



News sheet - Apr 2004

Cetacean Survey Training Courses June - September 2004

Join a short course to learn all about British cetaceans, how to survey for them, and contribute to their conservation!

Organised jointly by The Sea Watch Foundation and The Mammal Society

Dates:

19th – 20th June

17th - 18th July

14th - 15th August

5th - 8th September (extended 4-day course)

cost of workshop: introductory weekend - £110*;

extended 4-day - £160*

** excluding accommodation and meals, 10% discount for members of The Mammal Society and Sea Watch Foundation.*

These exciting new courses will consist of illustrated lectures and video presentations as well as headland watches and boat surveys aboard the MV Sulaire.

There are two types of course: a weekend course for those with little previous knowledge or experience of cetaceans; and an extended 4-day course for those who already have some knowledge of cetacean watching.

For the extended course, there will be more “in-depth” lectures, and, weather permitting, extended time at sea, with additional training in field techniques like photo-identification.

Both courses will include lectures/videos on conservation issues facing UK cetaceans, species identification, and recommended survey methods for monitoring cetaceans. The course will be based at the Cardigan Bay Marine Wildlife Centre in New Quay, West Wales, and will provide an unparalleled opportunity to see marine mammals in the wild and to contribute to cetacean conservation in Britain.

The practical element of the course will combine both land and boat-based watches allowing participants to directly learn how to conduct systematic watches and fill in standardised recording forms.

Boat-based work will also teach participants the skills needed for:

- estimating group size and distinguishing calves, juveniles and adults
- assessing sea state and other key environmental details
- photographic techniques

There will also be the chance to practise species field identification and the recording of different behaviours.

The courses will be taught by experienced and enthusiastic staff from the Sea Watch Foundation.

All participants will receive a detailed manual on how to record and monitor cetaceans.

Funding support for the courses comes primarily from the Countryside Council for Wales.

Outline of the course

Indoor Session 1:

- introduction to cetaceans: biology, ecology and behaviour (beginners course only)
- cetaceans in UK: methods and applications for surveying and monitoring cetaceans
- species identification: video

Indoor Session 2:

- conservation problems currently faced by UK cetaceans
- methods for monitoring conservation threats (followed by video and discussion session)

Boat Trips

- how to use recording forms, conduct watches, identify species, record group size and behaviour, and record environmental parameters
- estimate range, measure bearing to sighting (extended course only)
- how to use a camera to photograph cetaceans, key ID features to be photographed
- photo-ID: individual features to photograph, how to develop and maintain ID catalogues (advanced course only)

Land-based Watches

- watches from a nearby headland will enable participants to practise their identification skills
- learn how to monitor boat activity and their possible effects on cetaceans

To book, please contact the Mammal Society at 2b Inworth Street, London SW11 3EP; Tel: 020 7350 2200 • Fax: 020 7350 2211 • www.mammal.org.uk • training@mammal.org.uk. The booking form can be found on the web site.

North-west Scotland: Report from Ian Birks – regional co-ordinator for North-west Scotland:

March / April:

This is very early season for the North West Highlands for visible cetacean activity. Usually the first minke sightings are recorded from around the end of March and occasional inshore forays by harbour porpoises apparently checking to see if the fish stocks have begun the spring increase.

In 2004, the weather has been so bad that, between strong wind and rain, there has been little luck with either. I saw my first sea bird activity over fish shoals on 26th March and the following day through misty drizzle and in a lull of wind to force two, I saw two harbour porpoises corraling and lunge feeding among and area that had been worked by seabirds a short time before. This was well out to the centre of upper Loch Gairloch.

The foul, weather continued and although we launched our yacht just before Easter, we were unable to use it due to the wind and rain. Not until 18th April was I again to see harbour porpoises, at 10am in a calm before the storm. Complete cloud cover and snow falling on the surrounding hills. Not spotting weather. By 30th April, we had gannets around and at 8.45pm they led my eye to one harbour porpoise a half mile out in Strath Bay. Again full overcast with the wind temporarily easterly 1-2.

West Scotland: Report from Tom Gaillard, Hebridean Whale & Dolphin Trust

SIGHTINGS

Harbour porpoise Sightings of the coastal harbour porpoise in March and April were mainly reported in the Sound of Mull, hotspot for the species. A total of 9 sightings, totaling 21 individuals were recorded. Three sightings of 2 and 3 individuals were reported on Saturday 24th April near the fish farm in Bloody Bay (near Tobermory). One individual was reported breaching, rather unusual behaviour for the species.

Regular observers have noticed that sightings rates are higher near the fish farm when salmon have been fed, although no studies have been undertaken to determine the influence of fish farm nutrients on harbour porpoises.

