

REPORT OF THE INDIAN OCEAN CETACEAN SYMPOSIUM 2009



Paradise Island Resort & Spa, Maldives
18 - 20 July 2009



**Organized by the
Marine Research Centre, Maldives
www.mrc.gov.mv**

Executive Summary

This report presents details of the Indian Ocean Cetacean Symposium (IOCS), held in Maldives in July 2009. This marked the 30th anniversary of the International Whaling Commission's (IWC) Indian Ocean Sanctuary. The Symposium was a scientific meeting, convened by the Maldivian Marine Research Centre, and attracting some 60 scientists from 22 countries. The meeting was opened by the Vice President of the Republic of Maldives. Keynote addresses were given by Dr. Sidney Holt and Dr. Roger Payne. A total of 43 presentations were made, demonstrating the wide range of cetacean research being carried out within the Indian Ocean. The Indian Ocean Sanctuary was acknowledged as an important management tool for the protection of large whales (which suffered very high, and illegal, catches mainly by Soviet whalers in the 1960s). However, the Indian Ocean Sanctuary provides little protection for small cetaceans, which suffer from a range of threats, but particularly from fisheries by-catch. The IOCS formulated and adopted the Lankanfinolhu (Maldives) Declaration, which among other things calls upon the IWC to ensure the continuation of the Indian Ocean Sanctuary in perpetuity; and on coastal countries to monitor and reduce catches of cetaceans in their fisheries; stresses the importance of improved education; reminds all Indian Ocean parties to the Convention on Biological Diversity of their commitments to protect at least 10% of all ecosystems, including marine and coastal waters; supports the wider adoption of responsible whale and dolphin watching guidelines and regulations; and encourages Indian Ocean states, in collaboration with the IWC and other relevant organizations, to develop a collectively agreed action plan to improve conservation outcomes for cetaceans in the Indian Ocean Sanctuary. Other physical outputs from the IOCS include a poster of Indian Ocean cetaceans (distributed to all participants and to every school in the Maldives), and a peer-reviewed, dedicated issue of the IWC's Journal of Cetacean Research and Management containing 15 scientific papers on Indian Ocean cetaceans.

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Indian Ocean Blue Whale, *Balaenoptera musculus indica*

INDIAN OCEAN CETACEAN SYMPOSIUM 2009

IOCS Background and Aims

In 1979, the International Whaling Commission (IWC) declared the Indian Ocean (north of 55°S) as a sanctuary from commercial whaling. 2009 marked the thirtieth anniversary of the Indian Ocean Sanctuary, and one aim of this scientific Indian Ocean Cetacean Symposium (IOCS) was to mark that anniversary.

The designation of the Indian Ocean Sanctuary prompted a flurry of benign cetacean research, culminating in a landmark scientific meeting held in Seychelles in February 1987 (Leatherwood and Donovan, 1991, UNEP Marine Mammal Technical Report 3). But over the following 20 years, there was no regional gathering, and cetacean research in the Indian Ocean might seem to have languished. A second aim of the IOCS was to demonstrate that this is not the case, and to showcase the breadth and quality of cetacean research being carried out within the Indian Ocean Sanctuary.

A third aim of the IOCS was longer-term: to promote scientific collaborations and further research (particularly involving coastal country scientists) and conservation of cetaceans within the Indian Ocean.

Indian Ocean Cetacean Symposium

The Indian Ocean Cetacean Symposium was held at Paradise Island Resort, Maldives, 18-20 July 2009. The opening session of the Symposium was attended by the Vice President of the Republic of Maldives Dr. Mohamed Waheed; the Minister of Fisheries and Agriculture Dr. Ibrahim Didi; the Minister of Tourism, Arts and Culture Dr. Ahmed Ali Sawad; the Minister of Housing, Transport and Environment Mohamed Aslam; other senior government figures, other invitees and local media. Opening addresses are presented in Annex 2.

The Symposium was attended by 60 scientists and other delegates from over 20 countries. They gave 43 presentations highlighting cetacean research carried out in 18 Indian Ocean coastal countries and on the high seas. These presentations covered a wide variety of topics, under three general headings: regional reports, species reports and conservation and management. Abstracts of most presentations are given in Annex 3.

The final session of the IOCS was given over to discussion of research opportunities and priorities, and to the range of threats being faced by cetaceans within the Indian Ocean Sanctuary. It was recognized that the Sanctuary did indeed provide protection from commercial exploitation for large whales, which had been very heavily exploited (particularly, and illegally, by Soviet whaling fleets in the northern Indian Ocean in the 1960s). The Arabian Sea population of humpback whale is still very small and in continued need of monitoring and conservation action.

In contrast, the northern Indian Ocean population of blue whale appears to be recovering, with good numbers seen off Sri Lanka and the Maldives in recent years, although no population assessment has yet been carried out. In the eastern Indian Ocean, satellite tagging of pygmy blue whales has shown that they migrate from the southern coast of Western Australia right up to Indonesia, swimming through the deep inter-island channels and into the Banda Sea. These whales passed through Indonesia's recently declared Savu Sea National Marine Park and Alor District Marine Protected Area, into the Coral Triangle center of marine biodiversity. Such studies demonstrate not only the highly migratory nature of some cetaceans

(and the consequent need for international collaboration in research and conservations) but also the potential importance of MPAs.

The great whales not only have some protection within the Indian Ocean Sanctuary, but also clearly count among the charismatic megafauna and consequently attract much research interest. In contrast, small cetaceans receive little or no protection from the Indian Ocean Sanctuary. During the IOCS, fisheries by-catch was highlighted as a common problem in many countries. Coastal dolphins are particularly vulnerable and are frequently taken in gillnets, which are widely used in many coastal countries (as mentioned in presentations from South Africa, Mozambique, Madagascar, Tanzania, Pakistan, India, Sri Lanka, Bangladesh, Thailand and Myanmar). Only in Maldives (where most forms of net fishing are banned in order to protect the traditional pole-and-line tuna fishery) is by-catch not a problem.

Directed fisheries for dolphins also occur right around the Indian Ocean basin. Examples were provided from Mozambique, Pakistan and Sri Lanka. IOCS participants emphasized the need for all fishing nations to monitor cetacean catches and work to reduce them to the minimum level possible. Working directly with fishermen and coastal communities is essential to this effort. Other threats identified included ship strikes, military sonar, oil and gas exploration, as well as pollution and (for coastal species) habitat degradation. In all of these cases, development of appropriate mitigation measures was required.

The potential economic value of whale and dolphin watching, which is bringing employment and recreation to growing numbers of people around the Indian Ocean was also recognised. But at the same time, the need for appropriate training and the development, implementation and enforcement of whale watching guidelines or regulations was also acknowledged.

IOCS participants encouraged the IWC to sustain the Indian Ocean Sanctuary in perpetuity, and recognized that the Scientific Committee of the IWC is an invaluable international forum for regular consideration of the results of research on all Indian Ocean cetaceans and their implications for conservation. The participants noted the need to improve the management and conservation of all Indian Ocean cetaceans through collaboration with and between Indian Ocean governments and other international bodies (including but not limited to the Convention on the Conservation of Migratory Species of Wild Animals CMS, the Convention on Biological Diversity CBD, the Indian Ocean Tuna Commission IOTC, Indian Ocean Marine Affairs Cooperation IOMAC, the Bay of Bengal Programme Inter-Governmental Organisation BOBP-IGO and the Bay of Bengal Large Marine Ecosystem Project BOBLME).

All of these issues were highlighted in the Lankanfinolhu Declaration (see box below) which was formulated and adopted by all IOCS participants. This Declaration is also available online at: www.mrc.gov.mv

IOCS Outcomes

In addition to the Lankanfinolhu Declaration, other outcomes from the IOCS included:

- **Media coverage.** The national media attended the opening session of the Symposium in force, perhaps encouraged by the presence of the Vice President and other government Ministers. As a result the Symposium and its sponsors received widespread media coverage in the Maldives. The media reported on the opening speeches and keynote addresses. In addition, interviews on cetaceans

and the threats they face in the region were given by the convening committee and by Symposium participants to local TV, radio and newspapers.

- A poster depicting the cetaceans of the tropical Indian Ocean. This was produced especially for the IOCS and distributed to participants and guests. Following the Symposium, complimentary copies of the poster were distributed to every school in Maldives. The Convening Committee is especially grateful to the artist Martin Camm for supporting this effort (www.wildlifeartcompany.com).
- A presentation by OBIS-Seamap (<http://seamap.env.duke.edu>), demonstrating the possibilities and value of data archiving.
- An award for the best presentation at the IOCS by a coastal country scientist. This was presented to Muhammad Shoab Kiani (Pakistan), with Kanjana Adulyanukosal (Thailand) receiving a runner-up certificate.
- Two public lectures, presented on the day after the IOCS. Dr. Michel Vély gave an illustrated talk on whales to schoolchildren on Himmafushi (an inhabited island near to the IOCS venue). Dr. Roger Payne gave a talk to over 200 school children and other invitees in Malé.
- A peer-reviewed volume of 15 scientific papers. This is the final, physical output from the IOCS, and has been produced as a dedicated issue of the IWC's *Journal of Cetacean Research and Management* (Volume 12, part 2, 2012). The IOCS Convening Committee acknowledges with gratitude the professional work of the IWC editorial team (notably Greg Donovan, Helen Sharp, Stella Duff and Andrea Cooke) in bringing this work to publication. www.iwcoffice.org

More intangible was the opportunity provided by the IOCS for Indian Ocean cetacean scientists to interact and develop plans for future research. The attendees included a broad mix of young regional scientists and more experienced figures. There were ample opportunities for all participants to interact between sessions and in the evenings, and this was further facilitated by the relatively small size of the Symposium. There were also opportunities for scientists to develop partnerships with funding agencies, with representatives from the Save our Seas Foundation, the US Marine Mammal Commission, the Australian Marine Mammal Centre, the Bay of Bengal IGO, the Whale and Dolphin Conservation Society and the Wildlife Conservation Society attending the IOCS. The role of electronic media was emphasized and participants were introduced to the newly formed regional list server marinemammalsofindia@yahoogroups.com.

The participants without exception considered the IOCS to have been extraordinarily valuable, expressed strong appreciation for the support of the sponsors, and are now looking forward to the next Indian Ocean Cetacean Symposium!



Awards for best presentation by a coastal country scientist to Muhammad Shoab Kiani (Pakistan) by Dr. Roger Payne (L), and to runner-up Kanjana Adulyanukosal (Thailand) by Dr. Sidney Holt (R)



*Group photo of participants at the Indian Ocean Cetacean Symposium 2009
Paradise Island Resort and Spa, Maldives, 18 – 20 July 2009*

LANKAN FINOLHU (MALDIVES) DECLARATION

The International Whaling Commission, IWC, declared its Indian Ocean Sanctuary (IOS) in 1979. The IOS provides protection from commercial whaling for all large whales and orca. However, whales now face threats from other human activities in addition to whaling, for example pollution (including sound pollution), ship strikes and entanglements with fishing gear. Small cetaceans are not covered by the provisions of the IOS, but are also facing many threats, including by-catch, direct catches in fisheries and habitat degradation.

To mark the 30th anniversary of the IOS, the Indian Ocean Cetacean Symposium was convened in Maldives, 18-20 July 2009. Sixty delegates, from 15 government agencies, 13 NGOs, 6 IGOs and 11 academic institutions, travelled from 22 countries to participate in the symposium. Results of cetacean research carried out in 18 coastal countries (South Africa, Mozambique, Tanzania, Mauritius, Madagascar, Comoros, France (Mayotte), Seychelles, Oman, Pakistan, India, Maldives, Sri Lanka, Bangladesh, Myanmar, Thailand, Indonesia and Australia) and the high seas were presented at the symposium.

