development off Russia’s Sakhalin Island, gray whales were recorded leaving their feeding areas during surveys only to return days after the surveys stopped. Reduced
The blue whale’s noisiest neighbour:
There are very few places in the world where blue whales are known to feed. Australia is lucky enough to have some of these places: in the Perth Canyon, off the coast of Western Australia, and in waters off the southern coast, from west of Kangaroo Island, South Australia, down to Cape Otway, Victoria. Yet these same southern waters have recently been opened up to oil and gas exploration, with seismic testing pending in the exact areas where blue whales come to feed. This has prompted the Government’s own whale scientists to express concern about the prospect of seismic surveys at a time and place likely to be biologically important for feeding blue whales.

Seismic surveys have also recently taken place at Scott Reef, Western Australia, at the exact time that blue whales pass south by the reef on their way to Australia from suspected breeding grounds in Indonesia. Australia’s oil and gas industry is fast becoming the worst of the blue whale’s noisy neighbours. Blue whales need to consume approximately 3,000kg of krill every day just to survive; that’s a tough enough life as it is, without being forced to make the choice between avoiding prime feeding habitats or enduring deafening noise in a desperate bid to feed.

Quieting a sea of sound: It is not just blue whale habitat that is affected by seismic surveying. There are over 340 exploration and production leases in Australian waters, stretching from Victoria all the way round to the Northern Territory, with the vast bulk off the north-west coast. There are government guidelines about seismic surveying but the scope of these is limited to preventing physical harm to whales in the immediate vicinity of seismic vessels.

The guidelines do nothing to address the risks of displacing animals from habitats critical for life-sustaining activities like feeding and breeding, or inducing behavioural change and chronic stress in whales. Instead the guidelines rely on uncertain and ineffective mitigation methods. However a recent US government-run workshop pointed out that alternatives to airguns exist, and are in development around the world. These include alternatives such as marine vibroseis, which is capable of gathering seismic data at volumes 100 times quieter than airguns, resulting in a 10,000-fold reduction in the area of impact. But the oil and gas industry has been slow to embrace technological change that can massively reduce the impact of seismic surveying on the marine environment.

As one unnamed industry insider put it, “airgun design has not changed for 30 years, even though the electronics of operating them has. The oil industry is very conservative, is happy with what it has and sees no need to change anything.”
Digging, dredging and pile driving: As if it weren’t enough that whales were being subjected to noise from ships and seismic blasts, they are also forced to endure an ongoing assault on their senses from everyday construction.

For example, pile driving is used for harbour works, bridge construction, oil and gas platform installations, and the construction of offshore wind farm foundations. Dredging in the marine environment is undertaken to maintain shipping lanes, extract geological resources such as sand and gravel, and to route seafloor pipelines. Beaches are mined to provide sand for a variety of uses, such as aggregate in concrete, fill, and beach rehabilitation.

Offshore wind farms create low-frequency noise at high source levels during their construction but at moderate source levels during their operation. As with seismic testing, there is particular concern that prolonged exposure to such noise sources may drive whales away from prime habitat areas for long periods, or even permanently.

Additionally, there are worries that constant exposure to such background noise can result in secondary impacts; for example, humpback whales exposed to explosions associated with construction off Newfoundland showed little behavioural reaction to the noise yet were subsequently much more likely to become fatally entangled in fishing nets.17

17 IFAW Australia, Breaking the Silence, 2013 www.ifaw.org
Even World Heritage areas are under threat: As the offshore petroleum industry moves from exploration to production, greater areas are being targeted for, or in the midst of, some form of construction and industrial development.

The northwest coast of Australia is of particular concern, given the concentration of offshore activity here. The area off the Pilbara is already relatively industrialised but increased shipping and industrial development is spreading as new developments target pristine coral atolls off the Kimberley coast.

Further south, offshore oil and gas development imperils the UNESCO World Heritage waters of Ningaloo Reef, home to blue, humpback and sperm whales, with deep sea drilling now taking place just tens of kilometres from the reef. On the other side of the country another World Heritage area, the Great Barrier Reef, faces rapid coastal development to accommodate ports to export coal. The Government’s own Great Barrier Reef Marine Park Authority has determined that underwater noise pollution from these developments potentially pose “unacceptable and high risk impacts” to snubfin dolphin populations there.

Bubbles and balloons: Technologies are readily available to reduce the noise generated by pile driving. Using continuous pressure or suction rather than a hammer action to place the pile into the sea bed is one option. Another is to reduce the noise travelling from the construction site through the deployment of bubble curtains, or hydro sound dampers comprising gas-filled latex balloons, around the piles. Both physical barriers and bubble curtains can effectively reduce the spread of noise, but bubble curtains are only practicable in low tidal currents and relatively shallow water. Yet industry needs incentives to use these technologies.

The German government recently introduced noise limits for pile driving activities in the North Sea which saw the rapid development and uptake of quieter technologies by industry. Other activities, such as dredging and blasting, are inherently noisy, and the most effective mitigation is simply reduction of such activities and their elimination in areas of the most importance to whales and other marine life. In its 2004 overview of the impacts of underwater noise on whales, the Scientific Committee of the International Whaling Commission proposed the development of “underwater noise” budgets on local, regional and ocean basin scales, as a way of monitoring, regulating and capping the amount of noise that can be generated from a variety of sources.
Hunting for submarines, killing whales:
There is growing consensus that some whale species – and particularly a group of whales
known as beaked whales – are at risk from the
use of “active sonar” by military vessels. This
active sonar takes two forms: “low frequency” (or
LFAS), in which towed arrays listen for submarines
over distances of hundreds of kilometres, and
“mid frequency” (MFAS), which scours for
submarines at closer distances of just a few
kilometres. The latter are deployed more widely,
with approximately 300 in active deployment with
the world’s navies.