Bottlenose dolphin A group of 15-20 individuals, including at least 3 calves, is regularly seen around the isle of Mull. The group travel very close to the shore. They are usually first spotted in the Sound of Mull, travelling northward and sighted the next day on the West side of the island. The group was recorded on 10-11th April and 17th April. Two bottlenose dolphins were also seen off the West coast of Mull of Kintyre at the end of April.

Common dolphins A group of eight common dolphins spotted off the lighthouse of Tobermory on 28th April. Fairly unusual sighting as the species is mainly seen further offshore.

Minke whale The first sightings of minke whale were reported at the beginning of April. They were first seen by a local whale-watching operator off the Ardnamurchan Lighthouse. Later on that month, HWDT team onboard Silurian spotted several minke whales in the passage of Tiree. Minkes were seen travelling solitarily.

STRANDINGS

On the 12th March 2004, a 7ft long common dolphin had been washed up on Ardalanish Beach, Isle of Mull. From the initial post mortem the animal was found to be a young adult male. The condition of the animal was poor and had not fed for some time. This may have compromised the health of the animal and due to the wild weather conditions in the days before the stranding led the animal to sadly, live strand. More analysis is currently being carried out to see if the animal was suffering from disease.

Two common dolphins were seen stranded on the West Coast of the Isle of Harris on Thursday 22nd April. Gale force winds and sea state conditions may have been the causes of the stranding. Divers in Harris managed to rehabilitate the two dolphins.

North-east Scotland: Report from Iain Macdonald – regional co-ordinator for North-east Scotland

March and April were difficult times to look for cetaceans, although the Moray Firth bottlenose dolphins were seen a few times, including a sighting of a very small calf swimming with adults, but surfacing much more frequently than the larger dolphins. The first minke whales were reported in April during a beautiful spell of calm weather on the north coast of Sutherland.

The following are cetacean reports from Sutherland between 1st March and 30th April:

Sun 7th March About eight bottlenose dolphins, including minimum of one calf seen at Balintore

Fri 19th March Eight unidentified dolphins seen at Clashnessie Bay

Mon 12th April About six harbour porpoises, one tail slapping, at Sputie Burn, between Golspie and Brora. Seen by Kenny Graham

Mon 12th April Six dolphins, species not confirmed but they were of large size, at Latheronwheel. Seen by David Mackay

Sat 24th April One bottlenose dolphin seen at Golspie

Sat 24th April Two minke whales off Strathy Point - sighting by Mr Mackay, via David Barclay

Sun 25th April Minimum of one minke whale + c. 4 harbour porpoise off Strathy Point. Seen by David Barclay

Sun 25th April One harbour porpoise seen at Golspie

Tues 27th April One harbour porpoise seen at Brora

South Grampian: Report from Kevin Hepworth – regional co-ordinator for South Grampian

The last two months have been very busy and characterised by relatively flat seas with sudden bursts of huge seas. This has meant some that careful planning has enabled three boat surveys to take place on the 27th March, 10th and 24th April. All have been very productive although the one on 10th March attended by Dr Peter Evans and Pia Anderwald must rate as exceptional so a big thank you to Peter for organising the entertainment. The downside of the

weather has meant that after a particularly fierce period of northerlies at the end of March, three harbour porpoise were washed up on the beach at Aberdeen. At the same time three were also washed up near Montrose. Early evidence suggests this may have been due to bottlenose attacks, but I suspect the animals were weakened by attacks and that the weather tipped the balance. An eyewitness report of about a dozen bottlenose dolphins attacking and tossing a harbour porpoise around at Aberdeen Harbour on the 14th April and a similar event in Stonehaven Bay on the 9th April suggest there is severe conflict when these two species meet. However, in the Aberdeen case, the harbour porpoise did seem to make good its escape and the outcome in the Stonehaven case was unknown.

The three boat surveys have been blessed with abundant bottlenose encounters, often lasting for a minimum of forty minutes and the first two were so calm that several harbour porpoise encounters also ensued. On all occasions, the dolphins were very playful around the boat, but slow moving and each time were left behind as the boat continued on its transect.

Land-based watching has again proved extremely productive with almost 55 sightings being reported from 34 different days, of which only bottlenose dolphins (40 records) and harbour porpoise (15 records) were seen. The majority of the bottlenose dolphin sightings are from the Aberdeen area with nearly half from here although good reports of mobile animals from Montrose, Arbroath, Stonehaven, Cove and Collieston have also come in. Group size tends to range from 2-4 up to a stunning 37 on the 15th March (and possibly 35+ on the 10th April boat trip). Porpoise sightings have been consistently of 1 or 2 animals with a group of 3 on the 24th April in Nigg Bay. Nearly all the porpoise sightings have been from the Aberdeen Bay to Cove area, although this is probably a reflection of where most effort has been rather than distribution.

