Global Priorities for Reduction of Cetacean Bycatch

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Abstract

Progress at reducing the scale and conservation impact of cetacean bycatch has been slow, sporadic, and limited to a few specific fisheries or circumstances. As a result, bycatch remains perhaps *the greatest immediate and well-documented threat* to cetacean populations globally. Having recognized the critical importance of reducing bycatch levels to prevent the depletion, and in some cases extinction, of cetacean populations, World Wildlife Fund-US launched a global bycatch initiative early in 2002. Their strategy calls on governmental and non-governmental bodies to move quickly, cooperatively, and thoughtfully to achieve bycatch reduction. As a supportive step, a working group was established to identify priorities and provide guidance on how financial and other resources should be invested to address bycatch issues. The group conducted a global survey of cetacean bycatch problems and identified a series of specific problems that should be addressed as priorities, with emphasis on: (1) situations that are especially critical (e.g. a species' or population's survival is immediately at risk from bycatch) and are not being addressed adequately; (2) circumstances where rapid progress could be made with a modest investment of resources; (3) situations in which bycatch is believed to pose a threat to cetaceans but a quantitative assessment is needed to verify the risk; and (4) fisheries in which a currently available solution (technical, socio-economic, or a combination) appears feasible.

Introduction

It has been well known for several decades that large numbers of cetaceans (hundreds of thousands per year) die in fisheries around the world (e.g., Perrin 1968, 1969; Ohsumi 1975; Lear and Christensen 1975; Mitchell 1975). Nonetheless, progress at quantifying the scale of this problem, identifying specific conservation threats, and reducing the mortality has been slow, sporadic, and limited to a few specific fisheries or circumstances. For example:

- After a protracted period of scientific research, technology development, non-governmental lobbying, and legal challenges, dolphin mortality in the eastern tropical Pacific tuna purse seine fishery has been reduced dramatically (Hall

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1998; Gosliner 1999). Important questions linger, however, about the impacts of continuing chase and capture operations on the viability of dolphin populations.

- The high mortality of cetaceans (and other marine species) in large-scale drift gillnet fisheries on the high seas has been largely eliminated, at least in some ocean regions, through decisive action by the United Nations General Assembly, which declared a global ban beginning in 1993 (Northridge and Hofman1999). However, the reach of this driftnet ban did not extend to several key areas, notably the Baltic Sea (ASCOBANS 2002), the Mediterranean Sea (Tudela et al. 2003), and Exclusive Economic Zones (EEZs) where cetacean bycatches remain significant (e.g. for Dall's porpoises, *Phocoenoides dalli*; IWC 2002:328), and it is uncertain whether the ban has been fully implemented outside EEZs in parts of the South Atlantic and South Pacific.
- In New Zealand a sanctuary was created in 1988 explicitly to reduce bycatches of Hector's dolphin (*Cephalorhynchus hectori*) (Dawson and Slooten 1993) and since then further measures have been taken to address the bycatch threat to this endangered species (Reeves et al. 2003, pp. 87-88). Again, though, such measures may not have gone far enough, especially in the case of the critically endangered North Island subspecies (Dawson et al. 2001; Baker et al. 2002).
- In the United States, amendments to the Marine Mammal Protection Act in 1994 established a process in which maximum allowable annual removal limits are set for each marine mammal stock based on the potential biological removal (PBR) level, and fishing activities are subject to monitoring and regulation to assure that those limits are not exceeded (Wade 1998; Read 2003). This approach has substantially improved fishery management in the United States in terms of mitigating cetacean bycatch – through gillnet closures in some coastal areas and the mandatory use of acoustic deterrents (pingers) in others. Nevertheless, one of the most serious bycatch problems in U.S. waters (involving North Atlantic right whales, *Eubalaena glacialis*) continues to fester (e.g., Knowlton and Kraus 2001).
- In European Union (EU) waters, closure of the albacore (Thunnus alalunga) driftnet fishery in the Bay of Biscay, Celtic Sea, and west of Ireland, prohibition of driftnets from 1 January 2004 (except in the Baltic Sea), and prohibition of tuna purse-seine fishing on dolphins represented important measures to reduce bycatch (Kaschner 2003). Denmark implemented a mandatory pinger program in certain North Sea bottom-set gillnet fisheries after undertaking rigorous studies of harbor porpoise (*Phocoena phocoena*) bycatch levels and conducting pinger trials (Vinther 1999; Larsen et al. 2002). The recent Council Regulation (EC) No. 812/2004 goes further, requiring pinger use with all gillnets deployed in EU waters from boats more than 12m in length, phasing out the use of driftnets in the Baltic by 2008, and imposing a requirement for on-board observers programs to monitor cetacean bycatch in certain fisheries.

In spite of those positive examples (none of which is without ongoing problems and all of which require consistent monitoring), bycatch remains *the greatest immediate and well-documented threat* to the survival of cetacean species and populations globally (Northridge and Hofman 1999; Reeves et al. 2003; Read et al. 2003). The bycatch problem is particularly acute in developing nations whose waters (including certain rivers

and lakes) support the greatest number of cetacean species and populations at risk, and whose fisheries tend to be small-scale and decentralized, making assessment, monitoring, and conservation intervention difficult.

