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# River dolphins: a review of activities and plans of the Cetacean Specialist Group*

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Three odontocete genera contain the world's living species of *obligate* river dolphins: the baiji or Yangtze River dolphin (*Lipotes vexillifer*), the boto or Amazon/Orinoco River dolphin (*Inia geoffrensis*), the susu or Ganges River dolphin (*Platanista gangetica*), and the bhulan or Indus River dolphin (*Platanista minor*). These animals do not, and possibly cannot from a physiological or ecological standpoint, live in marine waters. In contrast, a fourth genus, *Pontoporia*, which with the other three comprises the superfamily Platanistoideae, apparently lives only in coastal marine waters. The franciscana (*Pontoporia blainvillei*) is thus a 'river dolphin' phylogenetically but a 'marine dolphin' ecologically.

Several additional species of small odontocetes can be regarded as *facultative* river dolphins. This group includes the Irrawaddy dolphin (*Orcaella brevirostris*), the finless porpoise (*Neophocaena phocaenoides*), and the tucuxi (*Sotalia fluviatilis*). The systematics and zoogeography of facultative river dolphins are not entirely straightforward. Mainstream cetacean systematics has been fairly conservative, and the three genera, *Orcaella*, *Neophocaena*, and *Sotalia*, are each considered monospecific (Rice, 1977; Mead & Brownell, 1993). This is in spite of the fact that some riverine and coastal marine populations of the same species are allopatric and may exhibit consistent morphological differences. For example, in the case of the tucuxi, researchers refer to a freshwater (or riverine) form and a marine form (Borobia *et al.*, 1991; da Silva & Best, 1994). Also, Zhou (1991) proposed that the finless porpoises in the Yangtze River could be easily distinguished from those in Chinese coastal marine waters on the basis of external appearance. An interesting question that has not been conclusively answered for any of the facultative river dolphins is whether all individuals are equally capable of living in both fresh and saline environments. Our experience suggests that some, and possibly most or all, of the *Sotalia* born in the upper Amazon (i.e. in Peru, Colombia, or Ecuador; Figure 1) remain in fresh waters for their entire life. Conversely, it seems unlikely that all of the tucuxis born at sea along the Atlantic coasts of South and Central America would move up rivers to spend a part of their life in fresh waters.

The white whale or beluga (*Delphinapterus leucas*), an arctic and subarctic odontocete, offers an intriguing model for comparison with the river dolphins. While scientists have long known that herds of white whales congregate in certain river mouths during the summer open-water season, then move offshore as ice forms in nearshore embayments (Kleinenberg *et al.*, 1969), it was only recently shown that these whales molt during the period of estuarine occupation (St. Aubin *et al.*, 1990; Smith *et al.*, 1992). The combination of relatively higher temperatures and lower salinities in estuaries is thought to accelerate the turnover of superficial cells, thus enhancing, if not triggering, the molting process. Insofar as they depend on this seasonal exposure to runoff and return annually to the same river mouths, sometimes ascending rivers for hundreds of kilometers, white whales can be considered at least partially 'anadromous.' Are they, in fact, incipient river whales? And are riverine tucuxis, finless porpoises and Irrawaddy dolphins best understood as marine species that have simply gone somewhat farther in the same direction as belugas?

Various other cetaceans also move far up rivers, at least occasionally. For example, the Indo-Pacific hump-backed dolphin (*Sousa chinensis*) has been known to ascend the Yangtze River as far as 150 km (Zhou, 1991) and common dolphins (*Delphinus* sp.) the Hudson River, in the northeastern

*The full range of activities of the IUCN/SSC Cetacean Specialist Group is described, in detail, in the new Action Plan (Reeves and Leatherwood 1994a), available from IUCN World Headquarters, Gland (Switzerland).