The only other item of note is that one group of about a dozen bottlenose dolphins contains 'Cutter' - a dolphin with a deep ragged gash about half way up the front of its dorsal, which represents the fourth consecutive year that this individual has been seen off Aberdeen in March/April. The group also contains three other recognisable animals, which have also been seen previously.

We are now in the final stages of preparing our summer programme of boat surveys and hope to make additional surveys during the week if there is sufficient interest. This year we also hope to spend more time at local galas and environmental events raising local awareness.

North-east England: Report from Andy Tait – regional co-ordinator for Northumberland, Tyne & Wear

March sightings started on 5th March with a single porpoise 250 metres off Lizard Point in the middle of a sunny morning followed by another in the evening skirting Cresswell only 15 metres off the reef in very poor visibility.

The next sighting was on the 8th with two porpoises both feeding, one 400 metres out and the other 100 metres further out at Lizard Point. On the 21st, there was a single porpoise swimming slowly north off Whitburn Point.

April sightings started further north with six porpoises seen between Seahouses and Brownsman Island, swimming east from a tour operators boat on the 11th, then on the 26th in a quiet sea, two porpoises were seen 300 metres off Lizard Point moving north at lunchtime. The rest of the month saw very rough seas.

Other sightings:

Tues 9th Mar – 11:00 – two harbour porpoises seen 1 mile NE of Newbiggin Point by Ali Simpson

Sun 21st Mar – 16:00 – one harbour porpoise seen swimming north 1km off Whitburn Point by Peter Collins

Sun 4th Apr – 12:45 – two harbour porpoises seen by Nicki Hankinson

Sun 25th Apr – 09:00 – one minke whale seen 1km off Whitburn swimming north by Peter Collins

South-east England – Reports from regional co-ordinators Jon Bramley and Stephen Savage, and to Sea Watch central office

Wed 29th Apr – 10:00 – eight bottlenose dolphins observed near the Harbour Arm, Hastings by Andy Phillips

No other live sightings reports received.

Dorset: Report from Jo Wharam (Durlston Marine Project) – Regional Co-ordinator for Dorset

March was an extremely quiet month with the first dolphin sighting on 25th. 5–7 bottlenose dolphins (including 1 calf) were seen 300m off Durlston Head. Early April saw a couple of sightings of a pod of 7 animals off Portland. They were leaping and breaching and appeared to be feeding as there were large numbers of seabirds overhead. Things started hotting up at Durlston towards the end of April with groups of between 2 and 12 animals reported moving between Kimmeridge and Poole harbour entrance for the last few days of the month. A new calf and ‘No-nose’ were identified within the group which seemed much more active than previous sightings and put on some impressive aerial displays. On the day that the pod was ‘absent’ from the Purbeck area, reports of 6–9 animals were received from Portland Bill. The last sighting in April was of a group of 8–12 bottlenose dolphins sighted from a fishing boat near the entrance to the Swash channel, Poole harbour entrance. ‘No-nose’ and the new calf were spotted and the pod was last seen leaping and bow riding its way towards Bournemouth....

South-West England: Report from Ray Dennis, Sea Quest and David Ball – Silver Dolphin Centre, Porthleven

Mon 1st March – one fin whale and a school of c. 60 common dolphins seen feeding with seabirds off Roseland Peninsula by Brendan Godley

Thurs 4th March – four harbour porpoises off Porthgwarra seen by Jean Lawman

Fri 5th March – one harbour porpoise in St Austell Bay seen by Roger Lane

Thurs 11th March – one at entrance to River Tamar seen by P.C. Lawton

Thurs 11th March – one in Plymouth Sound seen by P.C. Lawton

Fri 12th March – 09:15 – c. 12 BND seen heading west at Porthleven by the Silver Dolphin Centre

Fri 12th March – five bottlenose dolphins seen at Marazion by Chris Barnard

Fri 12th March – two harbour porpoises seen at Porthgwarra by Jean Lawman

Sat 13th March – four harbour porpoises seen at Minack theatre by Jean Lawman

Sat 13th March – ten BND seen at Marazion via Vince Smith

Wed 17th March – 17:00 - two common dolphins seen heading east at St Ives by Tim Bain

Wed 17th March – 12 BND seen at Porthleven by David Ball

Wed 17th March – six harbour porpoises seen at Runnelstone by Jean Lawman

Thurs 18th March – six common dolphins seen at Newlyn via Sennen Cove web site

Fri 19th March – 10:00 – eight BND seen heading NW at St Ives by St Ives Coastwatch

