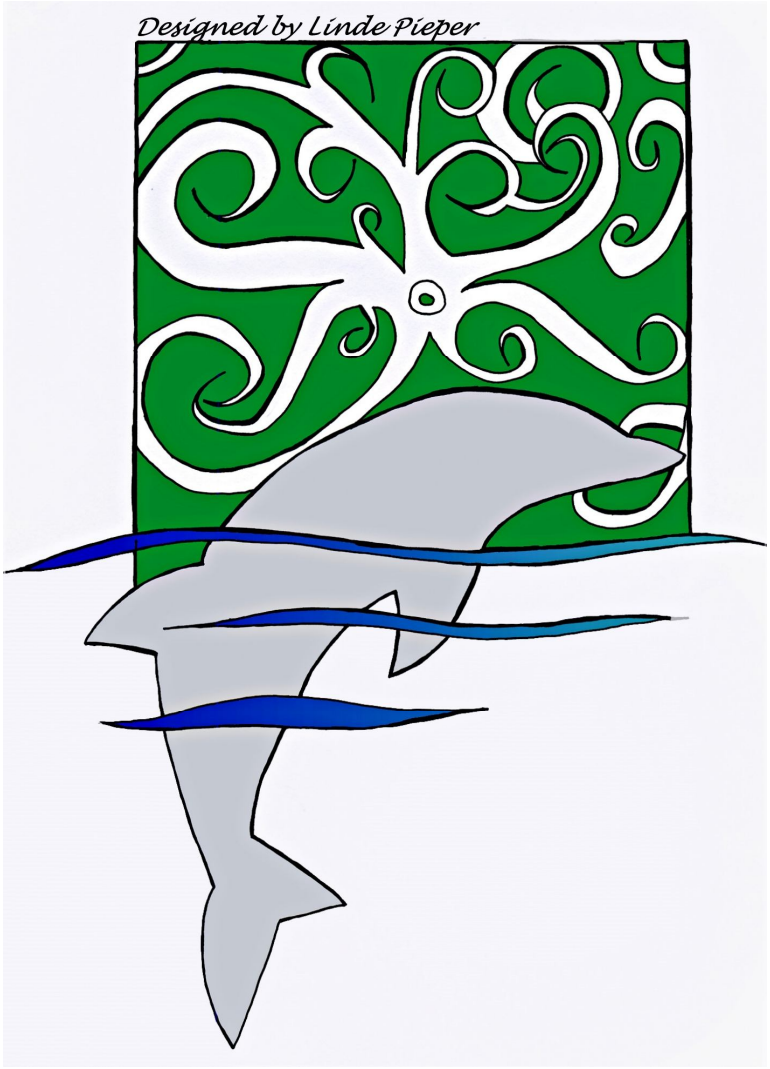


Determining and quantifying threats to coastal cetaceans: A regional collaborative workshop

February 22-24, 2011

Permai Rainforest Resort (Kuching, Sarawak)

FINAL REPORT

Edited by Gianna Minton and Brian D. Smith

FOREWORD

By Randall Reeves, Chair of the IUCN Cetacean Specialist Group

There was a time when the impetus for most meetings and workshops on marine mammals in southern Asia (as well as Africa and South America) came from North America and Europe. In those days, Asian marine mammalogists were working largely in isolation, on shoestring budgets and with minimal (if any) institutional support. Their work rarely made it into the mainstream scientific literature. When they occasionally managed to attend an international conference, it was mostly to learn about discoveries made by scientists from elsewhere, using tools and study methods that were, or seemed, inaccessible. Thank goodness those days are behind us.

The workshop in Kuching is a good, but by no means unique, example of how things have changed over the last couple of decades. It was conceived and organized within the region and supported by an Asian conservation foundation. Participants came from many parts of southern Asia, most of them with advanced degrees and solid experience. A few carefully selected experts from outside the region were invited, not just to lecture and pontificate but to engage in peer-to-peer discussions. As is plainly evident from the workshop report, those discussions were lively and frank, just as one would expect from such a capable and motivated group.

Like most workshops, this one generated a long wish-list of follow-up activities. Some of these may prove difficult in some parts of the region, but I'm encouraged by the practical tone of the report. The participants clearly were not starry-eyed novices, nor were they dismissive cynics. It is a challenge to balance realism and idealism, and this group did an admirable job of striving to achieve such a balance.

The problems discussed at the workshop can be addressed only partly through science. Although it is important to know what species are present and in what numbers, their ecological needs, how many are dying in fishing gear, and how the animals respond to various kinds of human activity, that isn't enough. We also need to know what makes us humans do what we do and how our behaviour can be modified to reduce our impacts on the natural environment. It is vital to pose some of the tough questions raised at this workshop, such as those having to do with the pros and cons of nature-oriented tourism, whether to engage with industry and if so how, and the most effective means of conducting community outreach and education. However, getting at the human dimension of conservation is not what most biologists and ecologists have been trained to do, so there is a clear need for us to collaborate more closely with economists and social scientists as well as with fishermen, teachers, journalists, tourboat operators and other people who are part of local communities.

The Sarawak Dolphin Project at the Universiti Malaysia Sarawak is to be commended for the painstaking, thorough, and considerate way the workshop was planned and conducted. By all accounts, those lucky enough to attend were inspired, informed, and treated to unmatched local hospitality. It is impossible to measure precisely the "success" of an event like this one. In the coming months and years, it will be difficult even for those directly involved to know how their individual thinking, options, and choices were affected. The metric that will matter most, by far, is to what extent the workshop, and the many connections established among those involved, have helped to create a better future for coastal cetacean populations in the region.

Finally, it's important to acknowledge the principal workshop sponsor, Ocean Park Conservation Foundation, Hong Kong (OPCFHK). Over the last two decades OPCFHK has become a regional force for conservation. In fact, not just this workshop, but also much of its underlying groundwork in research, education, and awareness, is a legacy of OPCF support.

WORKSHOP SUMMARY

The "Determining and quantifying threats to coastal cetaceans: A regional collaborative workshop" was hosted by the Universiti of Malaysia's Sarawak Dolphin Project and funded by the Ocean Park Conservation Foundation, Hong Kong (OPCFHK). Participants (27) from the Asian region were resident for 3 days and 4 nights in the Permai Rainforest Resort, overlooking the Salak-Santubong Bay, one of the core habitats of Irrawaddy dolphins and finless porpoises in Sarawak. The core participants were from Peninsular and East Malaysia, Bangladesh, Brunei, Hong Kong, India, Indonesia, Myanmar, the Philippines, Sri Lanka and Thailand, with international representation from the USA, Australia and Britain. The opening ceremony included presentations and participation by local stakeholders, academics, and NGOs.

The workshop focused on identifying key gaps in our knowledge of coastal cetaceans in Southeast Asia, evaluating techniques for determining and quantifying threats, and using the results from scientific studies for conservation management. The emphasis was on small cetaceans with near- and inshore distributions that do not extend beyond the continental shelf: the Irrawaddy dolphin *Orcaella brevirostris*, finless porpoise *Neophocaena phocaenoides*, Indo-Pacific humpback dolphin *Sousa chinensis*, and Indo-Pacific bottlenose dolphin *Tursiops aduncus*. Participants also recognized that nearshore waters in Southeast Asia provide vital habitat for populations of some pelagic species (e.g., spinner dolphins *Stenella longirostris* and dwarf spinner dolphins, *S. longirostris roseiventris*) and support at least two large baleen whales: small-form of Bryde's whales *Balaenoptera edeni* and Omurai's whales *B. omurai*.

Topical presentations were given by international experts and case studies were presented by regional participants. Research and monitoring techniques were discussed for conducting population and bycatch assessments, establishing stranding networks, and investigating the impacts of coastal and freshwater development. Developing strong partnerships with local fishing communities, national universities, government agencies, and nature tourism operators was stressed.

During three days of presentations, discussions, and exchange of reference and media materials, workshop participants identified the following knowledge gaps that hinder effective conservation and management:

- The size, range and identity of populations, information particularly important for species with restricted and patchy distributions such as those occurring along the complex coastlines and island archipelagos of Southeast Asia;
- Details on bycatch, including the gears responsible, species involved and mortality rates, which present a special research challenge due to the small-scale and diverse nature of coastal fisheries in Southeast Asia;
- Basic ecology and life history parameters of species populations, including survival rates, prey composition, and habitat preferences, information vital for conducting viability analyses and assessing the impacts of environmental changes associated with declining freshwater supplies, coastal reclamation and climate change; and
- Resource use and the socioeconomic status and attitudes of human communities, which is essential for incorporating their needs in, and ensuring their support for, conservation plans

Workshop participants agreed on the following recommendations for research and monitoring:

- Genetic studies should be undertaken to assess population identities and isolation. If (sub) populations are found to be genetically distinct, greater priority should be placed on implementing measures to protect them.
- An emphasis should be placed on risk assessment techniques including statistical analysis of trends in relative abundance and modelling the spatial and temporal overlap between cetacean distribution and threats.

- Increased use should be made of passive acoustics to detect cetacean presence, especially for those species that are difficult to detect visually (e.g., finless porpoises) and are located in inaccessible locations or at times of year when visual/boat surveys are not practical. Acoustic hard- and software is becoming more user-friendly, effective and less expensive.
- Standardized fisheries/community questionnaires should be developed, shared and adapted to local conditions so that the results can more easily compared across the region. The content of the questionnaires should be guided by ethical standards required by many universities and research/funding bodies and include a statement informing respondents of these standards.
- Shore-based surveys should be considered as an alternative to boat surveys in locations where suitably high observation platforms are available, especially when investigating behavioural responses to potential disturbances from coastal construction or vessel traffic.
- Platforms of opportunity, including tourism and seismic, fisheries, and oceanographic survey vessels, should be used as feasible to collect data on cetacean distribution, abundance, and responses to anthropogenic activities.

Workshop participants also made the following recommendations for networking and follow-up workshops:

- Strong communication should be maintained between researchers in the region by initiating an e-mail bulletin board or e-discussion forum. The Sarawak Dolphin Project agreed to set up and moderate such a forum to enable easy exchange of news, reports, resources, photographs, and published papers.
- A series of training workshops should be organised with a focus on (1) estimating population parameters using line-transect, shore-based, photo-identification, and acoustic surveys, (2) necropsies to determine the cause of death, (3) spatial modelling, and (4) assessing the status of populations according to IUCN Red List criteria.

Workshop participants on final day in Permai Rainforest Resort

ACKNOWLEDGMENTS

The Workshop Organising Committee would like to thank the Ocean Park Conservation Foundation, Hong Kong for providing the funding to make the workshop possible. Sarawak Shell Bhd. made a very generous contribution of 4GB pen drives for each workshop participant to promote and facilitate the exchange of valuable resources and files during our 4 days together. The Permai Rainforest Resort provided excellent meeting facilities, food and accommodation and continues to offer invaluable support to the Sarawak Dolphin Project. The Universiti Malaysia Sarawak (UNIMAS), provided transportation, administrative support, and other vital logistical support for the workshop. Finally, we would like to thank all of the workshop participants and speakers, many of whom (partly) subsidized their own travel costs to join us. We look forward to continued collaboration in years to come!

CONTENTS

CORE WORKSHOP PRESENTATION ABSTRACTS AND Q AND A

Keynote presentation – Conservation status of coastal cetaceans and priorities for assessment and monitoring in Asia

Brian Smith – Director, Asian Freshwater and Coastal Cetacean Program, Wildlife Conservation Society and Asian Coordinator, IUCN Cetacean Specialist Group

Objectives of the talk

- Provoke ideas and encourage discussion.
- Review conservation considerations and the cetacean species in SE Asia.
- Share ideas on prioritizing threats, species and populations.
- Share ideas on conservation management, monitoring and research.
- Inspire action and collaboration.

Special challenges for conserving coastal cetaceans in Southeast Asia

- Complex and extensive coastlines and island archipelagoes make comprehensive surveys difficult or impossible to achieve.
- Shoreline complexity and the clumped distribution of freshwater input mean that populations are often isolated by natural barriers.
- Poverty, dense human populations and increasing extreme climate events mean that the subsistence needs and economic well being of local people generally take precedence over wildlife conservation.

Review of the species – their distribution, abundance, and ecology

- Irrawaddy dolphins are "Vulnerable" due to low population sizes (10s to low 100s, except in Bangladesh and Thailand), a declining range, and severe threats from bycatch and habitat loss. This "freshwater-dependent" species occurs in deep pools of large rivers, lagoons and coastal waters with freshwater inputs.
- Finless porpoises are "Vulnerable" due to population declines in some areas (e.g., Yangtze River and inland Sea of Japan) and widespread threats from bycatch and habitat loss. Three subspecies are recognized, probably within two species, which adds concern for conserving their full range of genetic diversity. Finless porpoises are found in shallow bays, estuaries, and some large rivers.
- Indo-Pacific humpback dolphins are "Near Threatened." The total population size of the "species" is probably more than 10,000 mature individuals. Population reductions can be inferred due to bycatch and habitat loss in coastal and estuarine waters. Similar to finless porpoise, there is growing evidence that *S. chinensis* includes two or possibly more species. This means they could be at greater risk than indicated by their current RL status.
- Indo-Pacific bottlenose dolphins occur widespread in multiple local populations in the Indo- Pacific. Bycatch and habitat loss may be affecting the species. Lack of data precludes a rigorous assessment. The species generally occurs in shallow waters over the continental shelf, around oceanic islands, and at the edges of submarine canyons.
- As a species spinner dolphins are "Data Deficient" but annual kills on the order of 100s or 1000s have been reported from the Indian Ocean. The *roseiventris* or dwarf subspecies is distributed in shallow waters of SE Asia, including the Gulf of Thailand, the Timor and Arafura Seas, and shallow waters of Indonesia, Malaysia, and probably Myanmar.
- Other pelagic species occur close to shore in some areas but in deep water so they are not considered as coastal. Populations of these species are generally not demographically isolated so they are at reduced risk compared to coastal species.
- The small form of the Bryde's whale *Balaenoptera edeni/brydei* and Omurai's whale *B. omurai* have been described as having a coastal distribution in Asia. Both species are among the most poorly known cetaceans and the difficulties in telling them apart make assessing their status even more challenging. These whales have been hunted by artisanal whalers in Indonesia and the Philippines and their nearshore distribution makes them vulnerable to fisheries interactions and habitat degradation.

What are the threats to coastal cetaceans in SE Asia? - moving beyond laundry lists.

- Some threats must be addressed with immediate conservation action. Waiting for the results of additional research could result in the extinction of populations or species.
- Bycatch is almost certainly the most dire threat to the persistence of coastal cetacean populations.
- Wherever entangling nets and small cetaceans are found together there will be mortalities and injuries.
- Bycatch can evolve into directed hunts as traditional taboos against the killing and eating of cetaceans break down and markets develop for their products.
- These hunts can threaten cetacean populations especially when combined with incidental catches.
- In some areas habitat loss and degradation, vessel traffic and harassment from dolphin-watching tourism may be threatening populations.
- Prey depletion from overfishing by both commercial and artisanal operations may also be seriously affecting some populations.
- Long-term environmental changes in estuaries from excessive freshwater withdrawals cause habitat loss for cetaceans that depend on freshwater inputs.
- Warming ocean temperatures may cause cetaceans to shift their range in a poleward direction. The northern Indian Ocean and parts of the Asian Pacific are ecological "cul-de-sacs" where range shifts are impossible.

Short-term threats that must be addressed immediately to avoid loosing populations and species

- Bycatch
- Directed hunts
- Live-captures

Removals must be significantly reduced.

Long-term threats that should be addressed but are generally not critical to the immediate survival of species and populations

- Habitat loss
- Prey depletion
- Pollution
- Climate change
- Harassment

To a certain degree coastal cetaceans may be resilient to withstand these threats if they are not already dead. But we still know very little about these potential long-term threats. For instance:

- What are the ecological implications of changing freshwater regimes from water development and climate change for freshwater-dependent cetaceans?
- Do coastal cetaceans die from vessel collisions versus a carcass colliding with a ship after it has died of other causes?
- What are the pathological effects of chemical contaminants, and what can we do beyond adding to the call for reducing inputs into the environment?
- What is the relationship between behavior changes caused by dolphin- watching tourism and swim-with-dolphin programs, and survivorship and fecundity?

Rigorous research is needed to address these questions. A participatory approach can achieve strong results. Monitoring will be required to assess the effectiveness of management measures to reduce or eliminate mortalities from bycatch and directed hunts. This includes field surveys and the establishment of community based and government supported mortality monitoring networks. The limited ability to detect trends in the abundance and mortality of cetaceans, especially at low population sizes, means that it is often more effective to directly monitor threats with surveys of fishing operations and fish markets.

Priorities for conserving coastal cetacean species in SE Asia

- For all its limitations the IUCN Red List provides a useful mechanism for identifying species and population at the greatest risk.
- Priority species in SE Asia include Irrawaddy dolphins (VU), finless porpoises (VU), and to a lesser extent Indo-Pacific humpback dolphins (NT).
- Priority populations include Irrawaddy dolphins in the Malampaya Sound (CR) and Indo-Pacific humpback dolphins in the Taiwan Strait (CR).

- A major emphasis of the Red List subgroup of the IUCN SSC Cetacean Specialist Group is to assess demographically isolated populations. One priority is the Chilika Lagoon population of Irrawaddy dolphins in India.
- Another might be Irrawaddy dolphins and finless porpoises in Sarawak where researchers found fairly low encounter rates of 0.2 and 0.13 groups/hr, respectively, in nearshore waters.
- 50% of all sightings of Irrawaddy dolphins were within 50 m of deployed gillnets.
- Others? – Identification of priority populations for RL assessment would be a useful output of this workshop.

Some populations may have declined to levels too low for conservation interventions to be effective.

- Virtually no cetaceans were recorded during extensive surveys in Vietnam but researchers documented an extremely high density of gillnets and 16 species from bones at whale temples.
- Another example of a "lost" population may be Songkhla Lake, Thailand, where aerial surveys in 2004 indicated that the population size is probably less than 20 individuals. The high density of fixed fishing gears (~40,000; >8000 km of linear barrier), which isolates the population, and the deaths of 1-7 dolphins per year, mostly from fishery interactions, do not provide much reason for hope.

A strong argument could be made that we also need to prioritize conserving populations that still occur in sufficient numbers for early conservation interventions to be effective. Ambulance chasing is not an efficient way to conserve wildlife.

- For instance in Bangladesh researcher recorded 5,383 Irrawaddy dolphins (CV=39.5%) and 1,382 finless porpoises (CV=54.8%)
- Another example of a priority population might be Irrawaddy dolphins in the northeast Gulf of Thailand which supports about 1,400 individuals.

Then there are populations of coastal cetaceans in SE Asia that we do not even know exist. For instance Irrawaddy dolphins were not recorded in the Philippines until 1995 (Malampaya Sound). This was the only location where the species was known in the Philippines until a record was reported from the Ioilo Strait in 2005. A survey then revealed their occurrence along the Guimaras coast in 2007, and near Bago-Pulupandan in 2009.

Region-wide surveys will be difficult or impossible to achieve because the species occur along complex shorelines and in archipelagos.

- There is a need to develop habitat profiles for coastal cetaceans and then use these profiles to select unsurveyed areas that are likely to support viable populations of threatened species. The models would then need to be field tested and refined. At a smaller scale interview surveys can also provide information on potential hotspot sites to be confirmed with field surveys.

In summary, priorities for addressing threats

- Immediate management interventions are needed to reduce bycatch and directed hunts.
- Additional research is needed to determine if other factors are threatening populations and species.

Q and A reflected in panel discussion that followed (p. 21).

By-catch monitoring: A brief overview:

Simon Northridge, Sea Mammal Research Unit, University of St. Andrew's, Scotland

This presentation included a brief overview of the various methods that can be used to assess levels of cetacean (or other species) by-catch in fisheries. The methods discussed included:

- "Indirect" methods:
    - Anecdotal accounts
    - Strandings
    - Interview surveys
    - Reward schemes
    - Logbooks
    - Fishery research surveys
- Direct monitoring
    - Video
    - Onboard observers
    - Independent platform observations at sea

    - Contracted fishermen - self reporting
    - Fish-landing site inspections
- Scarring analysis
    - From strandings
    - From Photo ID/ catalogues scar analysis

Whatever method for bycatch assessment is chosen, a critical first step is getting a thorough overview of the fisheries gear involved and levels of fishing effort. While indirect methods usually suffer from biases introduced by unreliable memories, unreliable recording by fishermen, direct methods are particularly challenging to implement in small scale artisanal fisheries. Where indirect methods are used, it is a good idea to use some forms of direct methods to "ground truth" the results from indirect methods like interviews or stranding analyses. In any assessment, direct relations with the fishing industry or fishing communities is vital:

- Important to have community 'on-side'
- Conservation is about changing people's behaviour – not to be confused with confrontation
- Bycatch mitigation should complement monitoring as needed
- Transparency vital – must be clear what information being sought will be used for.

Published references or reports to support this presentation include:

- Moore, Cox et al 2010. An interview based approach to assess marine mammal and sea turtle captures in artisanal fisheries. Biol Conservation 143:785-805
- Northridge, S. and Fortuna, C., 2008. Protocol for data collection on bycatch and depredation in the ACCOBAMS region. International Workshop on Bycatch within the ACCOBAMS Area, FAO, Rome, Italy (2008). Available at: http://www.accobams.org/

Q: There has been a lot of controversy over certification programmes as a means of promoting consumption of "sustainably" caught or "tuna friendly" fish. How can these schemes be applied to small artisanal fisheries?
A: Certification programmes are constantly adapting, and it is possible to produce consumer guides such as the Malaysia WWF and MNS guide to sustainable seafood: www.saveourseafood.my

Means to quantify threats from fisheries and fisher's use of cetaceans' core habitat through on board Fisheries observations (including interviews with crewmen) and landing site inspections

Louella Dolar (Tropical Marine Research for Conservation (TMRC), LLC)

Fishery activities are one of the major threats to cetaceans in many parts of the world. This threat is more immediate in South and Southeast Asian countries where the coastlines are long, where a great proportion of the human population lives by the coast and where fishing activities are very intense. Fishing methods documented to incidentally catch cetaceans include gillnets, purse seines, driftnets, trawls, longlines, trammel nets, fish and crab traps, fish corrals and weirs. Incidental cetacean catches or "by-catch" by these fishing methods is estimated to be about 300,000 per year globally. Coastal cetaceans including the Irrawaddy dolphin (*Orcaella brevirostris*), Indo-pacific humpback dolphin (*Sousa chinensis*), Indo-Pacific finless porpoise (*Neophocaena phocaenoides*), Indo-Pacific bottlenose dolphin (*Tursiops aduncus*), Omura's whale (*Balaenoptera omurai*), and a subspecies of spinner dolphin, the dwarf spinner dolphin (*Stenella longirostris roseiventris*) are in greater risk because their habitats overlap with areas greatly used by humans. Compounding the risk is the fact that in some cases their populations have been greatly fragmented and in the case of Irrawaddy dolphins their populations are very small. Also, by-catch in many developing countries has an ambiguous meaning. Often many fisheries have multiple targets, and almost everything that is caught has value, either commercially, for domestic consumption or as bait. Moreso, it has been shown that in some places, the target species have shifted to include former by-catch.

