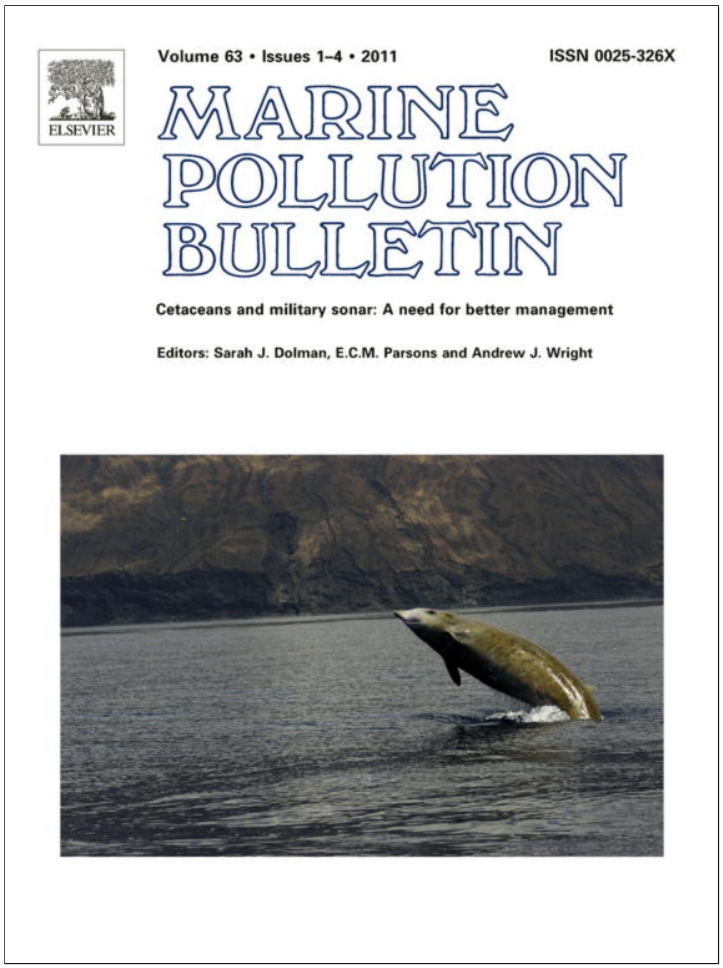

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Active sonar, beaked whales and European regional policy

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ABSTRACT

Various reviews, resolutions and guidance from international and regional fora have been produced in recent years that acknowledge the significance of marine noise and its potential impacts on cetaceans. Within Europe, ACCOBAMS and ASCOBANS have shown increasing attention to the issue. The literature highlights concerns surrounding the negative impacts of active sonar on beaked whales in particular, where concerns primarily relate to the use of mid-frequency active sonar (1–10 kHz), as used particularly in military exercises. The authors review the efforts that European regional policies have undertaken to acknowledge and manage possible negative impacts of active sonar and how these might assist the transition from scientific research to policy implementation, including effective management and mitigation measures at a national level.

1. Anthropogenic sound and beaked whales

In recent years, regional conventions, primarily ACCOBAMS and ASCOBANS, have shown an increasing interest and concern in marine noise pollution issues within Europe. Various reviews, resolutions and guidance from international and regional fora have been produced (for example, ASCOBANS, 2006; ACCOBAMS, 2007; CMS, 2008; OSPAR, 2009a,b). Objectives vary from improving understanding of impacts through increased and co-ordinated research; critically examining existing management measures; and development, implementation and reporting back on mitigation measures undertaken. All acknowledge the significance of marine noise pollution and the potential impacts on cetaceans in general, and all highlight concerns surrounding the well-documented impacts of active sonar on beaked whales in particular. In addition, the EU Marine Strategy Framework Directive is likely to be important with regard to noise pollution, with member countries having a deadline to transpose this legislation by July 2010.

As this political interest has blossomed, the science and science-based policy surrounding the issue (Boyd, 2008; Southall, 2009) has also developed. It is now widely acknowledged that effective mitigation measures against intense marine noise sources are required for a variety of marine species. Further, it is acknowledged that beaked whale mass mortality events (strandings and mortalities at sea) that result from active sonar use (as listed in Hildebrand, 2005) require special consideration (for example Cox et al., 2006).