Thurs 25th March – two harbour porpoises seen at Porthgwarra by Jean Lawman

Fri 26th March – six BND seen at Charlestown Lookout and reported via Stella Turk

Sat 27th March – one minke whale seen in Mounts Bay by Laurie Williams

Sat 27th March – nine BND seen in Plymouth Sound via Douglas Herdson

Sun 28th March – 14 BND seen feeding in Falmouth Harbour by Vicki Bushby

Sun 28th March – ten harbour porpoises seen at Porthcurno by Jean Lawman

Sun 28th March – one minke whale and nine harbour porpoises seen at Botallack Head by Paul Semmens

Sun 28th March – ten Risso’s dolphins seen at Gwennap Head by Jean Lawman

Sun 28th March – one harbour porpoise seen at the Brisons by Phil Clarke

Mon 29th March – five harbour porpoises seen at Botallack Head by Paul Semmens

Wed 31st March – 11:00 – ten BND seen in Mounts Bay by Mr Roynan

Sat 3rd April – one harbour porpoise seen at Porthgwarra by Jean Lawman

Sun 4th April – one harbour porpoise seen at Porthgwarra by Jean Lawman

Thurs 8th April – one orca seen at Perranuthnoe by Christine Newman

Fri 9th April – three harbour porpoises seen at Runnelstone by Jean Lawman

Fri 9th April – two Risso’s dolphins seen off Bude Harbour mouth by Widemouth Bay Coastal Watch

Sun 11th April – ten Risso’s dolphins seen at Newlyn by Linton Proctor

Sun 11th April – one harbour porpoise seen at Botallack Head by Paul Semmens

Mon 12th April - 12 bottlenose dolphins seen at Lyme Regis by Martin Collins

Wed 14th April – 14:00 - one adult and one calf bottlenose dolphin seen at St Ives

Sat 17th April – one minke whale seen at Marazion by Linton Proctor

Fri 23rd April – 18 common dolphins seen off Fowey by Richard Strode

Fri 23rd April – 12:45 - two orcas seen north of the Brisons by Anon

Fri 23rd April – six Risso’s dolphins seen in Sennen Bay via Sennen Cove web site

Sat 24th April – three harbour porpoises seen off Botallack Head by Paul Semmens

Wales: Report from Fernando Ugarte, Cardigan Bay Marine Wildlife Centre

Most of our information about cetacean activity in West Wales comes from land and boat based surveys carried out by the Cardigan Bay Marine Wildlife Centre in the Cardigan Bay candidate Special Area for Conservation (cSAC).

Several groups of harbour porpoises were sighted from boat-based surveys during March and April. This was in contrast to surveys made in February, when only a few porpoises were seen.

Bottlenose dolphins were also a rare sight during February and March, but became increasingly common during April. During April, bottlenose dolphin groups made brief incursions into New Quay Bay remaining in the bay for only a few minutes at a time.

News from the Cardigan Bay Marine Wildlife Centre

The aim of the Cardigan Bay Marine Wildlife Centre (CBMWC), in New Quay, Wales, is to encourage awareness about the marine wildlife in Cardigan Bay and carry out research on the marine mammals in the area to ensure the long-term wellbeing of these animals and the local marine environment. It is funded mainly by the Countryside Council for Wales (CCW) and works in close cooperation with the Sea Watch Foundation, which helps to access funding and supervises the research work. The CBMWC also works very closely with the West Wales Chartering Company, owned by the centre’s manager and founder, Steve Hartley.

In May 2003, Helen Bates was hired as education officer/assistant manager, and I became the science officer of the CBMWC. Our past year of work here has been an active one, and we feel fortunate to live in a place where, from our houses and office, we can see dolphins during the summer and porpoises during the winter.

Among many other things, Helen has developed educational materials and activities and carried out marine awareness sessions in classrooms, schoolyards, beaches and boats.

Much of the data for our studies has been collected from Steve's boat, a 10m motor vessel called "Sulaire" (derived from gannet in Gaelic), which goes out almost every day during the summer season, giving passengers combined research and natural history tours. On board the Sulaire, research assistants collect data about the area searched and the animals seen while Steve and I take identification photographs of the bottlenose dolphins. We use distance sampling to estimate the density of marine mammals and have covered thousands of kilometres in the Cardigan Bay candidate Special Area of Conservation (cSAC).