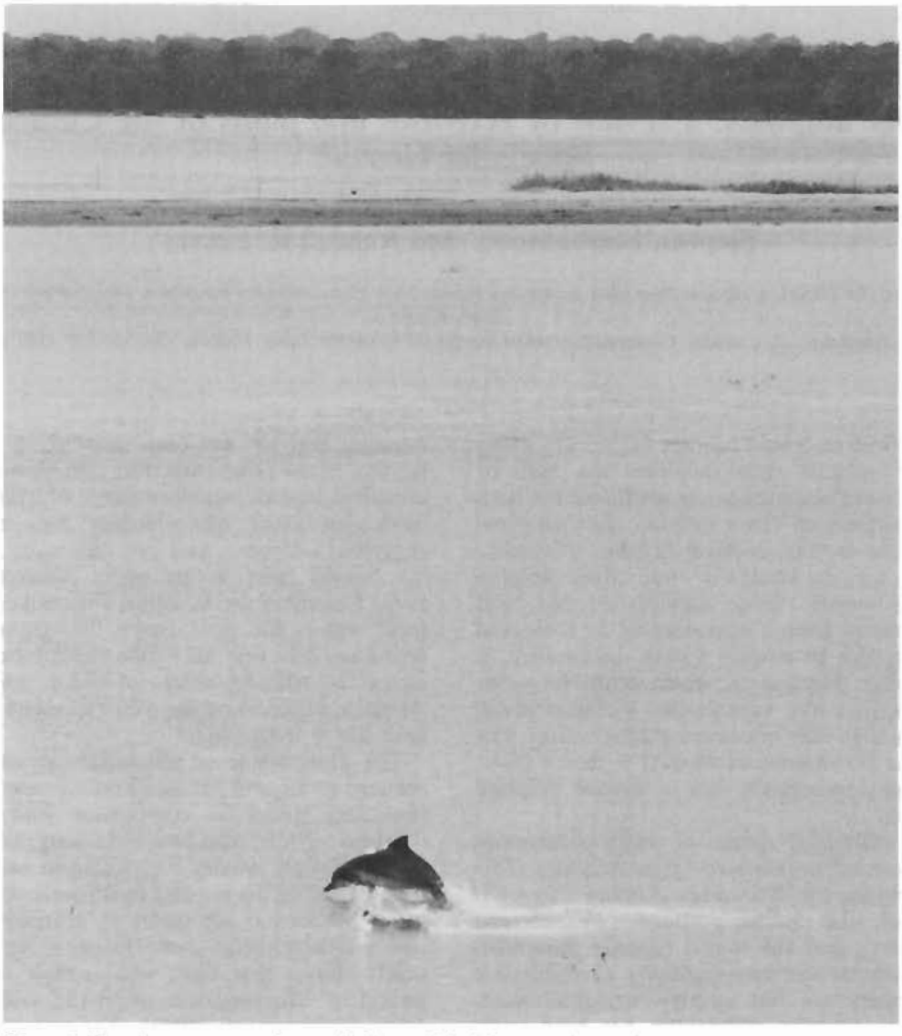

**Figure 1.** Tucuxis are commonly seen in the turbid whitewater rivers of the Amazon Basin. They are generally quicker and more active than the botos that share their entire freshwater range. [Confluence of Yarapa River (foreground) and Amazon River (background), Peru, 8 July 1994; Tamara Crosby.]

United States, as far as 230 km (Stoner, 1938). The Chilean dolphin (*Cephalorhynchus eutropia*) goes at least 5 km up the Valdivia River (Goodall *et al.*, 1988). Mysticetes sometimes wander up rivers, too. For example, a minke whale (*Balaenoptera acutorostrata*) ascended the Snohomish River in Washington State for a distance of 16 km before being shot (Scheffer & Slipp, 1948), and a humpback whale (*Megaptera novaeangliae*) swam a similar distance up the Sacramento River in northern California before being driven back to the sea by noise-makers (Warhol, 1986).