Concerns over the negative effects of anthropogenic sound upon members of the beaked whale family have primarily related to the use of mid-frequency active sonar (1–10 kHz), as used particularly in military exercises, after a series of mass strandings involving this species (Evans and England, 2001; Evans and Miller, 2004; Cox et al., 2006). Within the ASCOBANS region, no localised mass strandings of beaked whales have been reported, although an unusually high number of Cuvier's beaked whale (*Ziphius cavirostris*) (18), four Sowerby's beaked whale (*Mesoplodon bidens*) and five unidentified beaked whale, as well as 29 long-finned pilot whale (*Globicephala melas*) strandings occurred at widely separated localities along the UK and Irish coast in the first seven months of 2008. It was not possible to identify cause of death for any of those strandings, since they were not in sufficiently fresh condition for post-mortem analysis (Dolman et al., 2010).

Within the ACCOBAMS region, the most recent detailed pathological examination was conducted on four Cuvier's beaked whales that stranded in Almería, southern Spain in January 2006 (Fernández, 2006), coincident with a NATO naval exercise in the Cartegena Exercise Area (an important habitat for beaked whales).

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The pathological findings in the Almeria mass stranding were very similar to previous "atypical"[1] beaked whale mass strandings associated spatially and temporally to military naval exercises in the Bahamas in 2000, and in the Canary Islands in 2002 and 2004 (Fernández, 2006).

2. Status and distribution of beaked whales of the North Atlantic and Mediterranean

Six species of beaked whale from three genera within the family Ziphiidae have been recorded in recent times within European waters. These are northern bottlenose whale (*Hyperoodon ampullatus*), Cuvier's beaked whale, Sowerby's beaked whale, True's beaked whale (*Mesoplodon mirus*), Gervais' beaked whale (*Mesoplodon europaeus*), and Blainville's beaked whale (*Mesoplodon densirostris*).

The northern bottlenose whale is found in the temperate and arctic North Atlantic, from the ice-edge to the Azores, particularly in deep waters. Its main areas of concentration, identified from former whaling activities, appear to be west of Norway, west of Spitsbergen, north of Iceland, around the Faroe Islands, and in the western North Atlantic: in the Davis Strait off Labrador and The Gully off Eastern Canada (Mead, 1989a; Reeves et al., 1993; Hooker et al., 2008).

The Cuvier's beaked whale is the most widespread of beaked whales, occurring probably world-wide in warm and warm-temperate seas. It has an apparent preference for warmer waters, rarely recorded as far north as the British Isles, but with one record from Iceland (Evans et al., 2008e). Further south it is the most common ziphiid in the Bay of Biscay and around the Iberian Peninsula, and it is the only species known to occur regularly in the Mediterranean (Evans et al., 2008e; Podestà et al., 2006). It is seen year-round in the Canary Islands.

Sowerby's beaked whale is known only from the temperate North Atlantic, mainly in European waters; its distribution is presumably centred upon deep waters of the mid- and eastern North Atlantic, mostly north of other *Mesoplodon* species (Mead, 1989b; MacLeod, 2000; Evans et al., 2003, 2008a; Reid et al., 2003).

The range of True's beaked whale is poorly known. It may be widespread in deep waters of the temperate Atlantic extending to the SW Indian Ocean, since there have been records from eastern North America, NW Europe, NW Africa and South Africa (Mead, 1989b; MacLeod, 2000; Evans et al., 2008b). The great majority of European strandings have been from Western Ireland, with sightings putatively of this species in the Bay of Biscay, Azores and Canaries (Evans et al., 2008b).

Gervais' beaked whale is known only from the Atlantic where it apparently favours warm temperate and subtropical waters. The type specimen was found floating in the English Channel in 1848, but most records come from the western North Atlantic (Mead, 1989b; Jefferson and Schiro, 1997; Evans et al., 2008c). One record of Gervais' beaked whale exists from the Mediterranean (Podestà et al., 2005).

Blainville's beaked whale is one of the most widely distributed species of *Mesoplodon*, recorded from tropical and warm-temperate seas of all oceans. In the eastern North Atlantic, there are records from Iceland, Wales, France, Portugal, Spain (Mediterranean included), and Madeira, but the species is found mainly around the Canaries and in the western North Atlantic (Mead, 1989b; Jefferson and Schiro, 1997; Evans et al., 2008d).

