A low-cost solution for documenting distribution and abundance of endangered marine fauna and impacts from fisheries

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Conservation of marine mammals which have diverse social, cultural, economic and ecological values is complicated and challenging. The dugong is an interesting candidate species to identify pragmatic and effective solutions.

Dugongs are seagrass-dependant marine mammals found in tropical and subtropical coastal waters, broadly coincident with the tropical Indo–Pacific distribution of seagrasses. Their conservation is complicated as they are characterised by fragmented populations distributed over vast ocean areas, substantial differences in life history parameters associated with seagrass availability; high costs of real-time monitoring; and small-scale artisanal gillnet-fisheries, which cause the greatest mortality.

Dugongs are vulnerable to fisheries, traditional hunting, large-scale losses of seagrass, smaller-scale habitat loss and boat traffic. Entanglement in fishing gear is the predominant threat as dugongs are by-caught in many kinds of fishing gear, in both commercial and artisanal fisheries. However, the magnitude of the impact is largely unquantified in many countries.

Little reliable information documents these impacts, particularly because much of the dugong's range is in developing countries which lack the necessary resources to conduct surveys. Knowing where dugongs are and what pressures they are under is critical for conservation, but documenting impacts from fisheries and distributions / abundances of dugong populations in a cost-effective and timely manner presents a unique challenge.

The Convention on Migratory Species (CMS) Dugong MoU Secretariat, in partnership with the Marine Research Foundation and a team of global experts, developed a survey questionnaire which can be implemented at low cost and across large geographical areas. The survey is also designed to collect data on marine turtles and cetaceans, and can be adapted to just about any marine or freshwater species. Indeed, the survey is providing baseline information for eight developing countries in a proposed Dugong and Seagrass Conservation Project funded by the

Global Environment Facility. The questionnaire-based survey was developed by an expert panel using the outcomes of Project GLoBAL's Rapid Bycatch Assessment and builds on protocols developed at the Phuket Marine Biological Center, San Francisco State University and James Cook University. The multi-disciplinary panel ensured that the survey design would be widely applicable across regions and issues, scientifically sound, and culture-sensitive. The survey protocols were reviewed by a number of social science and bycatch assessment experts to determine language and scientific rigor. The questionnaire was then field tested in three countries and further refined prior to dissemination, and has undergone fine-tuning since it was first launched in 2010.

The questionnaire survey comprises 106 questions, of which the last six are internal questions to the interviewer which relate to interviewee confidence, knowledge and accuracy. These are used to provide quality control on the data sets. Questions address the personal background of the interviewee, the fishery (or other employment form), and numbers, trends, and locations of dugongs, sea turtles and cetaceans. It also includes a data table for sightings of all marine fauna, which are drawn on to maps during the interview. This spatial component is one of the key strengths of the process, as it captures locations of fishing pressure and seagrass distribution. Interviewees each get a clean map on which to mark fauna records and their fishing areas, eliminating bias. Maps and sighting tables are linked by a code number to the questionnaire itself.

A standardized Excel spreadsheet was developed into which data are uploaded, with locked fields controlled via filters to minimize data entry error. Locked formula cells process the data in real time and construct 27 different graphic and numerical outputs in a standardized form, so that data are similarly interpreted from location to location. Graphic outputs relate to respondent demographics, fishing vessel and gear types, dugong numbers and trends, and perceptions of changes and importance of dugongs by the respondents. Users are unable to edit the graphs, but are able to copy their data into a new file and analyse separately / more thoroughly should they wish.

A Project Manual was developed to explain the project rationale and introduce the CMS Dugong Questionnaire Survey. It discusses such topics as interview methods and techniques, data integrity, survey design effort and efficiency, stratified and random sampling, field data collection and control, and how to link graphics to table data and survey numbers. Other chapters address uploading graphics and spatial data and creating and exporting Google Earth layers to GIS, and basic GIS analyses once all data are uploaded.

The questionnaire was deployed in 18 countries spanning four key geographic areas (Pacific, Southeast Asia, South Asia and East Africa) with 6153 respondents, and the results of the surveys provide the latest information on the distribution and abundance of dugong populations, while identifying and mapping areas of important dugong habitat such as seagrass beds, and assessing the relative risks to distinct populations from fisheries.

While it is impractical and illogical to provide an indication of the results from every data point, or indeed an overall synthesis given the geographical extent and the limitations on coverage within each individual country, we provide below a selection of facts derived from the programme.