By-catch has been shown to impact cetacean populations, reducing them to levels from which it may be difficult for them to bounce back. However assessment of by-catch is a difficult endeavor. Important steps involved in assessing threats from fishers are 1) inventory of fisheries, 2) prioritization of fisheries / regions and 3) collection of data. Inventory of fisheries includes listing all the types of fishing methods and gears used in the area of interest, their sizes and license numbers if available, listing target species, and noting the area and season of fishing. Fisheries should then be prioritized as to which types are likely to have by-catch, how grave the threat to cetacean populations is, involvement of endangered species, viability of the habitat and of the population(s) and accessibility of the area to be studied. By-catch data can then be collected using one or a combination of the following: 1) interviews (though easy

and cheap, can be inaccurate and unreliable), 2) on-board monitoring, 3) landing site inspections, 4) putting observer boat at sea to observe fishing activities and 5) examining strandings for evidence of by-catch. On-board monitoring and landing site inspections are two methods that are the most direct and relatively reliable. However, they require substantial resources and direct access to fishing vessels and landing sites, respectively.

On-board monitoring can be traced back to the eastern tropical Pacific (ETP) where it was first used. In the 1950's and 1960's, hundreds of thousands of dolphins were deliberately caught and died in purse seines annually. The fishing method was anchored in the ecological/behavioral relationship between yellow fin tuna and dolphins; they associate closely in that region, and catching the dolphins allows catching the tuna with them. Pressure from the public and provisions of the U.S. Marine Mammal Protection Act resulted in the government putting observers on the purse seine vessels to monitor by-catch. This together with the improvement in fishing gear has brought by-catch to about only 1,000 dolphins per year, which should be sustainable. In Southeast Asia there are two known occasions where on-board monitoring of by-catch was carried out. The first was by the Earth Island Institute in the Philippines in May-August, 1992 as part of its "Dolphin Safe" international program and the other one was by Saifullah Jaaman in Sarawak, as part of research for his doctoral dissertation.

The steps involved in setting up on-board monitoring include 1) determination of the fishing method that poses the greatest threat to cetaceans, 2) consulting or coordinating with the government and if possible an international organization, 3) linking up with the owners of the vessels to explain the project, get permission to board, determine fleet size, know the landing sites, fishing schedules and seasons and areas fished, 4) recruiting or hiring observers, 5) training observers on how to identify cetaceans and gather necessary information/data from the by-catch, how to fill out data sheets, how to use camera, GPS, etc., 6) setting up boarding schedule and boarding observers. There should always be contact with the person in charge of deploying the fishing fleet for changes in fishing schedule and fishing grounds. Four types of data sheets are important in gathering needed information: 1) vessel record that includes detailed information on the type of fishing vessel (e.g. length, size, gross tonnage, engine, capacity, boat captain's name, number of crewmen, etc.), 2) vessel activity and effort log – this includes the observation effort as the boat travels to the fishing ground, its speed, track, environmental conditions and cetacean species sighted along the way, 3) cetacean sighting forms that detail the species, location and approximate number of cetaceans sighted along the way to the fishing ground, and 4) set record that includes details about the set made, e.g. location, time and environmental parameters when the set was made, whether set was made around fish aggregating device (FAD) or not, whether intense mercury lights were used during the set, species of fish caught, volume of catch, duration of set, absence or presence of dolphins when set was made, dolphins and other species of by-caught animals, species, size, sex of by-caught animals, how the by-caught animals were handled, etc. If dolphins are present in the area where the set is made, behavior of the animals should be noted before, during and after the set. Adjustments and changes should be made on the protocol to suit the type of fishing vessel and area. If the fishing method impacts the habitat, detailed observations on how this happens should be made.

Inspection of landing sites requires lesser resources than on-board monitoring and is relatively easier to execute. However, it has its limitations. In places where dolphins are protected by law, boats may discard its by-caught animals at sea for fear of reprisal from the authorities and the public. Also, vessels may decide to change landing sites anytime they want. Information to be obtained from landing sites includes types of fishing methods that have cetacean by-catch, description of the vessel and fishing method, fishing effort, seasonality of fishing, fishing grounds, target species, and types/species of by-catch. For the specific fishing vessel that has a cetacean by-catch, more detailed information should be obtained on fishing effort and fishing ground for that day (e.g. soaking time of net, number of hours fishing) as well as fishing grounds covered throughout the year and quantification of annual fishing effort. The species, number, size and sex of by-caught cetaceans should be noted and photographs taken. If possible other information and samples should be collected (e.g. skin sample for DNA analysis, stomach contents, skull, skeleton, etc.). This information and the samples can be useful in understanding the ecology of the species concerned and the extent of the impact of the fishery in the population. Landing sites should be visited on a regular basis and be covered over a long term period if possible. If a trained fisherman or local cooperator is employed in collecting data, the need to collect accurate data should be emphasized, and spot checks should be made.

Collecting data on by-catch should be complemented with cetacean population studies in order to give meaning to the numbers obtained. An assessment of the abundance of the cetacean(s) of interest will enable determination of the impact of by-catch on the population. Removals above 2% annually are considered unsustainable and warrant conservation action. Results of these studies should be shared with local stakeholders and governments in order to design mitigation actions and if possible identify other economic options for the fishermen.

Diagnosing and quantifying threats from fisheries to coastal cetaceans in their core habitat: A case study from Bangladesh:

Rubaiyat Mansur Mowgli, Elisabeth Fahrni Mansur, Brian D. Smith (WCS, Bangladesh Cetacean Diversity Project)

The nearshore waters of Bangladesh support a taxonomically diverse and relatively abundant cetacean fauna, which correlates with a wide diversity of environmental gradients (river-sea and shallow-deep) available within a relatively small area and the enormous biological production driven by extreme fluvial and oceanographic processes. These highly productive waters also provide a vital source of food and livelihoods for the estimated 35 million people living in the coastal areas of Bangladesh with an extensive production of fish and invertebrates.

Interactions with fisheries could potentially threaten the long-term viability of the coastal cetacean populations in Bangladesh. For example, approximately one third of the photo-identified Indo-Pacific bottlenose dolphins at the head of the Swatch-of-No-Ground of Bangladesh exhibited injuries that were almost certainly related to entanglements with fishing gear. Evaluating cetacean bycatch levels and the types of fishing gears responsible for incidental kills is therefore a research priority. By correlating fishing gear types with wound types, the ranking of threats from different gear types to coastal cetaceans present in Bangladesh will be possible.

In order to diagnose and quantify threats from fisheries to coastal cetaceans in their core habitat the identification of core habitat for each species, core fishing grounds according to gear types, and possible interactions and conflicts between cetaceans and fishing activities are required.

Measureable outcomes from Bangladesh so far include a) the identification of core habitat for several species and core fishing grounds according to gear types; b) three new Wildlife Sanctuaries recognized for their importance in regards to cetaceans in the process of being officially declared; c) completion of the field work for an assessment of the abundance, movement patterns and fishery interactions of Indo-Pacific humpback dolphins including detailed records of fisheries activities, intensity and gear types; d) set-up of photo-identification catalogues for Indo-Pacific bottlenose dolphins with a total of 1144 individuals, and Indo-Pacific humpback dolphins with around 100 individuals identified so far; e) systematic collection of records and samples of cetacean carcasses through a Mortality Monitoring Network, and f) a floating dolphin exhibition featuring cetaceans and their needs reaching over 5000 members of fishing communities.

Q: You refer to a network of protected areas that will be officially declared within the next 6 months. What will the mitigation measures be in these protected areas – what will be the implication for fishers who live in them?
A: The BCDP will suggest some options – such as gear restrictions or adaptations and/or seasonal closures, but the exact measures and how they will be enforced is still being determined together with the fishing communities and the government. A workshop bringing these key stakeholders together is planned for April 2011.

Q: How were the boundaries of the protected areas determined?
A: Refer to the following paper: Brian D. Smith, M. Abdullah Abu Diyan, Rubaiyat Mowgli Mansur, Elisabeth Fahrni Mansur and Benazir Ahmed (2010). Identification and channel characteristics of cetacean hotspots in waterways of the eastern Sundarbans mangrove forest, Bangladesh. Oryx, 44, pp 241-247 doi:10.1017/S0030605309990159

Q: What if there is a shift in the distribution of the dolphins after the protected areas are put in place and the "core areas" are no longer core areas (as occurred in the Mahakam)?
A: The provisions for the declaration of the protected area include a stipulation that they should be re-evaluated every 10 years.

Q: Would it be possible to share the criteria used in wound analysis of dorsal fin photographs for signs of fisheries interaction?
A: A slide was shown and shared the next day with very clear examples of different types of gear-induced scarring.

Q: Is there any formal collaboration between Bangladesh and India for the cetacean research or conservation management efforts in the Sundarbans?
A: Not yet.

Using indirect means to assess fishing gear interactions:
Simon Northridge, Sr. Lecturer at St. Andrew's University, and Advisor to the UK Government on cetacean bycatch

Entanglement in fishing gear can often leave telltale signs. Post mortem analysis can help to identify the type of gear involved in the by-catch. Rope, twine or mesh often leave impressions on the skin. Having samples of the types of twine most often used can allow researchers to match up twine/rope to impressions, and taking imprints/casts of the impressions using dental putty/plaster can also be useful. Measuring the distance between nodes or knot impressions can help to determine the mesh size of the gear involved. Impressions/marks may be feint or difficult to identify, so that time and good lighting may be required to observe the patterns left on the skin. Some marks such as rope marks may also be caused post mortem if the carcase has been moved and incisions can be made to check for subcutaneous bleeding/bruising, which can only take place before or at the time of death and not afterward (as would be the case if rope had only been used to tow a dead animal).

Animals can sometimes survive for long periods with gear attached to their body, with skin healing over entanglement wounds. Those that survived encounters sometimes bear entanglement scars which can be used to generate estimates of the proportion of a population that has interacted with fishing gear. Some dorsal fin nicks and tears may also be caused by entanglement, and a coordinated approach will be needed to identify the characteristics of such scars.

Published references or reports to support this presentation include:

- Robbins, Landry & Mattila 2009 Estimating entanglement mortality from scar-based Studies, Report to the Scientific Committee of the International Whaling Commission, SC/61/BC3

Q: What material do you use to take casts/impressions?
A: An embedding material such as Histomer made by Histotech, which is designed to make casts of organs.

Q: How do you distinguish anthropogenic scarring from that caused by normal social/aggressive interactions between animals?
A: This can be difficult and probably has to be investigated thoroughly for each different species and maybe even population. An ongoing unpublished study in the UK is comparing scarring that could be examined closely on carcasses with scarring in photos of live animals, and may help to provide useful guidelines in the future.

Deep Sea yet near-shore cetacean habitats of Indonesia: Managing critical habitats for migratory and oceanic whale species.

Benjamin Kahn, APEX Environmental, Coral Triangle Oceanic Cetacean Program

The Savu Sea is positioned in eastern Indonesia at the nexus of two oceans. It boosts an exceptional bio-diversity and abundance of whales and dolphins and includes critical habitat, 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:
a) the area's ecological significance for oceanic cetaceans and other large migratory marine life.
b) 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. A total of 18 cetacean species have been identified to date during 336 encounters over 51 field days and 367.0 hours covering 2916.4 nm and 112 hydrophone listening stations. Photo identification studies were conduct 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 well as various fisheries activities which may have an unsustainable (by)catch of cetaceans. Satellite tagging results on sperm and blue whales indicate that:
a) these whale species spend considerable time in the eastern Indonesian waters (Savu and Banda Seas).
b) their movements range 1000's of km
c) the northern Banda Sea may be an important habitat for blue whales.

d) the narrow, yet deep-sea passages of Savu Sea function as multi-species migratory bottlenecks for large whale species such as blue and sperm whales.

A large-scale 3.5 million hectare Marine Protected Area (MPA) has been declared within the Savu Sea seascape by the Ministry of Fisheries and Marine Affairs, with long-term technical assistance from this program and other partners, in order to better manage the increasing local pressures on these vulnerable megafauna species and their 'near-shore yet deep water' habitats. This approach builds on a similar cetacean management initiative in Raja Ampat, Papua Barat, Indonesia. It's Dampier Strait MPA has been expanded from 46,240 ha. to 301,886 ha, based largely on its ecological importance as an important canyon and corridor habitat for large cetaceans including sperm and Bryde's whales as well as numerous small odontocete species. In Kaimana, Papau Barat a provincial-level MPA has been declared in 2008 (a KKLD of 597 ha), after cetacean surveys identified this region as an important habitat from Bryde's whales in addition to exceptionally diverse coral reef. These cetacean initiatives will increase both coverage and representation of deep-sea yet near shore habitats under protective management, with a beneficial effect to Indonesia's Marine Protected Area network planning and functionality.

Working with coastal communities and other stakeholders toward the formation of stranding networks: A case study from Sri Lanka: Anouk Ilangkagoon (Member of the IUCN Cetacean Specialist Group) **and India** : Dipani Sutaria, FERAL (Foundation for Ecological Research, Advocacy and Learning).

Cetacean stranding networks have been setup and operated in both Sri Lanka and India but given the size disparity of the two countries the approach and success rates have been somewhat different. Most strandings in both countries have been of animals that have washed ashore dead while, live strandings have been rare. Live stranded river dolphins in India and other small cetaceans in both countries have often been rescued and released while this is rarely possible with large whales. Sri Lanka being small in size has had the advantage of strandings being reported and documented from as far back as the 1890's and both literature and museum specimens are available. However there was no formal stranding network till the mid-1980's when it was initiated by the National Marine Mammal Project of the National Aquatic Resources Agency involving informants from coastal communities and local authorities. Once this network became operational it became possible to respond to strandings quickly and assist and re-float live animals, identify species not previously known to occur in the waters of the country, conduct necropsies on dead animals and collect samples for further analyses and retrieve skeletons of dead animals for study, education and display purposes. Despite a stranding network being in place there have also been some failures due to re-floated animals stranding again in another location, dead carcasses being moved around by tides, inefficient local authorities being unable to manage the situation till the response team arrives, stranding sites being difficult to reach in a timely manner because of remoteness, lack of access and security reasons. In India there has been no formal stranding network in place but individual researchers have set up project specific networks in certain areas (Goa, Orissa, Chilika Lake). Meanwhile the Central Marine Fisheries Institute has documented strandings from many areas of the Indian coastline over the years. In 2008 the 'Marine Mammals of India' website (www.marinemammals.in) was set up and it now works as a common platform for collating stranding data online. Local scientists have helped in creating free booklets on how to respond to strandings in regional languages. In 2009 the Ministry of Environment and Forestry in collaboration with NOAA convened a Consultative Workshop with the goal of setting up a nationwide stranding response team. Non-governmental and government research institutions, individual researchers, MoEF and Fisheries representatives are involved in this process which is presently ongoing.

Q: Are there any rehabilitation facilities in Sri Lanka?
A: No there are no proper rehabilitation facilities in Sri Lanka but if and when needed animals are taken to the veterinary facility at the National Zoological Gardens.

Q: In Sri Lanka or India – is anyone allowed to examine/necropsy strandings? Or are only permitted parties allowed to do so?
A: In India only the authorities are allowed to necropsy or collect biological samples. In Sri Lanka anyone can collect biological samples and do necropsy on dead animals but a vet has to be present for any treatment or euthanasia of animals that are still alive.

Q: In some areas using a university as the focal institution for a stranding network can help to overcome political sensitivities. An example is in the Gulf of Mexico where the marine mammal stranding network was started through Texas A&M . Would this work in India?
A: Our experience is that working through a network of NGOs would be more effective.

The Hong Kong Stranding Network 1993-2010: A successful collaboration of management authorities, conservation organisations, academic institutions and veterinary science
Lindsay Porter and Shadow Sin, Ocean Park Conservation Foundation, Hong Kong

In 1973, the Agriculture and Fisheries Department of the Hong Kong Government (now the Agriculture, Fisheries and Conservation Department of the Hong Kong SAR Government [AFCD]) began to investigate and collate information on dead and live stranded marine mammals which occurred in Hong Kong territorial waters. In 1993, the AFCD initiated a research programme when concerns were raised that large scale development projects, increasing pollution levels and depleted fish stocks may be threatening the population of Indo-Pacific humpback dolphins (*Sousa chinensis*) which were known to be resident in Hong Kong western waters. Part of this programme of research was to develop a systematic strandings programme which provided information that would otherwise have been difficult to observe in the wild such as life history parameters, i.e., growth rates, feeding habits; incidents of disease and mortality, i.e., pathogens, toxins; varieties, quantities, sources and concentrations of anthropogenic contaminants;. and other information on taxonomy and molecular ecology. Further, the strandings programme also documented the assemblage of marine mammal species which occurred either as residents or transients of Hong Kong. The Hong Kong strandings programme is still a core source of information for marine mammal studies in Hong Kong. Some 500 hundred strandings have been documented, 16 different species of marine mammals identified and over 50 papers written concerning various aspects of ecology, health and conservation of the resident populations of Indo-Pacific humpback dolphins (*S. chinensis*), finless porpoise (*Neophocaena phocaenoides*) and other, transient species. The strandings programme has been successful as it is well structured and receives the full support of AFCD. The programme is continually reviewed and modified to meet the needs of conservation and research as new concerns and science emerges. The reporting mechanism is well supported by other government departments and the local community through awareness initiatives largely driven by NGOs in conjunction with AFCD. Local and international universities assist in sample analyses and have produced a wide range of papers which define species, isolate contaminants of concern, describe growth patterns and identify causes of death. As of 2006, in depth necropsies and pathological analyses have been conducted by Ocean Park Conservation Foundation, Hong Kong (OPCFHK) which has added a new dimension of detail to the programme, thus furthering our understanding of the multitude of factors which contribute to stranding events.

Q: Is there a traditional Chinese medicine (TCM) use for *Sousa*?
A: No, fortunately this species is considered "sacred" and not used for TCM.

Q: Are finless porpoise or *Sousa* more frequently involved in by-catch in Hong Kong?
A: In the earlier years of the stranding network, a higher percentage of *Sousa* mortality could be attributed to by-catch than finless porpoise mortalities, but in 2010 a higher number of finless porpoise (20) were reported stranded than *Sousa* (7).

Q: Are OPCFHK vets looking at the possible immune-suppressant effects of contaminants in cetaceans in Hong Kong?
A: Not yet, the carcasses examined have not been fresh enough for these tests.

Q: Is anyone collecting specimens on the Mainland China side – Zuhai?
A: Yes, under the guidance of Prof. Wu Yuping from the Zhuhai campus of Sun Yat-sen University, and Lin Wenzhi (Joe) from the Pearl River Estuary Chinese White Dolphin National Nature Reserve.

Long-term Monitoring of Hong Kong's Cetaceans: Implications for Conservation & Management

Samuel Hung, HK Cetacean Research Project, HK Dolphin Conservation Society
Bernd Würsig, Texas A&M University
Thomas A. Jefferson, Clymene Enterprises

In Hong Kong, we have records of 17 cetacean species, but only two of these are resident: the Indo-Pacific humpback dolphin (*Sousa chinensis*) and Indo-Pacific finless porpoise (*Neophocaena phocaenoides*). Our research program is multi-disciplinary, but most topics are geared towards aspects of population biology to aid conservation efforts, so our field studies tend to have practical management-related goals. These studies are mainly line transect surveys, photo-identification, genetic and environmental contaminants analyses from tissue samples, general indications and analyses of causes of mortality (largely from stranding events), acoustic analyses of the environment and the animals, and – as a relatively new component – theodolite tracking from shore to describe habitat use in particular high-use areas.

Hong Kong lies at the eastern edge of the productive Pearl River Estuary, with the Pearl River being the second largest river in China, with huge freshwater output and much pollution. Only the western side of Hong Kong receives such estuarine influence, while the eastern and southern sides are influenced more by oceanic currents. The Pearl River Estuary is a huge system extending far away from Hong Kong, mainly past Zhuhai and Macau to the southwest. Dolphins spend most of their time in the western parts of Hong Kong, influenced by the Estuary, while finless porpoises are in the more oceanic water in southern and eastern Hong Kong. The latter display distinct seasonal variations in distribution, with more porpoises occurred in southern waters of Hong Kong during winter and spring and in eastern waters during summer and autumn.

For an understanding of distribution, abundance and habitat use patterns, we divided our study area in Hong Kong (HK) and the Pearl River Estuary (PRE) into different survey blocks to facilitate an effective sampling scheme using line-transect survey methods; however, most of the effort in the past has been focused around Lantau Island, the largest of Hong Kong's islands, where most humpback dolphins occur. As a second major research technique, we used photo-identification (photo-ID), with which we observed dolphins during line-transect surveys. We used professional digital cameras equipped with up to 400 mm telephoto lens to take high-resolution photographs of natural markings on dorsal fins as well as unique spotting patterns or injury marks. We used photo-ID data to study individual range use, including core areas, as well as dolphin association patterns. We also used detailed investigations of stranded animals for further analyses of potential causes of mortality.

A major cause of mortality is related to environmental contaminants, with high concentrations of organochlorine, organotin and heavy metals from industrial, agricultural and residential sources. The more chemicals we investigated, such as polybrominated compounds, the more problems from environmental contaminants we found. The bioaccumulation of DDTs and PCBs in local dolphins corresponded with sex and age, with adult females being able to "dump" some contaminants during lactation (but their calves receive the offloaded contaminants).

Incidental catch is probably a bigger problem for finless porpoises than humpback dolphins, as some of the porpoise carcasses showed clear evidence of net entanglement. Humpback dolphins seem to be able to break through fishing lines, but in some cases even though they are not drowned in fishing nets, the entanglement still leaves behind permanent injury marks.

Frequent vessel traffic between Hong Kong and major Chinese cities and Macau in the Pearl River Estuary region is another major threat. High-speed ferries travel daily through dolphin and porpoise habitat, north and south of Lantau Island, and we estimate that the traffic volume may have doubled or even tripled in the past 10-15 years. Since high-speed ferries may kill dolphins outright, without a program to monitor the impacts of this threat, we have no way to estimate how many animals are killed during this type of collision. However, quite a number of identified individuals were injured by boat propellers (probably from slower boats), and some dolphins are being displaced from their favourable habitats.

Dolphins and porpoises of Hong Kong also face threats of habitat loss and underwater noise from various sources in their daily lives. Around the dolphin habitat, different projects are proposed every year, such as coastal reclamation, seabed dredging, bridge building and trawling activities. These habitat losses diminish the dolphin range in Hong Kong, and force them to spend more time in foraging. As well, the underwater environment in Hong Kong is quite a noisy place, and such noises can come from various sources, such as percussive piling, shipping traffic and small dolphin-watching speed-boats. This could potentially be a huge problem for dolphins and porpoises, as their primary sense is to use sound to forage and interact with each other.