Beaked whales are not known to occur in the remaining European marine waters, i.e. in the Black Sea.

[1] Frantzis (1998) describes an atypical cetacean stranding as a stranding event involving more than two whales (including one or more species) that strand approximately simultaneously but not in the same location.

3. Management and mitigation

To determine population level impacts based on percentage 'takes' of individuals (of the sort which form the basis of US environmental legislation for the protection of cetaceans) requires knowledge of population range and size (Elith et al., 2006) and trends over time (Austin, 2002; Cañadas et al., 2005). The IUCN Red List classifies population trends of all *Mesoplodon* species as "unknown" and all but Cuvier's beaked whale (Least Concern) as being "Data Deficient" (IUCN, 2009). Baseline population data are not available in Europe for any beaked whale species, nor are they likely to be in the near future. Traditional ship-based survey techniques may not help monitor impacts even if data were available in Europe. Taylor et al. (2007) in a review of US large-ship surveys concluded that the percentage of precipitous declines that would not be detected for beaked whales was 90% (where a precipitous decline was determined as a 50% decrease in abundance in 15 years).

It is likely that there are undiscovered populations, or perhaps even species, of beaked whales in the ocean (Pitman, 2002; Yamada, 2002), Whilst Perrin's beaked whale has a distribution off the Californian coast, a region where considerable marine research has been undertaken, this species was only recently discovered, and we know nothing about its biology (Dalebout et al., 2002). They are difficult to observe (Barlow and Gisiner, 2006), and they are already living at their physiological limits (Hooker et al., 2009; Zimmer and Tyack, 2007; Tyack et al., 2006; Wright, 2009). Further, we are increasingly aware of the limitations of on-board mitigation measures to protect individual animals from injury at close range to the sonar source, particularly for species such as beaked whales (see, for example, Barlow and Gisiner, 2006; Parsons et al., 2008; Dolman et al., 2009). Given the low received levels at which beaked whales are likely impacted by active sonar, short-range on-board mitigation measures alone are not appropriate to protect individuals or populations (Parsons et al., 2008).

It is clearly a challenge to effectively protect beaked whales – a group that we know little about, from the negative impacts of naval sonar. To ensure protection of all marine wildlife, mitigation of naval sonar should remain inside regulatory frameworks (Dolman et al., 2009). Generally, naval activities including active sonar may be exempt, yet many navies choose to apply environmental legislation. Indeed, sonar guidance is developed individually by a country for use by their own navy. On the whole, navies self-regulate and set their own mitigation strategies (Glassborow, 2006). The marine mammal mitigation guidance in use during naval exercises and other operations in Europe and worldwide shows variation between regions in most aspects (Table 1). Guidance is also needed for the management of naval exercises in waters where none currently exists. Both ASCOBANS (the Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas) and ACCOBAMS (the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area) have developed such guidance.

4. ASCOBANS

ASCOBANS was concluded in 1991 under the auspices of the Convention on Migratory Species (CMS or Bonn Convention), and entered into force in 1994. In February 2008, an extension of the Agreement area came into force, which changed the name to "Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas" (Fig. 1). The Secretary General of the United Nations has assumed the functions of Depository of the Agreement. ASCOBANS is open for accession by all

Table 1
Some marine mammal guidance implemented during naval exercises. Y = yes; N = no; N/R = not required (Carron, 2004; Kvadsheim and Sevaldsen, 2004; Cerutti, 2005; Ministry of Defence, 2005; NATO, 2007; Kvadsheim, 2008).