Celebrating the 30th anniversary of the International Whaling Commission's Indian Ocean Sanctuary,

Noting the important role the IOS has had in stimulating cetacean conservation research in the region and in bringing together the participants from coastal states for this symposium,

Recalling the substantial and illegal catches of large whales taken from the Indian Ocean, especially during the 1960s,

Recognizing that more than two billion people live in countries bordering the Indian Ocean, many of whom depend upon its marine resources for their livelihoods and food security,

Conscious of the ecological role of cetaceans in ensuring healthy coastal and marine ecosystems,

Valuing the welfare and continued existence of cetaceans in the Indian Ocean,

Concerned by the declining health of Indian Ocean ecosystems and its impacts on all cetaceans, and in particular by the continued by-catch of small cetaceans in the fishing gears of many nations,

Noting the migratory nature of many cetaceans within the Indian Ocean,

Mindful of the growth of whale and dolphin watching within the Indian Ocean, and the increased opportunities it provides for employment, education and recreation in coastal communities,

Cognizant of the need for improved coordination, prioritisation and cooperation in efforts to improve conservation outcomes for all cetaceans throughout the Indian Ocean,

The participants in the Indian Ocean Cetacean Symposium,

Congratulate the International Whaling Commission on the formation and the continuation of the Indian Ocean Sanctuary;

Recognize the important role played by the Republic of Seychelles in the formation of the Indian Ocean Sanctuary;

Call upon the International Whaling Commission to ensure the continuation of the Indian Ocean Sanctuary in perpetuity;

Stress the importance of improved education and awareness at all levels of society for the conservation of cetaceans and the sustainable use of marine ecosystems;

Encourage all fishing nations that have by-catches and directed catches of Indian Ocean cetaceans to greatly increase efforts to determine the scale of these catches and to reduce them to the minimum level possible;

Urge all Indian Ocean coastal states to strengthen national legislation and compliance (and where necessary enact new laws) to protect all cetaceans and their habitats within their exclusive economic zones;

Reiterate the commitments made under the United Nations Convention on the Law of the Sea (UNCLOS), Compliance Agreements, the UN Food and Agriculture Organisation's Code of Conduct on Responsible Fishing, and the UN Highly Migratory and Straddling Stocks Agreement to conserve highly migratory species (a category which includes almost all cetaceans) and also the marine mammals, and to manage fisheries for prey species in such a manner as not to impede the biological productivity of dependent species;

Suggest that Indian Ocean coastal states promote implementation of the provisions under the Convention on the Conservation of Migratory Species of Wild Animals (CMS) and further foster regional arrangements/agreements to ensure the improved conservation of all cetaceans;

Remind all Indian Ocean parties to the Convention on Biological Diversity of their commitments to protect at least 10% of all ecosystems, including marine and coastal waters, and the opportunity this presents for the protection of cetacean hotspots and critical habitats;

Urge organizations using seismic surveys for offshore oil, gas and mineral exploration and production (and the countries in which they operate) to adopt international best practice to minimize impacts on cetaceans;

Support the wider adoption of responsible whale and dolphin watching guidelines and regulations, for the long-term benefit of both cetaceans and humans;

Encourage Indian Ocean states, in collaboration with the IWC and other relevant organizations to develop a collectively agreed action plan to improve conservation outcomes for cetaceans in the IOS;

Draw attention and agree to the fact that a small steering committee has been convened at the IOCS to assist in the scoping and initiation of a possible action plan.

Adopted this 20th day of July 2009

Paradise Island Resort & Spa
Lankanfinolhu
Republic of Maldives

Cetaceans of the Tropical Indian Ocean

Blue Whale
Balaenoptera musculus (24m)

Humpback Whale
Megaptera novaeangliae (14m)

Finless Porpoise
Neophocaena phocaenoides (1.7m)

Indo-Pacific Bottlenose Dolphin
Tursiops aduncus (2.4m)

Common Bottlenose Dolphin
Tursiops truncatus (3m)

Pygmy Killer Whale
Feresa attenuata (2.4m)

False Killer Whale
Pseudorca crassidens (5m)

Cuvier's Beaked Whale
Ziphius cavirostris (6m)

Risso's Dolphin
Grampus griseus (3.1m)

Fraser's Dolphin
Lagenorhynchus hosei (2.3m)

Bryde's Whale
Balaenoptera brydei (14m)

Ginkgo-toothed Beaked Whale
Mesoplodon ginkgodens (4.7m)

Long-beaked Common Dolphin
Delphinus capensis (2.4m)

Rough-toothed Dolphin
Steno bredalensis (2.5m)

Killer Whale
Orcinus orca (8m)

Sperm Whale
Physeter macrocephalus (male 27m)

Southern Right Whale
Eubalaena australis (15m)

Longman's Beaked Whale
Indopacetus pacificus (6m)

Indo-Pacific Hump-backed Dolphin
Sesia chinensis (2.5m)

Spinner Dolphin
Stenella longirostris (1.8m)

Short-finned Pilot Whale
Globicephala macrocephala (5m)

Blainville's Beaked Whale
Mesoplodon blainvilliei (4.5m)

Irrawaddy Dolphin
Orcaella brevirostris (2.4m)

Pantropical Spotted Dolphin
Stenella attenuata (2.3m)

Melon-headed Whale
Peponocephala electra (2.5m)

Dwarf Sperm Whale
Kogia sima (2.7m)

Symposium Sponsors

Produced for the Indian Ocean Cetacean Symposium, Maldives 2009
Cetaceans are whales, dolphins and porpoises
Artwork: © Martin Camm, www.wildlifeartcompany.com
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Lengths quoted are approximate average adult sizes. Not to scale

Annex 1

AGENDA OF THE INDIAN OCEAN CETACEAN SYMPOSIUM 2009

18 – 20 JULY 2009, PARADISE ISLAND RESORT & SPA

17 July 2009

- Delegates arrive
- 1700 Registration
- 1800 Evening reception

Day 1 - 18 July 2009

- 0830 Registration
- 0930 Delegation from Malé arrives
- 1000 OPENING CEREMONY
 - Recitation from the Noble Quran
 - Welcoming remarks by Dr. Shiham Adam, Director General, Marine Research Centre
 - Address by Dr. Ahmed Ali Sawad, Minister of Tourism, Arts and Culture
 - Presentation of the Symposium Poster to H.E. Vice President of the Maldives, Dr. Mohamed Waheed Hassan Manik by the Minister of Fisheries and Agriculture, Dr. Ibrahim Didi
 - Address by Chief Guest Dr. Mohamed Waheed, Vice-President of the Maldives
 - Vote of thanks by Dr. Charles Anderson
- END OF OPENING CEREMONY
- 1045 *Coffee break*
- 1115 Keynote addresses by invited speakers
 - Negotiating the Indian Ocean Whale Sanctuary, Dr. Sidney Holt
 - Cetaceans, pollution and the Indian Ocean Sanctuary, Dr. Roger Payne
- 1230 *Lunch break*
- 1345 Malé delegation departs
- 1400 First session
- 1530 *Coffee break*
- 1730 End session
- 1900 Video presentations

Day 2 – 19 July 2009

- 0900 Resume first session
- 1100 *Coffee break*
- 1120 Second session
- 1230 *Lunch break*
- 1400 Resume second session
- 1530 *Coffee break*
- 1715 Group Photo
- 1730 Excursion (spinner dolphins)
- 1930 Video presentations

Day 3 – 20 July 2009

- 0900 Third session

1100 *Coffee break*
1120 Resume third session
1230 *Lunch break*
1400 Fourth session
1530 *Coffee break*
1730 End session
1930 Farewell dinner

Day 4 – 21 July 2009

Delegates depart

Malé public lecture/ Himmafushi School lecture



Dr. Shiham Adam and Dr. Sidney Holt during the opening session

Annex 2

OPENING SPEECHES AT THE INDIAN OCEAN CETACEAN SYMPOSIUM 2009

Welcome Address, Dr. Mohamed Shiham Adam, MRC

Your Excellency the Vice President Dr. Mohamed Waheed Hassan Maniku; Minister of Fisheries and Agriculture Dr. Ibrahim Didi; Minister of Tourism, Arts and Culture Dr. Ahmed Ali Sawad; distinguished delegates, invited guests, members of the press, ladies and gentlemen: on behalf of the Marine Research Centre, I am pleased to welcome all of you to this Indian Ocean Cetacean Symposium. I thank those of you from overseas, especially those who have come from the farthest reaches of the community to contribute to the success of this Symposium.

2009 marks the 30th anniversary of Indian Ocean Sanctuary. This year also marks the 25th anniversary of the Marine Research Centre - a small section formed within the Ministry of Fisheries 25 years ago this week! The section was established with only 9 staff. Four of them are here today. One who cannot be here is our founder director, Mr. Maizan Hassan Maniku. Sadly he passed away in 2002 at the age of just 49. Hassan Maniku was well ahead of his time in the field of marine resource management. He placed great importance on scientific excellence, on international cooperation, and on the involvement of local communities. These are themes that we will be exploring during this Symposium

Cetaceans - whales and dolphins - are a key component of the pelagic ecosystems of our region. As top predators, some species, such as Killer Whales and False Killer Whales, are believed to play a keystone role in pelagic community structuring. Towards the other end of the food-chain, the great whales including Blue Whales, Bryde's Whales and Humpback Whales, which all occur in our waters, may be equally important in their ecosystem roles.

Understanding the ecology of these animals will be a key to better understanding of our pelagic ecosystems. This is important, not just to satisfy academic curiosity, but because so many of our countries and our citizens rely on pelagic fisheries for their livelihoods and their food supplies. Here in the Maldives, for example, fishermen use the presence of dolphins to locate schools of yellowfin tuna. Exports of yellowfin were worth US\$30 million last year.

So we have a very real interest in the conservation of these dolphins. Indeed the capture of any cetacean is banned in the Maldives, and has been since 1993. In order to conserve these animals we need improved understanding, and for that we will require greater international cooperation and scientific excellence. So I am looking forward to hearing of progress during this Symposium.

Many, if not most, of the cetaceans in this region are migratory to a greater or lesser degree. We will never understand what they are up to in their lives if we do not adopt an international perspective to our research. Again this Symposium is an excellent venue for us to forge new partnerships for international cooperation

To achieve improved understanding, we also need to engage with fishermen and others in coastal communities. For it is these people who interact with whales and dolphins on a daily basis. It is these people who sometimes catch dolphins in their nets. It is these people who may earn their livings by taking tourists to watch whales. It is these people whose actions may need some management to secure the future for whales and dolphins in our region.

Clearly there is much to be done. We certainly know much less about whales and dolphins in the Indian Ocean than we might like to think we do. As just one example, I understand that a 'new' species of whale is going to be announced at this Symposium. Yes, there really is a whale swimming in the tropical Indian Ocean that we know nothing about. For all we know there could be one swimming within just a mile or two of where we are right now! It is really remarkable, that in this day and age that there is a large mammal, 15 feet or more in length, presumably inhabiting a vast area of the ocean, about which, until now, we have known absolutely nothing. This is just one indication about how little we know about whales and dolphins, and about the oceans in general.

I like to put on record the support and hard work of members of our convening committee: Dr. Abdulla Naseer, Dr. Roger Payne and in particular Dr. Charles Anderson. Charles been instrumental in helping to shape this symposium, right from the very idea over two years ago to what we see here today. And for Shahaama Abdul Sattar, who worked tirelessly to make this a reality. She deserves an especially big 'thank you'.

Ladies and Gentlemen, I hope this Symposium will bring a significant step forward in our understanding of whales and dolphins in the Indian Ocean. And that will bring improved understanding of this precious ocean of ours. I wish you all well in your deliberations. Thank you.

Opening statement by Vice President of the Maldives, Dr Mohamed Waheed

Good morning to you all. It is my pleasure to welcome you all to the Maldives. I understand we have many very renowned researchers in the field of cetacean research and we are honoured that you are here this morning.

Thank you for giving me this poster. I have always wondered why we don't have such posters displayed in our schools, because our children don't really know the richness of marine life in the Maldives. We don't get a true perspective of where we are in relation to the rest of the environment that we live in. So, I think that it is really important you came out with these posters for this occasion. I hope you will provide these posters to all the schools in the country. I will insist on them being displayed.

This year, 2009, is an important anniversary for whale conservation. Many years ago in 1929 the idea of sanctuary for whales was first proposed by the Argentinean lawyer José Suarez working under the auspicious of the League of Nations. 60 years ago in 1949 José Suarez's dream was realized in the declaration of the first sanctuary by the then newly formed International Whaling Commission. These sanctuaries were large sections of southern oceans from which all whaling was banned. In the post-war years when food was scarce commercial interests were paramount. The sanctuary did not last long but it threatened important business. 30 years ago, in 1979, the IWC formed the Indian Ocean Sanctuary. So 2009 is the 30th anniversary of the Indian Ocean Sanctuary. We are here today to celebrate this important milestone.

I am especially happy to welcome two legendary figures in cetacean research and conservation, for both were instrumental in bringing the Indian Ocean Sanctuary many years ago: Dr Sidney Holt and Dr Roger Payne. Thank you for being here with us. I am looking forward to your key note speeches later in the morning.