While there are multitudinous threats from existing and proposed developments, the biggest of all infrastructure projects will be a 40-km long Hong Kong-Zhuhai-Macau Bridge that will span across the eastern side of the Pearl River Estuary, from Macau and Zhuhai to Hong Kong. The bridge itself will need the construction of over 1,000 bridge pile piers, four artificial islands (three in Chinese waters and one in Hong Kong waters), a 6-km long underwater tunnel in Chinese waters, and another tunnel in Hong Kong waters. We have been working with government to formulate mitigation measures to minimize the impacts, but are still unsure how this bridge will impact the future survival of the dolphin population as there is a lack of transparency on the Chinese side on how they will follow through with badly-needed mitigation measures and a well-constructed dolphin monitoring programme.

The most obvious way to show people how dolphins are affected by adverse impacts of human activities, will be to look at the temporal changes in their numbers. That's why we have devoted much effort in conducting systematic line-

transect surveys, to estimate dolphin density and abundance, both in Hong Kong and for the population across the border. Currently, the population of humpback dolphins in the Pearl River Estuary is estimated to be 2,600-2,700. Only a small fraction of this population uses Hong Kong waters, with about 100 dolphins occurring regularly.

For long-term temporal trends in dolphin numbers, we recently estimated annual dolphin abundance using line-transect analysis, and with autocorrelation tests we were able to detect significant declines in dolphin numbers across three main areas of dolphin occurrence in Hong Kong. Temporal trend analysis told us that dolphins have diminished their use in Hong Kong, which is probably due to the overall deterioration of habitats in relation to anthropogenic activities. On a finer scale, we have evidence that dolphins have decreased their habitat use of an area with mud-pit dredging and dumping activities, and of an area of high traffic intensity. However, future work is needed to continue the monitoring of such trends, and formulate solid evidence for the causes of such declines.

Finally, using density maps of overall sightings, as well as density maps of sightings with feeding, socializing and nursing activities, and information on where individual core areas overlapped the most, we developed a dolphin habitat rating system to show government authorities where important dolphin habitats can be found. Based on that, we also proposed certain areas that should be set aside for marine protected areas, with a strong scientific basis for such establishment.

Two social units overlap ranges in the northwest Lantau area. Since relatively fewer interactions occur between these two social clusters than within the two, the overlapping region may represent an important area for gene flow. Interestingly, preliminary evidence also indicates that the reason why individuals come to the overlap area may be related to their reproductive status, as more mothers bring their calves there. So this overlap area of the two social clusters represents a very important dolphin habitat. Unfortunately, the Hong Kong section of the HK-Zhuhai-Macau bridge will cut through the overlap area where the two social clusters meet, so extra caution should be taken when bridge building begins, and we plan to use shore-based theodolite tracking to examine individual movements near and underneath the bridge area, along with dedicated behavioral and acoustic analysis information. Our overarching goal is to investigate the potential impacts of habitat disturbance and destruction on local dolphins, and how to mitigate this adverse impact. Further work is also needed on the finless porpoise population, in which little is known about their overall population status.

Q: The presentation identified two distinct social groups of *Sousa* in the HK area with one area of geographical overlap. Have you been able to detect differences in the vocalization patterns or "dialects" between these two groups?
A: Not yet. Research so far has focused more on possible changes in vocalization rates or volume in response to background noise, but that would make a good topic for study. There is no obvious physical barrier to separate the two social clusters, and we believe that their segregation may be fairly recent. We have also seen the two social clusters occur at times in the same group, so it is likely that any differences in the vocalization patterns cannot be detected.

Q: How can you distinguish between natural shifts in distribution and those caused by disturbance?
A: Obviously there are lots of factors within the habitat of humpback dolphins that can affect their distribution patterns, including fisheries resources, environmental parameters (e.g. salinity, temperature, turbidity), and human disturbance (e.g. vessel traffic, construction noise, coastal reclamation, dredging activities). It is difficult to tease apart each factor to examine how it has affected the distribution of dolphins, and most likely it includes a suite of factors that influence the distribution patterns that we have observed. So it is difficult to distinguish between natural shifts in distribution and those caused by disturbance. However, it will be interesting to compare this humpback dolphin population in the Pearl River Estuary with other areas that are more pristine and less prone to human disturbance, but those areas need to be similar in habitat characteristics (e.g. a large estuarine system with some islands, long natural coastlines, deepwater channels) to make any meaningful comparison.

Q: What proportion of the day are the dolphins exposed to noise pollution (vessel traffic construction etc).
A: Construction activities and vessel traffic continue 24 hours a day. We are not sure how this affects the dolphins' rest cycles. Some research in other part of the species' range has determined that the natural rest period for the *Sousa* is mid-day (e.g. South Africa), but such a "rest period" is not so apparent to the population in the Pearl River Estuary, probably due to habitat differences (e.g. tidal cycle). Instead of recommending a daily "rest period", in Hong Kong we recommend temporal closure for certain noisier construction activities (e.g. pile driving and other noise-propagating activities) as mitigation measures (see Jefferson et al. 2009). The temporal closure for such disturbing activities usually includes the peak months of which calves are born (e.g. June and July in the case of humpback dolphins), or the months

of peak occurrences (e.g. December to May in the case of finless porpoises, due to their distinct seasonal occurrence in southern waters of Hong Kong).

Q: It is striking, and impressive that this population manages to persist in the face of such high levels of habitat disturbance and transformation. Do you have any insight into what it is that makes this population apparently so much more resilient than some others, such as the Yangtze River dolphin or the vaquita?
A: It is difficult to know whether this population's resilience is related to its biological constitution, the continued availability of prey despite so many disruptions, or behavioural patterns that allow them to adapt more easily or avoid fishing gear. We should also consider that the range of this Pearl River Estuary is very extensive (~ several thousands of km^2) and dolphins have more "wiggle room" to move from one place to another to avoid human disturbances (if those disturbances are fairly localized). A large population (over 2,500 individuals) to start with also helps its long-term survival and recovery from threats related to infrastructure projects. However, when you look at the situation of the *Sousa* population in Eastern Taiwan Strait, in which only less than a hundred animals are left, and they live in a narrow stretch of coastlines with more confined range due to habitat fragmentation, they are much more susceptible to large-scale development and entanglement in fishing gears, and less resilient than the Pearl River Estuary population. Nevertheless, we should not be lulled, however, into a false sense of security, as every population is likely to have a "tipping point" beyond which numbers will drop rapidly and recovery may be almost impossible. The significant decline in dolphin numbers in Hong Kong detected through continued line-transect surveys (Hung 2011) is an alarming sign for us to shore up our conservation effort.

Q: This work presented here was striking in its very practical application of relative abundance patterns (a grid cell analysis) to recommended measures for mitigation of threats in identified core areas of habitat. For many coastal species – especially those that are sparsely distributed, or have inconspicuous surfacing patterns, or those that are not possible to study with photo-ID (such as finless porpoise), relative abundance data may be all that is available for use in management. Do you think that the scientific community and managers will recognise the value of these methods as being more than an inferior alternative to DISTANCE methods?
A: Yes, they should. Obviously, estimating abundance through DISTANCE or mark-recapture methods will give managers a good sense of what they are managing, and detecting temporal trends of dolphin abundance will also be extremely important to determine the effectiveness of the conservation strategies. However, the grid cell analysis offers a lot more information in the fine-scale, especially for localized development activities, to determine whether those activities have overlapped with some important habitats of the dolphins. We need to emphasize that the grid analysis is only one of the several tools we use in Hong Kong to conduct an impact assessment on dolphins, and data for such analysis are from systematic line-transect surveys. So the grid analysis can also be regarded as sort of a by-product of the line-transect survey, which also offer important information on abundance [using Distance Sampling] for the overall area. Besides the grid analysis, we should also attempt to use other analyses to complement with the grid density results, including range use/core area use of individual dolphins, encounter rate of mother-calf pairs and activities, etc., to evaluate the importance of a specific area to the dolphins/porpoises. Researchers should also make increased use of acoustic methods to detect and monitor the presence and abundance of inconspicuous species like finless porpoise. Soon we will employ a theodolite-tracking method to examine fine-scale habitat use and behaviour of dolphins in an area of coastal development (e.g. Hong Kong-Zhuhai-Macau Bridge) as well. Basically, the more information from different analyses one can gather the better, as results from different analyses usually complement each other well.

Literature cited in and relevant to this presentation:

- Hung, S. K. 2011. Monitoring of Marine Mammals in Hong Kong waters – data collection: final report (2010-11). An unpublished report submitted to the Agriculture, Fisheries and Conservation Department of Hong Kong SAR Government, 154 pp.
- Jefferson TA, Hung SK, Würsig B (2009) Protecting small cetaceans from coastal development: Impact assessment and mitigation experience in Hong Kong. *Marine Policy* **33**, 305 - 311.

The possible effects of dolphin tourism on coastal cetaceans: A case study from Bali, Indonesia
Putu Liza Kusuma Mustika, Alastair Birtles, Helene Marsh , James Cook University, Queensland Australia

Dolphin watching tourism at Lovina, North Bali developed from the late 1980s when local artisanal fishers formed self-regulating cooperatives. Up to 179 dedicated small fishing vessels carry passengers to watch dolphins that are predictably found 3-4km from the shore close to shore. Our research examined the sustainability status of dolphin watching in Lovina from the perspective of Quadruple Bottomline Sustainability that included the biological, social, economic and managerial elements of sustainability. .

This industry depends on predictable access to coastal dolphins, particularly dwarf spinner dolphins (*Stenella longirostris roseiventris*). Between 35 to 100 tour boats operated daily in Lovina in 2009-2010 and a pod of dolphins could be surrounded by up to 83 boats. Most boatmen attempted to get as close as possible to the dolphins (generally much closer than the recommended 50m minimum approach distance stipulated in Australian and many other national-level regulations). The dolphins generally surfaced only briefly (<2 minutes). Most dolphin groups were surrounded by boats making controls impossible. Many boats were driven erratically making it very difficult to measure the impact of this industry on the local dolphin population. However, examination of the boatmen's performance indicated that the operations at Lovina were way outside accepted international norms.

Our tourist survey indicated that the industry largely caters for Western tourists, mostly tertiary-educated. The respondents' satisfaction levels were low to medium (average 7.1 on the scale of 10). Western respondents who were neutral to very comfortable with their dolphin encounters were more likely to promote the tour. The industry attracted at least 37,000 overnight visitors per annum in 2009-2010 (~60% of the region's overnight tourists) and contributed at least 46% of the total direct tourist expenditures for accommodation, meals, transportation, communication and souvenirs (USD 4.1 million p.a.). The boatmen enjoyed an above average income but trip fees constituted only 3% of the total expenditures generated by dolphin watching tourism; the remainder is spent on local businesses e.g. accommodation, restaurant and transport who become the substantial beneficiaries.

The boatmen were concerned about the industry's long-term sustainability, especially with regards to encounter management practices and other operational issues such as garbage and safety. Agreed rules for encounter management could be developed as voluntary guidelines to provide a sense of ownership for the local boatmen. The local code could later be elevated to national-level guidelines or regulations. Economic incentives such as shared licences, tradable daily permits and buyout of latent boat permits would be options for limiting the fleet size, but the implementation would require support from government and non-government organisations as well as the boatmen and their industry organisations.

Our comprehensive approach provided valuable insights into the industry and should be applicable to other studies designed to inform sustainable marine wildlife tourism in developing countries; such research appears to be rare.

Q: Did you notice any difference in behaviour between groups of dolphins in the presence of tourist boats vs. those when no tour boats were present?
A: This was not addressed in the study.

Q: Why would you want to encourage longer dolphin watch tours (past 7:30am) if finishing early means that the dolphins spend less time in the presence of boats?
A: A longer dolphin watch period in the morning should encourage boat drivers to take more time, give way to others and not be jostling for positions and speeding around the animals.

Community outreach and education in Bangladesh - partners in conservation:

Elisabeth Fahrni Mansur and Brian D. Smith, WCS, Bangladesh Cetacean Diversity project

The Wildlife Conservation Society's Bangladesh Cetacean Diversity Project (BCDP) works to conserve cetacean diversity and abundance in Bangladesh with local communities and institutions. The Educational Outreach Program (EOP) aims to foster support among local communities, government agencies, partner organizations and institutions for effective cetacean conservation interventions. Its objectives are to create a motivated and skilled network of students, resource managers, and educators for developing and implementing science-based, community-involved conservation approaches that balance the survival needs of freshwater and coastal cetaceans with the sustainable use of natural

resources by local communities; and to strengthen local support among resource users, local institutions, government and non-government agencies for the establishment of a protected area network for cetacean diversity through an innovative educational outreach and training program.

The fundamental premise behind the project is that a protected area network, whose design is grounded in sound science and based on extensive consultations with local people, is an appropriate strategy for balancing the survival needs of cetaceans and local human communities. Subsistence needs of local communities must be integrated into proposed management plans for the rules to be seen as legitimate, and to therefore encourage maximum compliance with conservation goals. By focusing on developing local capacity in conjunction with scientific knowledge about cetacean species and their habitat the BCDP is building greater capacity for sustainability into conservation efforts.

The interactive EOP disseminates information on cetacean conservation and sustainable fisheries management to local communities and fishermen, especially those located within the proposed protected area, through a network of trained educators from local communities and institutions, and locally appropriate and innovative environmental education tools. The program trusts that well-informed people will make decisions in favor of sustainability, and believes this to be a more effective approach than trying to convince people to refrain from harmful practices.

The BCDP Training Program provides intensive training and technical support for local scientists, students, and resource managers who will carry out specific projects. It provides opportunities and guidance through an internship program to graduate students for their Master's and Ph.D. theses, offers volunteering opportunities for students from all national and some private universities, and conducts technical training courses with field experience for local scientists, university students and resource managers on population, habitat, and threat assessment techniques for estuarine, coastal, and pelagic cetaceans.

Q: Have you thought about ways to quantify or measure the impact of your education and outreach efforts?
A: We are thinking about some form of pre- and post- interaction assessment of attitudes, but have not done so yet. Ultimately we are hoping to instigate behaviour change and an attitude change is the first step toward that. One indicator of a positive impact is that increasing number of community members are participating in our activities.

Q: Have you thought about trying to integrate the content of your educational outreach into teacher training in the public school system?
A: The government school curriculum is already too overloaded, and until environmental education is an official part of the curriculum we cannot expect teachers to take this on. Instead we prefer to work with NGO's who have direct contact with communities and can integrate content about dolphin (habitat) conservation into their efforts to educate communities about hygiene, water supplies, etc. We are also working with the government to try and introduce marine and freshwater ecology and conservation into the official curriculum.

Workshop participants during fisheries by-catch presentation by Simon Northridge

DISCUSSION AND WORKING SESSION SUMMARIES

Opening Panel Discussion – Diagnosing and ranking the threats faced by coastal cetaceans in Asia: Moving beyond laundry lists

Panel members: Brian Smith, Bernd Würsig, Simon Northridge and Louella Dolar

Question to panel members: What are the most critical threats facing coastal cetaceans in SE Asia that need to be addressed with immediate conservation action, and how do these vary according species, populations and regions?

Panel member answers:

- While it is generally agreed that fisheries bycatch presents the main threat to marine mammals around the globe, with an estimated 600,000 marine mammals killed in fishing gear around the world annually, it is never going to be an easy problem to overcome. Gillnets are the gear most often involved in by-catch, and they are used extensively in the SE Asian region because they are so effective for catching target species of fish and crustaceans.
- The bycatch problem may be linked to over-exploitation of fish resources and this problem can be compounded by government subsidies for fishing boats, fishing gear, and petrol to try and support fishermen.
- While full bans on fishing are unlikely, time-area closures and/or the designation of protected areas that can also serve as replenishment areas for commercially valuable fish or crustaceans may have some success.
- There is a dichotomy between large-scale commercial fisheries, which are more prevalent in "developed" parts of the world, and small-scale artisanal fisheries that are perhaps more common in the nearshore environments where participants to this workshop are based. While many methods for by-catch assessment and mitigation have been tested in large-scale commercial fisheries, artisanal fisheries can present different challenges and need to be better integrated into global fisheries management. For both cases, direct engagement of the industry/fishers themselves is likely to be the most productive approach.
- Reductions in by-catch have been achieved for the endangered population of Hector's dolphins off the coast of New Zealand, through a combination of education and limits on gillnet use. After years of effort, similar reductions are also finally taking place in Baja, California, where coordinated efforts and investment from government, NGO's and enforcement agencies, as well as a shift from fisheries toward tourism, is making the outlook for the vaquita look a little more positive. We can learn lessons from examples like these.

Q: How do we define "Coastal" in this workshop? In some areas with a narrow continental shelf, pelagic or deep water cetacean species like spinner dolphins can occur very close to shore.
A: This is true, but these pelagic species are more likely to range over wider areas and have more opportunities to mix with other populations that feed in deeper offshore areas not as seriously affected by humans and probably fisheries. There is good reason to focus our discussions on populations that are limited by their habitat to continental shelves and estuaries. These populations are more likely to be "clumped" and genetically isolated, without means to escape to less disturbed waters.

Q: Eco-tourism and dolphin watching are often viewed as a recipe for shifting livelihoods of fishermen and promoting more sustainable "use" of dolphin populations. But dolphin watching can also cause disturbance to populations if not conducted responsibly (for example in Bali and Bohol, Philippines where the industry is not regulated). What are your views on this?
A: "It is better to harass dolphins than to kill them". In principal dolphin watching can be an excellent means of giving a economic value to healthy dolphin populations and instilling the general public with a sense of appreciation for these animals in their natural habitat. However, efforts should be made to ensure that tour operators adhere to guidelines that limit disturbance to animals (setting maximum boat numbers and speeds and minimum approach distances) and maximise the educational components. Training for boat-drivers and guides

on appropriate boat handling and approaches can be effective. Tourism enterprises should also be conducted in ways that benefit local communities.

Q: If this meeting is intended to promote conservation through better management and policy change, why does it not involve more government representatives?
A: This workshop is intended primarily for researchers throughout the region to exchange knowledge and learn about scientific methods for better diagnosing and quantifying threats. We see this as a crucial first step in the process that will allow us, as scientists, to present more convincing and robust evidence to managers and stakeholders on the need to work collaboratively on management/policy options for protecting cetaceans and sustaining productive fisheries and a healthy coastal environment..

Q: Often as researchers we are presented with the opportunities to work "with" or "for" developers in assessing dolphin populations and the threats presented by proposed developments. By accepting funding or corporate sponsorship from industry, or by acting as contractors to conduct environmental impact assessments, are we compromising our credibility as scientists? Or are we gaining opportunities to conduct research that might otherwise not take place and possibly helping to instil a sense of ownership and responsibility in the funding/contracting body?
A: If we, as researchers, accept funding or a contract from industry, we can safeguard the credibility of our results by ensuring that they are assessed by an independent review panel and maintaining complete transparency in our research results. Examples of this approach are reviews of research conducted on the impact of naval sonar on cetaceans, and the impact of hydrocarbon exploration and development on the endangered western gray whale population off the Sakhalin Islands.

The panel discussion session became very lively, and participants joined in with a number of suggestions, and topics for later discussion, including:

- The need to collaborate with social scientists to better understand relationships between local communities and wildlife.
- To draw up a list of tried and tested (fisheries by-catch) mitigation measures that researchers can consider when designing conservation plans with managers.
- The usefulness of standardizing data collection methods to allow for more meaningful comparison of cetacean population, habitat and bycatch assessments, and human socio-economic, cultural, and community assessments.
- The importance of drawing expertise from, and directly involving researchers working with other taxa (e.g. sea turtles, coral reefs, mangrove ecosystems), as well as stakeholders ranging from local community members to local, regional or national governments and national or international NGO's.

Discussion panel during opening morning of workshop:
(left to right: Simon Northridge, Louella Dolar, Brian Smith and Bernd Würsig)

Fisheries Practical working groups

Case Study 1, Kuching Bay Sarawak: Chairs: Louella Dolar and Brian Smith. Rapporteur: Gianna Minton
Case Study 2: Cowie Bay, Sabah: Chair: Simon Northridge Rapporteur: Lindsay Porter

Participants were split into two groups, one for each case study area, and given the following assignment:
For your study area:

- List and rank fisheries methods/types/gear in your study area according to:
  - Predominance/frequency of use
  - Perceived threat to cetaceans in your area
- List/rank cetacean species in your area according to:
  - Frequency/predominance
  - Level of perceived threat from fisheries interactions
- Rank methods to assess by-catch in the case study area (using the extensive list of methods presented by Simon Northridge and Louella Dolar in the morning presentations):
  - What would be used in an ideal world to obtain the most robust estimates of by-catch rates?
  - What methods are the most likely to work in this case study area based on logistical, legal, financial restraints and realities
- Come back to the plenary session and present a research plan/proposal that includes:
  - Your focal species – justify why of conservation concern – based on hard survey data or "hunch"?
  - Focal fisheries to monitor observe – justify why chosen – based on previous bycatch data/incidents or numbers in fleet or data from other study areas/regions?
  - Your chosen methods of assessment and rationale for choosing these methods.
  - How the data can be applied to management – what would the potential recommendations for mitigation entail?

Fisheries Practical working group 1: Case study, Kuching Bay, Sarawak
Chairs: Louella Dolar and Brian Smith. Rapporteur: Gianna Minton

Focal species and justification
The bycatch assessment would include all cetacean species that occur in Sarawak waters but, the focal species would be Irrawaddy dolphins and finless porpoises. Both are considered "Vulnerable" in the IUCN Red List, and both are also the most frequently encountered species in our study area. Preliminary results show that both species are affiliated with nearshore, estuarine areas, with Irrawaddy dolphins (N=35) encountered in the shallowest depths, ranging from 2.0 to 5.4 m with a mean of 3.3 (SD 1.4), closest to shore (mean of 1.4 km, SD 1.9), and closest to river mouths (mean 3.5 km, SD 3.6). Their distribution overlaps with observed fishing effort in the study area, with 50% of all on-effort Irrawaddy dolphin sightings made in the Kuching area observed in close association (~50m) with fishermen, in 6-10 m long fibreglass boats, setting gill nets of varying mesh sizes. The close proximity of these entangling nets and the dolphins almost certainly indicates at least some level of bycatch. Although by-catch of Irrawaddy dolphins has not been directly recorded by researchers during the past 3 years, anecdotal reports from fishermen indicates that it does occur, and a number of animals in the photo-ID catalogue bear scars indicative of fisheries interactions. Three finless porpoise carcasses have been reported over the past 3 years, one of which was confirmed to have been entangled in the line of a crab trap.