The scope of this brief review of the recent activities and plans of the IUCN/SSC Cetacean Specialist Group (CSG) is limited primarily to the platanistoid river dolphins. Our basis for limiting it in this way is somewhat arbitrary. The platanistoids are a coherent systematic group and share many morphological traits. They are nevertheless divergent in some ways and, as discussed above, do not encompass the full array of dolphins that live in rivers and lakes. Our main objectives here are to review the available evidence on status of the five species, to identify the major threats to their populations, and to describe briefly the conservation actions that have been proposed in the new five-year action plan of the CSG (Reeves & Leatherwood, 1994a). In a final few paragraphs we

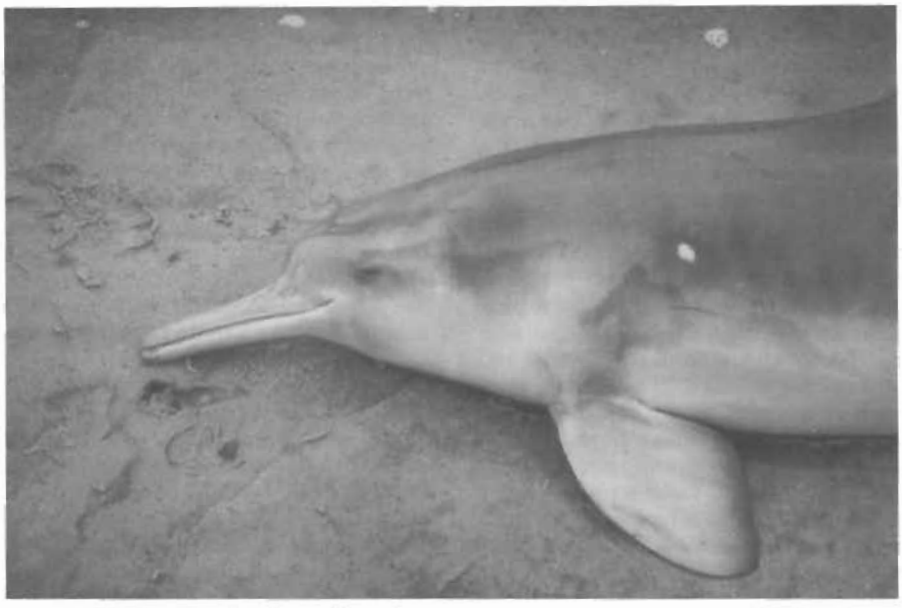

**Figure 2.** A young franciscana from the coast of Brazil. (Courtesy Salvatore Siciliano.)

call attention to the most critical conservation problems facing other cetaceans.

### Franciscana

Nearly everything that is known about this species has come from specimens either found stranded on shore or removed from gillnets (Figure 2). Few scientists have had the opportunity to observe live franciscanas at sea, and none of these dolphins have been in captivity for more than a few weeks (Brownell, 1989; Monzón & Corcuera, 1991; Crespo, 1994). No rigorous estimate of population size has ever been attempted. Catch levels, estimated to have been 2000 per year in the late 1960s at a single site (Punta del Diablo, Uruguay; Brownell & Ness, 1970), indicate that franciscanas were then reasonably abundant in at least some parts of their range: coastal waters from Itaúnas, Espírito Santo state, Brazil (18°25′S), to Rio Negro province, Argentina (41°09′S) (IWC in press). In recent years more than a thousand franciscanas have been killed annually along the three southern Brazilian states of Rio Grande do Sul, Santa Catarina, and Paraná (Pinedo, 1994). Repeated calls have been made for better information on kill rates and population size (see Perrin *et al.*, 1989), but it is still impossible to assess the status and trend of the population(s).

By-catch in fisheries has long been recognized as the single greatest threat to the franciscana's survival (Van Erp, 1969; Mitchell, 1975; Brownell, 1975, 1981), yet no concrete action has been taken to address the problem, apart from a patchwork of attempts by individual researchers to document catch levels in local areas (e.g. Praderi *et al.*, 1989; Macri & Crespo, 1989; Crespo, 1994; Pinedo, 1994). Incrementally, researchers have extended the known range of the species and established its involvement in more and more fisheries. A decline in catch rate of franciscanas has been noted in Uruguay (Pinedo *et al.*, 1989), but it is unclear whether this change is due to lessened fishing effort, relocation of the fishing grounds, or a reduced franciscana population. Although in Uruguay the oil from dead franciscanas was formerly sold to the tanning industry, and some carcasses were used as pig feed, such uses are apparently now obsolete. The meat of incidentally caught franciscanas is sometimes eaten by fishermen (Monzón & Corcuera, 1991), and the blubber is sometimes used as bait for longlines (Crespo, 1994).