While bycatch in set and drift gillnets remains a principal concern, incidental mortality in trawl nets, purse seines, beach seines, and longline gear is also worrisome. The International Whaling Commission's (IWC's) management procedure for baleen whale populations explicitly requires that mortality from bycatch in fisheries (and ship strikes) be taken into account when setting allowable catch levels for whaling. As a consequence, in 2001 the IWC Scientific Committee established a Working Group on Estimation of Bycatch and Other Human-Induced Mortality (under terms set forth in the report of the 52nd annual meeting; IWC 2000:32). This working group provides an international forum for collating and analyzing data on bycatch, with emphasis on baleen whales.

Having recognized the importance of reducing bycatch levels to prevent the depletion, and in some cases extinction, of cetacean populations, World Wildlife Fund-US (hereafter WWF) launched a global bycatch initiative in early 2002. The strategy behind this initiative (Read and Rosenberg 2002) calls upon governmental and non-governmental bodies to move quickly, cooperatively and thoughtfully to achieve bycatch reduction. It also specifically refers to the IWC Scientific Committee and the IUCN (World Conservation Union) Species Survival Commission's Cetacean Specialist Group (CSG) as key sources of guidance in establishing priorities and assessing the effectiveness of measures taken to reduce bycatch.

WWF asked the CSG chairman (Reeves) to lead a working group to rank cetacean bycatch problems (i.e., assign priorities) and provide guidance on how to direct resources for addressing them. It was expected that the group's report would be useful to governmental decision makers, aid agencies, nongovernmental organizations, and related audiences. Rather than simply identifying the species or populations at greatest risk or the geographical locations where the bycatch problem is most severe, the group was asked to emphasize *opportunities*, i.e., situations where the prospects for successful intervention appeared especially good.

Approach and Scope

Our goal was to classify and rank problems according to an agreed set of criteria, and to provide a clear rationale for each problem assigned high priority for funding and intervention. The emphasis was on: (1) situations considered especially critical (e.g., a species' or population's survival is immediately at risk from bycatch); (2) circumstances where rapid progress could be made with a modest investment of resources; (3) situations in which bycatch is believed to pose a threat to cetaceans but a quantitative assessment is needed to verify the risk; and (4) fisheries in which a currently available solution (technical, socio-economic, or a combination) appears feasible. Each problem description was to include the species involved, abundance estimate, description of population status (declining, stable, increasing, etc.) where possible, type of fishery (gear, target species), and latest recommendations regarding mitigation (i.e., what needs to be done to solve the

problem, based on existing action plans, meeting/workshop reports, and expert opinions within the working group).

In contrast to the IWC Bycatch Estimation Working Group's narrow emphasis on baleen whales (covered by the Revised Management Procedure), the focus of the present study encompassed all cetaceans throughout the world.

Our review used the following previous global syntheses as starting points.

- IWC (1975)

At its inaugural meeting in 1974, the IWC Scientific Committee's Subcommittee on Small Cetaceans produced a systematic overview of the conservation and biology of small cetaceans (defined to include the minke whales plus all odontocetes except the sperm whale). A number of regional bycatch problems were highlighted.

- IWC (1994) and Perrin et al. (1994)

A 1990 IWC workshop on mortality of cetaceans in passive fishing nets and traps reviewed world fisheries on a geographical basis and then reviewed the impacts of those fisheries, species-by-species (or in many cases population-by-population). Additionally, the workshop reviewed information on causes of incidental mortality and attempted to identify solutions.

- IWC (1992)

The 1990 workshop's findings were used by the IWC Subcommittee on Small Cetaceans in responding to an IWC resolution that called on the sub-committee to 'commence a process of drawing together all available relevant information on the present status of those stocks of small cetaceans which are subjected to significant directed and incidental takes and on the impacts of those takes on the stocks' (IWC 1992:178). The subcommittee's report was presented to the United Nations Conference on Environment and Development in June 1992.

- Perrin (1988, 1989), Reeves and Leatherwood (1994), and Reeves et al. (2003)

The CSG Action Plans represent attempts to identify and describe the world's most serious cetacean conservation problems, including those involving bycatch.

We used the documents listed above, as well as annual reports of the IWC Scientific Committee, the general scientific literature, our own experiences, and information obtained directly from colleagues, to ensure that our search was taxonomically inclusive and truly global.

Criteria

The following criteria were used to determine priorities:

- Level of risk to the affected population(s) or species represented by bycatch.
- Whether the problem was already being addressed effectively through national legislation, bilateral agreements, or international conventions (in order to minimize duplication of effort and avoid suboptimal allocation of conservation resources).
- Feasibility of intervention, based on factors such as political stability in the country or region, institutional capacity within the country or region to assure effective implementation and follow-through (including long-term evaluation of effectiveness), and availability within the country or region of individuals or groups capable of carrying out the needed work.
- Whether a successful outcome was likely to provide a model for solving other similar cases.

The second and third items in the above list require elaboration. With regard to the former, we believe that, in principle, bycatch problems in the European Union, United States, Australia, and New Zealand waters are more likely to be addressed by governmental agencies and nongovernmental organizations than are problems elsewhere. This is because those jurisdictions have strong legislative instruments, prosperous economies, and relatively high levels of public awareness of, and engagement with, marine mammal conservation. Therefore, although we made no distinction between them and the rest of the world as we identified, characterized, and ranked bycatch problems, we tended to assign a lower priority to bycatch problems in EU, US, Australia, and New Zealand waters. With regard to the third item, it was assumed that technical aspects of bycatch assessment, mitigation, and monitoring could be learned quickly by motivated persons with a background in related topics (e.g., conservation biology, fishing technology).