Data can be scaled at local, national (e.g. states in Malaysia) or regional (e.g. all African countries) levels depending on analytical needs.

"In India over 70% of participants had fished for more than 10 years (e.g. Figure 1). The majority of respondents were 25 years old or above, and over 90% of interviewees claimed fishing to be their only activity."
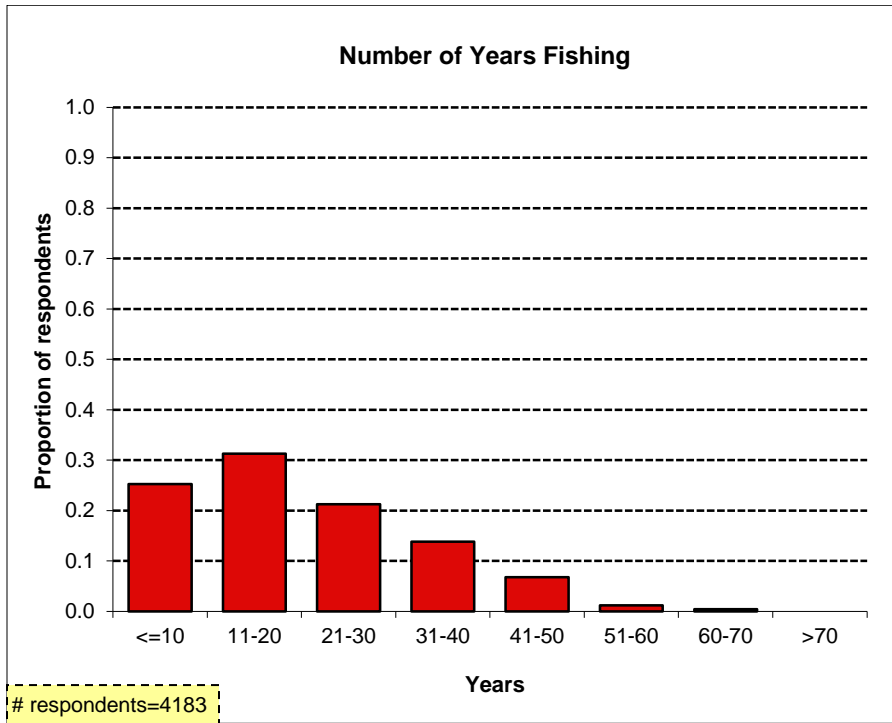
Number of Years Fishing

respondents=4183

Figure 1. The proportion of respondents in all surveys that had been fishing for various numbers of years.

"In east Malaysia respondents most commonly encountered dugongs while fishing (e.g. Figure 2.). >50% of dugongs were released alive. <15% of interviewees knew about dugong hunters in their village or in other villages."
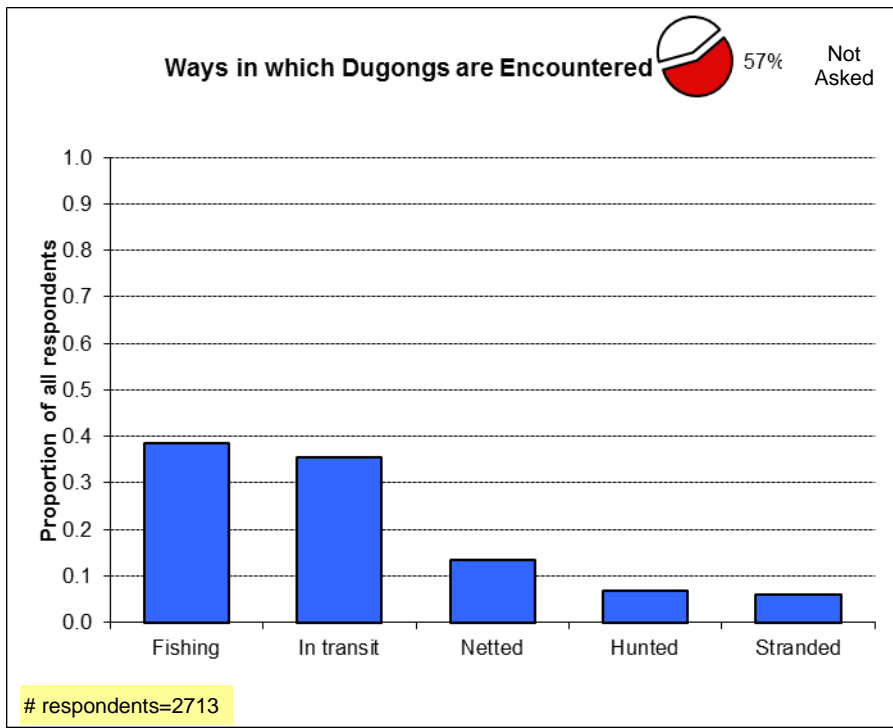

Figure 2: Proportion of respondents in all surveys who encountered dugongs in different ways.