The Indian Ocean Sanctuary was set up by the IWC so that large whales should get protection from commercial whaling. That end has been largely achieved, although much remains to be done to safeguard populations of smaller whales and dolphins. But another hope for Indian Ocean sanctuary was that it would provide the stimulus and the location for the expansion of benign whale research: research that did not require killing the whales. Benign cetacean research has indeed flourished within the Indian Ocean Sanctuary in recent years, and one of the main aims of this Symposium is to highlight the extent and the quality of that research.

Here in the Maldives, we are at the very heart of the Indian Ocean Sanctuary. Although we are not an IWC member, we whole heartedly support the IOS, its aims and its continuation. The Maldives has never been a whaling nation. But there are many whales here and others have come to exploit them. In the 19th century, American whalers flocked in this region in search of sperm whales. Cochin and Colombo were regular ports of call for American whalers, and so too was Seychelles and the Maldives. Indeed Herman Melville, the celebrated author of *Moby Dick*, wrote the poem 'The Maldives Shark' in 1888. Sharks were of course the bane of the whale-men, snatching bites from their catches before they could be cut up and taken on-board. Even today some species of sharks are still known as whalers.

Then a century later in 1960's the mammoth industrial ships of the Soviet Union visited our waters, leaving with the carcasses of hundreds of whales. These catches were illegal under the rules of IWC and were not reported until after the fall of communism and the breakup of the Soviet Union. Many older people in the atolls remember a time, in their youth, when the blows of whales were a frequent sight. They tell us that such sightings of whales became increasingly scarce in the 1960's. We now know why.

Previous speakers mentioned the value of whales and dolphins for both tourism and fisheries. I have alluded to their direct value in the past to commercial whalers. On this increasingly over crowded planet there is an inevitable tendency to think of everything in terms of dollars and cents. While there is the need for such a pragmatic approach, we must also remember that whales and dolphins have value in their own right. They belong to this planet as much as we do.

And that brings me to another significant anniversary. In just two days from now it will be the 40th anniversary of the first moon landing. Let us not forget that it was the pictures of the Earth from space, most of them taken during the Apollo program, which quite literally gave us all a new perspective of our own planet. We take those images for granted now, but when they were first published, they showed for the first time just what an ocean-dominated planet we live on. Ours truly is a Blue Planet. Those images also showed us how small and vulnerable our world appears in the vastness of space.

The Indian Ocean Sanctuary is wonderful institution, set up 30 years ago to protect the richness of the Earth's marine life. I applaud your efforts in carrying out valuable research into the whales and dolphins of the Indian Ocean, in highlighting the threats that they face, and in helping to ensure that they, and other marine wildlife, are protected into the future.

I wish you successful deliberations and I hope that this symposium will contribute for the advancement of research in this area. Thank you.



Dr. Mohamed Waheed, Vice President of the Republic of Maldives, addressing the opening session

Opening speech by Minister of Tourism, Arts and Culture, Dr. Ahmed Ali Sawad

Bismillah Hirrahmaanirraheem. Assalaamu Alaikum. Honourable Vice President, Honourable Ministers and the very Distinguished Academics and everyone gathered here. Good morning.

When I was initially asked to make a little address to this gathering, I called up and said actually my mandate is tourism and arts and culture. I know very little, if anything at all, about these mammals. But of course the reply was very apt. It's about all these resorts that you see in the Maldives. It's about the hundreds of thousands of tourists that visit the Maldives. It's about a large chunk of our economy. Tourism in the Maldives has a very delicate equation with environment. We all know that and at every opportunity that we get, we make a mention of that, reasserting our commitment to that delicate equation. Every resort where investors invest several millions of dollars, at the end tally with that equation. Right now we are all gathered in a very beautiful resort. There are several of these. Very high end, luxury resorts. But the thousands of tourists that visit here do not just come to stay in their rooms. They want to see nature. They want to see what's underneath this vast stretch of blue ocean. The turquoise lagoons, the reefs. And these wonderful mammals that we are going to talk about today are part of that ecosystem. Anything that happens to them directly impacts on our tourism, our environment and our economy. And that impacts on the common man.

So I think it's important for me to assert to this gathering, the commitment of this government and the tourism sector, of the significance and our resolution and commitment, to ensure that what we have today is passed on with a better prospect for our future generations. These islands were here long before the population inhabited this part of the world. These mammals were here long before, and future generations have a right to the same environment. That brings us a huge responsibility. The responsibility to ensure that proper guidelines, regulations, monitoring mechanisms are set up to ensure that responsibility is fully exercised and delivered. And my inspiration today is that with the wonderful community of academics gathered here, we will find a way and I'm very hopeful.

On our part I once again give the commitment and also a bit of a news; that we are in the process of formulating regulations that will ensure that the relationship between industry, environment, economy and the common man are built on a sustainable pattern. Recently our Honourable Environment Minister, Mohamed Aslam had initiated a conservation zone in Baa Atoll. Part of the atoll is known for whale sharks. Part of the atoll is also known for wonderful manta rays and turtles and other innumerable fauna. We have taken an initiative. It's time we stopped and ensured that everything that we say has a value to the common man. And that responsibility, this government is fully committed to and engaged with.

When we talk about regulation, you know when we sit down, it's easy for a few experts to devise strategies. But in the end it's the common man that is impacted with those strategies. So I feel, I strongly feel that there is a need to engage the common person as well. When we talk about this in the Maldives, we are talking about our fisher community, the local villagers.

I'll just narrate, very briefly, an incident that I came across very recently. As some of you may be aware, land in the Maldives belongs to the government and this has been the case for centuries. Our regulations provide so. And investments on the industrial land, particularly the tourism sector is provided through public tendering and joint ventures with the government. There was one particular property that had been tendered out for development as a tourism product. The impact of this development on the environment, sorry to say wasn't really assessed. A project proposal was made to revise that. Papers were brought to the table and a couple of our ministers sat down together. Honourable Minister Aslam pointed out that cannot happen. That's a whale shark gathering zone. That needs to be protected. I said we have a huge investment. The government has already contracted out an advance payment from these investors and they have got developers down there. A crucial decision had to be made. But it didn't really take up much time and the President himself said 'No, a line has to be drawn. A very clear line has to be drawn.' We are not talking about ourselves; we are talking about our future. Not just 10 years, 15 years. We are talking about perpetuity. A future and perpetuity that is sustainable. And we have a new government. A very young breed of us. I give you our commitment. We will make sure that line is maintained.

I'm sorry I would not like to keep you much engaged with my words here. I'll just make this short. I once again give our commitment and my assurance and hope that meetings like this, gatherings like this will ensure that block by block we will build that edifice of a sustainable ecology. Thank you.



Minister of Tourism, Arts and Culture, Dr. Ahmed Ali Sawad addressing the opening session



Dr. Roger Payne presenting his keynote address

Annex 3

ABSTRACTS OF SCIENTIFIC PRESENTATIONS

(Note: these should not be cited without prior permission of the authors)

KEYNOTE ADDRESSES

Negotiating the Indian Ocean Whale Sanctuary

Dr. Sidney Holt

Sidney Holt was directly involved in the events leading up to the declaration of the International Whaling Commission's Indian Ocean Sanctuary in 1979. In his keynote address, he provided a fascinating personal overview of these events, reflecting on the background to the issue of whale sanctuaries within the IWC and the particular role of the Seychelles Government in the development of the proposal for a sanctuary in the Indian Ocean. He described the political, scientific and practical factors surrounding the acceptance of the proposal by the IWC and briefly touched upon subsequent events. A peer-reviewed paper summarizing much of this address is published in the dedicated Indian Ocean issue of the Journal of Cetacean Research and Management (2012): www.iwcoffice.org

Cetaceans, pollution and the Indian Ocean Sanctuary

Dr. Roger Payne

Roger Payne was also involved with the formation of the Indian Ocean Sanctuary. But in his keynote address he concentrated on current concerns, describing the findings of the five-year (2000-05) round-the-world *Voyage of the Odyssey*, which included two years in the Indian Ocean. Their global survey of sperm whales clearly demonstrates that this near-apex predator, and presumably many others, are concentrating so many toxic pesticides and metals that they are not only dangerous for humans to consume, but are also likely to become poisoned themselves as these chemicals accumulate. He stressed that this is a clear warning of dangers we are inflicting upon ourselves. Details of the *Voyage of the Odyssey* and its scientific results are available from www.oceanalliance.org.

SESSION 1: REGIONAL REPORTS

Status reports and reviews from individual countries or areas

Records of marine mammal species in Tanzania waters after 10 years of research

Omar A. Amir, Per Berggren and Narriman S. Jiddawi

Records of marine mammal (whales, dolphins and dugong) species diversity have increased significantly since the establishment of a marine mammal research group in Zanzibar, Tanzania in 1999. Since then the number of marine mammal species recorded has increased from 3 to 14. The data presented in this report reflect the efforts of 10 years in collecting information from marine mammals stranded and incidentally caught in Tanzanian waters. Additional information from dedicated and incidental sightings on whales and dolphins is also provided. From 2000 through 2008 a total of 231 specimens of whales, dolphins and dugong were recorded as bycatch and strandings. Two hundred and ten (91%) records referred to specimens from bycatch in drift and bottom-set gillnets, and 21 (9%) referred to specimens from strandings. A total of fourteen marine mammal species have been recorded. Based on incidental catch and sightings records, Indo-Pacific bottlenose, spinner and humpback dolphins (which are observed year-

round) and humpback whales (which are observed seasonally during June/July to November) are the most common species in Tanzania.

Cetacean studies and conservation in Seychelles: Country report

Gendron, Gilberte, David Rowat, Vincent Lucas, Michel Vely and Florian Giroux

The area around the shallow Seychelles plateau has long been associated with whales and historically with whaling. According to Bureau of International Whaling Statistics, around 1350 whaling voyages have been conducted in the Indian Ocean. Mahé was an important base for whaling around Seychelles, the highest capture rate being in the mid 19th century with the rate remaining remarkably stable until 1870. The target species was primarily sperm whale (*Physeter macrocephalus*), most captures being made north of Denis and Bird Islands or south of the plateau off Fortune Bank. After 1870, small-scale whaling continued on Ste Anne Island with 450 sperm whales captured between 1913 and 1915. Seychelles initiated the Indian Ocean Whale Sanctuary under the International Whaling Commission in 1979. The little formal research that ensued is reviewed, including: important areas identified for Bryde's whale (*Balaenoptera edeni*), sei whale (*Balaenoptera borealis*) and to a lesser extent fin whale (*Balaenoptera physalus*); studies on the sperm whale populations; and migrations of humpback whale (*Megaptera novaeangliae*). Results from more recent studies are discussed, including a research cruise primarily looking for heavy metal contaminants in sperm whales and several one week visual surveys from Aldabra to Mahé. Seychelles has taken an active approach to SW Indian Ocean regional cooperation on cetaceans attending the first workshop organized in Isle Saint Marie, Madagascar, by the Indian Ocean Commission to set up a regional network for cetaceans and dugong. Seychelles hosted the second workshop in 2008 for the IOC to further develop the network and research programme. Research into human-cetacean interactions has become a national priority with Seychelles hosting an international workshop on long-line depredation by cetaceans and sharks in 2007, under the umbrella of IOTC (www.iotc.org). National initiatives on the monitoring of cetaceans are presented including the development of a marine mammal observation network and dedicated surveys for cetaceans conducted in cooperation with tourism sector partners. Ongoing programmes using platforms of opportunity such as live-aboard boats and aerial surveys for other species are presented, along with a dedicated monitoring programme on humpback whales in the granitic islands and around Aldabra. This programme includes both photo-ID and biopsy sampling for genetic analysis and, subject to funding, will include a satellite tagging component to define movement patterns. On-going research into cetacean depredation on long-lines is briefly described, this programme being the subject of another presentation.

Oman: Research activities, key findings and the world's rarest whales?