Priorities

Three tables were constructed to identify candidate problems, based on *documented* species- or population-level threats (Table 1), *suspected* species- or population-level threats (Table 2), and problem *fisheries*, *countries*, or *water bodies* (Table 3). Entries within each of these tables were evaluated against the above criteria, resulting in nine specific projects that are described in Appendices 1-9. These nine projects are thus offered as high-priority investment opportunities for funding agencies. We have not attempted to rank the projects against one another, as choices will depend on the capacities, predilections, and internal priority-setting factors of the various funding agencies.

We emphasize that all species, populations, fisheries, countries, and regions mentioned in the three tables rank high as global conservation priorities and therefore merit attention.

Issues

A number of issues were identified during our consideration of cetacean bycatch problems. These are listed here as a way of cautioning readers about the complexity of bycatch problems and the difficulty of finding effective, lasting solutions:

- In some regions, legislation making bycatch illegal has caused serious problems for monitoring, especially where fishermen continue to catch cetaceans but dispose of carcasses clandestinely.
- In a number of regions, bycaught cetaceans have market value and are therefore brought ashore and sold. This may occur despite prohibitions against the sale of cetacean products (e.g., Van Waerebeek and Reyes 1994; Van Waerebeek et al. 1997).
- In some regions where bycaught cetaceans are valued as food or fish bait, the distinction between bycatch and directed catch (hunting) has become blurred (e.g., Read et al. 1988; Leatherwood and Reeves 1989; Dolar et al. 1994; Van Waerebeek and Ofori-Danson 1999).
- Outside North America, western Europe, Australia, and New Zealand, there have been very few observer programs designed to monitor cetacean bycatch (e.g., Leatherwood and Reeves 1989:44; Zerbini and Kotas 1998; IWC 2004:319; Bordino and Albareda 2004). With a few exceptions, the evidence for bycatch tends to be anecdotal and non-quantitative, consisting of stranding reports, interviews, port monitoring, and opportunistic observations by scientists and fishery observers. These kinds of evidence are less than ideal, but innovative, rigorous analyses can lead to credible estimates of bycatch levels (e.g., Secchi et al. 1997) or trends (e.g., Pinedo and Polacheck 1999).
- Dependence on interview data or official reports may lead to the erroneous conclusion that bycatch is rare or non-existent in a given area. Apart from strategic response bias on the part of fishermen and the general lack of rigor in compilations of national fishery statistics, the situation can be confounded by three factors: (a) Bycatch is a rare event in the experience of a given fisherman, leading him to conclude (rightly or wrongly) that the fishery-wide scale of the problem is small or negligible. (b) As cetacean populations become increasingly depleted (regardless of the causes), the incidence of bycatch declines regardless of the trend in fishing effort. In extreme cases, the cetacean population may have been locally extirpated, effectively reducing the bycatch rate to zero and rendering moot the question of whether there is any longer a “bycatch problem.” (c) Reporting of a significant cetacean bycatch may be a low priority, or politically unacceptable, in countries where fishery development is considered vital for food security or maintaining the balance of trade.
- In some areas that experience intensive gillnet fishing but lack basic information such as which cetacean species occur, bycatch may pose a serious conservation threat, yet the lack of quantitative observations makes it difficult to assign levels of priority. Moreover, the fisheries in such areas are often small-scale and decentralized, making it difficult to estimate or monitor cetacean bycatch rigorously (e.g., through an appropriately designed on-board observer program) (Donovan 1994).

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Table 1. Bycatch Priorities based on Documented Species- or Population-level Threats (* indicates those that meet the criteria established for this paper).

- Vaquitas, gillnets
- Baijis and electrofishing, rolling hooks (longlines with multiple leaders and hooks)
- North Atlantic right whales off eastern North America, vertical trap lines and gillnets
- North Pacific right whales off Asia, vertical trap lines and gillnets
- *Irrawaddy dolphins, marine: Philippines, *matang quatro* crab nets
- *Irrawaddy dolphins, freshwater: Mekong River, Mahakam River, Songkhla Lake, and Ayeyarwady River, gillnets
- Ganges river dolphins in India and Bangladesh, gillnets
- Finless porpoises in Inland Sea (Japan), gillnets
- Finless porpoises in Yangtze River, gillnets and electrofishing
- *Franciscanas, coastal gillnets
- Hector's dolphins along North Island, coastal gillnets
- Harbor porpoises in Baltic Sea, gillnets
- *Harbor porpoises in Black Sea, coastal gillnets
- J-stock minke whales in Japan and South Korea, trap nets
- *Dusky dolphins in Peru, drift gillnets
- Indo-Pacific humpback and bottlenose dolphins in Natal (South Africa), anti-shark nets
- *Indo-Pacific humpback and bottlenose dolphins on the south coast of Zanzibar (Tanzania), drift and bottom-set gillnets

Table 2. Bycatch Priorities based on Suspected Species- or Population-level Problems (* indicates those that meet the criteria established for this paper).