The possibility of introducing longlines to replace gillnets in the shark and scaenid fisheries that take large numbers of franciscanas as a by-catch was raised (not for the first time) at the 1994 meeting of the IWC's Sub-committee on Small Cetaceans. A pilot project to replace gillnets with longlines was recently completed with cooperation of fishermen in a long-standing shark fishery in northern Peru. It was clearly demonstrated that fishermen could catch comparable numbers of sharks per vessel per unit of effort while at the same time taking fewer non-target organisms such as small cetaceans

(Reyes, 1993). Even so, the transfer has not received widespread acceptance. Since franciscanas (as well as turtles and, in some areas, seabirds such as albatrosses) are also caught in surface longlines, any initiative towards a wholesale changeover needs to be approached with considerable caution.

The new CSG action plan includes two projects explicitly related to the franciscana. The first is an investigation of stock structure. Can the two proposed forms, or stocks, of *Pontoporia*, one occurring north and the other south of Santa Catarina, Brazil (Pinedo, 1991), be validated by comparing molecular characteristics, parasite faunas, contaminant loads, growth and reproductive rates, and skeletal or cranial morphology? The second project is to design and implement an experimental survey of franciscanas. Ultimately, it is hoped that a method can be found for monitoring and detecting changes in their populations. There is no immediate prospect of obtaining useful estimates of absolute abundance, so an index of some kind will probably have to suffice. Just managing to carry out a systematic survey, with enough observations of franciscanas to support statistical analyses, constitutes a formidable challenge.

Two other projects in the action plan are highly relevant to franciscana conservation. Although considerable attention has been given to the problem of incidental mortality in Uruguayan waters over the past 25 years, there has been a long-standing need to investigate more closely the by-catches of cetaceans in fisheries along the coasts of Brazil and Argentina. Regional projects in the action plan call for coordinated and expanded efforts of this kind in both countries. Substantial progress has been made in recent years, largely due to the personal dedication of young researchers working with minimal resources. Some of the results of these initial efforts were presented at a meeting on franciscana conservation in Buenos Aires in September 1992, co-sponsored by the CSG, the Whale and Dolphin Conservation Society (WDCS), and the United Nations Environment Programme (UNEP) (Crespo, 1994). Much more work that includes quantification of effort, by area, season, and type of fishery, will be necessary before the magnitude and consequences of incidental mortality of this species can be properly assessed.

## Boto

We consider the boto to be the least endangered of the platanistoid species. It still occupies a vast and convoluted range, which includes some waterways that remain little affected by human activities. Folklore throughout much of the Amazon and Orinoco has protected this dolphin from direct exploitation (e.g. see Stocks, 1987). Many river-dwelling people in Peru, where we have been working for the past four years, regard the animal with superstitious dread. They are loathe to have anything to do with a dead bufeo (as the dolphin is known in this region), fearing that handling it will precipitate a long series of retributive consequences for them and their families. Perhaps because fish, turtles, manatees, and various semi-aquatic and land mammals have been so readily available, both Indians and settlers have generally neglected botos as a source of food, oil, and leather. The export of live botos to oceanaria in North America and Europe flourished during the 1960s but has now virtually ceased.

The main purpose of our expeditions upriver of Iquitos has been to study the distribution, abundance, habitat preferences, and conservation needs of botos and tucuxis. It has been heartening to find both species present throughout the mainstems of the large whitewater (Amazonas, Marañón, Ucayali) and clearwater (Tigre) river systems as well as in most of the blackwater streams and lakes that we have visited. Our focal study area has been the Samiria River, a Marañón affluent and principal artery of the 2 080 000-hectare Pacaya-Samiria National Reserve. There are hundreds of botos in the Samiria system, and probably thousands more elsewhere in Peru. When one considers that Peru contains only a small portion of the total suitable habitat for botos in South America, it becomes clear that they are, by far, the most abundant of the riverine platanistoids.