Baldwin, Robert, Andy Willson, Gianna Minton and Tim Collins

Cetacean field research activities in Oman to date have been focused in four main areas of Oman's coastal waters: in the Sea of Oman around Muscat, and in the Arabian Sea off Ras al Hadd, in the Gulf of Masirah and off the Dhofar coast. The main focal species are *Megaptera novaeangliae*, *Balaenoptera brydei*, *Stenella longirostris*, *Delphinus capensis*, *Sousa chinensis* and *Tursiops aduncus*. Other species (n=13) are subject to opportunistic study on encounter. This presentation summarised key findings of research on humpback whales aimed at furthering conservation, including distribution and habitat use with respect to depth and slope, feeding and breeding behaviour, stock identity and structure, population status and threats. The Arabian Sea humpback whale has a distribution that appears to be centred in southern Oman. Additional records of humpback whales in this region include recent records from Iran, Pakistan and Yemen and historic records from Kuwait, India, Iraq, Sri Lanka and the United Arab Emirates. Humpback whales have additionally been recently recorded in the Red Sea waters of Egypt and the Maldives, which may

represent southern hemisphere vagrants or the southernmost extent of the Arabian Sea population. The Arabian Sea population originated from southern Indian Ocean whales, but have a northern hemisphere breeding cycle and are resident year-round off Oman. The population is isolated, with estimated divergence time of c 58,600y, probably as a consequence of range contraction of southern hemisphere whales. The population is severely bottlenecked (including a recent bottleneck coincident with Soviet whaling catches about 40 years ago) and shows every sign of continuing decline. Gene flow seems to have occurred between the Arabian Sea and the Western Indian Ocean after divergence but current gene flow is highly unlikely. Encounter rates during research surveys in Oman are low (0.55 whales/survey hour) and photo-identification studies yield a high proportion of re-sightings. An abundance estimate of Arabian Sea humpback whales based photo-identification data from Oman is 82 individuals (95% CI 60-111, Chapman/Petersen), making this one of the rarest baleen whales in the world. Major threats include those from fisheries activities, coastal development and shipping. Cetacean research in Oman is led by the Environmental Society of Oman, working in collaboration with government offices and a number of international collaborators.

Occurrence and conservation of cetaceans in the coastal waters of Pakistan

Gore, Mauvis, Rupert Ormond, S. Kiani, U. Waqas, B. Hussain, J. Siddiqui and E. Ahmad

Prior to 2004, there were suggestions of high numbers and diversity of whales and dolphins along the coast and offshore of Pakistan, although few records were available and no systematic survey had been undertaken. In 2004 the Cetacean Conservation Pakistan project was launched with a view to: (1) undertaking quantitative surveys to determine the variety and abundance of species in different regions; (2) working with the local fisher communities to collect local knowledge and promote public awareness; and (3) developing and promoting a marine cetacean conservation strategy. Boat-based surveys have established that the following species of marine cetaceans are common in Pakistani waters. Bottlenose dolphins occur in several large populations in inshore waters between Karachi and the border with Iran, and are seen at least as far offshore as Astola Island. The Indo-Pacific humpback dolphin is common inshore around the mouth of the Indus Delta and in several other large sheltered bays, where the finless porpoise also occurs much less frequently. Spinner dolphins were observed in abundance offshore of the eastern Balochistan region, as were the less abundant Risso's dolphins. In addition, a number of other species were recorded at sea and from beach cast specimens, including sperm, fin, Bryde's and Cuvier's beaked whales, and orca. Work with local fisher communities has supported this picture and led to their co-operation with the project. Other project initiatives have resulted in the formation of a multi-agency project advisory panel and the establishment of a national whale and dolphin conservation society. Policy development work has led to the preparation of a marine cetacean biodiversity action plan, and support by government for the establishment of the first marine national park, incorporating an area important for some of the key marine cetacean species. More detailed studies of selected species are in hand, including photo-identification of the Indo-Pacific humpback dolphin. The findings have supported the conclusion that the marine cetacean species present are very similar to those reported from neighbouring Oman, and it seems likely that at least part of the population migrates regularly between the two countries in response to seasonal changes in abundance of food resources.

Stranding status and threats to cetaceans at coast of Balochistan, Pakistan

Abdul Rahim

Twenty species of cetaceans (whales and dolphins) have been recorded from Pakistani seas, and more than twelve species occur in Balochistan waters. The Balochistan coast has great potential for marine fisheries, and fishermen currently use a variety of fishing gears to catch fish, including longline, harpoon, cast net,

trawling (bottom and surface), gill net, encircling net and wire net. Some methods of fishing have adverse effects on non-target species, for example destroying benthic plants (seaweed or seagrass) and animals (corals, sponges, mollusks). It has also been recorded that these fishing methods are killing cetaceans, especially dolphins which are taken as by-catch or accidental catch. A large proportion of stranded dolphins observed on the Balochistan coast show signs that death occurred due to fishing methods used by the fishermen. Shark fishing is another threat to the cetaceans of the Balochistan, since fishermen use dolphin flesh as bait for shark fishing. Biotoxins from plankton blooms associated with upwelling is also a cause of cetacean deaths. The WWF-Pakistan Wetlands Program, at the Makran Coastal Wetlands Complex (MCWC) site, has conducted a broad study of stranded cetaceans along the Balochistan coast and is monitoring the threats to cetaceans. On the basis of these threats, PWP is developing a better management plan for the conservation of cetaceans.

A preliminary composite cetacean survey in the Indian Ocean Sanctuary, April 1995

Eyre, Elizabeth J.

A forty-day voyage from Hobart to Haifa included a visual and acoustic census for cetaceans in the Indian Ocean Sanctuary. One hundred and sixty-three sightings were made, 157 occurring within the Sanctuary. Twelve species were identified. Sperm whales (*Physeter macrocephalus*) were encountered most frequently, whilst spinner dolphins (*Stenella longirostris*) were numerically dominant. Other species sighted included bottlenose dolphin (*Tursiops* sp.), common dolphin (*Delphinus* sp.), spotted dolphin (*Stenella attenuata*), rough-toothed dolphin (*Steno bredanensis*), Risso's dolphin (*Grampus griseus*), killer whale (*Orcinus orca*), short-finned pilot whale (*Globicephala macrorhynchus*), false killer whale (*Pseudorca crassidens*), Bryde's whale (*Balenoptera edeni*) and unidentified ziphiids. The highest number of sightings occurred west of the Seychelles, east of Somalia and in the Red Sea. An area east of Ras Hafun accounted for 50% of the total number of sperm whales encountered, and included adults, subadults and calves engaged in resting and social activity. Thirteen hours were spent listening for cetaceans using a towed array. Although routine hydrophone tows did not detect cetaceans as efficiently as visual scanning, this was in part due to interference from other noise sources. The 1995 voyage followed a similar visual survey in 1993, where cetacean 'hot-spots' were described. Relatively little research has been undertaken in the oceanic waters of the Sanctuary, and this paper is based on an unpublished IWC report (SC/49/O33) in the context of current knowledge and with supplementary material.

Cetaceans and cetacean research in India

Kumarran, R.P.

Twenty-five species of marine cetacean have been recorded from Indian waters. However, detailed study is available only for few selected species. As there has been no large-scale commercial interest in marine mammals in India for more than a century, information on cetaceans has been mainly collected from fishery by-catch. Nineteen species of cetaceans have been reported accidentally caught in gillnets in peninsular India. All species of marine mammal enjoy protection under the Indian Wildlife Protection Act. Each maritime state is responsible for implementing the conservation policy. Their priorities differ so much that adjacent states may not extend the same level of protection for a given species. Owing to the lack of uniformity in effort, most information on cetaceans is from the southeast and southwestern maritime states. Data on different aspects such as distribution, taxonomy, fishery interactions, stomach contents, basic biology, pollution, conservation and management for selected few species of cetaceans have become available in the last ten years. This paper aims to evaluate the strengths and weakness of cetacean research methodology in India.

Cetacean sightings and acoustic detections in the offshore waters of the Maldives during January-March of 2003 and 2004

Clark, Rebecca A., Christopher M. Johnson, Genevieve Johnson, R. Charles Anderson, Roger Payne, Iain Kerr, Celine A. J. Godard, Peter T. Madsen

This study took place in the Maldives in 2003-04 during January to March (i.e. the northeast monsoon seasons), as part of a global investigation of sperm whales undertaken by the *R/V Odyssey*. It provided data on cetacean biology through visual and acoustic observations. The Maldives survey was conducted over a period of 72 days and covered 10,915 track line km. A total of 157 sightings and 1,160 acoustic detections of 17 cetacean species were recorded. Risso's dolphin (*Grampus griseus*), sperm whale (*Physeter macrocephalus*), pantropical spotted dolphin (*Stenella attenuata*) and spinner dolphin (*Stenella longirostris*) were the most frequently sighted species. The Maldives houses a rich and seemingly abundant cetacean community. In comparison with other areas visited by the *R/V Odyssey*, Maldives had a cetacean acoustic detection rate 2.5 times higher than the eastern Indian Ocean and tropical Pacific, and non-physeteroid sighting rates 1.7 times higher than the tropical Pacific and 6.7 times higher than the eastern Indian Ocean. This rich cetacean community presumably benefits from both a favourable habitat and the no-bycatch fishing techniques practiced in the Maldives.

Cetaceans in the Maldives – A review

R. Charles Anderson, S. A. Sattar and M. S. Adam

The cetaceans of the Maldives were poorly known until relatively recently, but have received increased attention over the past decade. Twenty-three species of cetacean have now been recorded. A number of sightings surveys, and one acoustic survey, have been completed. The species most frequently seen is the spinner dolphin (*Stenella longirostris*). A national system for reporting cetacean strandings has been in place since 2000; some 160 strandings of 16 species have been reported to date. The species most commonly reported stranding is the sperm whale (*Physeter macrocephalus*). All cetaceans are protected by law within Maldivian waters. More significantly, most forms of fishing with nets, including gill-netting and purse-seining are banned in the Maldives to protect the traditional pole and line tuna fishery. Cetacean-watching is becoming increasingly popular, with spinner dolphins being the main attraction, although other species are also targeted on specialist trips.

Sightings and acoustic detections of cetaceans in the offshore waters of Sri Lanka in early 2003

de Vos, Asha, Rebecca Clark, C. Johnson, G. Johnson, I. Kerr, R. Payne, P.T. Madsen

This study took place in the off-shore waters of Sri Lanka in the first half of 2003. During three research cruises conducted between 29 March and 17 June 2003 the *R/V Odyssey* covered a total track line of 4,480 km around the island resulting in 624 h of acoustic effort and 71 sightings of 11 species. Sperm whales (*Physeter macrocephalus*, n=12), blue whales (*Balaenoptera musculus*), Risso's dolphins (*Grampus griseus*) and Fraser's dolphins (*Lagenodelphis hosei*) were the most frequently sighted species. Of the 1,106 acoustic detections made, 11.3% were from sperm whales and the remainder were attributed to unidentified dolphins and other sounds. Many sightings were closely associated with productive submarine canyons that were enriched by the outfall of neighbouring rivers. Additionally, two species of large whale (sperm whale and Bryde's whale) and many species of dolphins were sighted with calves indicating that the waters around Sri Lanka provide breeding grounds to many species. Sri Lankan waters hold a rich, but little surveyed cetacean fauna that warrants further study and implementation of conservation measures.

A review of cetacean research and conservation in Sri Lanka

Ilangakoon, Anoukchika D.

Sri Lanka is a developing island nation in the northern Indian Ocean with a long tradition of fisheries around its shores. The territorial waters of the island are rich in cetaceans with high species diversity and year-round abundance. However, present knowledge is limited due to a lack of dedicated research. The available scientific literature has records of stranded whales and museum specimens from as far back as 1889, while cetacean interactions with fisheries have been mentioned only since the mid-20th century. The first scientific records of live cetaceans based on direct vessel-based research observations were documented only in the early 1980's although travelers and historians have referred to whales in the waters around the island as far back as the 14th century. More recent research carried out in the last three decades has resulted in most of what is presently known about species diversity, threats and conservation issues. While large whales have been relatively safe in Sri Lanka's waters both in historical and present times, small cetaceans have become increasingly threatened due to the developing fisheries industry, with accidental by-catch being a major cause for concern. All cetaceans are now protected by national law in Sri Lanka but implementation of the relevant laws needs to be strengthened in order to achieve true protection. Both the prevailing gaps in knowledge and the lapses in law enforcement can be attributed to resource constraints in carrying out dedicated research and conservation measures in a developing country with more immediate human development priorities. Therefore development of sustained and long-term systematic research projects on cetaceans in Sri Lanka's waters is a priority need for the future.

A preliminary report on cetaceans from Bangladesh

Siddiqui, P.J.A., M.M. Hossain and M.S. Kiani

A preliminary survey for studying cetaceans was carried out in eastern section of Sundarban, covering Pasur and Balaswar Rivers up to Kachikhali Point in March 2009. A total of 210.7 km distance was covered. During the survey, a total of 22 cetacean sightings were recorded, including 18 sightings of Ganges river dolphin *Platanista gangetica* (46 adults and one calf), two sightings of Irrawaddy dolphin *Orcaella brevirostris* (4 individuals) and two sightings of unidentified small cetaceans (2 individuals). Sighting conditions were good throughout the survey period. Ganges river dolphins were predominantly recorded in the upper and middle sections of the channel, while Irrawaddy dolphin was sighted only in the lower section of the channel mouth. During the survey we also tried to record possible threats to cetaceans, which include competition for food resources due to the catch of fish and shrimp fry through set back nets (SBN) for aquaculture purposes, siltation due to damming, increasing salinity, heavy traffic, pollution, net entanglement, etc. Results indicate that cetaceans occur in these waters in good numbers but the information on their diversity, habitat, and actual abundance is not yet studied in detail. In addition, museum specimens were also studied indicating existence of three marine dolphin species and an unidentified baleen whale species. More surveys should be carried out in future for detailed studies for both the river dolphin and marine species of cetacean along the coastline of Bangladesh. Detailed studies will have a global significance for the conservation and management of cetaceans.