- Burmeister's porpoises in Peru, coastal gillnets
- Finless porpoises in marine waters of China and SE Asia, coastal nets and traps
- Finless porpoises in the Persian Gulf, coastal gillnets
- *Irrawaddy dolphins in Chilka Lake (India), gillnets; Bay of Bengal, heavy-mesh drift gillnets for elasmobranchs
- Humpback dolphins in West Africa, coastal gillnets
- Humpback dolphins in Madagascar and East Africa, coastal gillnets
- Humpback dolphins throughout their range in Asia, coastal gillnets
- Sperm whales in the Mediterranean, pelagic driftnets
- Bottlenose dolphins in the Black Sea, gillnets
- Bottlenose dolphins in the Mediterranean, gillnets
- Marine/estuarine populations of tucuxis, coastal gillnets
- Freshwater tucuxis in Amazonia, gillnets
- Short-beaked common dolphins in the Mediterranean, gillnets and driftnets
- Striped dolphins, Risso's dolphins, long-finned pilot whales, and Cuvier's beaked whales in the Mediterranean, driftnets
- Short-beaked common dolphins in western European waters, trawl nets and gillnets
- Finless porpoises in Korea and Japan, coastal nets and traps
- *Commerson's dolphins in Argentina, coastal gillnets and midwater trawls
- *Spinner dolphins and Fraser's dolphins in the Philippines, driftnets for large pelagics and flying fish, purse seines for small pelagics
- Spinner dolphins in Sri Lanka, drift and set gillnets in combination with direct harpooning

Table 3. Bycatch Priorities based on Problem Fisheries, Countries, or Water Bodies (* indicates those that at least partially meet the criteria established for this paper).

- Electrofishing and rolling hooks fishing in Yangtze River
- *Gillnet fisheries (including driftnet fisheries) in all rivers, lakes, and lagoons inhabited by cetaceans (e.g., Indus, Ganges, Brahmaputra, Karnaphuli, Yangtze, Mekong, Mahakam, Ayeyarwady, Amazon, and Orinoco systems)
- Crab trap fisheries in Sea of Okhotsk, Kuriles, and Kamchatka
- Pot fisheries for lobsters and crabs in southeastern Canada and northeastern United States
- *Crab net fishery in Malampaya Sound, Philippines (*matang quatro*)
- Gillnet fishery in Inland Sea, Japan
- Taiwan offshore and distant-water driftnet fishery
- *Coastal (artisanal) gillnet fisheries in northern Argentina, Uruguay, and Brazil
- Coastal gillnet fisheries in New Zealand
- Bottom-set gillnet fisheries in Baltic Sea
- Driftnet fishery for salmon in Baltic Sea
- *Coastal gillnet fisheries in Black Sea
- Pelagic driftnet fisheries in Mediterranean Sea
- Pelagic driftnet fisheries for salmon in Russian and Japanese EEZ (western Pacific/Bering Sea)
- J-stock minke whales in Japan and South Korea, trap nets
- Anti-shark barrier-net fisheries in South Africa and Australia
- Large-mesh drift gillnets in Peru (sharks, pelagics, cetaceans)
- *Large-mesh driftnet and purse seine fisheries in the Philippines (sharks, pelagics, cetaceans)
- Large-mesh driftnet fisheries in Indonesia (sharks, pelagics, cetaceans)
- *Drift and bottom-set gillnet fisheries off Zanzibar, Tanzania (sharks, pelagics, cetaceans)
- Gillnet fisheries in the Gulf of Tonkin, Vietnam
- Drift gillnet fishery for elasmobranchs in the upper Bay of Bengal, Bangladesh
- Drift and set gillnet fisheries in Sri Lanka

Appendix 1: Problem and Solution Description – Protecting Irrawaddy Dolphins from the Crab Net/Trap Fishery in Malampaya Sound, Philippines

A small, critically endangered population of Irrawaddy dolphins inhabits the upper reaches of Malampaya Sound, Philippines (Smith et al. 2004; Smith 2004). It is the only population of this species in the Philippines archipelago; the nearest known population is centered in northern Borneo, approximately 550 km to the south. The best available estimate of abundance for this population is 77 animals (CV = 27.4) based on surveys in 2001. Although mortality rates from entanglement in crab gear (*matang quatro* nets) have not been estimated rigorously, the available information strongly suggests that it exceeds 2.5% and could well be greater than 4.5%. This dolphin population is almost certainly declining because of bycatch in the crab fishery.

The CSG recommended immediate action to eliminate, or at least drastically reduce, dolphin mortality in this fishery. It urged that socio-economic alternatives be developed for the fishermen and emphasized the need for long-term monitoring of dolphin abundance and mortality (Reeves et al. 2003:89). Smith et al. (2004) suggested as possible alternatives to *matang quatro* net fishing, enhancement of the green mussel fishery, improvement of crab-pot catching efficiency, promotion of grow-out pens for groupers and other high-value fish, and development of community-based nature tourism. In addition, those authors recommended the step-wise closure of important segments of dolphin habitat to gillnet fishing, while emphasizing the need to convince local people that such gillnet-free zones would benefit them and should therefore be supported. Finally, Smith et al. stressed the importance of using the Irrawaddy dolphin as a "flagship species" in campaigns to promote sustainable fisheries and the maintenance of Malampaya Sound's natural productivity and biological diversity.

Irrawaddy dolphins in Malampaya Sound were listed as "critically endangered" in the 2004 IUCN Red List and even low levels of bycatch could cause their extirpation in the near future. Bycatch reduction measures, based on the recommendations of Smith et al. (2004), are urgently needed, along with a systematic monitoring program to gauge the efficacy such measures.