Focal fisheries and justification:
Fisheries observed in the study area include small pair trawlers (8-12m vessels), crab traps, seine netting, and three types of gillnets including (1) nets gill nets stretched across stakes in mangrove channels to trap fish on outgoing tides, (2) larger mesh (approx 10cm stretched diameter) gillnets set with floats in shallow coastal waters, and (3) smaller mesh bottom-set gillnets, designed to trap large prawns, set seasonally in waters less

than 10m deep. Gillnets are the most likely fisheries to be involved in cetacean by-catch and Irrawaddy dolphins are often been observed close to the latter two types, which are set for a number of hours and attended by fishermen who wait on their boats nearby. Stake-set gillnets are left for longer periods unattended – possibly overnight. These block large sections of waterways, and may present a more serious threat than attended nets in coastal waters, but this has not been assessed. Group members confirmed that bottom set gillnets were most likely to be involved in finless porpoise bycatch in Thailand, and stomach contents collected from two finless porpoise carcasses in Sarawak demonstrated overlap between prey species and commercially valuable prawns targeted by bottom-set gillnets.

Assessment methods:
Although direct observation methods would be preferable for assessing bycatch in the gillnet fisheries in Kuching, accompanying fishing operations on small open-decked fibreglass boats is not very practical or culturally sensitive (our researchers are female). We deemed interview surveys and landing site inspections to be most practical – especially since in our study area landing sites are inside the fishing villages so the two methods can easily be combined. The difficulty is finding ways to "ground truth" data obtained from interviews as it may be biased by poor memory, many individuals referring to the same by-catch or stranding event, or an unwillingness of interviewees to discuss by-catch. Similarly, fish landing site inspections may not yield accurate results if fishers do not bring carcasses into shore. Data obtained from these imperfect methods should be strengthened with the formation of solid working relationships with "key informants" in each fishing village – individuals who trust the researchers, are trained and then given incentives to report by-catch incidents. Colleagues should also be encouraged to report stranding incidents, and collect data on fish landings as well as cetacean by-catch. Interview-sourced data on the nature of fishing operations can be ground-truthed by direct observations of fishing effort during boat/line-transect surveys. By approaching fishers while their nets are soaking, we may also be able to obtain detailed information about what gears they are using and the fish species they are targeting. Researchers in the Philippines obtained detailed data on fisheries operations and grounds by giving fishermen GPSs at the start of the day and downloading their tracks at the end of the day. This would be feasible in Sarawak. Finally – scarring analysis of our Irrawaddy dolphin photo-ID catalogue may provide information on the proportion of the population that survives interactions with fishing gear.

Recommended mitigation and application to management frameworks.
The group was not able to adequately address this issue in the time frame allotted. It was revisited in the wrap-up panel discussion on Thursday afternoon. We discussed ways to make interview surveys and/or landing site inspections less intrusive to, and be viewed less suspiciously by, local villagers. We suggested requesting an evening meeting with the village head and other community members to inform them on the research and the importance of the project for better managing fish stocks and protecting the aquatic habitat. A general "statement" would be presented to fully explain the research and consultations would be sought to incorporate local input in the study design. Such an approach would be more effective and help meet ethical requirements for conducting human research.

Minton G, Peter C, Tuen AA (2011) Distribution of small cetaceans in the nearshore waters of Sarawak. R*affles Bulletin of Zoology* **59**, 91–100.

Irrawaddy dolphin and artisanal fishermen in Santubong Bay, Sarawak

Fisheries Practical working group 2: Case study, Cowie Bay, Sabah
Chair: Simon Northridge Rapporteur: Lindsay Porter

Background
Jamaan's (2009) interview study documented the number and scale of fisheries in the Eastern Malaysian area, i.e., Sabah, Labuan and Sarawak, and gives a snapshot of the potential impact of by-catch on small cetaceans therein. In Sabah, Malaysia's most eastern state, there are a variety of fisheries using gears and methods such as fish stakes, gillnets, long line, trawl, hook and line, barrier net and purse seines. These fisheries target different species, in different seasons and conditions and in all of Sabah's waters. Reportedly, some 4,456 traditional fishing boats operate near shore, while 4,356 gillnets, 1,422 trawlers and 222 purse seiners operate in deeper waters. Sabah's relatively shallow sea has resulted in an overlap of these different types of fishing practices in most areas. As previous reports indicate that by catch may be a threat to coastal cetaceans, this case study aims to focus on a small, productive area on Sabah's eastern seaboard, Cowie Bay, where the year round presence of two cetacean species has been documented (Amyra Suryatie Bt Kamaruzzan unpublished data and Jaaman 2010).

Focal Species
A three year study has been completed in Cowrie Bay and a photo-identification catalogue established for two species of cetacean, the Indo-Pacific humpback dolphin (*Sousa chinensis*) and the Irrawaddy dolphin (*Orcaella brevirostris*). Although the data are still undergoing analyses and residency indices and association patterns have yet to be determined, it appears that both populations are resident and restricted to the bay area. These two species are the focal species of this case study.

Focal Fisheries
There are 1,654 traditional fishing boats, and a total of 632 gillnets and 183 trawlers registered for the Cowie Bay area. All of these types of fisheries are known to cause cetacean bycatch (Jaaman et al. 2009).

Methods
This case study proposes to:

- document the type of gillnets used;
- understand the structure and organisation of Cowie Bay fishing practices;
- map fishing grounds and;
- define the distribution of cetaceans in the area.

To do this, fishing frequency, fishing effort, extent of bycatch and area size must be understood. This can be achieved in several ways;
Indirect Methods

1. Interview
2. Fisheries research

Interview methods have been used before and appear to work well. Basic fisheries research is lacking and thus needs to be investigated in all areas.
Direct

1. Independent platform
2. Contracted fishermen also investigate effort, number marine mammals, fish species (including limited onboard, independent observers)

It is unlikely that any bycatch incidents will be observed by onboard observers without extensive effort. It is therefore, more practical to use an independent platform from which several different types of research can be conducted, i.e., interviews, direct observations, fisheries catch observation. One option might be to contract individual fishermen to act as observers. These fishermen could then be observed by a limited number of onboard independent observers to assist in ground truthing and adding to observations.

Scarring: Photo-ID image analyses

The accumulation of scars and injuries likely to be caused by fisheries interaction can be documented from the photo-identification catalogue over an extended period of the time. Strandings are a rare event but should also be opportunistically investigated to try and establish the cause of death.

Management Applications (potential recommendations for mitigation)

The group did not spend much time discussing this aspect. In brief, it was anticipated that any areas of overlap between high-risk fisheries and core habitat for Indo-Pacific humpback and Irrawaddy dolphins, both population being restricted to Cowie Bay, will need dedicated management.

Jaaman SA, Lah-Anyi YA, Pierce GJ (2009) The magnitude and sustainability of marine mammal by-catch in fisheries in East Malaysia. *Journal of the Marine Biological Association of the United Kingdom* **89**, 907–920.

Jaaman, S. A. 2010. Marine Mammals In East Malaysia*: Distribution and Interactions with Fisheries*. VDM Verlag Dr. Muller Aktiengesellschaft & Co. KG. ISBN: 978-3-639-22208-1. 284 pages.

Pair trawler operating off the coast of Sarawak.

Monofilament net used off the coast of Sarawak.

WRAP UP PANEL DISCUSSION AND WORKSHOP RECOMMENDATIONS AND RESOLUTIONS

Part I: by-catch assessment case study follow-up Chair: Simon Northridge

1. How do we take by-catch assessment data to the next level? How do we tie by-catch estimates into knowledge of biological/ecological parameters of the target population? How do we determine what level of by-catch is acceptable, if any?
    - In general, participants felt that for coastal cetacean populations in the SE Asia region, the steps followed in European or US procedures for determining "sustainable" by-catch levels are unlikely to be feasible in the short term.
    - Few participants felt that they had sufficient biological data or population estimate data for their area to determine what a sustainable or "acceptable" level of by-catch would be. Even in areas where population estimates are available, information on annual recruitment or mortality rates is lacking, and knowing whether fisheries bycatch affects a certain cohort of the population more than others (e.g. what if it affects a high percentage of reproductively active females important for long-term survival of the population), is important for estimating sustainable bycatch levels.
    - However, participants felt strongly that the absence of detailed life history data and/or population estimates should not prevent mitigation efforts, even in populations where numbers appear to be robust, especially if by-catch is occurring in habitats known to be critical for breeding or feeding.
    - In any population already determined through an IUCN Redlist assessment process to be Endangered or Critically Endangered, managers should aim for a zero by-catch target. Lack of life history data should not prevent mitigation.

2. How do we integrate the results of assessment into management framework – possible to achieve more holistic ecosystem approach?
    - Mitigation can be made easier to implement and enforce if the fishing gears and methods involved in by-catch are already illegal as is often the case. Researchers can work with managers to convince them that enforcement of existing regulations is important for population survival.
    - As a precautionary measure, in cetacean populations where abundance estimates and other life history parameters are not available, managers should be encouraged to put a cap on the number of existing registered fishing operations in a population's habitat, until adequate data are available (possible only in systems where licenses or permissions are required for fishers).
    - Mitigation should be tied to sustainable fisheries – e.g. increasing fish stocks by curtailing fishing in key nursery areas or during fish breeding seasons, or providing incentives to use more selective gear. Mitigation measures that benefit fishermen are more likely to succeed. This will require collaboration with fishery scientists to understand the life cycles and population trends of targeted fish.
    - Mitigation could involve the provision of seed funding or training for alternative or supplementary livelihoods for fishermen – such as training for dolphin-watching/ecotourism (e.g. spinner dolphin watching in Bali), agriculture, livestock raising (e.g. Myanmar). However, this can be expensive and cause pressures on terrestrial habitat.
    - Mitigation measures can sometimes include cultural or religious frameworks already in place such as a stretch of the Mayu River in Myanmar inhabited by Irrawaddy dolphins declared by Buddhist monks as off limits to fishing. Some indigenous traditions also

include the concept of protected areas, seasonal taboos on hunting, etc. These can be used effectively for grass-roots conservation efforts.

- In summary, participants felt that there is no "silver bullet" that will reduce by-catch in every community or every fishing industry. Researchers and conservation managers need to collaborate with social scientists to understand the socio-economics of fishing communities/industries and devise management strategies that will be most suited to, and accepted by, those communities/industries.

Part II: Regional Recommendations an resolutions for follow –up: Chair: Brian Smith

1. Identification of key knowledge gaps\
    a. Identify areas of research for focused effort
    b. List priority (sub)populations for IUCN Redlist assessment
2. Suggestions for robust but realistic (given financial and capacity constraints) approaches to assessment and monitoring,
3. Suggestions on how to ensure that research and monitoring efforts feed directly into conservation interventions.
4. Suggestions for follow-up workshops and/or networking actions

<u>Identification of key knowledge gaps:</u>

- There is a need to better understand population structure, especially for those species with restricted and patchy/or clustered coastal distributions. If (sub) populations are found to be genetically distinct, there will be an even greater priority to implement conservation measures.
- While data collection on by-catch is essential, these threats and others must be analysed in relation to ecological knowledge of populations concerned. For many populations/species there exists very little information on reproductive rates, prey, and even distribution.
- Efforts should be made to use existing knowledge about habitat preferences to identify as yet un-surveyed areas that might contain undocumented populations of coastal cetaceans.
- While most participants felt that they did not yet have sufficient data to warrant a (sub) population assessment on species in their study area according to IUCN Red List criteruia, the Irrawaddy dolphin populations near Kuching, Sarawak, Malaysia, and Guimaras, Philippines, and the humpback whale population in Batanes, Northern Philippines, may be ready for assessment within the next year.

<u>Suggestions for robust but realistic (given financial and capacity constraints) approaches to assessment and monitoring</u>

In addition to promoting the use of interviews and fish-landing site inspections for fisheries bycatch, establishing stranding networks for gaining information on the causes of mortality, photo-identification and line-transect surveys to estimate population parameters, and community outreach, participants recommended the following approaches:

- Genetic studies should be undertaken to assess population isolation
- Increased use of risk assessment techniques, using GIS and statistical analysis of relative abundance and the overlap between cetacean distribution and threats.
- Increased use of (passive) acoustic methods to detect the presence and abundance of target populations – especially finless porpoise, which are difficult to detect visually, and in remote areas or at times of year when visual/boat surveys are not practical. Acoustic hardware and software is becoming more effective, user friendly, less expensive than in the past.
- The development and sharing of a basic standardized fisheries/community questionnaire that could be adapted by group members for their own use. By standardizing key questions/data formats, information can be compared across the region. A statement should also be included on the ethical standards to observe when conducting interview surveys.

- Use of shore based surveys, where suitably high platforms are available, as an alternative to boat surveys – especially for investigating behavioural responses to potential disturbances, such as coastal construction or boat-based tourism.
- Use of platforms of opportunity – such as seismic, fisheries or oceanographic surveys and/or tourism vessels to collect data on cetacean distribution and responses to human activities.

Suggestions on how to ensure that research and monitoring efforts feed directly into conservation interventions.

- There is a need to include fishermen in monitoring and assessment – not just through interviews – but by making them partners in research – e.g. giving them GPS units to record their tracks during fishing operations (as proposed in the Bangladesh for the Saving Lives Initiative), or identifying key informants in target villages who can be trained to collect data on bycatch or fish landings in their community.
- Stakeholders should be informed and involved in monitoring and assessment efforts from the beginning of research and monitoring efforts. Community leaders, policy makers, managers or developers can be invited to participate in surveys so that they both develop an appreciation for the animals and gain a realistic understanding of what the research entails.
- Market incentives appropriate for the SE Asian region could be developed and tried – for example – the distribution of consumer guides on sustainable fish/seafood, or financial incentives to fishermen to use gear less likely to cause by-catch.
- Researchers should make more efforts to share data and results with managers and with the public, using popular media and social networks.
- Data deficiency should not lead to inaction – knowing that through robust surveys an area has been identified as core cetacean habitat, should provide sufficient impetus to mitigate known threats regardless of whether an abundance estimate has been generated for the population. Similarly, knowledge that a specific fishery or sound source has caused mortality in other areas should motivate researchers and managers to explore mitigate approaches, regardless of whether the mortality has been quantified as "sustainable" or not. However, managers should be provided with options, rather than presented with demands for cessation of activities, so they can better balance the economic needs of local communities with cetacean conservation.

Suggestions for follow-up workshops and/or networking actions

- Participants strongly supported the idea of maintaining strong communication between coastal cetacean researchers in the region by initiating an email bulletin board or e-discussion forum. The Sarawak Dolphin Project agreed to set up and moderate such a forum that would allow an exchange of news, reports, resources, photographs, and published papers. (see http://groups.google.com/group/asian-coastal-cetacean-research?hl=en and https://sites.google.com/site/asiancoastalcetaceanresearch/home)
- Participants also strongly recommended that follow-up workshops be organised with a focus on capacity building in specific areas of research or methodology, such as:
    - Estimation of population parameters through line transect and/or photo-identification and/or spatial modelling. Some or all of these topics may be addressed in workshops planned by the Sea Mammal Research Unit (SMRU) of St. Andrew's University.
    - IUCN Red list assessment procedures.
    - Acoustic detection and monitoring.
    - Detailed necropsy for identification of causes of mortality.
    - Shore-based cetacean survey methods.

APPENDIX 1: PARTICIPANT LIST

Name of participant	Project or institution, Country	Contact email
Amyra Suryatie Bt Kamaruzzan	Marine Mammal Research Unit, Universiti Malaysia Sabah, Malaysia	amyrasuryatie@yahoo.com
Anna Norliza Zulkifli Poh	Sarawak Dolphin Project, Malaysia	annanorliza@gmail.com
Anoukchika Darini Ilangakoon	IUCN Cetacean Specialist Group, Sri Lanka,	anouki@zeynet.com
Aung Myo Chit	Irrawaddy Dolphin Project/Wildlife Conservation Society (WCS), Myanmar	nkgmaymyo@gmail.com
Benjamin Kahn	Apex Environmental, Australia	bkahn@apex-environmental.com
Bernd Gerhard Würsig	Texas A&M University, USA	wursigb@tamug.edu
Brian D. Smith	Asian Freshwater and Coastal Cetacean Program, WCS, USA	bsmith@wcs.org
Cindy Peter	Sarawak Dolphin Project, Malaysia	cindycharity.peter@gmail.com
Danielle Kreb	Yayasan Konservasi RASI, Indonesia	yk.rasi@gmail.com
Dipani Nitin Sutaria	Foundation of Ecological Research, Advocacy and Learning, India	dipani.sutaria@gmail.com
Efin Muttaqin	Indonesia Marine Program, WCS	e.muttaqin@wcsip.org
Elisabeth Anne Fahrni	Bangladesh Cetacean Diversity Project, WCS	edu@shushuk.org
Ellen Hines	San Francisco State University, USA	ehines@sfsu.edu
Fairul Izmal Bin Jamal Hisne	Malaysian Nature Society, Indonesia	projects@mns.org.my
Gianna Minton	Sarawak Dolphin Project, Indonesia	gianna.minton@gmail.com
Ham Gin Swen	Independent Researcher, Brunei	hgswen@hotmail.com
Jenny Ngeian	Sarawak Dolphin Project, Indonesia	jennyngeian@gmail.com
Jo Marie Vera Acebes	Balyena.org and Center for Rural Empowerment & the Environment , Philippines	jomacebes@yahoo.com
Kanjana Adulyanukosol	Marine and Coastal Resources Research Center (Upper Gulf), Department of Marine and Coastal Resources, Thailand	k.adulyanukosol@gmail.com
Lindsay Jane Porter	Kinabatangan River Project, Malaysia	ljp@smru.co.uk
Louisa Shobhini Ponnampalam	Institute of Ocean & Earth Sciences, University of Malaya, Malaysia	louisa.ponnampalam@gmail.com
Maria Louella L. Dolar	Tropical Marine Research for Conservation, Philippines	ldolar@san.rr.com
Poh Tun Min	Kinabatangan River Project, Malaysia	tunmin.poh@gmail.com
Putu Liza Kusuma Mustika	James Cook University, Australia	putu.liza@my.jcu.edu.au
Simon Patrick Northridge	University of St Andrews, Scotland	simon.northridge@st-andrews.ac.uk
Sin Ying Tung	Ocean Park Conservation Foundation, Hong Kong	shadow.sin@oceanpark.com.hk
Tara Sayuri Whitty	Center for Marine Biodiversity & Conservation at Scripps Institution of Oceanography, USA	tara.whitty@gmail.com; twhitty@ucsd.edu

APPENDIX 2: PROGRAMME

Mon Feb 21: Participants arrive in Kuching in the afternoon/evening and are transported to Permai Rainforest Resort, Santubong (approx 40min drive), registration throughout the afternoon/evening.

19:00-21:00: Evening meal provided at Rainforest Café

Tuesday Feb 22

Conservation status and research activities for coastal cetaceans in SE Asia

8:00-9:15	Registration for local or late-arriving participants
9:00	Arrival of participants and invited guests
9:30	Opening session • Welcoming address by Prof Datuk Dr Khairuddin Ab Hamid, Vice Chancellor of UNIMAS • Address by Bernd Würsig, Professor at Texas A&M University and co-editor of "The Encyclopedia of Marine Mammals" • Opening address by YB Dr. Abdul Rahman Junaidi, ADUN N4 Pantai Damai
10:30	Tea/coffee
11:00-11:45	Keynote presentation – "Conservation status of coastal cetaceans and priorities for assessment and monitoring in Asia" Brian Smith – Director, Asian Freshwater and Coastal Cetacean Program, Wildlife Conservation Society and Asian Coordinator, IUCN Cetacean Specialist Group
11:45-12:30	Panel Discussion – Diagnosing and ranking the threats faced by coastal cetaceans in Asia: Moving beyond laundry lists. Panel to include: Brian Smith, Bernd Würsig, Simon Northridge and Louella Dolar
12:30	Lunch (for all present at morning session) at the Rainforest Café
14:00	Network builders Part 1: Introductions and brief project descriptions –10mins each for 8 projects Chair: Bernd Würsig
15:30	Tea/coffee
16:00	Network builders Part 1: Introductions and brief project descriptions –10mins each for 8 projects Chair: Bernd Würsig
17:20	Finish
19:00	Dinner provided for full-time participants in Rainforest Cafe
20:00	Open house show and tell: A meeting room will be made available for participants to display and share educational materials, posters, survey questionnaires etc.

Wednesday Feb 23
Fisheries

7:00-8:30	Breakfast in the Rainforest Cafe
9:00	Interviews and other means to quantify marine mammal by-catch: Simon Northridge, St. Andrew's University
9:45	Plenary presentation and follow-up discussion: Means to quantify threats from fisheries and fisher's use of cetaceans' core habitat through on board fisheries observations (including interviews with crewmen) and landing site inspections: Louella Dolar (Tropical Marine Research for Conservation (TMRC), LLC)
10:30	Tea/Coffee break
11:00	Diagnosing and quantifying threats from fisheries to coastal cetaceans in their core habitat: A case study from Bangladesh: Rubaiyat Mansur (WCS, Bangladesh Cetacean Diversity Project)
11:45:	Using indirect means to assess fishing gear interactions**:** Simon Northridge, Sr. Lecturer at St. Andrew's University, and Advisor to the UK Government on cetacean by-catch
12:15	The Indo-Pacific marine corridors of the Coral Triangle: Nearshore yet deep-sea habitats and marine protected area networks in Indonesia: Benjamin Kahn, Apex Environmental
12:30:	Lunch at the Rainforest Cafe
13:30	Working with coastal communities and other stakeholders toward the formation of stranding networks: A case study from Sri Lanka: Anouk Ilangkagoon (Member of the IUCN Cetacean Specialist Group) and India : Dipani Sutaria, FERAL (Foundation for Ecological Research, Advocacy and Learning).
14:15	The Hong Kong Stranding Network 1993-2010: A successful collaboration of management authorities, conservation organisations, academic institutions and veterinary science Lindsay Porter and Shadow Sin, Ocean Park Conservation Foundation, Hong Kong
15:00	Tea/Coffee Break
15:30	Discussion groups on identifying and characterizing threats from specific fisheries in two case study areas: Sarawak (host location), and Sabah. Draw up mock study proposals for each case study. Chair Group 1: Louella Dolar: Sarawak case study – artisanal gill net fisheries in Kuching Bay Chair Group 2: Simon Northridge: Sabah case study – pair trawler fisheries in Cowie Bay
19:30:	Workshop dinner in Hotel restaurant

Thursday Feb 24

Coastal development, habitat degradation and stakeholder engagement

9:00 Long-term Monitoring of Hong Kong's Cetaceans: Implications for Conservation & Management, Samuel Hung, HK Cetacean Research Project, HK Dolphin Conservation Society, Bernd Würsig, Texas A&M University, Thomas A. Jefferson, Southwest Fisheries Science Center, NMFS (presented by Bernd Würsig)

10:30 Coffee/Tea break

11:00 The possible effects of dolphin tourism on coastal cetaceans: a case study from Bali, Indonesia: Putu Liza (Icha) Kusuma Mustika, (James Cook University)

11:45 Community outreach and education in Bangladesh - partners in conservation: Elisabeth Fahrni Mansur, WCS, Bangladesh Cetacean Diversity project

12:30 Lunch at the Rainforest Cafe:

13:30: Workshop wrap-up: Panel discussion: Brian Smith, Bernd Würsig, Simon Northridge and Louella Dolar

- Part I: for two case studies (with one in Sarawak) following up on the discussion groups on identifying threats from specific fisheries in different study areas.
- Part II: Regional Recommendations
    - identification of key knowledge gaps,
    - suggestions for robust but realistic (given financial and capacity constraints) approaches to assessment and monitoring,
    - suggestions on how to ensure that research and monitoring efforts feed directly into conservation interventions.,

15:00 Official closing

16:00 Optional End of workshop excursion – sunset mangrove tour

Friday Feb 25

Participants check out and travel home. Those whose travel schedules allow it, participate in optional excursions at participants' own expense – e.g. Sarawak Cultural Village, Kuching tour and/or Semanggoh Orangutan sanctuary or participate in morning mangrove/dolphin watch.