It is important, however, to avoid complacency. Wherever gillnets are used, dolphins become entangled and die. The use of gillnets continues to spread throughout Amazonia. We frequently find the channels of small blackwater streams blocked with gillnets, and fishermen tell us that botos regularly collide with their gear. Some of the animals escape or are released alive but others die (Figure 3). In oxbows and rivulets fishermen construct drop-traps to capture the prized paiche (*Arapaima gigas*) and manatee (*Trichechus inunguis*), but it is not unusual for dolphins to be killed in them instead. The scale of incidental mortality of botos in Peru is impossible to estimate without an intensive and sustained monitoring program. Our research team has examined five dead botos, two of which were definitely killed by nets or traps. Judging by what fishermen tell us at the village of San Martín, near the Samiria-Marañón confluence, a few tens of dolphins apparently are killed each year in and around the large oxbow on their doorstep (Tipishca de Samiria). Researchers in other areas have also reported by-catch rates that are high enough to cause concern—e.g. in Brazil (Best & da Silva, 1989; da Silva & Best, 1994) and Colombia (Beltrán & Trujillo, 1992; Kendall, 1993).

**Figure 3.** This young boto was killed in a gillnet set in the confluence of a small blackwater stream and an oxbow lake. (Tipishca de Samiria, Samiria River system, Peru, 28 July 1993; S. Leatherwood.)

One project in the new CSG action plan calls for studies of boto mortality in all areas where fishery conflicts are suspected, and a second proposes the use of tissue samples collected from carcasses to study genetic and biochemical differences among stocks. Another aspect of the latter project is photo-identification, a technique that has been applied with considerable success to botos in Colombia by Trujillo Gonzalez (1994) (Figure 4). We have proposed that there be a unified system for curating and archiving the tissues and photographs of botos. Such a system would facilitate collaborative work similar to that achieved with humpback and right whales (*Megaptera novaeangliae* and *Eubalaena glacialis*) in the northern hemisphere (e.g. see Hammond *et al.*, 1990).

Although considerable attention has been given to reports that fishermen sell the eyes and genitalia of botos (and tucuxis) as love-charms in Brazil (Kirby, 1985; Anonymous, 1985; Shoumatoff, 1986, 51) and Colombia (Obregón *et al.*, 1988; Trujillo *et al.*, 1992), we are not aware of any such market in Peru. Dead dolphins there are simply discarded and ignored by the *ribereños* (riverside inhabitants), who subsist mainly on fish, rice, and jungle meat (*carne de monte*; Padoch, 1988). Another action plan project calls for a study of folk beliefs that support the exploitation of cetaceans. The main goal is to establish whether claims of drug potency, for example, are legitimate. In the case of botos, it will be important to verify the belief of Best & da Silva (1989) that 'no intentional fishery for dolphin organs exists in the Amazon today.' It should also be borne in mind that some folk beliefs, such as those that make it taboo to kill botos and tucuxis in parts of Amazonia and Irrawaddy dolphins in Myanmar (Burma) (Thein, 1977) and at least parts of Indonesia (Tas'an *et al.*, 1980), might best be reinforced rather than debunked if one wishes to promote the conservation of cetaceans.

## Susu

The susu's historic range in the Indian subcontinent was extensive. John Anderson, a British surgeon stationed in Calcutta, estimated that the total range of *Platanista* in the 19th-century (including the Indus) spanned an east-west distance of 1880 miles and a north-south distance of 800 miles (Anderson, 1878). This did not include the upstream ends of the Ganges tributaries that extend into Nepal.