The data collected from May 2003 to April 2004 indicates that bottlenose dolphins are abundant in the cSAC from April to October, while harbour porpoises and grey seals are abundant from March to December. Our abundance estimates have very large variances, but roughly 140 dolphins, 407 porpoises, and 185 seals were present in the cSAC at any given time during summer and early autumn (the cSAC has an area of approximately 1000 km²). Because porpoises and seals are difficult to see, the numbers for these species are likely to be underestimations. We are still analysing the photo identification data from 2003 and, at the time of writing this, more than 114 dolphins have been identified. Some of these animals were photographed in the area by researchers working in 1990-1993 (Arnold *et al.*, 1997, report to CCW) and in 2001 (Gregory and Hartley 2002, report to CCW; Baines, unpublished data), showing that at least some dolphins are long-term seasonal residents to Cardigan Bay.

New work The scope of our work has expanded with some recent additions to our team. The first of those was my wife, Malene Simon, who finished an MSc on bioacoustics and became an associated researcher at the CBMWC. Malene is training volunteers to compile a catalogue of underwater whistles produced by the bottlenose dolphins. She has also made high frequency recordings of the dolphin's echolocation clicks using a hydrophone array and is running a pilot project with Mike Camplin, from CCW using PODs to monitor the bottlenose dolphins and harbour porpoises in the cSAC. PODs are instruments that can be left at sea for long periods of time to log the occurrence of echolocation clicks produced by dolphins or porpoises. Malene has worked closely with Steve Hartley and the local fishing community to deploy PODs at three headlands commonly used by bottlenose dolphins.

During summer 2004, the CBMWC has received a number of MSc students. One of them, Holly Foats, is writing her masters thesis on eco-tourism for the University of Plymouth. Holly is conducting a study into the demographics and satisfaction levels of tourists on marine wildlife boat trips and comparing this to the demographics of general tourists to New Quay. Jenny Lamb and Rob Lott are carrying out masters in marine mammals science at the University of Bangor. Rob is analysing our photo identification data for his thesis on the social structure of the bottlenose dolphins in Cardigan Bay. Jenny is looking at the use of the New Quay Bay by bottlenose dolphins and the effect of boat traffic on dolphin behaviour. She is using land-based observations to record the boat traffic and boat-dolphin interactions during daytime and a POD to investigate round the clock presence of dolphins in the bay.

Another very valuable addition to our team is Alasdair Davies, a multimedia designer who is producing interactive computer games and a website. Alasdair's work is supported with a grant from Environment Wales. The website is looking really good and will hopefully be launched by December 2004.

Volunteers An important part of our work has been to recruit a small army of volunteers and school work-experience students. They clean the building, man the visitors centre, arrange boat trip bookings for the West Wales Chartering Company, change smelly water from Helen's bleaching dolphin bones, help Helen, Malene the MSc students and myself, collect data onboard Sulaire and from the New Quay harbour wall, update sighting records on the Sea Watch and New-Quay websites and in our visitors centre and endlessly work with our multiple databases (land based study, boat surveys, identification pictures, sounds and literature). Much of their time is spent collecting land-based observations that contribute to the long-term monitoring of dolphins and boat traffic led by Liz Allan, from the Ceredigion County Council (since 1993, local volunteers have recorded the activities of dolphins and boats from the headlands of Ceredigion and, from summer 2004, we have been adding daily data from New Quay harbour to this study). As if all these tasks were not enough, the volunteers have, by their own initiative, contacted the University of Swansea and now collect data on jellyfish from the Sulaire and from beach walks done at low tide.

There are not enough words to express the importance of the work carried out by our volunteers to keep our centre, not only running, but vibrating with enthusiasm, inspiration and fun.

Fernando Ugarte

Active Sonar and Cetaceans – “Introduction” & “Conclusions” from Proceedings of International Workshop on the Effects of Active Sonar upon Cetaceans, held at the 18th Annual Conference of the European Cetacean Society, Las Palmas, Gran Canaria, 8th March 2003. Editors P.G.H. Evans and L.A. Miller. European Cetacean Society, Kiel, Germany. 84pp.

Active sonar, operating with sound source levels of up to 245 dB re 1 μ Pa @ 1 m at frequencies mainly between 1 and 150 kHz, is frequently used for fish-finding, oceanography, charting and in military activities (for example locating submarines). Since the mid-1990s, concern has been expressed over the potential impact these sounds may have upon cetaceans (particularly deep diving toothed whales of the Sub Order Odontoceti such as the beaked whales, family Ziphiidae), and post mortem studies of mass stranded animals in the Bahamas, Madeira and, most recently, in the Canaries have revealed multifocal haemorrhaging and ear damage.