Mitigation	France	Italy	Norway	NURC	Canary Islands	UK
Selection of area	Y	Y	Y	Y	N	Y
Buffer zone	N	Y	N	N	N	N
Coastal exclusion	N	N	N	N	Y	N
Detection system/database	N	Y	Y	Y	N	Y
Pre/post dedicated survey	Y	Y	Y	Y	N/R	Y
Increased lookout	Y	Y	Y	Y	N/R	Y
Trained observers	N	N	N	N	N/R	Y
Weather/sightability	N	N	N	Y	N/R	Y
Passive acoustic monitoring	Y	Y	Y	Y	N/R	Y
Other monitoring	N	N	N	Y	N/R	N
Min source required	N	N	Y	Y	N/R	N
Propagation conditions	N	N	N	Y	N/R	N
Soft start/ramp up	Y	Y	Y	Y	N/R	N
Delay if cetacean observed	N	N	Y	Y	N/R	N
Repeat ramp-up	N	Y	Y	Y	N/R	N
Power down if cetacean detected	Y	N	Y	Y	N/R	Y
Sonar off if cetacean detected	Y	N	Y	Y	N/R	Y
Exclusion zone	Y	Y	Y	Y	Y	Y
All marine mammals	Y	Y	Y	N	N/R	Y
Cow/calf pairs	N	N	N	N	N/R	N
Other species	N	N	Y	N	N/R	Y
Stranding response	N	N	N	Y	N/R	N
Reporting	N	N	N	Y	N/R	Y
Environmental Impact Assessment	N	N	N	Y	N/R	Y
Exclusion of specified area	N	Y	N	N	Y	Y
Research	N	N	Y	N	N	N

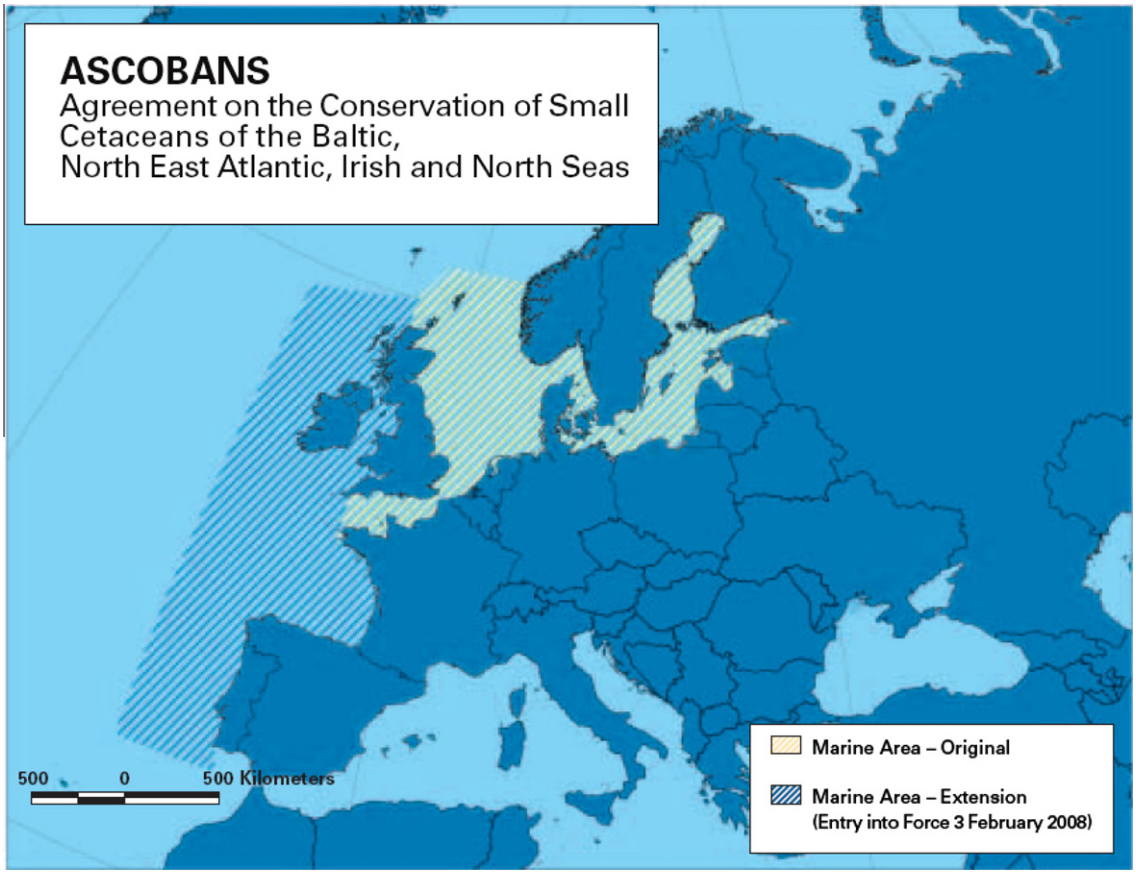

Fig. 1. Extension of ASCOBANS Agreement Area, proposed in 2006 and adopted in 2008.