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Appendix 2: Problem and Solution Description – Protecting Indo-Pacific Humpback and Bottlenose Dolphins from Drift and Bottom-set Gillnets on the South Coast of Zanzibar (Tanzania), East Africa

Incidental mortality in fisheries is thought to be a significant conservation problem for cetaceans in numerous areas along the western shores of the Indian Ocean. Relatively few such areas have been the focus of dedicated assessment efforts. The south coast of Zanzibar is one of these areas.

Small populations of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) and humpback dolphins (*Sousa chinensis*) inhabit waters off the south coast of Zanzibar. Dolphins were hunted (for bait and human consumption) in the area until 1996, and this activity likely reduced the local populations. The best current abundance estimates for the two species are 161 (95% CI 144-177) bottlenose and 71 (95% CI 48-94) humpback dolphins based on mark-recapture analysis of photo-identification data collected in 2001 (Stensland 2004). The hunt was gradually replaced by dolphin-oriented tourism beginning in 1992, and by 2001 about 35 local boats were engaged in carrying passengers to watch dolphins (Amir and Jiddawi 2001).

In 2000, a reporting and collection scheme was established to document cetaceans caught in fishing gear around Zanzibar. Since then, over 160 specimens of six species of dolphins have been retrieved after being killed in drift- and bottom-set gillnets. This bycatch occurs year-round, and about 30% of the recorded catches have been in drift- and bottom-set nets deployed by local boats from two villages off the south coast of Zanzibar. Observer programs were used in 2003-04 to estimate the magnitude of the bycatch and to assess the potential for negative effects on the dolphin populations. These programs covered 25% of the total effort in both fisheries (total 14 boats), and the results indicate annual anthropogenic mortality at 8% and 5.6% of the estimated number of Indo-Pacific bottlenose dolphins and humpback dolphins in the area, respectively.

Urgent action is clearly needed to reduce the pressure on these populations that are likely already depleted. Bycatch mitigation is important not only to conserve the dolphin populations for their own sake, but also to protect the interests of local communities for which dolphin-oriented tourism has become an important part of their livelihood.

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Appendix 3: Problem and Solution Description – Protecting Harbor Porpoises in the Black Sea from Coastal Gillnets

Harbor porpoises in the semi-enclosed Black Sea are geographically isolated from those in the Atlantic Ocean, and the Black Sea population is well differentiated genetically and morphologically from porpoises elsewhere (IWC 2004:316-17). The population is currently listed by IUCN as "vulnerable," but a reassessment to consider whether this listing under-represents its level of risk is needed. Based on data from a heterogeneous array of sources in the Black Sea riparian states (e.g., bycatch reporting schemes, stranding programs), Birkun (2002) inferred that thousands of porpoises are killed each year, mainly in large-mesh, bottom-set gillnets for turbot, sturgeon, and dogfish.

At its annual meeting in 2003, the IWC Scientific Committee made a number of recommendations concerning this issue, expressing "particular concern over the large but unquantified bycatches of harbour porpoises in gillnet fisheries" and concluding that "the conservation status of this population would be greatly improved if existing fisheries regulations restricting fishing effort and the use of certain gear types were enforced" (IWC 2004:35). This, then, becomes one of those situations in which a sufficient legal and regulatory system is in place to at least improve the conservation status of the porpoise population, yet in the absence of implementation and enforcement, such improvement is not being realized. Assisting the range states to improve the effectiveness of their existing fishery management programs may therefore be one promising strategy to pursue.

The IWC Scientific Committee also recommended that the magnitude of bycatch needs to be estimated – "a matter of some urgency for bycatches of harbour porpoises in bottom-set gillnet fisheries for turbot" (IWC 2004:35) – preferably using independent onboard observer programs but, short of that, using indirect means to estimate fishing effort and cetacean bycatches in what are essentially illegal, unreported, or unregulated Black Sea fisheries.

Harbor porpoises in the Black Sea are also a focal concern of the Agreement on the Conservation of Cetaceans of the Black and Mediterranean Seas (ACCOBAMS). At its second meeting (Istanbul, November 2003), the Scientific Committee of ACCOBAMS noted recent information provided by Alexei Birkun of Ukraine on the deteriorating conservation status of Black Sea harbor porpoises, and strongly recommended that Parties to the Agreement address this issue as a matter of urgency.

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Appendix 4: Problem and Solution Description – Protecting Dolphins (Especially Spinner and Fraser's Dolphins) in the Philippines from Large-mesh Driftnets and Purse Seines

Spinner and Fraser's dolphins experience substantial bycatch in Philippine fisheries. The annual bycatch of small cetaceans in a single tuna driftnet fishery in Negros Oriental was estimated at about 400 (Dolar 1994), and similar fisheries for large pelagic species operate in many additional regions of the country (Perrin et al., in press). Even more cetaceans may be taken in round-haul nets; one estimate for the eastern Sulu Sea was 2000 – 3000 per year. In a recent "rapid-assessment" survey of 105 fishing villages, 67% were found to have some level of cetacean bycatch, with the bycaught dolphins usually used for shark bait in longline fisheries (Perrin et al., in press). The total bycatch for the country has not been estimated because of (a) the relative absence of standardized documentation of both fish catches and bycatches and (b) the lack of data on fishing fleet operating dynamics (e.g., how many boats fishing, where and when). Cetacean abundance surveys have been carried out in limited areas, and preliminary analyses suggest that the bycatches are not sustainable (Dolar 1999; Perrin 2002).