APPENDIX 3: NEWSPAPER/LOCAL PRESS COVERAGE

The Star
http://thestar.com.my/news/story.asp?file=/2011/2/23/sarawak/8115382&sec=sarawak

Borneo Post
http://www.theborneopost.com/?p=95664
http://www.theborneopost.com/?p=95798
http://www.theborneopost.com/?p=95788

Sarawak Tribune
http://tribune.my/prime/6101-abdul-rahman-health-of-dolphin-reflects-health-of-environment.html

Workshop speakers and sponsors receiving tokens of appreciation: hand crafted Batiks with Sarawak tree of life and dolphin design.

Appendix 4: Compiled Participant Project Summaries

A. Sarawak Dolphin Project: Gianna Minton, Cindy Peter, Anna Norliza Zulkifli Poh, Jenny Ngeian (Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak)

1. Project background:
The Sarawak Dolphin Project (SDP), was launched in May 2008 as a joint conservation-based research project with a memorandum of understanding between the Universiti Malaysia Sarawak (UNIMAS), Shell Malaysia, and the Sarawak Forestry Corporation (SFC). Since July 2009, the project has continued with financial support from The Shell Chair for the Environment at UNIMAS, the Ministry of Science and Technology (MOSTI) E-science grants, and funding from the Ocean Park Conservation Foundation, Hong Kong.

The project is housed under the Institute of Biodiversity and Environmental Conservation (IBEC) at UNIMAS, and currently involves a full-time staff of one Research Fellow and three MSc students. It is further supported by university staff and volunteers. In its first two years, small boat surveys were conducted in three main study areas along the Sarawak coastline: Miri, Bintulu/Similajau, and Kuching. Due to low encounter rates in the Miri region, from 2010 onward surveys effort focused on Kuching and Similajau/Bintulu only.

2. Key species under study and characteristics of study area
SDP research and fieldwork continues to focus on the four dolphin species most commonly observed in the coastal waters of Sarawak, which are (in order of frequency): Irrawaddy dolphins (*Orcaella brevirostris*), finless porpoises *(Neophocaena phocaenoides)*, bottlenose dolphins (*Tursiops aduncus*) and Indo-Pacific humpback dolphins (*Sousa chinensis*).

The Miri and Similajau coastlines both run from approximately north to south and are interspersed
with rivers and streams of varying sizes at fairly regular intervals. The Kuching coastline runs from east to west and comprises a complex and interconnected series of wide rivers and mangrove channels, which empty into three major estuaries/bays. The Kuching study area includes some of the waterways encompassed in the Kuching Wetland National Park, while the Bintulu-Similajau study area includes the
entire coastline bordering the Similajau National Park. A further reason for choosing the Kuching and Similajau areas was the large-scale coastal developments planned in both places.

3. General aims and methods used
The main objectives and activities of our project include:

1) *Collection of important baseline data on the seasonal distribution, habitat use and conservation needs of coastal dolphins in Sarawak*: To this end, we are conducting line-transect surveys for both relative and absolute abundance. We cooperate closely with the Permai Rainforest resort, who provide us with a boat with a suitable viewing platform. Line transect surveys are combined with Photo-Identification (for Irrawaddy dolphins and humpback dolphins), and water parameter sampling. While one of our MSc students (Cindy) has nearly completed her thesis on the habitat use of Irrawaddy dolphins in the Kuching region, another (Anna) is just starting to look at mechanisms that allow habitat partitioning between the four species in our study areas.
2) *Assessment of threats to coastal cetaceans in our study areas*: Our third MSc student (Jenny) is embarking on a study of the interaction between fisheries and cetaceans, using survey interviews and direct observations during our line transect surveys, as well as analysis of stomach content samples obtained from stranded or by-caught specimens. Our continual measurement of water parameters, including salinity, turbidity, Ph and temperature, should also allow us to monitor potential changes in the cetaceans' habitat.
3) *Provision of training and field experience for local Malaysian scientists*: The three full time MSc students on our project should all progress to a point where they will be able to maintain the programme if and when the time comes for the Research Fellow to leave. Other volunteers have also been involved in the project and have gained practical research skills and awareness.
4) *Information dissemination and awareness raising through scientific and popular press, and community workshops*: The SDP has conducted a series of 6 community workshops, which it plans to follow up with brief questionnaire surveys to monitor the effectiveness of these as awareness raising tools. We have also developed an educational colouring book for children, informative postcards and bookmarks and promotional materials. We have a project

website: http://www.ibec.unimas.my/SDP2008, and are likely to be featured on a local documentary programme sometime within the next few months.

5) *Preliminary formation of a state-wide stranding network through work with coastal communities and fisheries offices*. A representative of our project is participating in the Malaysian Wide "round table discussions" involving many different stakeholders working to develop a nation-wide stranding network. At the same time, we have developed a poster that we are distributing to coastal fishing villages throughout Sarawak which we hope will increase awareness amongst fishermen as to who they should contact upon discovering a stranded or entangled cetacean.

4. Key perceived threats to coastal cetaceans in your study area.

Over the past year the project has felt an increasing sense of urgency, as a number of major coastal developments are planned along the Sarawak coastline. A flood mitigation channel which will introduce high volumes of silt-laden fresh water into one of our key study areas, and the construction of a major industrial park including a deep water port and aluminium smelter plant in the heart of another study area make it essential that we gather as much baseline data as possible on cetacean distribution and habitat preferences in those areas before these changes take place. Fishing effort is also on the rise, and previous studies have indicated that fisheries by-catch is most likely the most significant cause of anthropogenic cetacean mortality in Sarawak (Jaaman, 2006; Jaaman *et al.*, 2009).

Fisheries in our area include the use of cast nets, gill nets, and pair trawlers, as well as crab traps. The most commonly observed type of fishery in close proximity to Irrawaddy dolphins is the setting of gill nets from small fibreglass fishing skiffs with outboard engines.

5. Are any of your research methods aimed at diagnosing or quantifying threats? Have you obtained any estimates for (rates of) by catch in your study area? If so, we would be grateful if you could summarize these as well.

Previous studies by Dr. Saiful Jaaman have provided some estimates of annual cetacean and dugong bycatch in Sarawak. However, our project has not yet obtained any estimates. One of our MSc students will be focusing on the use of questionnaire surveys and stomach content analysis to try and get more precise and up-to-date estimates on by-catch rates in our study areas, and the possible overlap between commercial fisheries' target species and cetacean prey.

B. Cetacean Research in Peninsular Malaysia: Dr Louisa S. Ponnampalam (Institute of Ocean & Earth Sciences, University of Malaya) and Mr Fairul Izmal Jamal Hisne (Malaysian Nature Society)

1. Project background:

The Institute of Ocean and Earth Sciences (IOES), University of Malaya (UM) and the Malaysian Nature Society (MNS) is currently undertaking a collaborative effort in conducting cetacean surveys in the waters surrounding Tioman Island, Pahang and Langkawi Island, Kedah. The project in Tioman Island commenced in March 2010, with funding support from the Mohd bin Zayed Species Conservation Grant, while the project in Langkawi Island commenced in October 2010, with funding support from the Ocean Park Conservation Foundation, Hong Kong, Mohd bin Zayed Species Conservation Grant, and the University of Malaya Research Grant.

As the only scientific study on cetaceans in Peninsular Malaysia was conducted 10 years ago, and only conducted within the small confines of the various Marine Parks, the current projects undertaken by IOES-UM and MNS serve as a means of collecting essential baseline data on the diversity and distribution of cetaceans. Following these, the information will be used to build upon and further expand into research on habitat use, movement, and population size and status, all of which with the main objective of furnishing and advising national conservation and management efforts.

2. Key species under study and key types of coastal habitat in your region (e.g. mangrove channels, estuaries, rocky shores, coral reefs etc.)

The key species under study in Tioman Island is the Indo-pacific bottlenose dolphin (*Tursiops aduncus*). The main habitats found around the island are coral reefs, rocky shores and sandy beaches. Water depths in the study area ranges between 10 – 50 metres. To date, encounter rates with cetaceans have been low and comprised T. aduncus and Delphinus capensis. However, skeletal remains of cetaceans found on the island and third-party reports have indicated

that other species such as *Pseudorca crassidens* and *Feresa attenuata* also occasionally occur around the island's waters.

The key species under study around the Langkawi Archipelago are the Indo-pacific humpback dolphin (*Sousa chinensis*) and the finless porpoise (*Neophocaena phocaenoides*). Habitats found within the archipelago are of estuaries, rocky shores, mangrove channels, and sandy beaches. Most of these habitats are shallow (<10 metres), however the waters off Langkawi's east coast are deeper, between 20 – 40 metres. Other notable species reported to occur within Langkawi's waters include the Irrawaddy dolphin (*Orcaella brevirostris*), bottlenose dolphins (*Tursiops cf. aduncus*), and baleen whales, most probably that of Bryde's (*Balaenoptera edeni*) or Omura's whale (*B. omurai*).

3. General aims and methods used

The studies aim to identify cetacean diversity and distribution around the study areas. In Tioman, there is a specific focus to estimate the population size of *T. aduncus* using mark-recapture survey methods (i.e. photo-identification) and also to study their movement and site fidelity around the island. Interviews with local tour operators that operate from the various villages around Tioman have also been conducted to gauge the aesthetic value of cetaceans in the area, as well as to gather information on anthropogenic threats that are/might be impacting the animals. In Langkawi, the focus is to estimate the population abundance of *N. phocaenoides* and *S. chinensis* using DISTANCE sampling methods on line-transect surveys, and also to study the movement, side fidelity and population size of *S. chinensis* using mark-recapture survey methods (i.e. photo-identification). Interview surveys with local fishermen and tour guides are also being conducted around the various fishing villages and jetties on the island to gauge the aesthetic value of cetaceans in the area, as well as to gather information on anthropogenic threats that are/might be impacting the animals.

4. Key perceived threats to coastal cetaceans in your study area.

Around Tioman Island, key threats to cetaceans include coastal development (e.g. proposed reclamation for new airport runway), varying degrees of habitat degradation (i.e. coral bleaching, destruction of coral reefs, pollution, beach erosion, siltation) and fishing, including illegal fishing within the 2-nautical mile demarcation of the Tioman Marine Park. Fishing may possibly be a large threat as trawlers and purse-seine vessels are sometimes observed to operate within 2 nautical miles from shore, in spite of the Marine Park protection status accorded to the waters around the island. However, this protection falls short due to lack of enforcement. Other fishing methods used in the area include traps and hook and line.

Around the Langkawi Archipelago, coastal development leading to habitat degradation, interactions with fisheries and shipping/ferry traffic are perceived to be key threats in the area. Recently, plans were unveiled for further development on the more pristine northwestern side of Langkawi Island, to be implemented in the next five years. The RM1 billion investment will include upgrading of the existing golf course, construction of new luxury villas and hotels, and beachfront development. Fishing methods utilized in the area include trawl nets, purse-seine nets, gill nets and hook and line. Ongoing interviews with local fishermen revealed that finless porpoises occasionally become entangled in gill nets.

5. Are any of your research methods aimed at diagnosing or quantifying threats? Have you obtained any estimates for (rates of) bycatch in your study area? If so, we would be grateful if you could summarize these as well.

None at the moment, apart from collecting anecdotal information through interviews with local fishermen.

C. Ecology and Conservation of Orcaella brevirostris (Irrawaddy Dolphin) and Sousa chinensis (Indo-Pacific Humpback Dolphin) in Cowie Bay, Sabah:

Saifullah Jaaman and Amyra Suryatie Kamaruzzan, Universiti Malaysia Sabah (UMS).

1. Project background:

1.1 Organisation(s) involved: Universiti Malaysia Sabah (UMS); Ministry of Science, Technology and Innovation (MOSTI).

1.2 Geographical area covered: Cowie Bay, Sabah, Malaysia.

1.3 Length of time the project has been running: 24 months (Jan 2009 till Dec 2010).

2. Key species under study and key types of coastal habitat in your region (e.g. mangrove channels, estuaries, rocky shores, coral reefs etc.)

2.1 Irrawaddy dolphin; Indo-Pacific humpback dolphin
2.2 River, Mangrove Estuaries

3. General aims and methods used (e.g. photo-ID, line transect, etc.)
3.1 To determine the temporal and spatial patterns of distribution and abundance of Irrawaddy and Indo Pacific humpback dolphins, to include the identification of high-use areas, and their relationships with physical and biotic environmental parameters within Cowie Bay and its river system.
Method: Boat survey (Line-transect)
3.2 To determine the group size, group composition, habitat use, home range, movement patterns, association patterns and behaviour of Irrawaddy and Indo-Pacific humpback dolphins.
Method: Distance-sampling, Photo-ID
3.3 To describe the genetic identity and feeding habits of Irrawaddy and Indo-Pacific humpback dolphins in the study area.
Method: Fish-ID
3.4 To identify threats to Irrawaddy and Indo-Pacific humpback dolphins and estimate mortality rates in the study area.
Method: Observation, Interview and Questionnaires survey
3.5 To make recommendations with respect to the conservation and management of Irrawaddy and Indo-Pacific humpback dolphins within the study area.

4. Key perceived threats to coastal cetaceans in your study area. If fishing/by-catch is a perceived threat, please indicate what types of fishing are the most common in your area (e.g. set nets, pair trawlers, traps etc).
Fishing perhaps is a perceived threat but no report on incidental catches in this area. There a few fishing gears such as trawler, fishing boat, Nettings (Gill, trammel, drift nets) and Traps (Barrier net and Fish stakes) were used in Cowie Bay. Ferry boat and tugboats were also occurred and used as transportation.

5. Are any of your research methods aimed at diagnosing or quantifying threats? Have you obtained any estimates for (rates of) by catch in your study area? If so, we would be grateful if you could summarize these as well.
The interview and questionnaire surveys probably can quantify the threats in this study area. However, As far as the study is concerning, the results regarding threats on dolphins are still in progress.

Evaluation on the management and public opinions for the conservation of marine mammals in the west coast of sabah. Saifullah Jaaman and Amyra Suryatie Kamaruzzan, Universiti Malaysia Sabah (UMS)

1. Project background:
1.1 Organisation(s) involved: Universiti Malaysia Sabah (UMS); Ministry of Higher Education (MOHE).
1.2 Geographical area covered: The Federal Territory of Labuan, Kudat and Kota Kinabalu
1.3 Length of time the project has been running: 24 months (Apr 2008 till Apr 2010).

2. Key species under study and key types of coastal habitat in your region (e.g. mangrove channels, estuaries, rocky shores, coral reefs etc.)
Offices of Fisheries Department, Wildlife Department, Sabah Parks, fishing villages, fish landing jetties, anchored fishing boats, fish markets, schools and colleges.

3. General aims and methods used (e.g. photo-ID, line transect, etc.)
3.1 Aim: Evaluating the management and public opinions in the West Coast of Sabah
3.2 Method: Interview and Questionnaires survey

4. Key perceived threats to coastal cetaceans in your study area. If fishing/by-catch is a perceived threat, please indicate what types of fishing are the most common in your area (e.g. set nets, pair trawlers, traps etc).
As far as the study is concerning, the results regarding threats on dolphins are still in progress.

5. Are any of your research methods aimed at diagnosing or quantifying threats? Have you obtained any estimates for (rates of) by catch in your study area? If so, we would be grateful if you could summarize these as well.

The interview and questionnaire surveys probably can quantify the threats in this study area. However, as far as the study is concerning, the results regarding threats on dolphins are still in progress.

D. Communities of the Kinabatangan River, Sabah, Malaysia: A Study of People, Dolphins and Fisheries: Lindsay Jane Porter and Poh Tun Min

1. Project background

The Kinabatangan River of the Malaysian State of Sabah is an ecosystem renowned for its exceptional biodiversity and untouched habitats. RAMSAR recently designated the Lower Kinabatangan-Segama Wetlands (LKSW) as a "Wetland of International Importance." Both the Irrawaddy dolphin (*Orcaella brevirostris*) and the Indo-Pacific humpback dolphin (*Sousa chinensis*) occur within and adjacent to this area and are dependant upon the productivity of the wetland. With the establishment of the RAMSAR site and Malaysia's new stringent Wildlife Act (2010) there are now some resources available and government commitment to develop new conservation strategies. This newly initiated cetacean and fisheries project will contribute to the larger goal of establishing an effective management strategy for the LKSW which aims to preserve the integrity of the habitat and safeguard the species which dwell within and depend upon it. This project involves multiple organisations and stakeholders; Community Abai Project (CAP), Sabah NGOs Land Empowerment Animals People (LEAP); INGOs RAMSAR and The Japan International Co-operation Agency (JICA); and the government offices of the Sabah Wildlife Department (SWD) and the Department of Fisheries, Sabah (DOFS).

2. Key species under study and key types of coastal habitat

Previous studies, interviews with local fishermen and personal observations indicate that both Irrawaddy (*O. brevirostris*) and Indo-Pacific humpback (*S. chinensis*) dolphins regularly occur in the river and adjacent areas. Isolated populations of Irrawaddy and Indo-Pacific humpback dolphins are found throughout Asia. Both species rely heavily on the integrity of coastal areas to survive and are adversely impacted by fisheries interactions, habitat degradation and pollution. The IUCN lists riverine populations of Irrawaddy as 'critically endangered', coastal populations as 'vulnerable' and all populations of Indo-Pacific humpbacks as 'near threatened'. The LKSW, at 78,803 ha in size, is the largest RAMSAR site in Malaysia and is a, largely, undisturbed ecosystem comprising natural coastal mangroves, brackish and peat swamp forest systems, wetlands and shallow, sheltered estuarine habitats. There are a number of rare, endangered and threatened species within the terrestrial habitat, e.g., the Sumatran rhinoceros *Dicerorhinus sumatrensis harrisoni*, Borneo pygmy elephant *Elephas maximus borneensis*, Storm's stork *Ciconia stormi*, rhinoceros hornbill *Buceros rhinoceros*, Oran Utan (*Pongo pygmaeus*). The site also provides important spawning and nursery grounds for fish and prawns. All of these habitats and species are strongly influenced by seasonal variation in rainfall. As yet, there is little physical information which describes these seasonal patterns. Further, there is almost no information on long term changes which may occur due to climate change.

3. General aims and methods used

The overall aim of this project is to ensure the long-term viability of dolphin populations and the existing fisheries by providing appropriate and precise information to management authorities for incorporation into conservation action plans. This will be achieved through research, stakeholder participation and local partnerships with NGOs which strive to ensure the longevity of the human communities that also rely upon the river for their survival. Specifically for the dolphin populations, the project aims are to define:

- Population density and distribution throughout habitats, within and outside the RAMSAR site
- Population status, including the evaluation of threats
- Population structure, regionally and locally.

This will be achieved through a combination of line transect, photo-ID and modelling studies so that information on habitat use, distribution and abundance can be defined and those factors which play a key role in the species occurrence can be determined. A stranding programme shall be initiated although in a sparsely populated area strandings observations may be limited. This and directed sampling intend to provide tissue for molecular analyses which will contribute to defining population boundaries.

The fisheries component of this project seeks to determine the following:

- Fishery status and trends in and around the RAMSAR site
- Existing and potential threats
- Interaction with marine mammals

A series of deck surveys, interviews and site surveys will identify target and by-catch species, map gear usage and allow an assessment of historical and current fisheries status. The physical characters of the area shall also be mapped and monitored, i.e., coastline, salinity, temperature. The marine and riverine fisheries are important for the rural communities, providing employment, income, and a primary source of protein therefore, the fisheries study shall work closely with local stakeholders. This not only facilitates the gathering of important local ecological knowledge, but also develops community involvement and builds support for future conservation actions.

4. Key perceived threats to coastal cetaceans in the study area

As yet, threats to the marine mammals which inhabit this area are unknown as are threats to fisheries. For dolphins, it is likely that by-catch occurs and directed catches have also been reported in some areas. There are several types of fishing practices; trammel and gill nets, traps for fish and crustaceans and small scale trawling. All of these have a potential to both directly and indirectly affect dolphins. Other threats include the decrease of water quality from palm oil plantation development upstream. It must be noted, however, that the area is sparsely populated and is perceived to be minimally affected by man's presence.

5. Are any of your research methods aimed at diagnosing or quantifying threats?

It is intended that this study shall quantify existing threats to both dolphins and fisheries. Previous studies have indicated that high numbers of marine mammals and turtles are incidentally caught in fishing operations throughout the eastern Malaysian states of Sabah and Sarawak. Little information exists, however, which allows the specific impact of by-catch on individual dolphin populations to be understood. This study intends to quantify by-catch through a combination of interviews, observations and statistical modelling. Other threats e.g., anthropogenic non-lethal injury, can be recorded through direct observation and strandings. Also, tissue collection from stranded and other opportunities may further elucidate pollutant levels.

E. The Bangladesh Cetacean Diversity Project: Conserving Cetacean Diversity and Abundance in Bangladesh with Local Communities and Institutions:

Rubaiyat Mansur Mowgli, Elisabeth Fahrni Mansur and Brian D. Smith (Wildlife Conservation Society)

1. Project background

Through studies conducted in 2002-2005, the Wildlife Conservation Society (WCS) identified a 120- kilometer-wide belt of estuarine, coastal and pelagic waters in Bangladesh as a hotspot of cetacean abundance and diversity. This prime cetacean habitat extends across the world's largest contiguous mangrove forest in the Sundarbans Reserved Forest and offshore to a 900 plus-meter deep submarine canyon known as the Swatch-of-No-Ground (SoNG). In response to these findings, in 2006 the WCS established the Bangladesh Cetacean Diversity Project (BCDP). This project aims to significantly improve the long-term protection of cetacean diversity while current population sizes of several species at risk are known or appear to be sufficient for long-term persistence if threats can be reduced.

The strategy of the project is to work closely with government agencies, fishing communities, local NGOs and nature tourism operators to develop and implement a conservation plan that protects the range of cetacean diversity inhabiting the estuarine channels of the Bangladesh Sundarbans and surrounding marine waters including the SoNG. Major emphases of the project are: (1) conducting sound science to support the development of a conservation plan that includes establishing a protected area network; (2) involving and providing training and technical support to local scientists, resource managers and nature tourism operators to execute effective conservation actions and conduct rigorous research and monitoring; (3) consulting with and enlisting the support of government officials and local people for implementing a conservation and protected area management plan; and (4) communicating research results and conservation progress through the publication of technical reports and published papers, and in articles and files disseminated in the popular media.