Cetaceans in Myanmar and the way forward

Tint Tun

The Union of Myanmar has 1280 km of coastline, which can be divided into three coastal areas namely Rakhine, Ayeyarwady and Tanintharyi. Cetaceans are found in both coastal waters and the Ayeyarwady River (formerly known as the Irrawaddy River). Fishing with Irrawaddy dolphins in the Ayeyarwady River is unique to Myanmar. Irrawaddy dolphins have been protected by law since 1994. Cetaceans are accidentally caught during fishing. Strandings of whales have been reported from Myanmar coastal area

and some whale skeletons are displayed at public recreation parks. The study of the cetacean fauna is a new subject for Myanmar. Awareness raising, capacity building, research and conservation of cetaceans are still in need.

Cetaceans and mass strandings in Thai waters

Kanjana Adulyanukosol, Kongkiat Kittiwattanawong, Amree Itae and Surasak Thaongsukdee

A total of 24 species of cetaceans were recorded in Thai waters (Andaman Sea and Gulf of Thailand) from stranding and sighting records since 1993. They belonged to 6 families: Balaenopteridae (3 species), Physteridae (1), Kogiidae (2), Ziphiidae (2), Delphinidae (15) and Phocoenidae (1). The strandings in the Andaman Sea were greater than in the Gulf of Thailand in terms of both species and number. Most skeletons of stranded animals were deposited at the Phuket Marine Biological Center. There were 6 records of mass strandings: (1) Nine spinner dolphins (*Stenella longirostris*) found at Talibong Island, Trang in January 1999; among the 9 carcasses, diagnoses were made from 6, and 3 were lost. (2) Five spotted dolphins (*Stenella attenuate*) stranded at Ban Ko Kho Khao, Phang-nga in February 1999; two dolphins were released and three died. (3) Eight spotted dolphins (*S. attenuate*) stranded at Mai Phai Island, Phang-nga in March 2006; five animals died and three were released. (4) About 30 false killer whales (*Pseudorca crassidens*) at Racha Island, Phuket in June 2008; 29 whales were released and 1 whale died from drowning. (5) Three rough-toothed dolphins (*Steno bredanensis*) at Ao Nam Bor, Phuket in July 2008; all dolphins were released to the open sea near Racha Island. (6) Nine Irrawaddy dolphins (*Orcaella brevirostris*) stranded at Ban Bor, Sumut Sakhon in March 2009; all dolphins were released at the same place. It was difficult to diagnose the causes of death of the stranded dolphins. However, it was likely that the first two strandings were caused by disease. In the third stranding, three dolphins were in good health, one was drowned and one was struck by a hard object and could not balance itself. In the last three strandings, dolphins appeared to be in good health, and strandings were possibly caused by navigation errors and/or the landscape of the stranding sites (narrow bay and wide flat with low sloped beach or man-made obstacle).

Session 2: Species Reports

Behaviour, ecology and population estimates for individual species or groups of species

Humpback dolphins in the south-western Indian Ocean: habitat driven divergence in population structure and geographic fidelity. Does that matter for conservation?

Karczmarski, Leszek and Almeida T. Guissamulo

This study applies population modeling techniques to investigate socio-ecological dynamics and population structure of humpback dolphins (*Sousa plumbea*) in coastal habitats of southern Africa. The *plumbea*-form of humpback dolphin occurs in the western Indian Ocean, where it inhabits a narrow strip of shallow inshore waters off the coast of Africa and southwest Asia. In the African region, the continued survival of a number of populations remains uncertain; habitat loss and incidental mortality represent the greatest threats. Here we compare findings of two photo-identification mark-recapture studies, conducted in Algoa Bay, South Africa, and in Maputo Bay, Mozambique. Using population modeling and multivariate techniques we investigate population structure, social dynamics and patterns of geographic fidelity of humpback dolphins in these two different coastal habitats. Off the exposed Eastern Cape coast humpback dolphins live in small dynamic groups, while less than 1300 km to the north, in the relatively sheltered Maputo Bay, they form considerably larger and more stable units of association. Along the Eastern Cape coast both males and females range over long distances, presumably in search of food, while the Maputo

Bay population shows significantly stronger geographic fidelity. It seems that the abundance of resources and intra-group scramble competition determine group size and stability, while the distribution of foraging grounds and other critical resources determine individual ranging patterns and effective availability of mates. All the above factors and the apparently habitat-driven differences have serious implications in determining population vulnerability; their incorporation into demographic models as part of population viability analysis could lead to better management practices.

Photo-identification mark-recapture studies on Indus delta Indo-pacific humpback dolphins of Pakistan

Muhammad Shoaib Kiani, Mauvis Gore, Pirzada Jamal Siddiqui

Characteristics of Indo-pacific humpback dolphins (*Sousa chinensis*) provide an excellent opportunity to identify individuals through photography. Systematic boat surveys for photo-ID mark-recapture studies of the Indus Delta Indo-pacific humpback dolphins were carried out during four years of research (2005-2009). The aims of the study were to categorize individuals based on fin marks, fin shape, colouration patterns and marks on the body, in order to investigate their distribution, relative abundance, group composition and residence patterns. A computer-assisted photo-identification technique was applied to the photo-ID archive. A total of 122 encounters, with 339 animals sighted, was achieved during a cumulative encounter time of 51 h and total linear distance covered of 3494 km. Indo-Pacific humpback dolphins were present in the Indus Delta throughout the year, though with the highest number of sightings occurring in the winter months. The major creeks of the delta proved to be areas of high relative abundance. Approximately 22% of the total number of groups sighted had at least one calf. All encounters with dolphins were at depths of 20m or less and only three surveys resulted in no sighting. On a number of occasions single dolphins were sighted while groups with two to sixteen individuals were seen frequently. On one occasion a group of 50 individuals was seen in the Khobar Creek, which is currently the most fished creek. Total number of dolphins in the Indus Delta is still difficult to quantify considering the great extent of area, but it seems to be in low hundreds. These results imply that the Indus Delta creeks are important as feeding grounds, for daytime rest and social interactions, breeding and nursery/calving grounds for this population of humpback dolphins throughout the year. In view of these findings, it is of utmost importance to develop a sound conservation and management strategy for this humpback dolphin population which will also help fulfill the national conservation strategy of Pakistan. The population is exposed to a number of threats including increasing competition for food resources, by-catch, boat strikes, deforestation, pollution and increasing marine traffic. However, without more in-depth studies it is not possible to determine why this area appears to be so important to this population.

Genetic affinities of common dolphins (genus *Delphinus*) occurring in the Arabian Sea

Amaral, Ana R., M. Manuela Coelho, Luciano B. Beheregaray, Kelly M. Robertson and Luciana M. Möller

Common dolphins (*Delphinus* spp.) are amongst the most abundant small cetacean species occurring in the Arabian Sea. However, little knowledge exists on these populations and their taxonomic status is still controversial. Initial descriptions of common dolphins in this area identified the occurrence of both the short-beaked (*D. delphis*) and the long-beaked (*D. capensis*) forms. A third nominal species with an extremely long-beak, *D. tropicalis* was also described from the area, but its validity has remained contentious. The most comprehensive morphological study conducted so far, based on skull collections from the Indo-Pacific region, suggested that only *D. capensis* occurs in this region and that the *tropicalis*-form is in fact a long-beaked subspecies of *D. capensis*, which could possibly hybridize with the *capensis*-form in some areas. In the present study, we provide a first, preliminary genetic analysis of common dolphins occurring off the Sultanate of Oman, identified morphologically as representing the *tropicalis*-form. We sequenced a 1121 bp-fragment of the mitochondrial cytochrome *b* gene for 20 common dolphins

from Oman. Representatives from the Atlantic and Pacific Oceans of both *D. delphis* and *D. capensis* were also included in the analysis. We found low levels of haplotypic diversity ($h = 0.520$) for Oman common dolphins, but nucleotide diversity levels were within values described for other common dolphin populations ($\pi=0.0056$). Three haplotypes shared with Northeast Pacific *D. capensis* were found, one of them also shared with *D. delphis* from the North Atlantic. In the phylogenetic trees estimated with both Maximum Parsimony and Bayesian methods, the *tropicalis*-form did not form a monophyletic group, and neither did *D. delphis* or *D. capensis*. These results suggest that the taxonomy within the genus *Delphinus* is far from being resolved. The *tropicalis*-form appears to be more closely related to the *capensis*-form, but the possibility of hybridization with the *delphis*-form cannot be ruled out. The phylogeny obtained in this study further suggests that migrants from both the *delphis*- and the *capensis*-forms from the Atlantic and Pacific Oceans could have evolved into the extremely long beaked type, locally adapted to the tropical waters of the Arabian Sea. Future studies should include additional samples from the *tropicalis*-form and a nuclear DNA based phylogeny in order to further clarify the taxonomic status of *D. tropicalis*.

Behaviour of spinner dolphins, *Stenella longirostris*, off Muscat, Oman

Ponnampalam, Louisa S.

Surveys following focal groups were conducted on spinner dolphins between May and November 2006 around the Muscat capital area in the Gulf of Oman. Surveys lasted on average 6.1 hours from morning until the late afternoon. The focal group's predominant behaviour was recorded every 15 minutes and all instantaneous events categorized as leaps and slaps were enumerated for each 15-min sampling interval. Group geometry and dive times were also recorded. Spinner dolphins off Muscat were consistently observed nearshore from the mornings through to the early afternoons between Muscat and Bandar al Khayran. The predominant activity during the morning was apparent inactivity (thought to be rest) interspersed with milling. However, slow travel dominated the overall behavioural budget of the dolphins and peaked in the mid-afternoon. Dive times were the longest during bouts of apparent inactivity and did not differ significantly between milling and slow travel. Feeding was only observed in the late afternoon. The mean group size of the focal group did not correlate with their behaviour and did not significantly change throughout the day. However, group geometry was correlated with the predominant behavioural state. Mean water depth traversed by the dolphins (as a function of time of day) was significantly different between morning and late afternoon. This result was a reflection of the dolphins' movement offshore towards the edge of the continental shelf in the late afternoon, presumably to feeding grounds. Additionally, aerial and surface activities increased three to four-fold in the late afternoon compared with the morning. Yellowfin tuna were frequently seen associating with the focal groups, while small groups of long-beaked common dolphins were sighted on some days and seen intermittently throughout the day with the focal group. The data indicate that spinner dolphins in Muscat are likely adapted to resting while slowly travelling in deeper waters in the afternoon before commencing feeding at the shelf break at dusk. Additional questions are raised and the results are compared with behavioural studies on conspecifics elsewhere.

Spinner dolphins off tropical East Africa: group dynamics, daily occurrence, and 'unusual' pattern of behaviour

Karczmarski, Leszek

This study provides a baseline description of spinner dolphin (*Stenella longirostris*) behavioural ecology in the semi-pelagic habitat of Pemba Channel, East Africa. Fieldwork was conducted off the north-western coast of Pemba Island, Zanzibar Archipelago, Tanzania, over a 3-month period, mid-January through mid-April 2005. Spinner dolphins were seen daily; the animals approached the western shores of Pemba in mid-morning, generally moving in a northerly direction along the island's shoreline. This northerly movement

was predominant in the morning (92.5%), followed by movement offshore either north-northwest or southwest in early afternoon. Group size ranged from less than a hundred to several hundred animals; although some individuals were resighted throughout the study period, the overall group structure was fluid with membership varying from day to day. The pattern of group dynamics and predictable daily occurrence resemble that of spinner dolphins elsewhere. However, the daily behaviour of animals at Pemba differed considerably from what has been described for spinner dolphins in other locations. During the majority of encounters, the predominant behaviour was foraging, which took place over the slope of the island in the vicinity of fringing reefs and at entrances to inland lagoons. This active foraging during day-time, undocumented elsewhere for spinner dolphins, could be an expression of behavioural adaptability to local environmental conditions; the location of sites where foraging occurred suggests that bottom-living and reef-associated prey represent important food items for spinner dolphins in this region. Alternatively, it is possible that the spinner dolphins off Pemba represent a subspecies, the dwarf spinner dolphin (*S. l. roseiventris*), which is thought to be diurnally active and forage on reef-associated prey. The seemingly smaller size of the animals off Pemba is in accordance with such a supposition, although genetic data proved inconclusive. The population size and range remain unknown, but both are likely to be extensive. Genetic data, although limited, indicate a large genetic diversity, supporting further the notion of a large, possibly interbreeding population. Such a population is likely to range over large distances, including pelagic waters away from the direct vicinity of the island. However, their daily occurrence off Pemba's northwest shore and frequent use of a limited number of preferred locations indicates that there are certain sections of the Pemba Island coast that are particularly important, possibly vital, in the daily lives of spinner dolphins in this region.

