SEMAPHORE

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WHALES AND ACTIVE SONAR – CHALLENGES AND OPPORTUNITIES

The extent to which marine mammals are affected by human-created underwater sound, particularly active sonar, has been a topic of growing public concern in recent years. This *Semaphore* will explore the complex issues surrounding the effects of underwater sound on marine mammals and the importance the Royal Australian Navy (RAN) places on environmental management, to ensure long term access to vital offshore training areas.

Australia is fundamentally a maritime nation, potentially vulnerable to any efforts to block key trade and supply routes from above or below the sea. Maintaining a credible RAN anti-submarine capability remains important in a region that has seen significant growth in submarine forces. In addition, the increasing focus on littoral operations, linked partly to the need for maritime amphibious capabilities, means ships will need to operate in areas where conventional sonar technology is challenged by poor seawater transmission characteristics and complex sea floor structure. Modern conventional submarines are quieter through better design, and are therefore more challenging to identify by passive means. With no viable alternative technology, the RAN will continue to rely on a combination of passive and active sonar for detection of submarines. This requires regular and realistic sea-going training of personnel and maintenance of equipment to meet this complex and multi-faceted challenge.

Australian waters are populated or visited by around forty species of whales and dolphins,[1] ranging in size from dolphins to the Blue Whale (up to 30 metres in length). Unlike other parts of the world, Australian marine mammal population levels are almost uniformly stable, or recovering, and are not under threat from human activity. Depletion of some species through whaling and other human causes such as pollution and by-catch has strengthened community resolve to ensure their protection. In parallel, development of a whale watching industry with prospects for employment and wealth generation in regional areas has highlighted the economic value of marine mammal conservation.

All marine mammals have adapted to use sound as a primary tool for communication, identification and hunting prey. As a result, any human activity that produces underwater sound has the potential to impact on or disrupt these vital communication processes.[2] Underwater sound from RAN vessels can be emitted by explosives, ship and boat engines, underwater communication systems and active sonars.

The impact of sound disturbance on marine mammals can be manifested in a number of ways, including:

- masking of important biological sounds (sounds of prey or communication with other members of the pod)
- changing behaviour (dive patterns, movement, abandonment of activities such as hunting prey)
- stress (fright, flight)
- physical injury to hearing mechanisms
- tissue damage leading to injury or death.

The scale of impact is a function of the source sound output level (loudness), transmission reflection and absorption characteristics of the water column and sea floor, and distance from the source to the animal. Equally important is the auditory capability of the animal (can the species hear the transmission frequency?) and the animal's propensity to react to the sound (is it easily startled?). Scientists and regulators are particularly interested in managing 'biologically significant' sounds,[3] specifically those that affect important activities such as feeding, breeding and migration.

Recent articles have highlighted the challenges faced by navies worldwide in dealing with these issues.[4] For the RAN, the conduct of vital training activities in realistic conditions at sea is essential to maintaining necessary operational skills. Offshore training areas are concentrated close to the major fleet bases on the east and west coasts, to ensure ready access and minimise transit times between harbour and sea. These areas are also frequented by increasing whale populations.

For example, the West Australian Exercise Area, west of Fremantle, is inhabited by various species, including Blue whales which feed in the Rottnest Trench in summer and autumn. Humpback whales migrate through the area twice each year between their winter breeding areas in the tropical north and summer feeding grounds in the waters of Antarctica. Beaked whales are also seen in deep offshore waters over summer. Increasing numbers of marine mammals can therefore be expected to be encountered in the area regardless of time of year, reinforcing the need for RAN exercise planners and individual ships, submarines and aircraft to remain alert to possible whale interactions.

Beaked whales are acknowledged as potentially threatened by underwater sound. A number of multiple strandings of beaked whales have occurred coincident with naval use of active sonar in the northern hemisphere, and once during a seismic survey of the Gulf of California. Of these events, strandings in the Canary Islands and a highly publicised stranding in the Bahamas[5] have galvanised public and interest group attention to ensure that active sonar is used in a manner that avoids similar incidents in future.

Beaked whales are amongst the most poorly understood of all whale species. They are relatively small, elusive, generally do not congregate in large numbers, and their principal habitats often lie well offshore. Beaked whales have been observed in most southern waters of Australia from New South Wales to southwest Western Australia. They are unique in that they hunt for squid in deep continental slope waters, and are the deepest diving of all air breathing species, recorded at depths exceeding 2,000 metres, and able to breath-hold for periods in excess of a staggering 80 minutes.[6] Scientific understanding of the physiology of beaked whales is poor, unsurprising when they are commonly exposed to pressures of over 200 atmospheres and significant oxygen deficits during a single dive.