2. Key species under study and key types of coastal habitat in your region

The northern waterways of the Sundarbans mangrove forest encompass the farthest downstream range of the "endangered" Ganges River dolphin or shushuk (*Platanista gangetica*). In a generally narrow geographic band, occurring within the same habitat, is the farthest upstream distribution of a seasonally mobile population of the Irrawaddy dolphin (*Orcaella brevirostris*). Farther offshore but still occurring in habitat influenced by freshwater inputs are the Indo-Pacific humpback dolphin (*Sousa chinensis*) and finless porpoise (*Neophocaena phocaenoides*). Then, a

relatively short distance from the fluvial habitat of shushuks is the SoNG where a burst of biological productivity created by upwelling currents supports large groups of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*), pantropical spotted dolphins (*Stenella attenuata*) and spinner dolphins (*S. longirostris*), as well as a possibly resident population of Bryde's whales (*Balaenoptera edeni/brydei*).

The diversity of cetaceans occupying this relatively small area is remarkable, and rigorous abundance estimates of shushuks, Irrawaddy dolphins and finless porpoises indicate that large populations of these species remain. In fact, the Irrawaddy dolphin population in Bangladesh is the world's largest by an order of magnitude.

3. General aims and methods used

The Wildlife Conservation Society's Bangladesh Cetacean Diversity Project has conducted a wide range of research activities on cetaceans in estuarine, coastal and submarine canyon waters. These research activities include concurrent counts made by independent teams for estimating the abundance of Ganges and Irrawaddy dolphins in waterways of the Sundarbans mangrove forest (Smith *et al*. 2006), an investigation on the habitat selection of freshwater dolphins in the Sundarbans and an assessment of the implications of declining freshwater supplies and sea-level rise (Smith et al. 2009), line-transect surveys for assessing the abundance and habitat selection of Irrawaddy dolphins and finless porpoise in coastal waters (Smith *et al.* 2008), photo-identification surveys for assessing the abundance and movement patterns of Indo-Pacific bottlenose dolphins (Mansur *et al.* in review) and Indo-Pacific humpback dolphins (ongoing), point-transect surveys for assessing the distribution and density of fishing operations (ongoing), and genetic studies to determine the population identities of cetaceans occurring in the waters of Bangladesh (Smith 2009; ongoing). A sighting network established among trained nature tourism vessel captains has also contributed to the identification of channel characteristics and locations of hotspots for freshwater-dependent cetaceans in the Sundarbans mangrove forest (Smith *et al.* 2010). In addition, the BCDP has established a community based mortality monitoring network using university students as response teams.

4. Key perceived threats to coastal cetaceans in your study area

Optimism about the long-term survival of cetaceans in Bangladesh is tempered by increasing threats from incidental killing in gillnet and longline fisheries, depletion of prey due to a loss of fish and crustacean spawning habitat and to massive non-selective catch of fish fingerlings and crustacean larvae in small mesh "mosquito" nets, and toxic contamination from large, upstream human population centers. An additional threat is declining freshwater flows from upstream abstraction in the Ganges-Brahmaputra-Meghna river system and the compounding effects of sea-level rise.

5. Are any of your research methods aimed at diagnosing or quantifying threats?

Photographs of Indo-Pacific bottlenose and humpback dolphins reveal that major portions of both populations exhibit wounds caused by interactions with fishing gears. Using a point-transect sampling method we are collecting information on the distribution and density of coastal fisheries. We have also conducted interviews with fishermen and are investigating the technical specifications of deployed gears. Information from these studies, combined with knowledge on the distribution of cetacean groups and movement patterns of individuals from line-transect and photo-identification surveys, will provide baseline knowledge for diagnosing and quantifying threats from fisheries bycatch. This information will be supplemented with data obtained from our mortality monitoring network. In addition, during all field activities we keep a careful record of environmental parameters, including salinity, depth, temperature and turbidity. These data should allow us to roughly model and monitor the potential impacts of declining freshwater supplies and sea-level rise.

References

Mansur, R.M., Strindberg, S. and Smith, B.D. In review. Mark-resight abundance and survival estimation of Indo-pacific bottlenose dolphins *Tursiops aduncus* in the Swatch-of-No-Ground, Bangladesh. *Marine Mammal Science.*

Smith, B.D. 2009. Strengthening integrative research and education components of a program to conserve cetacean diversity in Bangladesh. Final report to the Ocean Park Conservation Foundation, Hong Kong from the Wildlife Conservation Society, August 2009.

Smith, B.D., Braulik, G., Strindberg, S., Ahmed, B. and Mansur, R. 2006. Abundance of Irrawaddy dolphins (*Orcaella brevirostris*) and Ganges river dolphins (*Platanista gangetica gangetica*) estimated using concurrent counts from independent teams in waterways of the Sundarbans mangrove forest in Bangladesh. *Marine Mammal*

Science. 22(3): 527-547.

Smith, B. D.; Ahmed, B. and Mansur, R. 2008. Species occurrence and distributional ecology of nearshore cetaceans in the Bay of Bengal, Bangladesh, with abundance estimates for Irrawaddy dolphins *Orcaella brevirostris* and finless porpoises *Neophocaena phocaenoides. Journal of Cetacean Research and Management*. 10(1):45–58.

Smith, B.D., Braulik, G., Strindberg, S., Mansur, R. Diyan, M.A.A. and Ahmed, B. 2009. Habitat selection of freshwater cetaceans and the potential effects of declining freshwater flows and sea-level rise in waterways of the Sundarbans mangrove forest, Bangladesh. *Aquatic Conservation: Marine and Freshwater Ecosystems*. 19(2):209-225.

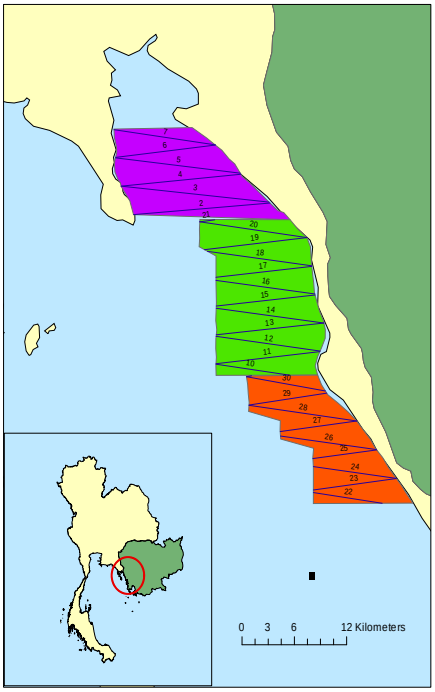
Smith, B.D., Diyan, M.A.A., Mansur, R.M., Fahrni-Mansur, E., Ahmed, B. 2010. Identification and channel characteristics of cetacean 'hotspots' in waterways of the eastern Sundarbans mangrove forest, Bangladesh. *Oryx* 44(2), 241–247.

F. Coastal cetacean research in the Trat province of Thailand: Ellen Hines (Department of Geography and Human Environmental Studies, San Francisco State University)

1. Project background: Include organisation(s) involved, geographical area covered, length of time the project has been running

Dr. Ellen Hines, Associate Professor, Department of Geography and Human Environmental Studies, San Francisco State University, San Francisco, CA, 94132 USA. ehines@sfsu.edu (Co-PI)

Mr. Somchai Manananansap, (Marine Biologist) Eastern Marine and Coastal Resources Center (Thai Department of Fisheries) in Rayong province. (Co-PI)
International Collaborators:
Anouk Illangakoon, Cetacean Specialist Group (IUCN), Sri Lanka
Louisa Ponnampalam, PhD, University of Malayia, Malaysia
Laura Morse, NOAA Fisheries Service, Seattle, WA, USA
Collaborators from the Eastern Marine and Coastal Resources Center:
Ms.Chalathip Chanchompu (Ong) - Marine Biologist
Mr.Thanainun Knocome (Joh) - Veterinarian
Ms.Lakhana Mankhedkit (Kik) - Biologist
Ms.Nongnuch Silapasan (Nuch) - Fisheries Official
Mr. Kriangsak Disthawoot (Kriangsak) - Assistant Biologist
Funding and support from OPCFHK, Project Aware, Thai Eastern Marine and Coastal Resources Center
Please see the map for the geographic area in the eastern Gulf of Thailand, in Trat Province. This project has been running since 2003, with field seasons during the dry season (minus 2005) up till 2009.



2. Key species under study and key types of coastal habitat in your region (e.g. mangrove channels, estuaries, rocky shores, coral reefs etc.)
Irrawaddy dolphins, *Orcaella brevirostris*
Finless porpoises, *Neophocaena phocaenoides*
Indo-Pacific humpbacked dolphins, *Sousa chinensis*

Key coastal habitat types include mangrove channels, shallow bay & estuaries, rocky shores, and beaches, with scattered shallow seagrass.

3. General aims and methods used (e.g. photo-ID, line transect, etc.)

- Investigate the spatial distribution of Irrawaddy dolphins along coastal waters of the Trat province
- Estimate the relative abundance of Irrawaddy dolphins in Trat province
- Determine the patterns of habitat use of Irrawaddy dolphins in Trat province.
- Investigate their behavior, group dynamics, and movement patterns.
- Specific techniques: line transect/Distance sampling, photo-id, interviews, GIS spatially explicit habitat modeling
- Investigate the potential threat local fishing practices pose to Irrawaddy dolphins in Trat province.
- Interview members of surrounding communities to assess their modern and historical relationship and interactions with dolphins
- Train Thai scientists in research methods so that this work can be continued throughout the year.
- Contribute research results as input to educational materials and conservation planning.

4. Key perceived threats to coastal cetaceans in your study area. If fishing/by-catch is a perceived threat, please indicate what types of fishing are the most common in your area (e.g. set nets, pair trawlers, traps etc).
Illegal trawling and push net fishing, bycatch, destructive fishing methods to habitat, water pollution from shrimp farms, some large unmanned set nets, some reports of hunting in Cambodia (nearby).

5. Are any of your research methods aimed at diagnosing or quantifying threats? Have you obtained any estimates for (rates of) by catch in your study area? If so, we would be grateful if you could summarize these as well.

Our interviews are directly aimed at diagnosing threats. Over the years we have conducted over 500 interviews. I'm still cautious, however at giving a defensive estimate. The number of bycatch/stranded animals is large enough to be of concern, however we do not know within how many years, as I believe our respondents do not list this accurately.

Also critical is that most respondents in all years reported that they did not report bycatch or strandings to authorities. In 2009, responses show that 16 animals were found incidentally caught in fishing nets and drowned. While again we do not have a time frame, this is also a vital issue that should be explored in more detail in future community surveys.

G. Current Situation of Coastal Cetaceans in Myanmar: Aung Myo Chit and Brian D. Smith (Wildlife Conservation Society)

1. Project Background

In 2002 the Wildlife Conservation Society (WCS), together with the Department of Fisheries (DoF), Myanmar, started working on cetaceans in Myanmar. The initial emphasis was on researching and conserving a freshwater population of Irrawaddy dolphins living in the upper reaches of the Ayeyarwady River. This work resulted in the Ayeyarwady population being classified as Critically Endangered by the IUCN (Smith 2004), the establishment in December 2005 of a protected area for the dolphins in a 74-km river segment at the downstream end of their distribution (Smith and Than Tun 2007), and a study completed on a cooperative fishery practiced between the animals and cast-net fishermen (Smith *et al.* 2009). The Myanmar Cetacean Project is currently implementing a management plan in the Ayeyarwady Dolphin Protected Area that includes twice-monthly patrols for educational outreach, monitoring, enforcement, research on the ecology and behaviour of the dolphins, and capacity building among DoF officers. In 2005, the project was expanded to include coastal waters with surveys of the Mergui Archipelago of southern Myanmar in February and March 2005 (Smith and Mya Than 2008), the Ayeyarwady Delta in December 2009 (Smith and Myo Chit 2010), and along the Rakhine coast of northern Myanmar in December 2010 (Smith and Myo Chit 2011).

The Union of Myanmar is situated between latitudes 09º 32' N and 28º 31' N and longitudes 92º 10' E and 101º 11' E bordered by India, China, Laos PDR, and Thailand (Figure 1). Myanmar is the largest country in Southeast Asia and it includes an extensive coastline that borders the Bay of Bengal and Andaman Sea. The country has four large rivers: the Ayeyarwady, Chindwin, Sittaung and Thanlwin, all flowing north to south. Complexes of smaller rivers include the Gwa, Thandwe, Laymyo, Kaladan and May Yu that meet the Bay of Bengal along the Rakhine coast, and the Pakchan, Kyaukpyu and Tennasarim that meet the Andaman Sea in the Mergui Archipelago. The Mergui Archipelago is composed of about 800 limestone and granite islands. It has special conservation significance due to its rich coral reefs and diverse island biogeography that spans Indochina and Sundaic realms.

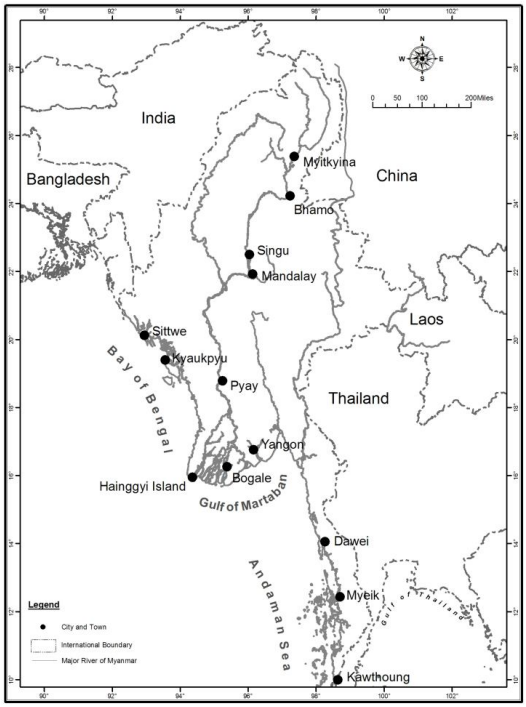


Figure 1. Map of Myanmar showing the locations referred to in the text.

2. Key species under study

The primary species under study in Myanmar is the Irrawaddy dolphin. This is due to their threatened status and riverine and estuarine distribution that puts them in close proximity to humans. The species is considered Vulnerable by the IUCN (Reeves *et al.* 2008a) and, as mentioned above, the Ayeyarwady population is considered Critically Endangered. Rigorous direct counts of Irrawaddy dolphins recorded 68 individuals in the Ayeyarwady River, with an overall estimate of 81 individuals that accounts for animals missed due to the multiple channels that could not all be covered during a single survey, and 50 individuals in inshore waters of the Rakhine coast. The latter population is almost certainly several times larger than indicated by the direct count due to sighting biases related to availability, perception, and poor sighting conditions which meant that some dolphins were almost certainly missed and because we were only able to cover a small fraction of their apparent range.

Other small cetaceans that have been recorded in the coastal waters of Myanmar include the finless porpoise *Neophocaena phocaenoides*, Indo-Pacific humpback dolphin *Sousa chinensis*, Indo-Pacific bottlenose dolphin *Tursiops aduncus*, spinner dolphins (probably the dwarf *rosieventris* subspecies). No population estimates are available for these species.

Of the species listed above, the finless porpoise is of particular conservation concern due to its classification as Vulnerable by the IUCN (Reeves *et al.* 2008b). The Indo-Pacific humpback dolphin is also a high priority species due to its apparently clumped distribution in brackish waters, classification by the IUCN as Near Threatened (Reeves *et al.* 2008c), and the possibility that Myanmar supports both the *chinensis* and *plumbea* forms of the species. During surveys of the Ayeyarwady Delta and the Mergui Archipelago, sightings were made of humpback dolphins that resembled the *plumbea* form (see Jefferson *et al.* 2008). However during the survey of the Rakhine coast, sightings were made of humpback dolphins that more closely resembled the *chinensis* form. These animals appeared similar to humpback dolphins observed in Bangladesh (Smith *et al.* 2008), of which genetic analysis of samples from two animals indicated a high level of divergence from samples analyzed during a range-wide study of the species complex (Rosenbaum *et al.* 2009).

3. General aims and methods

The main aim of the Myanmar Cetacean Project is to conserve isolated populations of Irrawaddy dolphins with a particular emphasis on those inhabiting the Ayeyarwady River and Delta, estuaries of the Laymyo, Meybone, Kaladan and May Yu rivers along the Rhakine coast, and in semi-enclosed bays adjacent to the Kyaukpyu and Tennasarim river mouths in the Mergui Archipelago. As the project progresses, identifying isolated populations of other species, particularly finless porpoises and Indo-Pacific humpback dolphins, and implementing management measures for their conservation will take on a greater priority.

Till date, we have utilized fairly simple direct counts for assessing species distribution and minimum abundance. This is due to the geomorphic complexity of the riverine and estuarine channels occupied by Irrawaddy dolphins in Myanmar that precludes the use of distance sampling techniques because the assumption of transect lines placed randomly in relation to animal distribution cannot be met. Distance sampling techniques have been used in the Ayeyarwady Delta and Mergui Archipelago; however, insufficient sightings were made to develop a detection curve for estimating density and abundance. We have been unable to use photo-identification techniques for estimating the abundance and ranging patterns of Irrawaddy dolphins in the Ayeyarwady River because the vast majority good quality photographs taken of the animals reveal no distinguishing marks that can be used to identify individuals. During all direct count and distance sampling surveys we keep a careful record of fishing operations according to type and conduct systematic interviews with fishermen and community leaders on conservation threats and their attitudes towards cetaceans. Additionally, fish markets and landing sites are visited to search for cetacean carcasses that may be obtained through bycatch or hunts.

4. Threats to the coastal cetaceans in the area

The majority of the coastline of Myanmar has not been surveyed and monitoring cetacean mortalities has only recently become a priority of the DoF. However, similar to most areas in Asia accidental entanglement in fishing gears is probably the most important factor threatening cetaceans in Myanmar. The large number of gillnets deployed in the nearshore waters of the Mergui Archipelago was cited as a possible reason explaining the low number of sightings of finless porpoises and Irrawaddy and humpback dolphins made in 2005 during a survey we conducted in the area (Smith and Mya Than 2008).

A particularly disturbing finding of our studies was a directed harpoon fishery for small cetaceans in the marine waters near Myeik and Dawei. During 11 days in March 2006, 13 Indo-Pacific bottlenose, one Indo-Pacific humpback, and three spinner dolphin carcasses (whole or already chopped into pieces) were found available for sale at a fish market in Maungmagan located about 20km north of Dawei. Fish sellers and a local scientist reported the appearance of Irrawaddy dolphins and finless porpoises at the same market. It is unknown how many of these animals were caught intentionally rather than incidentally, but one spinner and two Indo-Pacific bottlenose dolphin carcasses at the Maungmagan fish market had large puncture wounds consistent with being harpooned (Tun 2006).

References

Jefferson, T. A., Webber, M.A., Pitman, R.L. 2008. Marine Mammals of the World, A Comprehensive Guide to their Identification. Academic Press, London.

Reeves, R.R., Jefferson, T.A., Karczmarski, L., Laidre, K., O'Corry-Crowe, G., Rojas-Bracho, L., Secchi, E.R., Slooten, E., Smith, B.D., Wang, J.Y. & Zhou, K. 2008a. *Orcaella brevirostris*. In: IUCN 2010. IUCN Red List of Threatened Species. Version 2010.4. <www.iucnredlist.org> Downloaded on 30 January 2011

Reeves, R.R., Collins, T., Jefferson, T.A., Karczmarski, L., Laidre, K., O'Corry-Crowe, G., Rojas-Bracho, L., Secchi, E.R., Slooten, E., Smith, B.D., Wang, J.Y. & Zhou, K. 2008b. *Neophocaena phocaenoides*. In: IUCN 2010b. IUCN Red List of Threatened Species. Version 2010.4. <www.iucnredlist.org>. Downloaded on 30 January 2011.

Reeves, R.R., Dalebout, M.L., Jefferson, T.A., Karczmarski, L., Laidre, K., O'Corry-Crowe, G., Rojas-Bracho, L., Secchi, E.R., Slooten, E., Smith, B.D., Wang, J.Y. & Zhou, K. 2008c. *Sousa chinensis*. In: IUCN 2010c. IUCN Red List of Threatened Species. Version 2010.4. <www.iucnredlist.org>. Downloaded on 30 January 2011.

Rosenbaum, H.C., Mendez, M., and Rothchild, A. 2008. Conservation Genetics of the Humpback Dolphins (Sousa spp.)—Part II—From Species to Populations. Final Report to the Ocean Park Conservation Foundation, Hong Kong (OPCFHK)

Smith, B.D. 2004. Irrawaddy Dolphin (Orcaella brevirostris): Ayeyarwady River Myanmar) subpopulation, Critically Endangered, D, C2a(i, ii). 2004 IUCN Red List of Threatened Species. Version 2010.4. <www.iucnredlist.org>. Downloaded on 30 January 2011.

Smith, B.D. and Mya, T.T. 2007 Status and conservation of Irrawaddy dolphins Orcaella brevirostris in the Ayeyarwady River of Myanmar. Pages 21-40 In B.D. Smith, R.G. Shore, and A. Lopez (eds.) Status and conservation of freshwater populations of Irrawaddy dolphins. WCS Working Paper Series.

Smith, B.D. and Mya T. T. 2008. Species occurrence, distributional ecology and fisheries interactions of cetaceans in the Mergui (Meik) Archipelago, Myanmar. Journal of Cetacean Research and Management. 10(1):37–44, 2008.

Smith, B. D., Ahmed, B. and Mansur, R. 2008. Species occurrence and distributional ecology of nearshore cetaceans in the Bay of Bengal, Bangladesh, with abundance estimates for Irrawaddy dolphins *Orcaella brevirostris* and finless porpoises *Neophocaena phocaenoides*. Journal of Cetacean Research and Management. 10(1):45–58.

Smith, B.D., Mya Than Tun, Aung Myo Chit, Han Win and Thida Moe. 2009. Catch composition and conservation management of a human-dolphin cooperative cast-net fishery in the Ayeyarwady River, Myanmar. Biological Conservation. 142:1042-1049.

Smith, B.D. and Myo Chit, A. 2010. Preliminary report to OPCFHK on a project to assess the status of and develop a conservation plan for coastal populations of Irrawaddy dolphins in Myanmar. Unpublished report submitted to the Ocean Park Conservation Foundation, Hong Kong.