Aspects of habitat use of *Stenella longirostris* and *Tursiops aduncus* within the dolphin watching zone on the west coast of Mauritius

Cadinouche, Adèle, I. Webster and V. G. Cockcroft

Both spinner dolphins (*Stenella longirostris*) and Indo-pacific bottlenose dolphins (*Tursiops aduncus*) are widely distributed in tropical and subtropical waters. Since both use near shore habitats they are susceptible to anthropogenic activities. As such it is important to determine critical habitats for effective conservation management of these species. Preliminary results from the period 20 August 2008 to 24 February 2009 provide baseline data on the habitat use of the bottlenose and spinner dolphins that occur along the west coast of Mauritius. A total of 48 boat-based surveys resulted in 152 h of observation effort of which 123 h was with spinner dolphins (n=33) and 29 hours with bottlenose dolphins (n=12). 82% of observed time with the spinner dolphins was spent within the three bay areas; when tested this was significantly different to the time spent outside the bays (ANOVA $p=0.0011$). The major activities (significantly different Tukey-Kramer test $p<0.05$) within the bays were resting and socializing comprising 70-80% of this time. Outside the bays the predominant activity was travelling. Since October 2008 there has been a decrease in the proportion of time spent in the Bays while and increase in travel time. In addition, initial analyses of activity budgets indicate a reduction in resting and socialising. In comparison the bottlenose dolphins do not appear to use specific areas for any particular activities being found throughout the study area although with further surveys patterns may become apparent. Data collection will continue to determine whether changes in habitat use are results of seasonality or the dolphin watching activity in the area. In addition, final results will be used as a tool for future conservation measures.

Organ weights of three dolphin species from South Africa

Plön, Stephanie and K. Albrecht

Historical data on organ weights are available in the literature for a number of baleen whale species from examinations carried out on whaling stations. However, there appears to be a lack of information on organ weights in small odontocetes. Such data can contribute significantly to the knowledge on the ecology of a species, but are also becoming increasingly important as baseline information against which to monitor disease-related and other pathological changes. In the present study we examined organ weights from 724 common dolphins *Delphinus capensis*, 624 bottlenose dolphins *Tursiops aduncus*, and 145 humpback dolphins *Sousa chinensis* from the Port Elizabeth Museum marine mammal collection. These data were collected from animals incidentally caught and drowned in the anti-shark nets off KwaZulu-Natal, South Africa, between January 1974 and August 2007. The animals were dissected and data subsequently accessioned to the museum database. Liver, spleen, heart, left and right kidney, lung, trachea, left and right testis, pancreas and brain masses were all examined in relation to the body weight of the animals. Differences in organ weights between the sexes and adult and juvenile animals within and between species were investigated. In common dolphins the heart was heavier in relation to body weight (females: $0.62\% \pm 0.09$; males: $0.62\% \pm 0.11$) than in bottlenose dolphins (females: $0.60\% \pm 0.11$; males: $0.60\% \pm 0.17$), while in humpback dolphins it was the lightest (females: $0.52\% \pm 0.06$; males: $0.52\% \pm 0.09$). Common dolphins also had the largest testes, making up $2.21\% (\pm 0.73)$ of the total body weight in adult males, while adult bottlenose dolphins showed a mean combined testis weight of $0.61\% (\pm 0.24)$. Humpback dolphins had the smallest testes in relation to body weight with $0.43\% (\pm 0.13)$. The relationships of other organ weights to body weight and length will also be discussed. Heart and other organ weights in relation to body size may reflect the ability of the different species to travel long distances at high speed, while testis size in relation to group size is thought to be an indicator of the mating system of a species. In view of that, our results reflect the different ecologies of the three dolphin species: common dolphins are oceanic animals, traveling long distances at high speeds and occur in large groups of up to 500-1000 animals. Bottlenose dolphins form medium-sized groups and travel considerable distances along the coastline, while humpback dolphins occur inshore in small groups and do not appear to travel long distances.

The need for taxonomic investigations on northern Indian Ocean blue whales (*Balaenoptera musculus*) based on year-round occurrence off Sri Lanka and India

Ilangakoon, Anoukchika D. and Kumaran Sathasivam

The blue whale (*Balaenoptera musculus*) is one of the most commonly encountered cetacean species in the waters around the island of Sri Lanka. These northern Indian Ocean waters presently have one of the highest sighting rates for this species worldwide. We examined authentic sighting records of this species from the waters around Sri Lanka as well as published stranding records from the coasts of both Sri Lanka and India to determine seasonality of occurrence in these waters. The results of this analysis show that the species is present in these waters at all times of the year. These findings raise questions about the stock affinities and sub-specific status of these animals because this entire population, or a substantial part of it, is non-migratory at present. However, it is not known if this has been a constant phenomenon over the ages, due to the lack of historical data from these waters. If these animals have been non-migratory over long periods of time, it is even possible that they are of an entirely different subspecies from the two that are presently recognized for the Southern Ocean and Indian Ocean region. This question is further compounded by some museum specimens available in the two countries, of very large animals indicating true blue whales of the subspecies *B. m. intermedia*. However, that subspecies is known to undertake clearly defined, annual, latitudinal migrations and is generally found south of 55°S in the austral summer. Migratory patterns of the other recognized subspecies in this region *B. m. breviceuda* are less clearly defined and the apparently non-migratory behaviour of the northern Indian Ocean blue whales is more

akin to this subspecies. As no genetic analyses have been carried out on blue whales from these waters, it is not definitively known at present if they belong to either of these known subspecies from the region or if they are of an entirely different or intermediate subspecies displaying morphological characteristics of *B. m. intermedia* and behavioural patterns similar to *B. m. brevicauda*. Based on this hypothesis, we suggest that it is of urgent importance to obtain samples from these animals and carry out molecular biological studies in order to clarify their taxonomic status. Such investigations would be of the utmost importance in the context of long-term conservation and maintenance of genetic diversity.

Blue whale occurrence off the south coast of Sri Lanka with a preliminary investigation of factors affecting their aggregation

de Vos, Asha, R. Charles Anderson and Anoma Alagiyawadu

In the northern Indian Ocean, blue whales (*Balaenoptera musculus*) aggregate in numbers along the southern coast of Sri Lanka. Preliminary observations on seasonality, water depth and chl-a associations as well as plans for future work were presented.

Seasonal distribution and movements of blue whales, *Balaenoptera musculus*, in the northern Indian Ocean

Anderson, R. Charles, Trevor A. Branch and Francis Marsac

There appears to be a distinct population of blue whales, *Balaenoptera musculus*, in the northern Indian Ocean. The taxonomic status of these animals is uncertain; they are most frequently assigned to *B. musculus brevicauda*, but are probably referable to *B. musculus indica*. The migrations of these blue whales within the northern Indian Ocean are also poorly understood. This paper reviews sightings, strandings, captures and acoustic data and presents a migration hypothesis. It is suggested that most of these whales feed in the Arabian Sea off the coasts of Somalia and Arabia during the period of intense upwelling associated with the southwest monsoon. At the same time some blue whales also feed in the upwelling zone off the southwest coasts of India and Sri Lanka. When the southwest monsoon dies down in October these upwellings cease. The blue whales then disperse more widely in the region to eke out the leaner months of the northeast monsoon. Some blue whales feed off the east coast of Sri Lanka during this season. These whales pass by the north of Maldives and south of Sri Lanka in November-December, while heading eastwards, and return westwards in April-May.

Blue whales of the Savu Sea, Indonesia

Kahn, Benjamin

A multi-year visual and acoustic survey and research program has been conducted in the Savu Sea of eastern Indonesia, to investigate its ecological significance for large oceanic cetaceans and to assess the sustainability of a traditional sperm whale fishery in Lamalera, Lembata Island. This program has identified the Solor-Alor Island region as one of the most important habitats for oceanic cetaceans in Indonesia, as characterized by: exceptional cetacean species and habitat diversity (deep-sea yet near-shore); consistent distribution of large cetaceans (blue and sperm whales), relatively close to shore; relatively high abundance of blue whales (for Indonesian waters); high degree of cetacean species interactions (mixed schools and predator-prey activities including orca-sperm whale attack); important and/or critical habitats for multiple cetacean species (marine corridors like Ombai Strait between Alor and East Timor; major seasonal upwelling zones); intense fisheries pressures – sperm and baleen whales are target species for the traditional whaling communities; modern fisheries activities have a high potential for cetacean by-catch;

and significant potential and government interest to develop whale watching. In May-July 2005, two archival satellite tags were successfully deployed on sperm and blue whales, a first for Indonesia and possibly SE Asia. The blue whale's pop-up tag transmitted on 1 July 2005 at 7.3°S 130.4°E, after 60 days and 685 km minimal (straight line) distance from its initial position. The blue whale's overall path was in a general ENE direction and passed Alor, Ombai Strait, East Timor, Wetar, Bar Bar and Yamdela Island groups and ended in the SE Banda Sea. The blue whale dive results show (1) a distinct diel pattern in diving behaviour, with the blue whale diving relatively frequently over 200m in the daytime, suggesting feeding; and (2) significant temperature changes at depth, indicative of dives through thermoclines from 29°C - 13°C between 0- 265m depth (the oceanography of the area is strongly influenced by the Indonesian Throughflow). If this individual is typical, blue whales may spend at least several months per year roaming throughout the eastern Indonesian Seas. The high proportion of time spent at or near the surface during night-time hours by this blue whale does imply an increased vulnerability to fisheries interactions such as net entanglements. Off-shore gillnets, a common fishing method throughout Indonesia, are of particular concern, as are long-lines. Another potential threat is the common fishing practice of reef bombing (which may have acoustic as well as more direct impacts). In addition, ship strikes are an unknown, yet possibly significant threat to blue whales. The Savu Sea research area includes two major shipping channels between the Indian Ocean and east Asia, and these are also known to be used as migratory corridors by large cetaceans. It seems likely that at least part of the blue whale population within Indonesian waters migrate to/from Western Australia and beyond. Continued photo-identification and ecological field studies, satellite telemetry and genetic analysis may well shed light on this possibility. A large-scale 3.5 million hectare Marine Protected Area (MPA) was declared in May 2009 for the Savu Sea seascape, with the primary aims of better managing these rapidly increasing pressures on cetaceans and other large marine life, to safeguard their associated habitats, and to develop sustainable fisheries for local communities (an estimated total of 4.5 million people are dependent on the seas in this region). Such a management framework would also be needed to develop responsible whale watching activities in this remote region. Importantly, the initiative will boost the representation of 'deep-sea yet near shore' habitats in Indonesia's MPA networks. This conservation approach may be relevant as a model for the migratory passages in Papua New Guinea and the Solomon Islands, which are both large archipelagic nations with a high diversity and abundance of cetaceans.

Satellite derived movements of pygmy blue whales in the SE Indian Ocean

Gales, Nick J., Double, M., Jenner, C., Robinson, S., Gedamke, J and King E.

Pygmy blue whales are known to aggregate and feed during the austral summer in the shelf-edge waters off SW Australia. This population is thought to migrate seasonally to lower latitude waters to calve, but the location of these calving habitats and the linkages between them and the more southerly feeding grounds remain uncertain. This study will utilise satellite-linked radio transmitters deployed into the blubber and under-lying muscle to track the movements of whales from their feeding grounds to the northerly breeding grounds. The tags have proved to provide effective tracking data for humpback whales, and will be deployed on blue whales in early April 2009. At the time of writing this abstract, the tags have not been deployed, but by July 2009 it is hoped that up to 4 months of data will have been acquired. We intend to report on the spatial movements of these blue whales.