Range States (i.e. any state that exercises jurisdiction over any part of the range of a species covered by the Agreement or whose flag vessels engage in operations adversely affecting small cetaceans in the Agreement area) and by regional economic integration orga-

nizations. Ten countries have so far become Parties to the Agreement.[2]

One of the conservation management implications of this Agreement Area extension is that it now encompasses deeper waters of the eastern North Atlantic beyond the continental shelf edge. These include important habitats for beaked whale species of the family Ziphiidae.

Military activities using active sonar take place particularly in four regions within the ASCOBANS Agreement Area: in deep waters off the west coast of Norway; in the North-west Approaches to the British Isles extending to the west coast of Scotland; in the South-west Approaches at the western end of the English Channel and south of Ireland; and in the Bay of Biscay. All those areas are frequented by beaked whales – northern bottlenose whale and Sowerby's beaked whale in the north, Cuvier's beaked whale and Sowerby's beaked whale in the south.

5. ASCOBANS resolutions and proposed mitigation measures

In 2003, the Advisory Committee of ASCOBANS reviewed the possible effects of shipping, recreational and military activities upon small cetaceans in the Agreement Area (Evans, 2003).

During the 5th Meeting of the Parties to ASCOBANS (2006), resolution 4 on *Adverse Effects of Sound, Vessels and Other Forms of Disturbance on Small Cetaceans* "requested Parties and Range States to:

- develop, with military and other relevant authorities, effective mitigation measures including Environmental Impact Assessments and relevant standing orders to reduce disturbance of, and potential physical damage to small cetaceans,
- conduct research and develop appropriate management measures, guidelines and technological adaptations to minimise any adverse effects on small cetaceans of the above sound sources,
- develop and implement procedures to assess the effectiveness of any guidelines or management measures introduced."

Resulting from this resolution, the ASCOBANS Triennium Work Plan for 2007–2009 requested that the Advisory Committee should "*continue to review the extent of negative effects upon small cetaceans of sound, vessels and other forms of disturbance on small cetaceans, and to review relevant technological developments with a view to providing recommendations to Parties, by the 6th Meeting of the Parties, on possible ways to mitigate those negative effects*".

At the 6th Meeting of the Parties in 2009, a further resolution (No. 2) was passed on 'Adverse Effects of Underwater Noise on Marine Mammals during Offshore Construction Activities for Renewable Energy Production'.

On behalf of the Advisory Committee of ASCOBANS, an intersessional Noise Working Group was established in 2008. The WG presented draft guidelines at the Sixth Meeting of the Parties in Bonn, Germany.

Those draft guidelines contain a number of recommendations to improve monitoring and mitigation within the ASCOBANS Agreement Area. They have been developed alongside those established by Dr. Gianni Pavan for the Scientific Committee of the sister Agreement, ACCOBAMS. The main recommendations from this Working Group (ASCOBANS, 2009) specific to military sonar and civil high-power sonar, are summarised below, under three main phases:

(1) Planning phase:

(a) Exercise areas need to be well researched beforehand making the best use possible of data from past surveys and predictive models, introducing new surveys where necessary.
(b) Avoid important oceanographic features, such as canyons, steep walls, and seamounts, persistent upwellings, and bays, as well as Marine Protected Areas, and known habitat and other high-density areas.
(c) Navies should widely implement (and further develop) passive acoustic monitoring (PAM), as an effective tool for identifying high-density areas in exercise planning, and for real time monitoring of exercise areas.

(2) Real-time mitigation:

Effective real-time measures include those that are source-based (technical and procedural modifications to reduce emitted level or other damaging noise characteristics such as rise time, wide beam pattern, long durations and duty cycles, activity reduction and sound containment); and those that are operational (establishment of exclusion zones, restrictions to certain times of day or to duration of emissions, improvements in monitoring and reporting, etc.).