The first signs that these technologies might be
having severe impacts on whales came in the mid-
1980s, with a series of mass stranding events,
primarily of beaked whales, that usually coincided
with the use of MFAS by the military. Post-
mortem examination of beaked whales stranded
in the Bahamas in 2000 revealed haemorrhaging
around the brain and in the inner ears, the result
of acoustic trauma; the following year, the United
States Navy conceded that exercises in the
area involving active sonar were complicit in the
strandings.

In 2004, the Scientific Committee of the
International Whaling Commission stated that the
“weight of accumulated evidence now associates
mid-frequency, military sonar with atypical
beaked whale mass strandings. This evidence
is very convincing and appears overwhelming”.
Of 40 recorded instances of mass strandings of
Cuvier’s beaked whales since the 1960s, 28 have
occurred at the same time and place as naval manoeuvres or the use of active sonar.

Other species, including minke whales and sperm whales, have either stranded at the same time as beaked whales or been found to show similar symptoms, suggesting the problem may be even more widespread than recognised and that other whales may be dying at sea and not washing ashore. Nor are the impacts solely fatal ones; humpback whales, for example have been found to increase the length of their mating song in response to low frequency sonar, perhaps in an effort to compensate for the interference.

**Australian Navy sonar:** Although most attention has focused on active sonar used by the United States Navy, the Royal Australian Navy also uses it. In particular, the Perth Canyon region, which is a key feeding ground for pygmy blue whales, is also the location of naval exercises, including some using active sonar, by vessels operating out of Fleet Base West on nearby Garden Island. Sperm whales and beaked whales, known to be susceptible to active sonar, are also found in the area.

**Sharing our oceans safely:** Our understanding of the mechanisms by which active sonar affects beaked and other whales remains incomplete, as is awareness of the range at which these negative effects can be felt. Navies are not only responsible for introducing these technologies into the water, they also have the resources and the responsibility to fund and conduct research to determine just how these technologies affect whales, and over what distances. Having selected areas in which to conduct active sonar exercises, navies should also take the lead in identifying areas of key importance for whales and dolphins, in which those tests should not be conducted.

Confirmation of those areas can also be of immense value in assessing the cumulative impacts of the myriad other sound sources that are threatening to drown out the vocalisations and hearing of dolphins and whales off the coast of Australia and around the world.
As our understanding of ocean noise pollution and its impacts on whales and dolphins improves, so the imperative to take action increases. Solutions are available, however, and around the world, governments, industry and international organisations are taking steps to implement those solutions. From the EU designating man-made ocean noise as a pollutant, to Germany prescribing limits on noisy activities, from developments in propeller design and seismic technology to vessel speed restrictions, forward-thinking governments and industry players around the world are recognising the problem and the need to address it.

Even such efforts are far short of what has been called for by the likes of the Convention on Biological Diversity, which has stated: “There is a need to scale up the level of research and management efforts, to significantly promote greater awareness of the issue and to take measures to minimise our noise impacts on marine biodiversity”.

Yet even minimal efforts elsewhere are far in excess of anything currently happening in Australia.

As the volume of human activity increases around our coast, now is the time for targeted government interventions and industry innovation. Not only will such innovation benefit whales and dolphins, but it would place Australian companies at the cutting edge of corporate social responsibility in the maritime industries.
Without action, the Australian government risks diminishing its reputation as a global leader in whale conservation. Some actions will require concerted effort over the longer-term, but there are also immediate steps that can and should be taken. Key recommendations as to how government and industry can turn the volume down are as follows:

**To government:**
- define whale habitats where noisy activities should be excluded or noise limits imposed;
- develop underwater noise “budgets”, as a way of monitoring, regulating and capping the amount of noise that can be generated from man-made sources;
- restrict oil and gas exploration in important whale habitats, especially where exploration cannot be timed to avoid the presence of whales because different species are present at different times of year;
- update Australia’s guidelines for seismic surveys to address the issues of displacement from important habitat, behavioural change and chronic stress in whales, and to fundamentally emphasise the need to reduce source noise rather than rely on uncertain or ineffective mitigation measures;
- use lease conditions and the environmental approvals process to introduce noise limits to incentivise the use of quieter construction techniques and alternative technologies to seismic airguns;
- undertake noise inventories of the Australian shipping fleet, as recommended by the International Maritime Organization, in order to eliminate the noisiest vessels;
- re-route shipping lanes to avoid important whale habitats;
- introduce vessel speed restrictions in important whale habitats to reduce shipping noise;
- invest in research on habitat use and seasonal presence of whales within Royal Australian Navy exercise areas.

**To industry:**
- invest in research to further develop techniques that reduce noise at source;
- deploy new, quieter technologies for seismic surveys and offshore construction;
- support quieter (and fuel efficient) ship design;
- reduce shipping transit speeds to reduce noise (with the added benefit of increasing fuel efficiency);
- avoid activities in and travel through important whale habitat.

With the right incentives from government and industry innovation, it is possible to deal with ocean noise pollution just as we have learned to deal with other pollutants in the marine environment. That we cannot see it, is no excuse to not take action.

Governments, international bodies and industry, together with scientists and conservation organisations, can and must find a way to implement the practical solutions outlined in this report if we are to address the growing issue of ocean noise pollution and the threat this poses to whales.

http://www.acousticecology.org/docs/IWC56-noisesymposium.doc


http://rspb.royalsocietypublishing.org/content/early/2012/02/01/rspb.2011.2429.full.html


---

**VIEW OUR VIDEO**

find out more information
www.ifaw.org

**like us, follow us**
International Fund for Animal Welfare – Australia 
www.facebook.com/ifawoceania 
@IFAWAU