Genetic connectivity of blue whales in Australia

Attard, Catherine, Luciano Beheregaray, Curt Jenner, Peter Gill, Naohisa Kanda, Micheline Jenner, Margaret Morrice, John Bannister, Chris Burton, Michael Double, Rick LeDuc and Luciana Möller

Whaling has dramatically reduced the abundance of blue whales (*Balaenoptera musculus*) worldwide, leading to their classification as endangered by the International Union for the Conservation of Nature. In the Southern Hemisphere two subspecies have been identified: the 'pygmy' blue whale (*B. m. brevicauda*) in lower latitudes and Antarctic 'true' blue whale (*B. m. intermedia*) in higher latitudes. Australia has two known feeding aggregations in upwelling regions, one in the Perth Canyon, Western Australia and the other in the Bonney Upwelling, South Australia and Victoria. Blue whales are also reliably sighted annually in Geographe Bay, Western Australia, though the function of the bay to blue whales is currently unknown. There is also limited knowledge about genetic connectivity between putative blue whale populations and recognised subspecies. This study includes an investigation of the connectivity of the two Australian feeding aggregations, the subspecific identity of blue whales in Geographe Bay, and the level of gene flow between the two recognised Southern Hemisphere subspecies. Preliminary results based on both nuclear and mitochondrial genetic markers suggest no significant genetic differentiation between the two Australian feeding aggregations and low gene flow between the two subspecies. We also present our future research plans and discuss the implication of current results on conservation management.

Do fin whales live in the Northern Indian Ocean?

Brownell, Robert L. Jr

The fin whale, *Balaenoptera physalus*, is generally assumed to live in all the World's oceans. There are a few records of fin whales from the northern Indian Ocean, mostly from strandings. However, none of these records has been positively confirmed as a fin whale. It is likely that most were misidentifications of blue whale (which was often called fin whale in the past) or Bryde's whale (which has a prominent dorsal fin). During illegal Soviet whaling in the 1960s, some 3000 great whales were taken from the northern Indian Ocean; not one was a fin whale.

Humpback whales in the Indian Ocean Sanctuary: Illuminating population structure, dynamics, and connectivity from multiple lines of evidence.

Rosenbaum, Howard C., Pomilla, C., Mendez, M., Leslie, M.S., Best, P.B., Findlay, K.P., Minton, G., Cerchio, S., Ersts, P.J. Collins, T. Baldwin, R., Kotze, P.G.H., Meÿer, M., Razafindrakoto, Y., Vely, M., and Kiszka, J.

It is often presumed that traits for humpback whales described from studies in the northern hemisphere should apply to those in the southern hemisphere, with any differences linked to austral seasonality. However, a series of dedicated studies in the Indian Ocean reveal novel population structure and migratory patterns for humpback whales that were either unknown or counter to traditional assumptions. Our collaborative studies over the past decade, extending from the Antarctic to areas near the Equator, utilize large-scale genetic comparisons from wintering grounds, migratory corridors, and Antarctic feeding grounds (n>2000 individual whales) and integrates multiple lines of evidence including: photographic identification, acoustic comparisons, and reconsideration of whaling records. In the southwestern Indian Ocean, genetic differentiation exists with relatively high rates of exchange of effective migrants/generation occurring between the three proposed sub-populations. Genotypic recaptures between sub-populations within the Indian Ocean and across to the South Atlantic Ocean suggest a series of intricate relationships between wintering ground populations. Comparisons of whales sampled in the Antarctic feeding grounds (n=332) with wintering ground samples reveals even greater complexities for migration and connectivity than previously anticipated. We extend these comparisons to the small population of humpback whales in the northern Indian Ocean, and illustrate the very different population dynamics, genetic factors, and potential recovery patterns detected. Additional comparisons are made with populations in the eastern Indian Ocean off the coast of Australia. Overall, our findings for humpback whales in Indian Ocean illustrate: (1) significant population structure within and between wintering grounds; (2) intriguing patterns

of migrations, connectivity and interchange between populations; and (3) relationships with Antarctic feeding areas. This synthesis is particularly timely with the 30th anniversary of the Indian Ocean Sanctuary, and provides needed research showing the utility of Sanctuary for conservation of cetaceans. Finally, we show how these approaches can be used for projects that are in earlier stages of development involving other cetacean species in the Indian Ocean Sanctuary.

Humpback whale monitoring at Isle Sainte-Marie, Madagascar and in Comoros Archipelago (Western Indian Ocean), from 1999 until 2008, based on whale-watching

Vély, M., J-J. Bastid, M. Perri, F-X, Mayer, N. Rabearisoa, S-M. Ibrahima and N. Bertrand

Megaptera, an association for knowledge, observation and conservation of marine mammals, has conducted monitoring on humpback whales (*Megaptera novaeangliae*), at Isle Sainte-Marie, Madagascar (site 1), and around the four islands of the Comoros Archipelago (site 2). Monitoring was carried out on board ecotourism boats, during the whales' migration to breeding grounds in the austral winter, from 1999 to 2008. The objectives of this study were to better understand: (1) humpback whales movements in Western Indian Ocean, within the same site and between the two sites, both within and between seasons; and (2) the significance of the two sites for humpback whale reproduction. Flukes identification photos have been obtained from more than 500 individuals from site 1, and more than 150 from site 2. More individuals, photo-identified by one or both sides of the dorsal fin at both sites, and fluke photo-IDs collected from 1994 to 1997 at site 1, were added to this study. Whales appear to be more numerous and active (singers) at site 1 than at site 2. The two sites are different in terms of composition and percentages of whales groups. The photo-ID matching within each site shows differences in the length of time the whales are using each area. They appear to stay longer at site 2 than at site 1. No photo-ID matching has been successful between the two sites either during the same season or between seasons. Sites 1 and 2 are probably used in different ways by the whales, as far as breeding is concerned. Fewer whales stay for longer in Comoros Archipelago than in Isle Sainte-Marie, which appear to be a major site for reproduction in the western Indian Ocean (similar to Antongil Bay, Madagascar). Some matching between Antongil Bay and Mayotte has been described by Rosenbaum. The plan for the future is to verify if Isle Sainte-Marie and Comoros Archipelago share some individuals during different breeding seasons and even during the same season. Right whales (*Eubalaena australis*) were sighted twice during this period in Madagascar.

Predictive modeling of right whale (*Eubalaena* sp.) calving habitat in the Indian Ocean

Good, Caroline P. and A.J. Read

Worldwide, right whales migrate each winter from high latitude foraging grounds to lower latitude calving grounds where females give birth and remain with their calves for an extended period of time. We used sightings data from one well documented right whale calving ground off the southeastern U.S. to develop a model of optimal calving habitat based on the depth, surface temperature and surface roughness associated with calf presence (n=633). Physical data were obtained from satellite derived and directly measured sources. We employed Bayesian multivariate density functions to identify habitat parameters for model input and Receiver Operator Characteristic (ROC) curves to determine optimal habitat thresholds. We applied the model to the Indian Ocean to investigate how conditions preferred by right whales for calving in the northwest Atlantic compared with right whales elsewhere. The models correctly identified several well-known calving areas along the coasts of South Africa and Australia as well as historic calving zones off West Africa. Additionally, the model suggests additional areas which may provide optimal calving habitat. In some regions, including Mozambique and Tasmania, the model failed to detect known or historic calving habitat because these areas occur outside the optimal temperature ranges defined by the model.

Session 3: Conservation and Management

Surveys, fisheries, marine protected areas, whale-watching

Deep-sea yet near-shore cetacean habitats within the Marine Protected Area Networks of Indonesia: managing critical habitats for migratory and oceanic whale species

Benjamin Kahn

The Savu Sea is positioned in eastern Indonesia at the nexus of two oceans. It boasts an exceptional diversity and abundance of whales and dolphins, and includes critical habitats such as migratory bottlenecks (or marine corridors) for large whales as well as upwelling zones of regional importance within the Indo-Pacific. The Savu Sea's main corridor, Ombai Strait, is a transboundary passage between Indonesia and East Timor. An extensive and on-going cetacean survey and research program has been conducted by APEX Environmental and its partners since 2001, to investigate: (1) the area's ecological significance for oceanic cetaceans and other large migratory marine life; and (2) the sustainability and other aspects of a traditional Savu Sea sperm whale fishery, in collaboration with the local community of Lamalera on Lembata Island. Thus far, this program has identified the Solor - Alor Island region as one of the most important habitats for oceanic cetaceans in the Indonesian Seas, and possibly SE Asian waters. A total of 18 cetacean species have been identified during 336 encounters over 51 field days and 367 h covering 2916 nm and 112 hydrophone listening stations. Photo identification studies were conducted for two great whale species, the sperm (*Physeter macrocephalus*) and blue whale (*Balaenoptera musculus*), as well as for several oceanic dolphin species. Rare apex predator-prey interactions (orca-sperm whale attack) have been observed, as have various fisheries activities which may have an unsustainable (by)catch of cetaceans. Satellite tagging results on sperm and blue whales indicate that: (1) these whale species spend considerable time in the Indonesian Seas; (2) their movements range 1000's km; and (3) the narrow, yet deep-sea passages of Solor-Alor and the wider Savu Sea function as multi-species migratory bottlenecks. A large-scale 4.5 million hectare Marine Protected Area is currently under development for the Savu Sea seascape by the Ministry of Fisheries and Marine Affairs, with technical assistance from this program and other partners. It aims to better manage the increasing local pressures on these vulnerable megafauna species and their 'deep-sea yet near-shore' habitats. This approach builds on a similar cetacean management initiative in Raja Ampat, Papua Barat, Indonesia. Its Dampier Strait MPA has been expanded from 46,240 ha to 301,886 ha, based largely on its ecological significance as an important canyon and corridor habitat for large cetaceans including sperm and Bryde's whales as well as numerous small odontocete species. These initiatives will increase both coverage and representation of deep-sea yet near-shore habitats under protective management, with a beneficial effect to the planning and functionality of Indonesia's Marine Protected Area (MPA) network.

Coastal dolphin hunting in Madagascar: status of populations, human impacts and conservation actions

Cerchio, Salvatore, Norbert Andrianarivelo, Martin Mendez, Yvette Razafindrakoto and Howard C. Rosenbaum

In the southwest of Madagascar, traditional Vezo fishermen opportunistically hunt coastal dolphins for local consumption and sale of meat. Interviews with fishermen from the village of Anakao suggest that over 6000 individuals were slaughtered between 1985 and 2000, with 57% of takes occurring after 1995. Species most impacted were spinner, Indo-Pacific bottlenose and Indo-Pacific humpback dolphins, all having a strong coastal distribution and thus vulnerable to traditional hunting. In 2005, a drive hunt of 100-200 spinner dolphins was reported, supporting the figures reported in the interviews. Between 2004 and 2007, boat-based surveys were conducted in this region to establish status of cetacean populations. Eight

species of dolphins and two species of baleen whales were observed. At least five deep-water dolphin species were documented, highlighting the diversity and ecological importance of the region. Distributions of the three targeted species were primarily coastal and encounter rates very low. In 2008, similar surveys were conducted around Nosy Be in the northwest, where Sakalava fishermen are thought to not hunt dolphins. Group size of humpback dolphins was three times larger and individual encounter rate six times greater in Nosy Be than at Anakao. This dramatic difference suggests that the Nosy Be population is relatively healthy and provides further evidence for the depletion of southwest populations. In response to the apparent impact on dolphins, we have initiated a program of education and awareness-raising, and implemented a series of stakeholder workshops to promote economic alternatives to dolphin hunting in the southwest. This has resulted in the creation of a local Association formed of community stakeholders, with the explicit goals of cetacean conservation, economic advancement and development of community-based ecotourism in a region with a rapidly developing tourism industry. In addition, we are currently exploring the design of MPAs aimed to serve as resilient areas of marine life.

Cetacean monitoring from platforms of opportunity - more bang for less bucks!

Rowat, David

This presentation provides information on and examples of cost effective methods for long term monitoring of cetacean abundance using platforms of opportunity and data from surveys targeted at other species. Sighting data from different opportunistic sources are presented and compared, and advantages and disadvantages highlighted. Data sources include: daily boat-based coastal surveys; observer sighting data from vessels transiting offshore; ship's log-book data; aerial survey data; and random opportunistic sightings made by the public. Data from planned surveys with some measure of sighting effort provided significantly more information than opportunistic sightings made by the public. Log-book data sources combined with some measure of effort were useful but data derived often lacked species identification unless recorded by a trained observer. Aerial sighting data both from surveys targeted on cetaceans and also derived from surveys aimed at other species provided good synoptic data on abundance and distribution but also lacked species identification. Long term monitoring of cetaceans is resource hungry and expensive, prohibiting its implementation by many nations especially Small Island Developing States. The use of platforms of opportunity can provide acceptably accurate data once the limitations of the method of assessment are established. Surveys for other species and monitoring and compliance measures can also provide significant information at relatively low/no cost. Optimising facilities provided by platforms of opportunity can enable effective long term monitoring with relatively limited resources.