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The actual cause of these strandings remains unclear, but a number of theories have been suggested to explain a potential mechanism for injury. The most plausible of these imply a change in diving behaviour leading to symptoms of decompression sickness[7] or induction of stress through a fright and flight response to the sound. The difficulties in understanding and managing these risks are compounded by recent evidence that beaked whales hear quite poorly at the frequencies used by naval anti-submarine sonars.[8]

A stranding of melon headed whales during the 2004 Rim of the Pacific (RIMPAC) exercise off Hawaii influenced the US Navy to seek a permit to conduct sonar exercises during RIMPAC 06. This was granted by the US National Marine and Fisheries Service, though a subsequent court challenge by a US interest group resulted in a restraining order against the US Navy, citing 'overwhelming evidence' that active sonar can injure marine mammals. Subsequent negotiation saw the exercise proceed, but with significant mitigation measures in place.

Despite lack of scientific consensus, circumstantial evidence surrounding some whale strandings is enough to suggest the need to manage the potential adverse impact of some types of active sonar. Indeed, the Australian *Environment Protection and Biodiversity Conservation Act 1999* prescribes such a precautionary approach in cases where complete data is not available. The EPBC Act also focuses on *critical habitat* for each species, most importantly feeding, breeding and resting areas. These obligations formed the basis for the RAN developing appropriate mitigation standards to avoid adverse impacts on marine mammals.

Managing the potential for impact is challenging in an environment where the animals are mostly unseen, elusive, and have poorly understood physiology and behaviour. Some of the principal mechanisms available include separation of activities from known whale congregations in space and time (a planning function), detection and avoidance methods using observers, and management of transmissions to reduce received sound intensities to accepted levels where interactions are considered likely.

In recent years the RAN sought to develop environmental management strategies that would be recognised as amongst the best in the world, employing all of these mitigation techniques. Of particular note was the decision to adopt a consultative approach, ensuring that key government agencies, interest groups and the public had an opportunity to participate in the development of appropriate management strategies.

The *Maritime Activities Environmental Management Plan* (MAEMP) was progressively developed and finally implemented in 2005, to ensure that activities routinely conducted at sea are managed in a way that meets legislative obligations and community expectations, using a widely endorsed framework. The MAEMP has been designed with three levels of management:

- *Planning Handbooks* for some key training areas where a range of activities may be conducted simultaneously, to assist exercise planners in considering cumulative impacts and location specific issues.
- *Planning Guides* provide guidance on specific activities during the activity planning phase. Where necessary, both the Planning Handbooks and Guides recommend separation of an activity from a critical habitat.
- *Procedure Cards* provide specific guidance on individual activities, recognising the importance of managing activities in real time.

The MAEMP is widely acknowledged as amongst the most comprehensive and effective in use today, and has enhanced the RAN's reputation for proactive and innovative management of marine environmental issues. The MAEMP has also been well accepted by RAN personnel, who are keen to ensure that their responsibilities for environmental compliance and sustainable management are met.

However, uncertainties about marine mammals remain and there is a risk that overly precautionary measures and prescriptive management could impact unnecessarily on the RAN's training role at sea. In an effort to better understand the more vulnerable species, further scientific research into behaviour, population distribution and abundance is fundamental to ensuring effective mitigation measures and management practices are in place in key exercise areas. Information on individual species including feeding, breeding and resting areas, dive profiles, as well as auditory responses and behavioural reactions to noise, and the longer term biological consequences of noise impact, are all crucial to understanding the potential impact of human activities on marine mammals. Some valuable research continues on a number of whale species, including Blue whales off the West coast, but beaked whale research in Australia is minimal.

The key point is that the RAN would be a direct beneficiary of such research. This justifies allocation of dedicated research funding targeted at key species which are considered most at risk from the effects of underwater noise. Better knowledge would provide greater confidence that appropriate management strategies and mitigation measures are devised to avoid causing unnecessary harm. There is also need for continued education within the RAN about managing potential whale interactions during training activities at sea.

The consultative and innovative approach used by the RAN in managing potential marine mammal interactions puts the Navy in a leading position, by demonstrating that meeting necessary environmental compliance standards is possible without undue impact on training. Further research will help to minimise any regulatory constraints placed on activities at sea, and ensure that maximum value is obtained by conducting necessary training under realistic conditions. By maintaining its edge as leader in this field, the RAN can continue to demonstrate that both the environment and the Service can be winners.

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