The major need is for comprehensive monitoring and documentation of fishing effort and bycatch, through longitudinal monitoring of high-risk fleets with onboard observers and landing-site interviews. An important factor in selecting this project is that a solid institutional framework exists in the form of WWF-Philippines, including trained researchers and long-term commitment and vision.

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Appendix 5: Problem and Solution Description – Protecting Irrawaddy Dolphins from Gillnet Entanglement in the Mekong, Mahakam and Ayeyarwady Rivers and in Chilka and Songkhla Lakes

Irrawaddy dolphins are threatened throughout their range by entanglement in gillnets. Their apparently obligatory adaptation to relatively rare and circumscribed environmental conditions – deep pools of large rivers and sheltered inshore marine environments (including appended lakes) with substantial freshwater inputs (see Stacey and Leatherwood 1997; Stacey and Arnold 1999; Smith and Jefferson 2002) means that populations tend to be small and demographically isolated by large areas of unsuitable habitat. This makes them particularly vulnerable. Freshwater populations in three rivers – the Mahakam of Indonesia, Ayeyarwady of Myanmar, and Mekong of Vietnam, Cambodia, and southern Laos – and one population in a marine appended lake or lagoon – Songkhla in Thailand – are classified as "critically endangered," with gillnet entanglement identified as the dominant threat. The only other known freshwater population – in Chilka Lake, India – has not been adequately assessed but is known to be subject to bycatch in gillnets.

Although rigorous estimates of bycatch mortality have not yet been possible, all available information points to supposition that current recent and current bycatch levels are unsustainable. In the Mekong River from 2001-2003, an average of four deaths per year were attributed to gillnet entanglement (I. Beasley, pers. comm.), representing 5.8% of a population estimated to number only 69 individuals (Beasley et al. 2003). In the Mahakam River from 1997-1999, an average of more than three deaths per year was documented from gillnet entanglement, representing at least 8.8% of a population estimated to number only 34 individuals (Kreb 2002). In Songkhla Lake from 1990-2003, at least 15 Irrawaddy dolphins were believed to have been killed accidentally in gillnets (Beasley et al. 2002; Smith, unpublished) from a population that may number as few as 8-15 individuals (Smith, unpublished). In the Ayeyarwady River during a survey in 2002, a total of 3,050 gillnets were counted in the main channel and researchers found that gillnet encounter rates (i.e., number of gears observed each day) increased significantly in areas where dolphins were reported to have occurred historically but were not observed during the survey (Smith 2003). It is reasonable to infer that gillnet entanglement has been an important contributory cause of declines in the species' numbers and range.

Despite the grim diagnosis, there is reason to hope that the situation can be reversed. Throughout their freshwater range, local people generally revere Irrawaddy dolphins, and in recent years local awareness of their plight has increased greatly in many areas. Bycatch reduction will require interventions involving both socio-economic and technological change. In the Ayeyarwady River, for example, a network of protected areas is planned in which gillnets would be banned but a traditional fishery that involves "cooperation" between throw-net fishermen and Irrawaddy dolphins (see Smith et al. 1997) would be promoted. Small-scale, nature-centered tourism, in which tourists accompany the throw-net fishermen and observe them as they search for dolphins and deploy their nets, would be encouraged but managed to ensure that local people gain

economic benefits. Some gillnet fishermen in the Ayeyarwady already use a low-tech strategy to keep dolphins away from their nets and prevent depredation. They strike two iron bars together, in effect using sound as a deterrent. Outside the protected areas, fishermen would be required to remain with their nets when dolphins are in close proximity.

Specific solutions to the bycatch problem will inevitably differ from one population to another. However, a comprehensive approach that consists of eliminating gillnets from areas preferred by dolphins, providing socio-economic incentives to ensure the support of local fishermen, and employing simple technological solutions to minimize the potential for gillnet entanglement outside the no-gillnet zones, offers the best chance for conserving Irrawaddy dolphins in their freshwater range.

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Appendix 6. Problem and Solution Description – Surveying, Awareness Building, and Protection of Atlantic Humpback Dolphins in the Northern Gulf of Guinea (Ghana, Togo)

The Atlantic humpback dolphin (*Sousa teuszii*) is a coastal species endemic to West Africa between Western Sahara (Morocco) and Angola. Eight nominal geographical stocks have been designated for management purposes. No abundance estimates are available, but several stocks are thought to number no more than high tens or a few hundred animals, and others are represented only by a single specimen (Van Waerebeek et al. 2004). Although the species' range may have been continuous historically, gaps in distribution are increasingly apparent. Ironically, although the species was discovered in the Cameroon Estuary in 1892, its presence in the northern Gulf of Guinea, a coastline of more than 2,000 km, has not been confirmed since then (Van Waerebeek et al. 2004). Recent claims by local fishermen give hope that humpback dolphins may still occur sporadically and in low numbers near the Volta River delta and in contiguous western Togo (Lomé area). To date, bycatch monitoring of coastal fisheries in Ghana and Togo have failed to yield a single record. However, if populations are already severely depleted, this should come as no surprise. Bycatches of humpback dolphins are well-documented in other West African countries (Van Waerebeek et al. 2004).