The purpose of this workshop was to bring together whale biologists, pathologists, acousticians, and representatives of governments, oceanographic institutes and national navies with interests in this topic, to objectively review the existing evidence and, where detrimental effects are implicated, to identify possible mitigation measures. Attention focused upon the species involved and any characteristics that may make them especially vulnerable, as well as on the nature of the sound source (sound levels, peak frequencies, usage, and sound transmission in relation to oceanographic conditions).

Following an introduction to different types of active sonar, their characteristics and physical attributes of transmission through the water, a review was made of previous mass stranding incidents that had been linked with the use of active sonar. The major ones were in Greece (May 1996), the Bahamas (March 2000), Madeira (May 2000), and the Canaries (September 2002).

Pathological and physiological aspects of the potential impacts of active sonar were then considered with reference to the last three mass strandings, where opportunities existed for detailed post-mortem examination. This was followed by a session addressing research needs with consideration of controlled exposure experiments, measurements of hearing using acoustic brainstem responses, and the use of passive acoustic tools. Finally, mitigation measures currently adopted were considered both in the context of US legislation and of those used by NATO. Proposals for future measures that could be potentially effective were also made, including a range of precautionary measures that could be adopted.

The workshop took place on Saturday, 8 March 2003 at the Convention Centre in Las Palmas, Gran Canaria, immediately before the start of the 17th Annual Conference of the European Cetacean Society. It was attended by around 110 persons from 21 countries (see list of participants at the end of this volume), representing a wide variety of disciplines and interests. We specially welcomed representatives of NATO and several navies at the meeting.

For the Proceedings of the Workshop, we invited two extra contributions to those presented at the meeting – one from Joseph Johnson, Chief of Naval Operations for the Undersea Surveillance Branch in Washington, USA (who at the last minute had to cancel attending the meeting), and the other from Walter Zimmer of the NATO SACLANT Undersea Research Centre in La Spezia, Italy. We are very grateful to all contributors for their efforts, and to the University of Las Palmas and the government of the Canary Islands for kindly hosting the meeting.

Attention was first drawn to the possible link between the mass stranding of certain cetacean species and military activities in the 1990s, with beaked whale strandings in the Canary Islands (Simmonds and Lopez-Jurado, 1991), and in Greece (Frantzis, 1998). Unfortunately, in those cases, there were no opportunities for post-mortem examinations, although as presented here by Alexandros Frantzis for the Greek stranding, the coincidental nature of the incident strongly suggested a relationship. Since then, opportunities for pathological studies have presented themselves at subsequent strandings in the Bahamas (March 2000), Madeira (May 2000), and the Canaries (September 2002). The nature of those events are described here by Luis Freitas, Teri Rowles, and Vidal Martin respectively, with the accompanying pathologies reviewed by Darlene Ketten (Bahamas & Madeira) and Antonio Fernández (Canaries).

The results of post mortem examinations of mass stranded cetaceans, immediately following naval activities using mid-frequency long-range tactical sonar, provide compelling evidence that acoustic trauma from those activities, or at least injuries stimulated by behavioural responses to them, has in some way led to their deaths. Deep-diving medium-sized odontocetes particularly of the family Ziphiidae appear to be the most susceptible, with Cuvier's beaked whale *Ziphius cavirostris* making up more than three-quarters (36/47 animals specifically identified) of the total number of animals recorded stranding in four major incidents (May 1996 – September 2002). Other species for which the military manoeuvres were directly implicated in their deaths have included Blainville's beaked whale *Mesoplodon densirostris* and Gervais' beaked whale *Mesoplodon europaeus*, whilst two minke whales *Balaenoptera acutorostrata* live-stranded in the Bahamas but were successfully re-floated. Previous cetacean mass strandings in

the Canaries that were coincident with naval activities included also northern bottlenose whale *Hyperoodon ampullatus* and pygmy sperm whale *Kogia breviceps*. The unusual occurrence of the live stranding of two minke whales raises the possibility that under certain circumstances baleen whales may also be affected.

There was general agreement from all sides on the wish and need for more co-operation between biologists and navies. This can be expressed in two major ways: 1) data transfer between the two parties; and 2) the inclusion of biologists in planning those naval operations where a potential risk exists. Data transfer should be: a) from the navy to biologists – detailed information on protocols adopted at a particular manoeuvre involving active sonar (and the specific tactics being employed, since these vary depending on whether the vessels are involved in detection, tracking, or some other mode), locations, dates, depth and local bathymetry, directionality or direction of the source, and source levels, ping rates, numbers of ships pinging simultaneously, and the total duration over which that ping rate was used, the spectrum of transmissions used (for example are lower frequencies also used that might cause vestibular problems for whales?) as well other sound characteristics; and b) from biologists to the navy – autopsy results, strandings data, data on distribution and abundance, results of tracking to better understand behaviour, and proposals for “experiments” or procedures which may elucidate some of the factors involved. The involvement of biologists as observers in specific naval operations can help avoid unintentional exposure and may help provide information on the behaviour of animals in the area, with acoustic and visual monitoring before, during, and after exposure. The possibility for controlled exposure experiments such as those described by Peter Tyack and Mark Johnson should also be explored further, as well as “in situ” studies of whale hearing, including auditory brainstem response studies as described by Paul Nachtigall and Alexander Supin.