Specific measures include:

(a) Adopting a scientific and precautionary basis for an exclusion zone rather than an arbitrary and/or static designation, taking account of sound source and propagation characteristics.
(b) Mitigation procedures should be practical, using data that can be readily collected by fully trained marine mammal observers (visual and acoustic), accounting for operating conditions and constraints.
(c) Mitigation should include monitoring and reporting protocols to provide information on the implemented procedures and their effectiveness, and to provide datasets to be used for improving existing marine mammal databases.
(d) During operations, alert existing stranding networks in the area and, if necessary, introduce additional surveillance.
(e) Cease operating if any abnormal behaviour, stranding or death occurs that is thought to be related to the activity.
(f) If required, organise post-cruise surveys to verify if changes in population density/distribution, or anomalous deaths have occurred.
(g) Restrict use of high-power sources at night, during other periods of low visibility, and during significant surface-ducting conditions, since current mitigation techniques are generally inadequate to detect and localise marine mammals. Because of the impact of adverse weather conditions on the visual detection of mammals, emission during unfavourable conditions should be restricted.
(h) Passive acoustic monitoring (towed array technology for moving ships, radio-transmitting sonobuoys for stationary operations, or other suitable technologies with enough bandwidth to be sensitive to the whole frequency range of marine mammals expected in the area), should be used to improve detection capabilities. Real-time PAM should be mandatory for night operations or in poor visibility.
(i) Before beginning any emission, there should be a dedicated watch of at least 30 min to ensure that no animals are within the EZ, extended to 120 min if prolonged divers such as beaked whales have been seen diving on the vessel trackline or if suitable habitats for them are approached.

[2] Belgium, Denmark, Finland, France, Germany, Lithuania, The Netherlands, Poland, Sweden, and the United Kingdom.

Fig. 2. ACCOBAMS Agreement Area and contracting parties.

(j) On introducing a sound source, slowly increase acoustic power (ramp-up or soft start) to allow marine mammals sufficient opportunity to leave the ensonified area in the event that visual and passive searches are unsuccessful.
(k) The beginning of emissions should be delayed or shut down, if marine mammal species are observed within the EZ or approaching it. Ramp-up should not start until 30 min after the animals are seen to leave the EZ, or 30 min after they are last seen (120 min in case of beaked whales).
(l) Avoid exposing animals to harmful acoustic levels, by changing the ship's course, if applicable, or by reducing (power-down), or ceasing (shut-down) the acoustic emissions.

(3) Post-exercise monitoring and reporting

(a) Post-exercise monitoring should include cetacean surveys within the exercise area.
(b) Transparent reporting to national authorities should occur within a predetermined timeframe;
(c) Modelling of the generated sound field in relationship to oceanographic features (depth/temperature profile, sound channels, water depth, seafloor characteristics) and with existing background noise.
(d) Procedures for collecting observational data should be based on a standardised protocol.

6. ACCOBAMS

ACCOBAMS (Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area) is an agreement which was also created within the framework of CMS (Convention on Migratory Species) (Fig. 2). The main goal of the Agreement, enounced in its Art. 2.1, is to ensure that "Parties shall take co-ordinated measures to achieve and maintain a favourable conservation status for cetaceans". At the current time (April 2010), ACCOBAMS has been ratified by 23 Parties.[3] The Agreement's decisions are taken by Parties through the adoption of resolutions during their ordinary meetings (roughly every three years). Decisions are normally based on recommendations by the ACCOBAMS Scientific Committee.

ACCOBAMS has a Secretariat (headquartered in Monaco) which is more independent from the parent Convention (CMS) than that of ASCOBANS, and its Scientific Committee is a solely consultative, purely scientific body unlike ASCOBANS' Advisory Committee which is part scientific, part administrative. In addition, a feature which most distinguishes ACCOBAMS from ASCOBANS is that whereas the latter lies entirely in Europe, and all its Parties are EU member states, ACCOBAMS is composed in part by EU member states, and in part by Mediterranean and Black Sea countries, most of which are either African or Asian.

7. ACCOBAMS resolutions and proposed mitigation measures

The issue of anthropogenic noise has been addressed extensively by ACCOBAMS. It was first raised by the Scientific Committee during its second meeting (Istanbul, November 2003), with the adoption of Recommendation 2.7, "*with a view inter alia to refine and test existing guidelines on the use of noise in the context of cetaceans (...) and where appropriate, develop new guidelines*". On that occasion, a specific management recommendation was made, that "*the ACCOBAMS Parties consult with any profession using ... acoustic devices, including military authorities, and urge that extreme caution be exercised in their use in the ACCOBAMS area, with the ideal being no further use until satisfactory guidelines are developed.*"