H. Summary of Research Related to Coastal Cetaceans in Sri Lanka: A. D. Ilangakoon

1. Project background:
Research has been conducted in the coastal waters off the north-west, west and south of Sri Lanka consistently and the waters off the east intermittently. It has not been one continuous and long-term project but the work has been done under several short-term (1-2 years duration) projects covering different areas of the coastline over the past decade. These projects have been funded by different organizations and funding sources (ADB, OPCFHK, WDCS) at different times. The main focus of the work has been to investigate cetacean occurrence and diversity in Sri Lanka's coastal waters, identify 'hotspots' and determine threats. Meanwhile raising education and awareness regarding cetaceans and their conservation at a local level within Sri Lanka was also a secondary goal of the work. In this respect the firs guide book on cetaceans in Sri Lanka's waters was published in 2002.

2. Key species under study and key types of coastal habitats:
Sri Lanka, a 65000 km^2 island, has sandy shores with some fringing reef and a relatively narrow continental shelf in general, except in the north/north-west of the island. The narrow continental shelf results in deep waters close to shore and these coastal waters are nutrient rich and productive due to shelf-break related upwelling and enrichment from monsoon related river outfalls. There are also several submarine canyons very close to shore (eg. Trincomalee off the east coast and Dondra off the south coast) and as a result coastal waters support a high diversity of cetacean species including large baleen whales such as the blue whale and Bryde's whale. Odontocete diversity in coastal waters is extremely high with the spinner dolphin being the most common and widespread species while typical coastal species like the bottlenose dolphin and Indo-Pacific humpback dolphin are also found. However species usually associated with pelagic waters such as some "blackfish" (false killer whales, short finned pilot whales), spotted dolphins, and Risso's dolphins also frequently occur in coastal waters.

In the northwest the continental shelf broadens and merges with shelf of the Indian mainland. This area supports a variety of coastal habitats including some mangroves and seagrass habitats associated with the large Puttalam lagoon making it an ideal habitat for humpback dolphins which frequent the lagoon. Beyond the lagoon coral reefs and deeper waters occur and once more support a wide variety of large and small cetacean species.

Cetacean diversity is under study throughout Sri Lanka's waters but specific species are also being focused on in specific areas. These include Indo-Pacific humpback dolphins in the north-west, spinner dolphins in the south, west/northwest and blue whales in the south and east.

3. General aims and methods used:
Line-trasect methodology is used to study cetacean diversity around the island. Photo-ID of blue whales is being done opportunistically at present and is planned on a more formal scale off the south and east coast in the near future.

In addition landing site surveys to study patters of fisheries bycatch and add to the knowledge base regarding cetacean diversity in the wider Sri Lankan waters have been carried out intermittently over the past two decades. Specimens examined from bycatch surveys have however not been limited to species in coastal waters but to all species in Sri Lanka's territorial waters. Likewise, strandings (both dead and alive) are being investigated whenever information on such events becomes available in a timely manner. Again these are not limited to coastal species alone but help add to our knowledge about cetacean diversity in general and also regarding present and potential threats.

4. Key perceived threats to coastal cetaceans in this study area:
The single most important threat to small cetaceans throughout Sri Lanka's coastal waters is bycatch in the gillnet fishery which is the most widespread type of fishing gear being used. Additionally there is a small but growing directed take in certain areas of the country using hand harpoons. Both forms of take are indiscriminate with regard to species, sex and size.

More recently commercial whale and dolphin watching has become a new emerging threat due to the lack of regulation of these activities. While the industry is growing rapidly there are no regulations or codes of conduct in place and even if regulations were framed enforcement infrastructure does not exists at present.

Sri Lanka is located on a busy shipping route and the southern cetacean feeding grounds overlap with the main international shipping lane. In recent times several large whale strandings/mortalities that have undoubtedly been a

result of ship strikes have been recorded. This could therefore be another hidden threat that is only now being discovered.

5. Research methods aimed at diagnosing or quantifying threats and estimates for by catch:
Most of the research methods being used are useful in diagnosing threats. However at present no work on quantifying the known threats is being done. Literature on studies from the mid-1980's and early 1990's include varied attempts at quantify fisheries bycatch but different studies have used different methodologies and arrived at highly disparate figures. Therefore it is not possible at present to say that cetacean bycatch in Sri Lanka though widespread has been accurately quantified.

I. Towards Sustainable Dolphin Watching Tourism in Lovina, Bali, Indonesia: Putu Liza Mustika (James Cook University)

1. Project background
Lovina is the collective name of several villages west of the capital of Singaraja. In 2007, approximately 9,800 people resided in Kalibukbuk and Kaliasem villages, the two major coastal villages in Lovina that host the dolphin watching tourism. Kalibukbuk has three departure ports for dolphin trips (Banyualit, Aneka and Kalibukbuk) while Kaliasem has one (Kaliasem).

Dolphin watching tourism in Lovina began in the late 1980s when the interest of international visitors informally alerted local artisanal fishers to the tourism opportunities offered by the diverse cetacean community close to shore. Local small-scale fishers formed self-regulated dolphin-watching cooperatives operating from the four major departure ports mentioned above. Each cooperative is managed by a dolphin guide association. Dolphin tours are conducted using *jukungs* (8-10m long and 60-90cm wide with a two 5m outriggers) which take up to four passengers (IDR 60,000 or USD 6.6 per passenger per trip) for two hours in the morning (6-8am). There are at least 184 *jukungs* along the coasts of Kaliasem and Kalibukbuk villages, plus another 58 fishing *jukungs* at Temukus village at the western border of Kaliasem. All these vessels have the potential to bring tourists to see the dolphins. Almost all *jukungs* (179) are dedicated tour boats which are kept clean and have colourfully painted hulls and outriggers and increasingly powerful engines (currently approximately 12 HP). The remaining *jukungs* are regular fishing boats that fish daily and can take tourists for dolphin watching during the high visitation season. Each *jukung* is typically owned and captained by one boatman who is licensed by his dolphin association. The industry is otherwise unregulated.

2. Key species
During our boat surveys, we identified up to seven cetacean species in this inshore region: Southeast Asian spinner dolphins (*Stenella longirostris roseiventris*) Fraser's dolphins (*Lagenodelphis hosei*), Risso's dolphins (*Grampus grisseus*), short-finned pilot whales (*Globicephala macrorhynchus*), pan-tropical spotted dolphins (*Stenella attenuata*), Bryde's whales (*Balaenoptera edeni*), common bottlenose dolphins (*Tursiops truncatus*) (unconfirmed) and a sub-species of Spinner dolphin (Hawaiian spinner dolphins, *Stenella longirostris longirostris*).

3. General aims and methods
My research project aims to answer the following question:
"Is the dolphin watching industry in Lovina (Bali, Indonesia) sustainable from ecological, social, economic and managerial perspectives?"

Methods:

1. Boat survey to measure the ecological impact(s) of tour boats to dolphins with the following sampling strategies:
    1) Scan sampling, to investigate the reaction of tour boats when the dolphins are sighted
    2) Focal boat follow, to investigate the change in behaviour and numbers of boats between events with and without dolphins
    3) Point survey, to investigate the percentage of dolphins targeted by tour boats in the morning in Lovina
2. Tourist questionnaire survey to:
    1) whether the variables contributing to satisfaction levels of Western tourists were different to those affecting Asian tourists;
    2) whether these variables could be a catalyst to management intervention of dolphin watching in Lovina
3. Economic survey to:

1) determine the attractiveness of the industry to local villagers as a source of income, which indicates industry expansion pressures,
2) determine the economic impact of dolphin watching tourism on the local economy of Lovina and its most prominent stakeholders / beneficiaries

4. Boatmen interviews and workshops to analyse the strengths and limitations of the boatmen's understanding in the management of their industry

4. Key perceived threats to coastal cetaceans in Lovina

Dolphin watching tourism is perceived as the major threat to the coastal cetaceans in Lovina. Our related surveys implied that dolphin watching in Lovina attracts at least 37,000 overnight visitors per annum. More than 65% of tourists who joined dolphin watching trips in Lovina from June 2008 to December 2009 came from Western countries[1]. Their satisfaction levels ranged from low to medium (average 7.1 on a scale of 10; 51% of them provided a score of 8 to10) based on the Pearce and Hanan-Karp scales (2006). Western respondents who experienced neutral to very comfortable encounters with the dolphins were more satisfied and more likely to promote the tour. Our boat surveys estimated an average of 34.5 boat trips per day (se $\pm$ 6.29, ranging from 4 to 98) in Lovina, which was only 19% of the total tourist fleet capacity. Western respondents' satisfaction levels were lower when their preferred number of surrounding boats was 10 or less; more than 80% of them preferred having a maximum of 10 boats around.

The industry is lucrative to the involved boatmen, contributing USD 267,000 and USD 285,700 from annual admission fees in 2008 and 2009 or between 1.3 to 1.8 times the annual per capita gross domestic product in Buleleng. The higher net benefit implies that it is unlikely that the boatmen will leave the industry voluntarily. The industry might also attract other villagers into becoming dolphin boatmen, hence adding pressure to the already saturated industry. Details of tourist and economic surveys are available in the first author's PhD thesis.

5. Are any of your research methods aimed at diagnosing or quantifying threats?

Yes, see above. However, we found no information on cetacean by-catch in Lovina.

Reference:

Pearce, P. L. 2006, 'The Value of a Benchmarking Approach for Assessing Service Quality Satisfaction in Environmental Tourism', in *Managing tourism and hospitality services: Theory and international applications*, eds B. Prideaux, G. Moscardo & E. Laws, CABI, London, pp. 282-299.

Van Egmond, T. 2007, *Understanding Western Tourists in Developing Countries*, CABI, Wallingford, Cambridge.

J. Cetacean Research in East Kalimantan, Indonesia: Dr. Danielle Kreb, Conservation Foundation for Rare Aquatic Species of Indonesia (RASI)

In general, past and future cetacean research in East Kalimantan shelf and slope waters focuses on applied conservation research (studying abundance trends, population biology, threats, social ecology) and identification of priority areas for protected areas establishment while providing scientific management recommendations based on seasonal and year-round local abundance, distribution patterns (seasonal or residential occurrence), habitat use and cetacean species diversity. More dedicated surveys will focus on cetacean hotspot areas that have already been identified and important whale routes and feeding areas. Ultimately the aim is to extend the existing Marine Protected Areas to these areas. In total a minimum of 18 cetacean species and one dugong species were identified for East Kalimantan waters (Appendix 1).

Balikpapan Bay

From 1999 until 2003 cetaceans were studied in coastal waters of East Kalimantan (Appendix 2) with particular reference to coastal Irrawaddy dolphins for comparisons with the isolated freshwater dolphins in the Mahakam River. This research was part of a Ph.D. study conducted at the Institute of Biodiversity and Ecosystem Dynamics/ University of Amsterdam. The occurrence of coastal Irrawaddy dolphins was assessed along the East Kalimantan coastline between Balikpapan Bay in the south until Sangkulirang Bay in the north. Other cetacean species were opportunistically studied and identified. A more in-depth study took place in Balikpapan Bay to compare the population for the freshwater Irrawaddy dolphins in the Mahakam River by studying the following aspects: population dynamics,

[1] Western countries are defined as Europe, United States, Canada, Australia or New Zealand (Van Egmond 2007, p.6)

local abundance and distribution patterns, habitat use, social ecology, threats, acoustics.

The research in Balikpapan Bay was repeated by conducting three seasonal surveys in **2008** in order to detect relative and total abundance, residency patterns using photo-id mark-recapture analyses and monitoring of threats of Irrawaddy dolphins. Two cetacean species occurred in the mouth of the bay, i.e. *Neophocaena phocaenoides* and *Tursiops aduncus* whereas *Orcaella brevirostris* was the most abundant species inside the bay. Overall abundance of Irrawaddy dolphins in Balikpapan Bay has not changed in time but local distribution showed a shift in decreased presence in the more downstream part of the bay, where industrial boat traffic has become more intensive throughout the years. Threats identified are decreasing fish resources due to mangrove destruction for industrial development and harbor and bridge construction in primary habitat in the middle upstream section of the bay that is causing underwater noise pollution, which may, depending on the sound volume, potentially harm the animals and limit the dolphins movements to an even smaller portion in the most upstream part of the bay. Long-term effects after the harbors will become effectively used by large-scale ships will likely also cause habitat displacement as happened in the downstream section of the bay.

Noise testing from percussive piling activity and monitoring (training) to observe the presence and behavior of Irrawaddy dolphins and dugongs between **May and July 2010** was conducted in the project area of PT Dermaga Kencana Indonesia (DKI) at Muara Tempadung, Balikpapan Bay, East Kalimantan, Indonesia. Recommendations amongst others include to continue dolphin monitoring during any further piling operations following procedures; take pollution-preventive measures during jetty operational phase; ships travelling a low speed and using deep shipping lanes to prevent coral reef damage; no further mangrove opening to prevent sedimentation, which impacts on local fish resources and coral reefs.

Berau District

November 2003 – Initiating preliminary coastal cetacean diversity project in Derawan archipelago in Northeast Kalimantan waters.

October 2007 – June 2008 – Continuing research on cetacean diversity and density of coastal cetaceans in the MPA of Berau Archipelago, Northeast Kalimantan waters. Fifteen different cetacean species were encountered during these surveys and preliminary survey in 2003, as well as dugongs, including a remarkably long-beaked form of supposedly *D. capensis tropicalis*. Biopsy samples were collected for five species to shed light on their taxonomic status including *Stenella longirostris*, *Stenella attenuata*, *Tursiops truncatus*, *Tursiops aduncus*, *Sousa chinensis* and *Stenella l. roseiventris*. Sightings concentrated within 5-km radius of reefs. The observation of calves for several species during all three surveys indicates that these species may have a year-round presence in the area. Threats involve illegal fishing practices, such as blasting, trawling, overfishing and direct, illegal captures of dolphins for the international market, which stresses the need for an intensified patrolling in the area. For the species in the Berau delta, such as *Orcaella brevirostris*, *Sousa chinensis* and *Neophocaena phocaenoides* and reef dependent cetacean species (and dugongs), protection of mangrove and riparian forest is essential to reduce sedimentation and guarantee enough fish resources.

Bontang and East Kutai Distict

Nov 2009, May 2010– Leading and conducting marine mammal monitoring surveys along the East Kalimantan Coast north of Mahakam Delta to Tanjung Mangkalihat. Focus on identification of priority areas for MPA establishment based on seasonal and year-round relative local abundance, distribution patterns, habitat use and cetacean species diversity. In addition to species that were also observed in the Berau MPA, two large whale species were observed in this area, *Physeter macrocephalus* and *Balaenoptera physalus*, which latter endangered species has become very rare in the Southern Hemisphere but according to local residents daily occurs from November to May in the coastal area of Sandaran-Tanjung Mangkalihat indicating the importance of this area. A humpback whale and calf have been observed for two years in the Bontang Area usually during the southern wind season June-September. In August 2010, the calf was killed by bomb-fishers. For the next three months locally organized patrols by the NGO RASI and local villagers were organized until the whale season was finished. Besides lack of law-enforcement and awareness, threats include fish depletion because of reef destruction through bombing and fishing with poisonous compounds as well. Most direct catch and kill of dolphins was conducted by non-resident fishermen for oil and shark bait. Because of the isolation of the area where most whales and dolphins were observed, i.e. from Tanjung Magkalihat to Miang Island, we propose to extend the Marine Protected Area of Berau to this area south of and including the Mangkalihat Peninsula until Miang Island or Bontang with 500m depth cline to the shore. These areas should have special attention in terms of law-

enforcement of destructive and unsustainable fishing techniques, i.e. bombing, fishing with poison, trawling. Patrolling in this area should be intensified to prevent these illegal fishing techniques and any further illegal attempts to kill cetaceans. The current fin whale observations and reports on the occurrence of humpback whales in this area, requiring further study about their seasonal or year-round distribution patterns. Local awareness should be increased and fishermen should be facilitated to engage in sustainable fishing practices and/or seaweed culturing. There is a good potential for ecotourism through responsible forms of dolphin and whale watching, which may benefit isolated villages such as Sandaran.

Sesayap Delta and River, northeast Kalimantan

July, August, November 2009. Cooperation project with WWF-Indonesia/ Germany. Marine mammal observation surveys were conducted in Sesayap River and Delta in East Kalimantan in 2009 in order to obtain information on cetacean diversity, total abundance, distribution patterns and threats. Two cetacean species, i.e. Irrawaddy dolphin, *Orcaella brevirostris*, and Indo-Pacific humpback dolphin, *Sousa chinensis* were encountered. The most abundant species was the Irrawaddy dolphin, which is locally named as *lamud*. DNA analysis of a stranded Irrawaddy dolphin specimen in Malinau revealed a similar haplotype as those from Phillippines and Thailand (Songkla Lake) specimens. During both surveys, more sightings were made in the delta compared to the river and dolphins occurred in larger group sizes and with higher densities in the delta. The dolphins' distribution on the river is linked to tidal and seasonal patterns where the extent of saltwater intrusion determines the range of their distribution upstream the river. During 'normal years' without extreme drought dolphins' distribution is limited some 10 km below Malinau, some 90 km upstream of the Sesayap River. Threats include pollution from chemical cleaning of post-harvest shrimp-ponds and upstream coalmining activities as well as decreased fish resources due to increased sedimentation and unsustainable fishing techniques such as electro-fishing. Pollution preventive measures should be enforced to reduce pollution and sustainable fisheries facilitated such as aqua-culture of non-piscivorous fish species. School education should include environmental awareness issues and preserve cultural heritage including conservation of lamud.

Coastal cetaceans awareness campaigns

The coastal waters and islands off the coast of East Kalimantan in Indonesia was found to host at least eighteen cetacean species and one dugong species during the research as described above but their status and diversity are not well known to the general public and local authorities. In order to raise awareness about the conservation of marine mammals in East Kalimantan, posters were distributed at schools and villages in Berau, Mahakam Delta and Balikpapan Bay as well as to district and provincial authorities. In addition, presentations were given at junior high-schools and elementary schools in Derawan and Maratua (Berau archipelago), Balikpapan, Kampung Baru and Penajam (Balikpapan Bay). The posters portrayed pictures of locally occurring cetaceans and dugongs and had text boxes with conservation messages and contact information in case of strandings. In addition a reporting network has been established

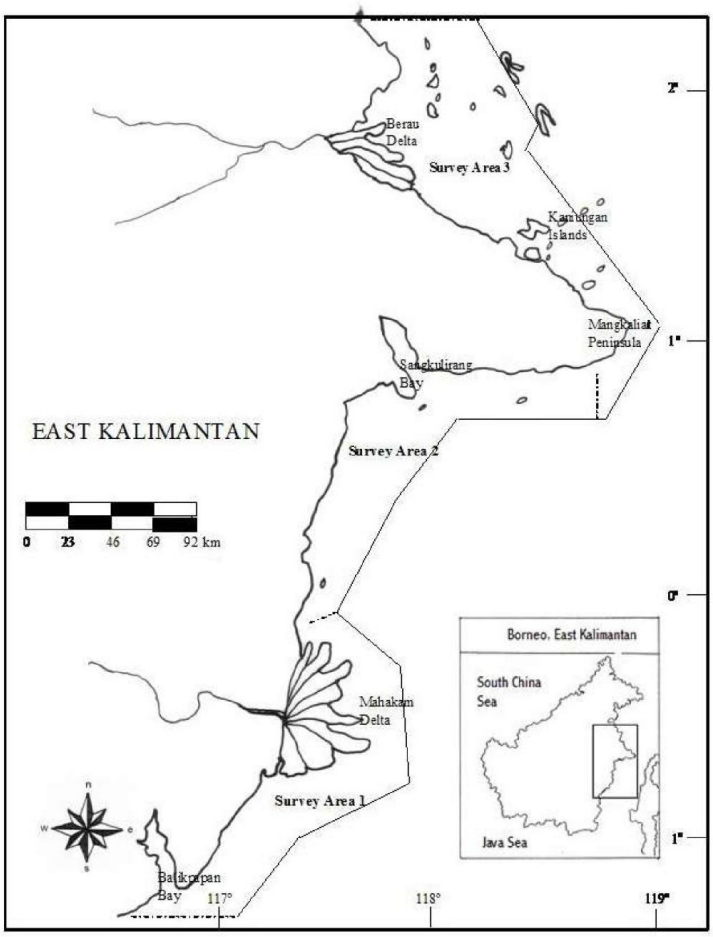
Appendix 1. Marine mammal species positive occurrence in East Kalimantan waters

	Species Latin Name	**Species Common Name**	**Coastal areas of positive occurrence**	**Observation*/ interview**	**Red List****
1	*Balaenoptera physalus*	Fin whale	East Kutai	observation	EN
2	*Delphinus capensis tropicalis*	Long-beaked common dolphin	Berau	observation	NE
3	*Delphinus delphis*	Short-beaked common dolphin	Berau	interview	LC
4	*Feresa attenuata*	Pygmy killer whale	Berau	observation	DD
5	*Globicephala marcorhynchus*	Short-finned pilot whale	Berau	observation	NT

6	*Megaptera novaeangliae*	Humpback whale	Bontang , East Kutai	observation	VU
7	*Neophocaena phocaenoides*	Finless porpoise	Berau, Balikpapan Bay	observation	NE
8	*Orcaella brevirostris*	Irrawaddy dolphin	Berau & Mahakam Delta, Balikpapan Bay, Sesayap, East Kutai	observation	DD
9	*Orcinus orca*	Killer whale	Berau	interview	NT
10	*Peponocephala electra*	Melon-headed whale	Berau & East Kutai	observation	LC
11	*Physeter macrocephalus*	Sperm whale	East Kutai	observation	VU
12	*Pseudorca crassidens*	False killer whale	Berau & East Kutai	observation	DD
13	*Sousa chinensis*	Indo-Pacific humpback dolphin	Berau & Sesayap Delta	observation	DD
14	*Stenella longirostris*	Spinner dolphin	Berau & East Kutai	observation	DD
15	*Stenella attenuata*	Pantropical spotted dolphin	Berau & East Kutai	observation	LC
16	*Stenella l. roseiventris*	Dwarf spinner dolphin	Berau & East Kutai	observation	NE
17	*Tursiops aduncus*	Indo-Pacific bottlenose dolphin	Berau, East Kutai, Bontang, Balikpapan Bay	observation	DD
18	*Tursiops truncatus*	Common bottlenose dolphin	Berau	observation	DD
19	*Dugong dugon*	Dugong	Berau, Balikpapan bay	observation	VU

*= Observations made during marine mammals surveys conducted in 2000-2003; 2007-2008; 2009; 2010 in Berau district, East Kutai District, Bontang, Mahakam delta and Balikpapan Bay

**EN= Endangered; NE= Not Evaluated; LC= Least Concern; NT= Near Threatened; VU= Vulnerable



Map of survey areas along the East Kalimantan coastline, Indonesia.