The pathological studies conducted upon beaked whales at three of the four mass strandings all showed widespread haemorrhaging, affecting several organs, but with the micro circulatory systems particularly affected. Head and ear traumas were commonly found, whilst haemorrhaging in the eyes was observed in some specimens from Madeira and the Canaries. It is not known whether such haemorrhaging occurs as a direct response to sonar exposure or subsequently during the beaching process. The presence of fat (and possible gas) emboli associated with haemorrhages and other lesions in all of the beaked whales examined in the Canaries by Antonio Fernandez and presented for the first time in this workshop opens up the possibility that a condition similar to decompression sickness (DCS) may have occurred. Although the lesions in the Canaries-stranded beaked whales are not conclusive proof of a DCS-like condition, they raise the possibility that acoustic exposure can induce physiological damage by a behavioural response (e.g. accelerated ascent rates) to the loud sounds rather than direct acoustic trauma. Another theoretical possibility is that *in vivo* bubble formation in these animals may have been driven by a physical effect of loud sound exposure on bubble precursors by a process such as rectified diffusion (Crum and Mao, 1996; Houser *et al.*, 2001). Although cetaceans have long been thought to be highly resistant or immune to *in vivo* bubble formation or DCS, gas bubbles and associated acute and chronic lesions have recently been reported in a small number of stranded animals (three Risso's dolphins, three common dolphins, one Blainville's beaked whale, and one harbour porpoise) examined in the UK over the period October 1992 - January 2003 (Jepson *et al.* 2003).

Clearly there is a need to resolve whether in particular situations, deep-diving whales do actually experience a decompression-like sickness either by too rapid vertical movements in an attempt to escape noise within a sound channel, or by other possible mechanisms, or whether there is a direct pathway by which fat embolisms occur. Alternatively, hair cell damage from previous exposure to loud sounds may further cause disorientation and panic.

Factors influencing the level of sound received by a whale need further elucidation. Presently, emphasis is placed on received levels measured in decibels re 1 micropascal and source levels measured at 1 metre range. However, as Bertel Møhl's contribution demonstrates, overall energy (expressed as dB re 1 $\mu\text{Pa}^2 \text{ s}$) may be a better measure or guide for possible acoustic damage, and should be taken alongside peak pressure measurements. Contributions from Ed Harland and Walter Zimmer highlight a number of potential variables. It is likely that animals at different ranges from the source will be exposed in different ways. Sound may be trapped within channels in the water column and there is a need to better understand the physical characteristics of the local marine environment in these situations. The omni-directional nature of the active sonar source and inter-pulse interval also influence received levels. Features such as its rise time and frequency composition must also be considered. If whales are endangered by active sonar largely through a behavioural response at depths, then a simple mitigation measure for reducing received levels is to reduce the duty cycle of the sonar. In this context, the behaviour of animals during exposure clearly needs further investigation. A number of the sonar exercises have taken place at night and animals have been reported coming ashore early in the morning. Questions that need to be addressed include whether whales are mainly foraging at particular depths during those activities, and if a sound channel is present, do they behave differently when exposed to the sound if they are below it, within it or above it. This is where the controlled exposure experiments described by Peter Tyack and Mark Johnson are likely to be especially valuable.

An important question that has yet to be answered fully is why should beaked whales apparently be specially vulnerable to active sonar. Is their hearing particularly sensitive to sounds within the frequency range 2-8 kHz? The

anatomical studies by Darlene Ketten and co-workers suggest that beaked whales may have a hyper-responsive vestibular system, particularly for lower frequency signals. At present, no audiogram exists for any beaked whale species, and it would be very valuable to undertake an auditory brainstem response study upon a species like Cuvier's beaked whale as described by Paul Nachtigall. Alongside such approaches should be further examination of the head and ear anatomy of beaked whales in relation to other taxa. Work in this direction using CT scans and computer modelling has already been started by Ted Cranford and colleagues (see Cranford *et al.*, 2003). Likewise, if sonar signals are eliciting a behavioural response that has repercussions on the formation of fat emboli, then that might explain why deep-diving species such as beaked whales appear to be particularly affected.