"In the Philippines, >90% of respondents were aware of what a dugong was (e.g. Figure 3). Most dugongs were encountered while fishing (e.g. Figure 2) and most were released alive."
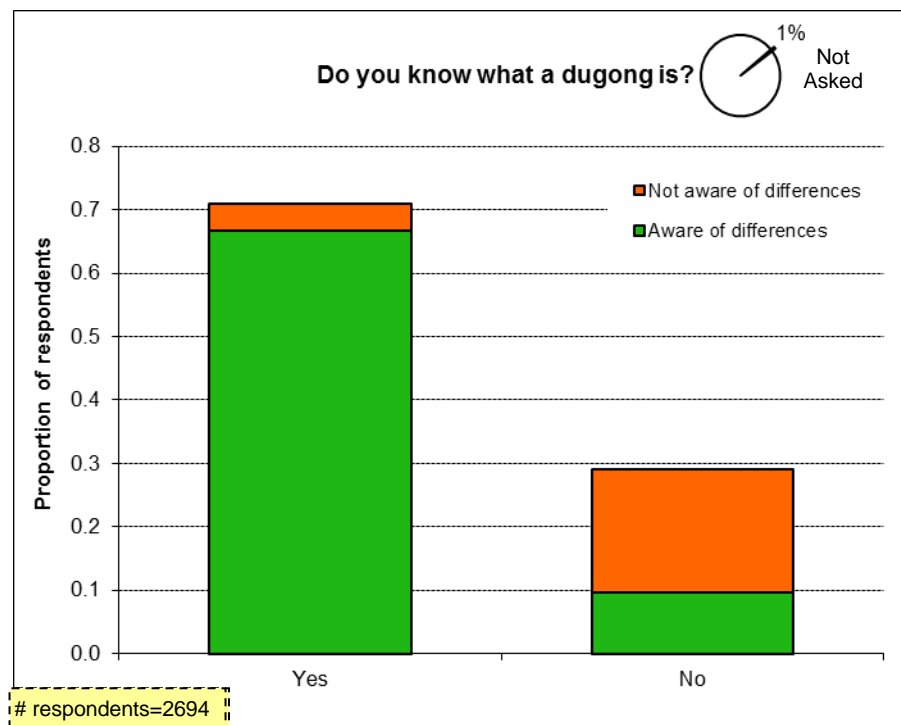

Figure 3. Proportion of respondents in all surveys who know what a dugong is, compared to other species (e.g. dolphins).

The questionnaire programme resulted in a rapid, low cost, low technology and easy to implement process for addressing information needs across the dugong's range. The average expense per country on deploying teams to conduct the interviews, analyse and enter data was around USD5000. Much of this was used for transport to and from remote survey sites, as staff costs were kept to a minimum by using volunteers and graduate students as interviewers. However some countries did not use the maps, and others adapted the questions and did not follow the prescribed format. Others used their own analysis methods and summarized dugong locations prior to submitting the reports, each of these resulting in incompatibility with other programme results. Thus an important lesson learned was that to be part of a global programme, it is important that all countries follow the same instructions and use the same methods to provide compatible results. Overall however, the questionnaire provided contemporary data on small-scale fisheries and the locations, trends and numbers of dugongs which can already be used by managers and decision makers.

Given the nature of the questions and the variability in responses, potential bias and respondent misinformation, the programme is not envisioned to provide absolute numbers and precise locations of fishing areas and dugong hunting grounds. Rather, the questionnaire provides a rapid, low cost solution to dugong and fishery data acquisition which is scientifically robust, with a spatial analysis component which results in an identification of 'hotspot' areas where dugongs

and fisheries overlap. These data along with the graphic outputs of the Excel sheet and the GIS analysis can be used to highlight priority areas for further detailed study and assessments.

The value of the work has already been demonstrated in the buy-in from the eight countries engaged in the GEF Dugong and Seagrass Conservation Project and the CMS Dugong MoU Secretariat plans to use the results of the questionnaire in other countries including India, Myanmar and Thailand to develop pilot projects to provide incentives to fishing communities to manage fishing interactions with dugongs.