The noise issue was subsequently addressed by the Parties during their second meeting (Palma de Majorca, November 2004), where they adopted a resolution (2.16) urging Parties and

[3] Albania, Algeria, Bulgaria, Croatia, Cyprus, Egypt, France, Georgia, Greece, Italy, Lebanon, Libyan Arab Jamahiriya, Malta, Monaco, Montenegro, Morocco, Portugal, Romania, Slovenia, Spain, Syria, Tunisia, Ukraine.

non-Parties to "*take a special care and, if appropriate, to avoid any use of man-made noise in habitat of vulnerable species*", "*facilitate national and international research*", and charging the Scientific Committee to "*review the technical bases of this Resolution and to develop by the next Meeting of Parties a common set of guidelines on conducting activities known to produce underwater sound with the potential to cause adverse effects on cetaceans*".

As a result, the Scientific Committee endeavoured to develop "*Guidelines to address the issue of the impact of anthropogenic noise on marine mammals in the ACCOBAMS area*", which were adopted during its 4th meeting (Monaco, November 2006) together with a recommendation to Parties and non-Parties to carefully consider the guidelines in order to regulate and mitigate underwater anthropogenic noise in the ACCOBAMS area. The SC guidelines explicitly addressed military and civil high-power sonar, seismic surveys and airgun uses, coastal and offshore construction works, offshore platforms, research (playback and controlled exposure experiments), and other mitigation needs.

However, Parties at their third meeting (Dubrovnik, October 2007) were unable to reach consensus on the guidelines that they had requested from the Scientific Committee. As a consequence, instead of the guidelines, a Resolution (3.10) was adopted, urging Parties to act in accordance with a series of conservation-oriented principles "as soon as possible", encouraging Parties to sponsor research in the ACCOBAMS area to detect and localise beaked whales by passive methods, and deciding, amongst other things, to "*establish a Correspondence Working Group by the Secretariat (...) to address anthropogenic noise deriving from activities such as seismic surveys and airgun uses, coastal and offshore construction works, the construction, the operation and the decommissioning of offshore platforms, playback and controlled exposure experiments, whale watching, blasting of residual war weapons, underwater acoustic devices, military sonar, civil high-power sonar operations and shipping activities, in order to develop appropriate tools to assess the impact of anthropogenic noise on cetaceans and to further elaborate measures to mitigate such impacts*".

Resolution 3.10 urges Parties to take a number of steps towards better management and mitigation of anthropogenic noise, some of which are pertinent to beaked whale protection, including:

- "Particular attention should be given to the management of habitats that host sensitive species, such as beaked whales".
- "Encourages Parties to sponsor research in the ACCOBAMS area to detect and localise beaked whales by passive methods".
- "Urging Parties and the management authorities of marine protected areas in the ACCOBAMS area to include consideration of high-power noise sources in their management plans".
- "Invites Parties to implement mitigation and monitoring measures for noise producing activities within the ACCOBAMS Area, including, avoiding key marine mammals habitats, areas of high marine mammals density and marine protected areas, and defining appropriate buffer zones around them; establish safe, precautionary and scientifically-based exclusion zones around the noise source; effectively monitoring for marine mammals in the vicinity of the source; and managing activities in the light of cumulative, seasonal, and historical impacts from multiple sources".

8. EU Marine Strategy Framework and Habitats Directives

The European Commission has recognised the importance of developing mitigation measures for the adverse effects upon cetaceans of anthropogenic sound. The *Marine Strategy Framework Directive (MSFD),* as adopted by the EU Parliament on 11 December 2007, provides an opportunity to protect cetaceans, including beaked whales from the potential negative impacts of noise pollution. EU Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive by July 2010 (Article 26, Paragraph 1).

Article 2 of the EU MFSD states: "This Directive shall not apply to activities the sole purpose of which is defence or national security. Member States shall, however, endeavour to ensure that such activities are conducted in a manner that is compatible, so far as reasonable and practicable, with the objectives of this Directive." Article 3 defines "'pollution' means the direct or indirect introduction into the marine environment, as a result of human activity, of substances or energy, including human-induced marine underwater noise, which results or is likely to result in deleterious effects such as harm to living resources and marine ecosystems...". In Article 3, Paragraph 5 the MSFD defines "good environmental status" as meaning the "environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations... and that anthropogenic inputs of substances and energy, including noise, into the marine environment should not cause pollution effects". In Europe, all cetacean species are provided 'strict protection' under the EU Habitats Directive (92/43/EEC).