K. Cetaceans in Thai waters: Kanjana Adulyanukosol and Surasak Thongsukdee (Marine and Coastal Resources Research Center, Samut Sakhon, Thailand)

Thailand has focused on cetacean research since 1993. The Department of Marine and Coastal Resources (DMCR) has responsibility on the research and conservation of marine endangered species includes cetaceans, dugong, and sea turtles. DMCR established 5 centers to conduct research on marine and coastal resources; one in the Andaman Sea (Phuket Marine Biological Center, PMBC) and 4 centers in the Gulf of Thailand (Eastern Gulf, Upper Gulf, Middle Gulf and Lower Gulf). The cetacean research program was initiated through collaboration with Danish scientists under the Project of Small Cetacean in the Gulf of Thailand and the Andaman Sea. Information on species, distribution and abundance, including biology and behavior of cetaceans has been obtained from interviews, strandings and surveys. Boat and aerial surveys of cetaceans were also conducted to identify species, distribution, population abundance and behavior. However, most of the data were from stranded animals. The stranding network on marine endangered animals has been in cooperation with the villagers, non-government and government organizations along coastal provinces.

Species Identification

So far, a total of 25 species of cetaceans (stranding, sighting, and skeleton) have been recorded in Thai waters (22 species in the Andaman Sea and 19 species in the Gulf of Thailand). These comprised species from six families; 1) four from the family Balaenopteridae (*Balaenoptera physalus, B. edeni, B. omurai* and *Megatera novaeangliae*) , 2) one

from Physeteridae (*Physeter macrocephalus*), 3) two from Kogiidae (*Kogia breviceps* and *K. sima*), 4) two from Ziphiidae (*Mesoplodon ginkgodens* and *Ziphius cavirostris*), 5) fifteen from Delphinidae (*Orcinus orca, Pseudorca crassidens, Feresa attenuate, Globicephala macrorhynchus, Peponocephala electra, Sousa chinensis, Tursiops aduncus, Steno bredanensis, Delphinus capensis, Stenella longirostris, S. coeruleoalba, S. attenuata, Lagenodelphis hosei, Grampus griseus,* and *Orcaella brevirostris*), and 6) one from Phocoenidae (*Neophocaena phocaenoides*). Stranding records from the Andaman Sea were greater in number and diversity than the records from the Gulf. The majority of the skeletons of stranded animals was deposited at PMBC, Phuket Province.

Surveys and population

Surveys for cetaceans were mostly conducted by boat and some were aerials surveys (small aircraft, helicopter and microlight). The methods of surveys were transect survey and opportunistic survey (cruising randomly or joining with). Recently Photo-Identification has been conducted in the upper Gulf, Eastern Gulf, and Khanom Bay. This year, PMBC has conducted Photo-Identification in Trang Province. The focused areas along both coastlines of the Gulf of Thailand and the Andaman Sea were: 1) the Upper Gulf – along the coast of Phetchaburi, Samut Songkhram, Samut Sakhon, Bangkok, Samut Prakan, Chachoengsao and Chonburi Provinces; 2) the Eastern Gulf - coast of Trat Province; 3) The middle Gulf – coat of Chumphon Province and Chaiya Bay, Surat Thani Province; 4) the Lower Gulf - Khanon Bay, Nakhon Si Thammarat Province and Songkla Lake, Phathalung Province; and 5) the Andaman Sea - Sriboya, Cham and Pu Islands, Krabi Province, coast of Tase village, Trang Province and Salai Islands, Satun Province. Among the 25 species of cetaceans in Thai waters, only 11 species were observed in the wild; 1) Bryde's whale (*B. edeni*), 2) Omura whale (*B. omurai*), 3) killer whale (O. orca), 4) false killer whale (*P. crassidens),* 5) Indo-Pacific hump-backed dolphin (*S. chinensis*), 6) Indo-Pacific bottlenose dolphin (*T. aduncus*), 7) spinner dolphin (*S. longirostris*), 8) striped dolphin (*S. coeruleoalba*, 9) spotted dolphin (*S. attenuata*), 10) Irrawaddy dolphin (*O. brevirostris*), and 11) finless porpoise (*N. phocaenoides*).

Statistical analysis of cetacean population was not available yet. The number of cetaceans was estimated from Photo-ID and maximum count. The number of Bryde's whales in the Upper Gulf was about 20-25 individuals. Irrawaddy dolphins were estimated to be about 100 individuals in the Upper Gulf and 100 individuals in Trat water in the Eastern Gulf. The biggest group of 20-25 bottlenose dolphins inhabited the areas of Khai Nok Island, Khai Nai Island, Maithon Island and Hae Island (between Phang-nga and Phuket Province). The large groups of Indo-Pacific hump-backed dolphins were along coast of Trang Province and Khanom Bay, Nakhon Si Thammarat Province.

Strandings

The stranding records of cetaceans in Thai waters ranged from 12-61 individuals per year (2001-2010). Stranded cetaceans were reported and most specimens were transferred to PMBC or to the other four centers for species identification and necropsy. During necropsy, tissue samples were collected for various fields of study such as genetics, parasitology, histology, heavy metals and organochlorines. Bones were collected for species identification and osteological examination. In the case of large whales or badly decomposed specimens, the carcasses were examined on-site and subsequently buried.

There were six records of mass strandings, of which five cases occurred in the Andaman Sea; one case in Trang Province, two cases in Phang-nga Province and two cases in Phuket Province, and one case in the Gulf of Thailand in Samut Sakhon Province. The first record was of nine spinner dolphins (*S. longirostris*) found at Talibong Island, Trang, in January 1999. Among these nine carcasses, six were examined and three were lost. The second record was of five spotted dolphins (*S. attenuata*) that stranded at Ban Ko Kho Khao, Phang-nga, in February 1999. Two dolphins were released and three died. The third record was of eight spotted dolphins (*S. attenuata*) that stranded at Mai Phai Island, Phang-nga, in March 2006. Five animals died and three were released. The fourth record was a stranding of 30 false killer whales (*P. crassidens*) at Racha Yai Island, Phuket, in June 2008. Twenty-nine whales were released and one whale died from drowning. The fifth record was of three rough-toothed dolphins (*S. bredanensis*) stranded at Nam Bor Bay, Phuket, in July 2008. All dolphins were released back to the open sea near Racha Island. The last record was of nine Irrawaddy dolphins (*O. brevirostris*) stranded at Ban Bor, Sumut Sakhon, in March 2009. All dolphins were released at the same place. It was hard to diagnose the causes of death of the stranded dolphins. However, it was likely that the first two mass stranding events were caused by diseases. In the third mass stranding event, three dolphins were in good health, one drowned and one was struck by a hard object causing it to be unable to balance itself and thus stranded. The last three records with good health conditions were possibly caused by lost navigation and/or the landscape of the stranding places (narrow bay and wide flat seafloor with gently sloping beach or man-made obstacle).

More than half of the strandings were caused by unknown threat. The known threats were diseases, fishing gear, miss navigation, and ingestion of plastic debris. Diseases were mainly caused the failure of respiratory system particularly infection on lungs (pus and parasites). A number of cysts were commonly found near genital region. Two cases of plastic ingestion were found in dwarf sperm whale (*K. sima*) at Phuket Island and finless porpoise (*N. phocaenoides*) at Upper Gulf area. A large Bryde's whale (*B. edeni*) died from small trawler in Chumphon Province and a Brydes' whale calf died from entanglement in gillnet for stingray in Trang Province. DMCR has employs 2 veterinarians at PMBC and the center in the Eastern Gulf. Veterinarians are in charge of the rescue program of marine mammals and sea turtles and diagnose the threats of dead animals. Rescue of stranded live cetaceans was succeeded only few cases.

L. Cetacean research efforts in Aceh Province, Indonesia: Efin Muttaqin (Wildlife Conservation Society)

The Wildlife Conservation Society has been working in Indonesia since 1965, and established as The Wildlife Conservation Society Indonesia Program in 1992. In 2002, a new team started the program in marine and has been working ever since with government and community partners to develop network of marine protected areas in Indonesia. WCS has collected biological and socio-economic data from 10 regions in Indonesia and evaluated MPA effectiveness within each of these regions, including four marine National Parks.

Our main findings infer that small traditional-based MPAs achieve better conservation for coral reef resources than in large marine national parks (McClanahan et al. 2006). Our work includes community based and scientific monitoring of marine ecosystems, the development and use of field protocols for governments and communities, the development of ecological and socio-economic database systems in World Wide Web and improved management practices for the conservation of marine resources.

We work closely with coastal communities and Indonesian government in reducing damage in coral reefs caused by destructive, illegal and unregulated fishing.

Currently our main focuses are:

- Marine protected area management
- Reduction of destructive fishing practices
- Community based fisheries projects
- Measuring and predicting coral bleaching impacts.

WCS achievements:

- Conducted first regional assessment of MPA effectiveness in Indonesia across 8 MPA networks
- Design and implementation of MPA zoning plan for Karimunjawa Marine National Park
- Ecological surveys of tsunami impacted northern Sumatra with James Cook University and local Universities
- Innovative community consultation and science based approaches
- Support for community based monitoring and livelihood programs

We work in:

1. Karimunjawa Marine National Park
2. Northern Sulawesi MPAs
3. Northern Aceh Community MPA

After the devastating Indian Ocean tsunami in December 2004, WCS proposes to work closely with local communities and government authorities to develop a scientific-based, community-supported network of marine protected areas to protect the outstanding coral reefs and marine wildlife of Aceh-Weh Seascape while stabilizing and diversifying the revenue base of local communities for a long term.

In order to support this program**,** WCS also conducted study to determine the distribution, seasonality, and movements of whale sharks and other megafauna and identify priority areas for their conservation including Cetaceans (dolphins and whale).

The activities that we have done are:
1. Collecting interview-based data about megafauna seasonal and sighting sites
2. Conducted a training course for Wildlife Conservation Society staff and research partners on line-transect techniques in assessing cetacean populations in 2009. The trainer was **Dr Brian Smith, WCS cetacean scientist**.
3. Conducted a survey for nearshore cetaceans in the waters surrounding Weh Island using line-transect in 2009

During the survey we observed a local hook and line fishery trawling for yellow-fin tuna *Thunnus albacares* associated with pan-tropical spotted dolphins. In this fishery, multiple small motorized boats (4-8 in a group) were observed following dolphin schools while trailing nylon lines with hooks. The fishery appears to depend completely on the dolphins for finding the tuna but to be non-harmful to the animals.

M. Humpback Whale Project in the Babuyan Islands, Philippines: Jo Marie Acebes (Balyena.org and Center for Rural Empowerment & the Environment (CREE))

1. Project background: Include organisation(s) involved, geographical area covered, length of time the project has been running

The Humpback whale project in the Babuyan Islands (Cagayan Province, northern Luzon, Philippines) began in 2000 under the auspices of WWF-Philippines. I managed the Project until 2003. After I left WWF I continued to participate in the project from 2004 to 2006. In 2007 I began running the project in my own capacity as a researcher with the funding assistance of different organizations and in collaboration with the Center for Rural Empowerment and the Environment (CREE). This project has been running for 10 years and is currently managed by the non-profit organization, Balyena.org.

A recent spin-off of this project is 'Promoting Responsible whale watching and cetacean awareness in the Philippines' which began in 2009, covering the Babuyan Islands and the coast of Cagayan, northern Luzon and Bohol in Central Visayas.

From the foundations of these projects, my colleagues and I formed a society of our own called Balyena.org – *Balyena at Lumba sa Pilipinas* (Whales and Dolphins in the Philippines). Although the idea for Balyena.org originated a couple of years earlier, we were only formally organized in late 2009. Balyena.org works in partnership with other non-profit organizations: Physalus and Marine Wildlife Watch of the Philippines. Our project focus areas are the Babuyan Islands and the Bohol Sea however we also conduct cetacean exploration surveys in least-studied areas around the Philippines.

2. Key species under study and key types of coastal habitat in your region (e.g. mangrove channels, estuaries, rocky shores, coral reefs etc.)

- Humpback whales and other cetaceans in the Babuyan channel, coastal areas and coral reefs of northern Luzon.
- Cetaceans along the coasts and coral reefs of the Bohol Sea. We are currently focusing on Blue whales and Bryde's whales in the Bohol Sea.

3. General aims and methods used (e.g. photo-ID, line transect, etc.)
Aims:

(1) To monitor the status and distribution of humpback whales and other cetaceans in the Babuyan Islands, Philippines;
(2) To estimate the abundance of humpbacks through photo-identification study.
(3) To provide scientific data for and facilitate the establishment of guidelines for responsible whale watching and ecotourism around the islands;
(4) To monitor and mitigate threats to cetaceans and its habitat around the Babuyan islands.
(5) To provide support for the first steps of implementation and refining of the Conservation Action plan for the Babuyan Islands particularly on sustainable coastal zone management.
(6) To increase the capacity of locals in the proper conduct of whale watching and help disseminate the cetacean-human interaction guidelines to the public.
(7) Increase the awareness of locals and the general Filipino public about cetacean biology, research and conservation through trainings and an educational outreach program.

(8) To explore the occurrence of previously exploited large whales in the Bohol Sea.
(9) To establish and maintain a cetacean stranding database for the Philippines.

Methods used:
1. Photo-identification study (for humpback whales)
2. Acoustic recordings (for humpback whales)
3. Strip transect
4. Key informant interviews

4. Key perceived threats to coastal cetaceans in your study area. If fishing/by-catch is a perceived threat, please indicate what types of fishing are the most common in your area (e.g. set nets, pair trawlers, traps etc).
- By-catch from gillnets and manta nets.
- Opportunistic catch using harpoons and gillnets. Cetaceans are caught when sighted close to fishing boats or when encountered during fishing trips but are not sought out directly.
- History of directed catches in some areas in northern Luzon and the Bohol Sea.
- Dynamite fishing
- Blasting for metal from shipwrecks

5. Are any of your research methods aimed at diagnosing or quantifying threats? Have you obtained any estimates for (rates of) by catch in your study area? If so, we would be grateful if you could summarize these as well.
We determine threats and assess the level of threats through direct observation (while conducting surveys), key informant interviews and fishing gear inventory.
We currently do not have estimates.

N. Linking Conservation to Ecosystem-Based Management: Understanding Bycatch of Irrawaddy Dolphins in Artisanal Fisheries: Tara Whitty (Scripps Institution of Oceanography)

1. Project Background
For my PhD dissertation (advised by Lisa Ballance and Paul Dayton), I will be studying the bycatch of Irrawaddy dolphins in artisanal fisheries. By studying the socioeconomic and cultural drivers of these fisheries in addition to how these dolphins overlap with fishing grounds in space and time, I aim to put Irrawaddy dolphin conservation in the context of ecosystem-based management.

I will be working at four sites: Malampaya Sound, Philippines; Guimaras, Philippines; Mahakam River, Indonesia; Trat Province, Thailand. In April-May 2010 and August-September 2010, I conducted preliminary research in the two sites in the Philippines, which I am hoping to continue through 2012.

I will be working closely with: Marivic Matillano (WWF-Philippines) in Malampaya Sound; Dr. Louella Dolar and Mark de la Paz (Master's student at Silliman University, Dumaguete) in Guimaras; Dr. Danielle Kreb and Budiono (Y.K. RASI) in the Mahakam River; and Dr. Ellen Hines (San Francisco State University) and Somchai Monanunsap (Eastern Coastal and Marine Resources Research Center, Thailand) in Trat Province.

2. Key Species & Habitat
This project focuses on four populations of Irrawaddy dolphins – one in a semi-enclosed, estuarine inlet (Malampaya Sound), one ranging among islands along two straits with riverine inputs (Guimaras), one in a large river system (Mahakam River), and one along open coastline (Trat Province).

3. General Aims & Methods
This project aims to:
1. Investigate the dolphins' use of habitat and potential for interactions with fisheries.
2. Assess the extent of bycatch and other interactions between Irrawaddy dolphins and artisanal fisheries.
3. Assess trends in fishing yield and practices as measures of sustainability.
4. Describe social and cultural ties of local communities to marine ecosystems and conservation.
5. Assess capacity of communities for various conservation approaches by examining characteristics such as social cohesion, governance structure, and sense of empowerment.

6. Provide a basis for comparing local conservation efforts for the Irrawaddy dolphin to conservation efforts in other countries.

I will conduct the following types of fieldwork:

- Photo-identification (using data collected by me, plus data previously collected by collaborators) to track habitat use of individual dolphins over time.
- Rapid bycatch and socioeconomic assessments (brief interviews, based on Project GloBAL's Rapid Bycatch Assessments) to characterize fishing practices, dolphin interactions and bycatch, ecosystem health, conservation attitudes, and management.
- Key informant interviews (extended interviews) to target particularly knowledgeable fishers and other stakeholders (e.g., dolphin-watching tours, industrial fishing companies, conservation practitioners).
- Group discussions to discuss ecosystem health and options for fisheries management and local conservation.

I will work with local field assistants, and will include local researchers and students as visiting volunteers. In Guimaras, I will not conduct ecological fieldwork, but instead will focus on interview-based fieldwork to complement the ecological research that my collaborators there will be conducting. To gain a broad and in-depth perspective, I will conduct detailed socioeconomic research at Malampaya Sound and Guimaras, with more rapid research at Trat Province and Mahakam River.

4. Key Threats

Bycatch in artisanal fisheries is a major threat for the Malampaya Sound population, and likely also is a significant problem for the other three sites. A wide variety of fishing gear is used at these sites, including gillnets, crab and fish pots, hook and line, and large stationary structures from which nets are suspended.

Additionally, the Guimaras population overlaps with industrial fishing, boat traffic, dredging/dumping; the Mahakam River population overlaps with heavy boat traffic; and the Trat Province population occurs in an area where industrial fishing was previously extensive and where tourism is developing.

5. Assessing Threats?

Using rapid bycatch and socioeconomic assessments, I am hoping to measure the extent of Irrawaddy dolphin bycatch at this site. I have preliminary results from my work in Malampaya Sound, in addition to data collected by WWF-Philippines over the years, but have not yet had a chance to look through the most recently collect interview data.

O. Conservation and Ecology of Cetaceans in Indian waters: Dipani Sutaria (Foundation of Ecological Research, Advocacy and Learning)

1. Project background

The study of cetaceans in post-colonial India was pioneered by the likes of Dr RS Lal Mohan, Dr Dhandhapani, and Dr Hussain, in the mid 1970's with support from Dr Stephen Leatherwood along with institutions like the Wildlife Institute of India and the CMFRI's. Studies were largely limited to information collected from bycatch and stranded animals. Upon discussions, we found that institutional bureaucracies and the lack of funds and expertise, has greatly limited the study of wild cetacean populations.

More recently, WWF-India, Aaranayak-Assam and Vikramshila Biodiversity Research & Education Center (VBREC) have all been intensely involved in the conservation and ecology of Platanista. The Chiika Development Authority has an ongoing conservation program in Chilika Lagoon for Orcaella, since 2002-3. The dedicated effort to study coastal and marine cetaceans though is still in its infancy. The enormous diversity of languages and culture along the 7500km Indian coastline plays a major role in the limited work produced from India. While institutional bureaucracies still limit the quality and quantity of work carried out, the study of cetaceans in India has started finding much resonance with young ecologists. Currently, there are independent projects ongoing along the Madras coast (TREE Foundation) and in Chilika Lagoon (NCF-India and JCU).

The study of wild populations of marine cetaceans was initiated in the Gulf of Kachchh marine protected area in Gujarat and in Goa in 200112; and in Orissa including Chilika Lagoon in 2004. In the Gulf of Kachchh and Goa the projects ran for 4 months during 200112 and focused on assessing cetacean diversity and abundance, along with beach surveys for carcass analysis. Projects along coastal Orissa and in Chilika lagoon started in 2004 and activities are ongoing. The organizations that have been involved are the University of Massachusetts, N Dartmouth – till 2003,

Foundation for Ecological Research, Advocacy and Learning, Pondicherry and James Cook University, Townsville, Australia. Wildlife Conservation Society, Ocean Park Conservation Foundation, Hong Kong, and Whale and Dolphin Conservation Society are the main funding agencies for these projects in India since 2002. The coastal monitoring of stranded or beached cetaceans was started as part of these larger research projects.

2. Key species under study and key types of coastal habitat

The key types of habitats we have worked in are mangrove channels, estuaries, rocky shores and sandy shores. Goa, Orissa and Gulf of Kachchh marine protected area have all these types of habitats. Chilika lagoon/lake where I carried out my PhD study is a brackish water habitat and the attached document gives a quick summary of the thesis results. The key species under study include the Irrawaddy dolphin, Indo-Pacific humpback dolphins, Finless porpoises, Spinner dolphins and Bottlenose dolphins. Sperm whales, Brydes whales and Dwarf sperm whale are some other species that are often beached. A comprehensive list of marine mammals documented from the Indian subcontinent has been attached here, though the Fin Whale and Sei Whale records can be contested

3. General aims and methods used

Given the lack of data regarding the ecology of coastal cetaceans, the general aims of all the projects have been:
1) to assess distribution and diversity of marine mammals in the study area
2) to estimate abundance of the study species
3) to obtain an idea of species distribution, mortality rate and cause from carcass analysis by beach surveys and interviews of local fishers
4) to create a historical database of species diversity and mortality
5) to increase the involvement of students, researchers and NGO's for local/regional level research and data collection

In Chilika Lagoon, we have an ongoing long-term project, which includes questions regarding population ecology and behavioral ecology. The ongoing research there by Coralie D'lima is specifically studying the relationship between fishers and dolphins. Apart from continuing the population monitoring, my own research is focusing on assessing association indices and social structure of the *Orcaella* population in Chilika. Vessel surveys for line transect and photo-Identification methods have been used for the projects. We have also carried out beach surveys, interviews and questionnaires and engage local students1village level to assist with the research, thus building capacity and awareness. Literature reviews and interaction/networking with interested individuals is carried out for objectives 5 & 6. Networking and sharing of information is one of the key steps to actually inspiring a countrywide interest in cetacean ecology and conservation. Nachiket Kelkar, Kumaran Sathasivam, Mayuresh Gangal, Elrika D'Souza, Coralie D'Lima, Rahul Muralidharan, Ipsita Harlekar– these are some new and upcoming ecologists working in the field of cetacean studies in India!

4. Key perceived threats to coastal cetaceans in your study area.

Chilika Lagoon: The main threats to Irrawaddy dolphins in Chilika are fishing related. Hook-Line fishing gear, Shark nets (large mesh size multifilament net), Trammel nets and boat-seine nets are the main threats. Shrinking habitat and laying nets across channels thus obstructing movement are other major threats to the population in Chilika.In coastal stretches of Goa, Gujarat and Orissa, fishing gear of large mesh size, Trammel nets, Boat seines and ship/boat strikes are some of the main threats.

5. Are any of your research methods aimed at diagnosing or quantifying threats? Have you obtained any estimates for (rates of) by catch in your study area?

In Chilika lagoon, we used qualitative methods – interviews with fishers and boat drivers to quantify threats to Irrawaddy dolphins. Based on our population counts and annual mortality figures, we were able to estimate the PBR value to be one or less animal per year. Data on cause of death is ambiguous, but maximum mortality is fishing gear related.

This summary included a table that is still In Press in the 2nd Volume of Mammals of South Asia, authored by Arthur, Sutaria and Sathasivam- edited by AJT JohnSingh and Nima Manjrekar, that should not be cited or published. It is available from Dipani Sutaria upon request.