If dedicated field investigations in Ghana's Volta River region and in western Togo were to demonstrate that humpback dolphins are still present, this might generate sufficient awareness and public support to trigger an evaluation process and, eventually, the implementation of conservation measures. Compared with most other West African countries, Ghana has a solid reputation in wildlife conservation. A gesture that could facilitate humpback dolphin conservation would be the addition of this species to the conservation program of Ada Sanctuary at the mouth of the Volta (Songhor RAMSAR site). Furthermore, if research were to indicate cross-border movements between Ghana and Togo, the chances of international attention and investment in humpback dolphin conservation might increase, e.g., on the part of the Convention on Migratory Species.

Tens of thousands of coastal Ghanaians live from the sea and therefore gillnet closures over large areas do not seem feasible on socio-political grounds. However, certain areas like the Ada Sanctuary of the Volta delta might be declared off-limits for gillnet fishing. Some public debate has been stirred by earlier work (see Van Waerbeek and Ofori-Danson 1999; Debrah 2000), but it has not created sufficient momentum to evoke a political response at the national level. This is partly because fisheries authorities remain unconvinced of the severity of the problem. More and better data, presented in peer-reviewed publications, eventually should boost public awareness. Also, the Ghana and Togo fisheries and wildlife departments hopefully will become more involved and cooperate to ban or a least limit commerce in cetacean products, e.g., restrict consumption to local fishing communities.

With sufficient funding and appropriate training, it should be possible to achieve systematic data collection at the national level, and in turn make progress toward

assessing trends and implementing sound conservation measures. In the longer term, introduction of tourism focused on dolphin watching seems feasible, as species diversity is unusually high, seas are calm, and tourism to exotic Ghana is rising.

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Appendix 7. Problem and Solution Description: Working toward Conservation of Burmeister's Porpoise, a Highly Cryptic Species, in Peru

Burmeister's porpoise (*Phocoena spinipinnis*) is one of the three most frequently bycaught cetaceans in Peruvian and Chilean waters. Until 1994, in Peru alone, annual catches amounted to a few thousand specimens, based on direct accounts of landings (Van Waerebeek and Reyes 1994). It was inferred that most of the landed porpoises had been bycaught because deliberate hunting is rare for the same reason that sightings are rare: the species is exceedingly difficult to see under normal sea conditions. Since 1994, when commerce in the meat of small cetaceans was outlawed in Peru, quantification of removals by fisheries has become increasingly difficult. Nonetheless, observations of discarded porpoise remains during non-systematic coastal surveys have confirmed that bycatches persist (Van Waerebeek et al. 1999).

Despite heightened awareness and concern for conservation, authorities in Peru remain unconvinced that any action beyond merely outlawing commerce is needed to reduce the mortality of cetaceans in fisheries. The case for additional conservation action is weakened by the lack of recent data and practical measures that would be both effective in the field and politically attainable within the Peruvian context.

Determination of population status is an enormous challenge due to the cryptic behavior of the porpoises, which renders standard visual surveys ineffective. Estimating the scale of bycatch is equally problematic as bycaught carcasses are no longer available for inspection at fish markets (Van Waerebeek et al. 1999). Although historically high abundance can be inferred from the large numbers of porpoises landed pre-1994, it is impossible to say to what extent they were depleted and whether the population is continuing to decline.

An independent observer scheme is required to study factors influencing the bycatch of Burmeister's porpoises by the artisanal fishing fleet. Such a program does not need to be large-scale, but it must be carefully designed. A three-part effort is proposed, to consist of:

- A coastal port survey for discarded remains to evaluate current fishery-caused mortality relative to former levels, using the same criteria. Both morphological and molecular genetic evidence (for unidentifiable remains) should be collected and archived.
- Boat-based observers in areas where large numbers of porpoises were killed in the past should attempt to document entanglement dynamics (gear-related, temporal, and circumstantial factors). If feasible, an acoustic porpoise-detector (Chappell et al. 1996) should be operated simultaneously in an experimental set-up. An objective of the observer program would be to estimate current Burmeister's porpoise bycatch by extrapolation from the observed bycatch per unit of effort, which could be applied to data from the nation-wide census of artisanal fisheries in September 2004.

- Compilation, analysis, and publication of substantial existing datasets that are relevant to this problem.

Successful implementation of those activities should make it possible to develop a stronger case for additional marine protected areas in Peru (e.g., Sechura, Banco de Mancora) and allow serious consideration of restrictions on gillnet use in such areas.

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Appendix 8. Problem and Solution Description: Protecting Franciscanas from Entanglement in Coastal Gillnets in Argentina, Uruguay, and Brazil

The franciscana (*Pontoporia blainvillei*) is the most threatened species of small cetacean in the southwestern Atlantic Ocean (Crespo 1998; Secchi et al. 2001a). It ranges in coastal waters from Itaunas, Espirito Santo, Brazil, to Golfo San Matías, Argentina (Crespo et al. 1998). Bycatch is the most significant threat to the species throughout its range, which has been divided for management purposes into four Franciscana Management Units (FMUs) according to ecological, morphological, and genetic information (Secchi et al. 2001a, 2004). At least three populations have been differentiated genetically (FMU 1, 2, and 3-4). Levels of bycatch mortality are generally high throughout the franciscana's range. Removal rates, estimated by dividing the mean bycatch by the mean abundance, have ranged from 1.6% for FMU 4 to 3.3% for FMU 3. However, all estimates are imprecise and may be badly biased.