It would be unrealistic to expect the world's navies to suspend all military activities involving all use of active sonar. There is an urgent need for research to identify risk factors for beaked whales. This may extend beyond military sonars - the stranding of beaked whales coincident with operation of airguns used for seismic operations (Malakoff, 2002) highlights the need to determine what acoustic exposures are dangerous for beaked whales. Ideally in the long run, this can be used to modify sonars to ensure that sounds produced by humans in the sea pose little or no risk to beaked whales. In the interim, the best approach will be to develop effective mitigation measures. The first obvious one is to try to identify areas for sonar testing far from beaked whales. At the same time, it is important to identify beaked whale habitats and to ensure that sound producers are informed to avoid projecting intense sounds in those areas. Unfortunately, beaked whale distribution and abundance is poorly known, and although we can identify some apparent "hot-spots" (as indicated in Colin Macleod's contribution), there are many parts of the world where information currently is almost entirely lacking. Furthermore, it is likely that the needs of the military will coincide with those of beaked whales - deep submarine canyons with steep walls are favoured by the military for sonar exercises because these are where submarines are better able to conceal themselves, but they also may form suitable habitat for deep-diving beaked whales.

In their reviews of mitigation measures, both Roger Gentry and Mike Carron highlight the need for preliminary surveys of an area before it is used for sonar exercises. Beaked whales spend a large part of their lives away from the surface at depth and so acoustic methods for detection become all the more important. However, so far, beaked whales have proved difficult to routinely detect acoustically. In this context, the wideband passive monitoring approaches being developed by Gianni Pavan and co-workers show promise. Nevertheless, there will always be limitations for those situations when beaked whales are acoustically silent. And here we come to a potential solution that is not so far removed from the problem itself - the use of high-frequency active sonar for whale finding prior to the use of medium-frequency active sonar for submarine finding. Both Joseph Johnson and Roger Gentry describe prototypes that are currently being developed in the United States. The energy source is relatively low power thus minimising potential harm to the whales, whilst maintaining a detection range (1-2 km) that potentially is adequate for effective monitoring. Field-testing under a variety of conditions is now required. Whale-finding sonar needs to be deployed from a slow moving vessel and so will likely require a separate ship for ongoing surveillance, rather than those ones used directly in the military activities.

Research is clearly needed on several different fronts, and for this we come back to the critical need for active co-operation between scientists from a range of disciplines and navies, with appropriate resources made available by governments if we are to achieve our objective of conserving biodiversity, and minimising any harm for living creatures of the marine environment.

REFERENCES

Cranford, T.W., Hock, M., McKenna, M., Wiggins, S., Shadwick, R., Sauter, A., Armsworthy, G., Krysl, P. and Hildebrand, J. 2003. Building an acoustic model of a Cuvier's beaked whale (*Ziphius cavirostris*). P. 23. In: *Conference Guide and Abstracts*, 17th Conference of the European Cetacean Society, Las Palmas de Gran Canaria, 9-13 March 2003. 285pp.

Crum, L. and Mao, Y. 1996. Acoustically enhanced bubble growth at low frequencies and its implications for human diver and marine mammal safety. *Journal of the Acoustical Society of America*, 99: 2898-2907.

Frantzis, A. 1998. Does acoustic testing strand whales? *Nature* (Lond.), 329: 29.

Houser, D.S., Howard, R and Ridgway, S. 2001. Can diving-induced tissue nitrogen supersaturation increase the chance of acoustically driven bubble growth in marine mammals? *Journal of Theoretical Biology*, 213: 183-195.

Jepson, P.D., Arbelo, M., Deaville, R., Patterson, I.A.P., Castro, P., Baker, J.R., Degollada, E., Ross, H.M., Herráez, Pocknell, A.M., Rodríguez, F., Howie, F.E., Espinosa, A., Reid, R.J., Jabert, J.R., Martin, V., Cunningham, A.A., and Fernández, A. 2003. Gas-bubble lesions in stranded cetaceans. *Nature* (Lond.), 425: 575-576.

Malakoff, D. 2002. Suit ties whale deaths to research cruise. *Science*, 298: 722-723.

Simmonds, M.P. and Lopez-Jurado, L.F. 1991. Whales and the Military. *Nature* (Lond.), 51: 448.

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Sea Watch Foundation's project "Encouraging Public Participation in Cetacean Monitoring" is supported by DEFRA's Environmental Action Fund. Furthermore, Sea Watch is supported by the Heritage Lottery Fund, BG International, Dong Efterforskning og Produktion and Atlantic Petroleum, and Countryside Council for Wales.

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