Cetaceans surveys as platforms of opportunity for seabird studies

Perera, Lester D. and Anoukchika D. Ilangakoon

Sri Lanka, a tropical island in the northern Indian Ocean, has a high avifaunal diversity, including endemics, residents and migrants. While research studies on land birds have been carried out in the island for well over a century, pelagic seabirds have been the least studied group. This is primarily due to the financial and practical constraints of examining a group of birds that are often difficult to study through land-based surveys. Likewise, dedicated vessel surveys to study seabirds alone are a luxury too costly for a small developing country. Therefore most records of seabirds were the result of sightings from coastal viewpoints and the occasional stranding. Several of these initial sightings were considered vagrancies due to a lack of substantial information relating to them. Another important group of little studied mega-fauna that abound in Sri Lanka's waters are the cetaceans. As some of these cetaceans are known to be endangered worldwide and because they are a charismatic group of large mammals, funding for research on them is more readily available. As a result some externally funded, dedicated vessel-based cetacean

surveys have been carried out in Sri Lanka's waters in the last few decades. In the course of these surveys some opportunistic data on seabirds were also recorded and even resulted in the addition of new species not known to occur in Sri Lanka before. These discoveries indicated that dedicated vessel-based cetacean surveys could become an important platform of opportunity for pelagic seabird observations and data collection in countries such as Sri Lanka that lack the resources for specific seabird surveys. Therefore, in 2008 we initiated a joint cetacean and seabird survey off south-western Sri Lanka in order to test this hypothesis. The objective was to pool the available resources and maximize the benefits of data collection for both these important faunal groups, using compatible survey methodology. This presently ongoing survey has already yielded very positive preliminary results in the very first field season. We present an overview of these preliminary results and benefits of this combined survey here, with an emphasis on how cetacean surveys can become successful platforms of opportunity for seabird studies in developing countries.

OBIS-SEAMAP: An online portal for visualizing marine mammal observations

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Our understanding of highly migratory marine mammal, seabird and sea turtle species is often limited to analysis of individual data sets developed in a single region and over one time period. Due to the large ranges of these animals, we need to examine multiple data sets collected over large areas and long time periods from various data providers. Such data sets should be made available through a common, coherent, interoperable and openly accessible information system. We attempted to meet this need in 2002, when we founded OBIS-SEAMAP (<http://seamap.env.duke.edu/>), a repository and web-based portal for marine mammal, sea turtle and seabird data sets. In this presentation we provide an introduction to the unique visualization, data query, and data backup features of OBIS-SEAMAP, with particular attention to the marine mammal community. OBIS-SEAMAP brings together geo-referenced species observation and telemetry data with tools to query and assess these species in a dynamic and searchable environment. Some of the benefits of this approach include: (1) mapping species distributions together with oceanographic information; (2) visualizing species distributions with a multi-resolution, spatially and temporally interactive online map interface; and (3) searching and downloading data of interest using multi-faceted criteria. To date, the OBIS-SEAMAP portal includes more than 2.2 million records from 244 datasets, spanning 74 years (1935-2009). These data are provided by a growing international network of data providers and growth of this data archive is accelerating as the values, usefulness and benefits to data providers of OBIS-SEAMAP are being recognized. We have identified a large gap in our global representation in the Indian Ocean, with only a handful of marine mammal datasets. We hope to develop collaborative relationships with researchers from this region to fill this gap and provide better worldwide coverage for future analyses.

Fishing communities and cetaceans in Pakistan

Umer Waqas, Mauvis Gore, Babar Hussain, Shoaib Kiani, Ejaz Ahmad

Fishing communities have been living for generations along the Pakistan coastline with the Arabian Sea. It stretches 1050 km across Sindh Province bordering India and Balochistan Province bordering Iran. The majority of coastal communities are solely dependent on fishery resources. Small cetacean by-catch, however, presents a serious threat both here and worldwide to conservation of cetacean species. It was essential to work with and reach out to the fishers and coastal communities of Pakistan, to learn about their knowledge and provide information on cetaceans, and to assess their interaction and attitude towards these animals. We established good working relationships with fishers and coastal community

members, visiting each village a number of times. We provided information on marine cetacean biology and threats to cetacean conservation both verbally and with printed material. We collected information on their sightings, and on beach casts and strandings of cetaceans through formal interviews using questionnaires developed for this purpose. Through the interviews, we gained knowledge of the attitudes and the types of interactions fishers and villagers had with cetaceans. We then conducted a workshop each for fishers from both Sindh and Balochistan to discuss how best to work towards accommodating cetaceans with fishing. Attitudes to marine cetaceans varied both within and between communities, and basic knowledge of cetaceans was poor. The names used for cetacean species related to the level of knowledge and interest of the fishers. It was also noted that some cetaceans were being targeted both directly and as by-catch. The beach cast and stranding data provided information on species not often seen at sea during boat surveys, although the cause of death was often difficult to investigate given the environmental conditions. The sightings reported supported our boat survey findings. Continued interaction with the fishers and coastal community members is key to improving the knowledge we gain on the marine cetaceans of Pakistan. It is also vital to reducing the incidence of threats to the cetaceans within the fishing range of local fishers, although large commercial fishers need to be approached separately. Increased knowledge of marine cetaceans and their importance to the environment appears to be bringing a gradual change in attitude of the coastal community members, which will improve the conservation of the cetaceans. Valuable data has been and can continue to be gained on beach cast, strandings and sightings through links with these communities.

Mitigating depredation in the Seychelles' semi-industrial longline fishery

Lucas, Vincent, Rabearisoa, N., Giroux, F., Vély, M., Rowat, D., Gendron, D., Tixier, P., Adam, O. & Guinet, C. Semi-industrial longline operators in the Seychelles sustain economic loss as a result of depredation by cetaceans on longline-captured fish. Trials were carried out to investigate mitigation of these losses. An analysis of depredation data collected by the Seychelles Fishing Authority since the onset of the semi-industrial longline fishery targeting swordfish and tuna in 1995 revealed an overall depredation rate of 21%, representing 4.2 fish lost/1000 hook. This was regarded as one of the highest loss rates in the world. For swordfish only, which is the main target species (60% of catches), it was estimated that the economic loss was about €340/1000 hook set, representing an overall loss of nearly €1,000,000 over the 1995-2006 period. Based on anecdotal information from fishers, the main culprits were presumed to be short-finned pilot whale (*Globicephala macrorhynchus*), false killer whale (*Pseudorca crassidens*) and several pelagic sharks. Given this high depredation rate and the significant economic loss they cause, an action plan to mitigate depredation by cetaceans on the Seychelles semi-industrial longline fishery was drawn up. Three research cruises were conducted onboard commercial semi-industrial fishing vessels between 2006 and 2008. The first trip conducted in 2006 had the following objectives: (1) to understand the fishing operation in order to design suitable mitigation devices; (2) to identify marine mammals involved in depredation on semi-industrial longline fishery; and (3) to identify and record acoustic signals generated by the vessel which may attract predators. The second trip, conducted in 2007 was mainly to test the mitigating devices. Improved versions of the devices were tested in 2008. The study shows that several species of cetaceans are likely to be involved in depredation on the semi-industrial longline fishery. Spinner dolphins, Risso's dolphins, pygmy killer whales and rough-toothed dolphins were identified in the vicinity of the fishing gears and were considered to be potential depredators. Tests of the 'SPIDER' mitigating devices, while initially promising, were ultimately not very successful; furthermore fitting the device on the fishing gear took considerable time and effort. Initial tests of a second device aimed to provide total physical protection to the captured fish yielded similar results and were inadequate especially for swordfish. A further trial is planned with an improved version of the device.

Cetaceans and dugong research and conservation project in the IOC countries (Comoros, France/Reunion, Madagascar, Mauritius and Seychelles)

Etienne, Denis and Adèle Cadinouche

An Indian Ocean Commission (IOC) regional project for research and conservation on cetaceans and dugong in the south-western part of the Indian Ocean Sanctuary, implemented by a multi-stakeholder network, has been designed and funding is almost identified. An IOC regional workshop was held in Madagascar in July 2007 to design this project. 50 participants represented the five IOC country delegations, civil society (NGOs and private sector), donors and scientific organisations. The goal of the project is to protect cetaceans and the dugong, improve scientific knowledge and promote sustainable ecotourism, by actions of conservation, research and education through an efficient network of all stakeholders, in the Indian Ocean Sanctuary and specifically in the IOC countries. The project is designed with six thematic components. (1) Creation of a regional network and institutional guidance. (2) Research and capacity building. (3) Cetacean-fisheries interactions (depredation and mortality). (4) Development of sustainable ecotourism. (5) Education and sensitisation. (6) Research and conservation on dugong in Madagascar, Comoros and Seychelles. A concept paper based on the conclusions, outputs and recommendations of the Madagascar workshop was proposed to the partners and potential donors during a workshop in November 2008 in Seychelles. A summary of this document will be presented at the current Indian Ocean Cetacean Symposium.

Assessing international priorities for marine mammal conservation

Thomas, Peter O.

The United States Marine Mammal Protection Act of 1972 (MMPA) established the Marine Mammal Commission (www.mmc.gov) as an independent Federal oversight agency that reports to the U.S. Congress on actions and policies to protect and conserve marine mammals. The MMPA imposed a prohibition on taking marine mammals, including sirenians, pinnipeds, cetaceans, marine otters and polar bears with the overall goal of maintaining the health and stability of the marine ecosystem. The MMPA and the work of the Marine Mammal Commission include both domestic and international elements, reflecting the international nature of marine mammal populations and the human activities that impact them. International priorities must be set on the basis of assessment the status and trends of marine mammal stocks and the factors that threaten them, and the identification of the management actions needed to ensure their conservation. The Indian Ocean Cetacean Symposium provided information on some, but not all Indian Ocean cetacean populations and described severe threats, especially for small coastal cetaceans. The level of scientific awareness is promising, but management and conservation efforts for small cetaceans in the Indian Ocean are sorely lacking at the local, national and international levels. There are few resources and few sources of political will to support national management efforts. The International Whaling Commission's Scientific Committee considers small cetaceans, but stronger links can be forged between marine mammal conservation and other international and regional biodiversity and marine conservation efforts in the region. The global conventions such as the Convention on Migratory Species and the Convention on Biological Diversity should consider conservation of marine mammal biodiversity alongside coral reefs and other marine priorities and regional fisheries management organizations are well placed to address issues of marine mammal by-catch and depredation in the Indian Ocean region.

Community-based management and rehabilitation of cetaceans and sea turtle in the southern part of Andaman Sea, Thailand

Praulai Nootmorn, Kanjana Adulyanukosol, Kongkiat Kittiwattanawong, Sonthaya Boonsuk, Chinkorn Thongchai and Amnuay Kongprom

Community-based management and rehabilitation of cetaceans and sea turtles by fishers on the Sarai Islands, Satun Province, in the southern part of the Andaman Sea, Thailand has been encouraged since 2006. A biologist officer has built capacity on species identification, data collection, surveillance and first aid-care among the local fishers. Fishers have become aware of the depletion of cetacean and sea turtle populations as a result of accidental captures in fisheries. A total of five species of cetacean were recorded, based on stranding and sighting records since 1999. They belonged to 4 families: Balaenopteridae, Ziphiidae, Delphinidae and Phocoenidae. The species most frequently recorded was Irrawaddy dolphin (*Orcaella brevirostris* n>25), followed by finless porpoise (*Neophocaena phocaenoides*, n>20) and humpback dolphin (*Sousa chinensis*, n>14). One Irrawaddy dolphin and one Bryde's whale (*Balaenoptera edeni*) were released alive in the open sea. Strandings reported included one Irrawaddy dolphin, one Bryde's whale and one Cuvier's beaked whale (*Ziphius cavirostris*). Most skeletons of stranded animals were deposited at the Phuket Marine Biological Center. Four species of sea turtle were recorded: green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), olive ridley turtle (*Lepidochelys olivacea*) and loggerhead turtle (*Caretta caretta*). Green turtle was the most frequently recorded. Eleven green turtles, two hawksbill turtles, one olive ridley turtle and one loggerhead turtle were released alive to the sea. A sanitarium was built to rehabilitate sea turtles. The stranded records reported were one green turtle and one hawksbill turtle.

IWC, IUCN and the Australian Government: roles in cetacean research and conservation in the Indian Ocean Sanctuary

Gales, Nick

No abstract

ANNEX 4.

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