Three major efforts have been made within the past decade to obtain density estimates in southern portions of the franciscana's range: aerial surveys along the Rio Grande do Sul coast of Brazil – 0.657 individuals/km^2 (Secchi et al. 2001b), aerial surveys in Buenos Aires Province – 0.296 ind/km^2 (Crespo et al. 2002), and boat surveys in Buenos Aires Province – 0.38 ind/km^2 (Bordino et al. 2004). The first and third sets of surveys were relatively small-scale, while the second was carried out on a much larger spatial scale. Results of the surveys need to be interpreted cautiously as there is great uncertainty about g(0) (the detection function for dolphins on the trackline), group sizes in aerial surveys, and how to extrapolate observed densities to unsurveyed areas.

The status of franciscanas was discussed at the 2004 meeting of the IWC Scientific Committee's Sub-committee on Small Cetaceans. The following elements of a conservation strategy for the franciscana, based in part on that group's recommendations, have been proposed:

- Political commitments on cooperation between the range states are needed. These, in turn, should lead to cooperation and coordination among fishery management and wildlife conservation agencies at the national and provincial levels. To date, bycatch monitoring or reduction has not been considered seriously by the relevant authorities in any of the three franciscana range states.
- Biological information on the franciscana needs to be sought on an ongoing basis, thus the need for continued support of research on, e.g., ecological parameters, genetics, abundance, and mortality rates.
- Pingers have shown promise for reducing bycatch mortality of franciscanas (Bordino et al. 2002). Also, replacement of gillnets with less harmful gear (possibly longlines) has been considered as a way of minimizing franciscana bycatch without reducing the economic potential of the fisheries. Both approaches to bycatch mitigation need further testing, implementation trials, and development.

- Educational programs involving artisanal fishermen and fishing communities are needed to promote awareness of the franciscana's vulnerability and to engage relevant stakeholders in the search for solutions to the bycatch problem.

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Appendix 9. Problem and Solution Description: Protecting Commerson's Dolphins (and Other Small Cetaceans) from Coastal Gillnets and Midwater Trawls in Argentina

Trawl fisheries have expanded exponentially off Patagonia during the last 20 years and have become extremely important to the regional and national economies. The main target species have included hake (*Merluccius hubbsi*) and shrimp (*Pleoticus muelleri*). Hake landings (large quantities of undersized hake were discarded at sea) consistently exceeded quotas during the 1990s (Bezzi et al. 1995) and that fishery collapsed in 1997 (Crespo et al. 2000). As a consequence of the collapse, fishing effort was reduced, jobs were lost, and reforms of various kinds occurred in the fishing sector. With the decline of the hake fishery, fishing effort for squid increased and part of the fleet shifted to other target species, such as the southern anchovy, taken with pelagic trawls (Crespo et al. 2000; Dans et al. 2003).

Pelagic trawls are harmful to pelagic dolphins, such as dusky, short-beaked common, and Commerson's dolphins (*Lagenorhynchus obscurus*, *Delphinus delphis*, and *Cephalorhynchus commersonii*), that feed on anchovies, mackerels, or sardines (Crespo et al. 1994, 1997, 2000; Dans et al. 1997, 2003). The South American form of Commerson's dolphin is endemic to Patagonia in waters between 42ºS and 55ºS; its actual distribution is restricted to particular areas within that range. Recent aerial surveys suggest that there are approximately 21,000 Commerson's dolphins along the entire coast, with 7,000 between 42-48ºS and 14,000 in Tierra del Fuego (Pedraza et al., in review). Bycatch levels are unknown, and genetic population structure has yet to be examined although two "ecological stocks" have been identified on the basis of differences in parasite loads and patterns of prey consumption (Berón-Vera et al. 2001). Since 2002, provincial government authorities have been calling for an assessment of marine mammal and seabird bycatch to take place *prior to* expansion of the anchovy fishery southward from 41ºS.

In addition to pelagic trawling, a shore-based gillnet fishery operates seasonally for Patagonian blenny (*Eleginops maclovinus*), hoki (*Macruronus magellanicus*), and silversides (*Odonthestes* spp). This artisanal fishery, which has long been known to involve incidental mortality of marine mammals and seabirds, operates off southern Santa Cruz and Tierra del Fuego, from Cabo Espíritu Santo in the north to Río Irigoyen (Goodall et al. 1994, 1995). Very strong nylon monofilament gillnets are set perpendicular to the coastline. Since tidal amplitude in this area is approximately 9 m, the nets are set during low tide and function passively as the tide rises. During the next low tide, fishermen inspect the nets for caught fish. Panel length ranges from 25 to 100m. No attempt has been made by local or regional authorities to estimate marine mammal mortality in this gillnet fishery.

The incidental catch problem in Argentina is both political and technological. Bycatch has not been a priority in fishery management. Those observer programs that have been implemented have not included cetaceans, pinnipeds, or seabirds as species of interest. As a consequence, it is presently impossible to estimate mortality levels or rates even

when, as in the case of Commerson's dolphins, at least rough estimates of abundance are available. There is a clear need to develop and test devices to prevent dolphins from entering trawls, and possibly also to assess the effectiveness and feasibility of using pingers to reduce dolphin mortality in the gillnet fishery. Finally, further research is needed to identify and delineate management units and to improve understanding of the reproductive biology of Commerson's dolphins.

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