9. Regional seas organisations: the OSPAR and Barcelona conventions

Whilst OSPAR lags somewhat behind most agreements and legal authorities in this region, it has produced two reports on the issue (OSPAR, 2009a,b). The assessment (OSPAR, 2009a) calls for additional mitigation by member parties, stating that the most effective mitigation measures are geographical and seasonal restrictions to avoid ensonification of sensitive species and habitats.

The Barcelona Convention has not yet tackled head-on the issue of the detrimental effects of noise in the marine environment, although addressing noise would be included in its objectives under the commonly accepted tenet that it is a form of pollution.

10. Proposals for the future

Progress to avoid potential conflict between activities that generate loud sounds and the well-being of cetaceans, particularly beaked whales, will only occur if a number of general actions take place. Probably the most important ones for all Parties involved are to:

1. Improve communication systems and cooperation between marine mammal scientists, conservation NGOs, national governmental and military authorities, and in liaison with the European Commission. For the ASCOBANS Agreement Area, this is best done through its Advisory Committee, with support from the recently formed Noise Working Group, and for the ACCOBAMS Agreement Area through the Scientific Committee.
2. Develop a better understanding of the mechanisms leading to mortality to beaked whales that are exposed to active sonar.
3. Promote acceleration of research into effective mitigation measures for active sonar.
4. Consider establishing protected areas in specific sensitive regions (including offshore) where routine military activities are restricted, and possibly setting aside particular areas where military manoeuvres can take place, with appropriate surveillance and mitigation measures in place.

More specifically, an appropriate precautionary step for the protection of populations of beaked whale species in European waters is needed, and to this end, the following actions should be required of European Navies:

1. As a matter of urgency, and at least until we can begin to understand the mechanisms that lead to deaths in beaked whale populations, the most effective measures for monitoring and mitigation surrounding the use of mid-frequency sonar should be applied globally for the protection of populations of beaked whales and other vulnerable species. Available tools include promising passive acoustic monitoring techniques (André et al., 2009; Gordon and Gillespie, 2009; Johnson, 2009) to detect and therefore assist in protecting beaked whales in real time as well as spatio-temporal measures for long-term exercise planning (Agardy et al., 2007; Dolman, 2007).
2. It is currently unclear how the recent US court decisions from California and Hawaii are likely to change the future of guidance for the US Navy, and for other navies operating in European waters. However, the most significant environmental gains are achieved at the planning stage (MoD Sustainable Development and Environment Manual, 2005). It is clear that accountability and transparency are important, and the production of Environmental Impact Assessments (EIAs), as the US Navy is currently undertaking for its exercise ranges, is a step in the right direction. Production of EIAs and Strategic Environmental Assessments (SEAs) can help with making the right decisions about when and where to operate active sonar. European navies should be undertaking full and transparent EIAs for their exercise activities, including active sonar use.
3. EIAs should consider behavioural responses in addition to injury in acknowledgement of what we understand from previous beaked whale mortality events (Weilgart, 2008; Parsons et al., 2008). Behavioural responses at much lower sound levels have the potential to produce a range of detrimental effects (e.g., Lusseau, 2004; Wright et al., 2007), including those that may result in injury or death, and given the likelihood that population level impacts can arise from non-lethal exposures (Parsons et al., 2008).
4. A commitment from nations to work with navies to mitigate, monitor and report back sonar activities and possible impacts to Conventions to which they are a Party, should be observed.
5. In the tradition of 'polluter pays', navies should continue to fund well-focused, independent research, including basic surveys and modelling of beaked whale habitat for purposes of both mitigation and monitoring. Independence in funding research is important to avoid conflict of interest. Where investigated, conclusions of research favour the interests of the sponsor (Wade et al., 2010). The solution is to enable structural changes to the funding of marine mammal research, allowing the science to operate outside political agendas (NRC, 2000; Weilgart et al., 2005).

The transition from scientific research to policy implementation is a challenging one. The transition from regional policy development to implementation of effective mitigation measures at a national level is no less challenging, but it is urgent in the case of naval sonar and associated beaked whale mortalities. It is also required under European environmental legislation.

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