In August 1992, with financial support from WDCS and Greenpeace Environmental Trust, the CSG convened a meeting of river dolphin specialists in New Delhi. Presentations by researchers from various parts of India and Bangladesh demonstrated that although susus still inhabit much of their former range, their numbers have declined in many areas, apparently due to directed hunting and by-catch in fishing gear as well as the damming and withdrawal of water from the Ganges in particular. Most of the recommendations made at the meeting

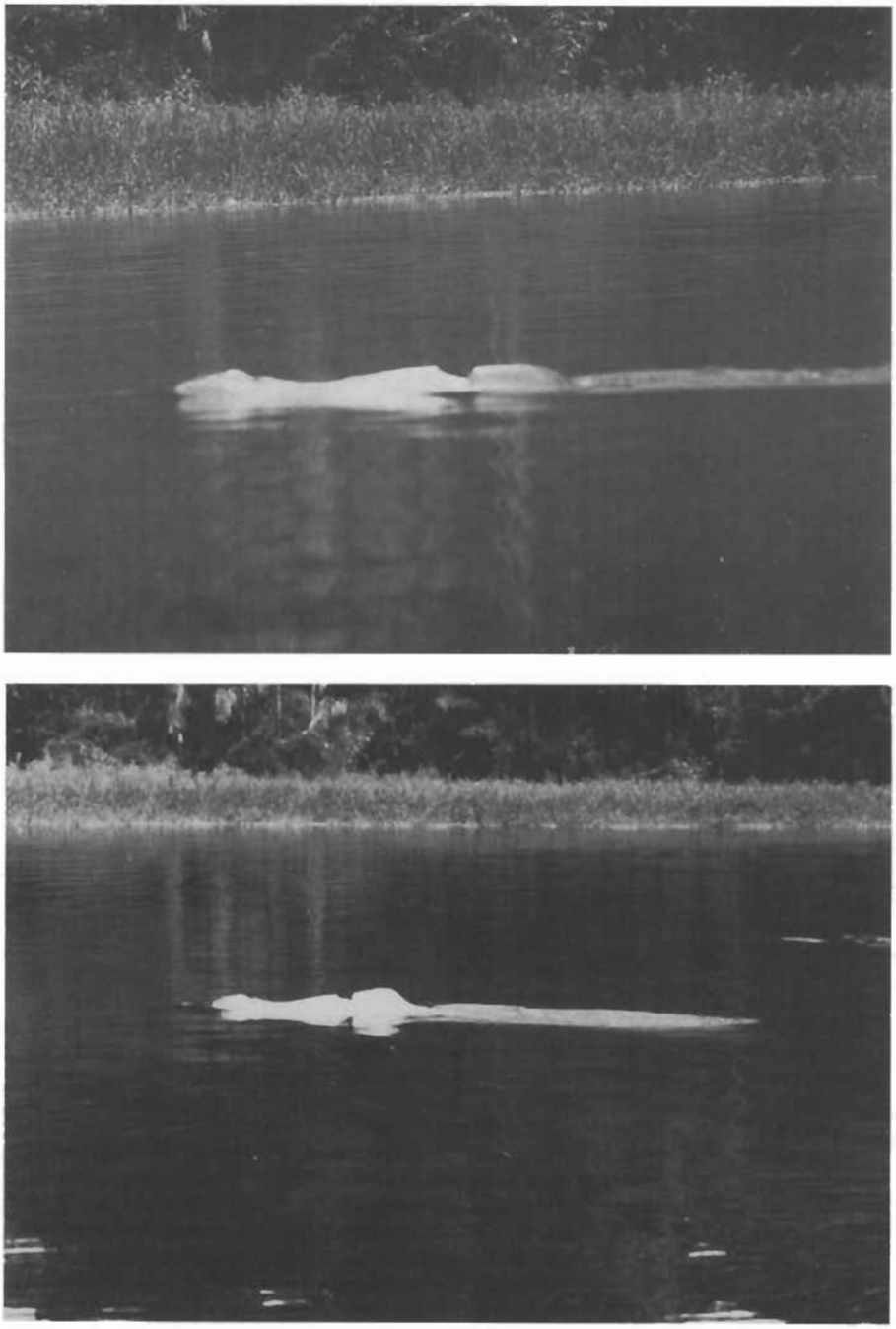

**Figure 4.** One of several botos with distinctive dorsal markings that have been photo-identified in the Lower Samiria River, Peru. This animal was videotaped at the Atun Cocha–Samiria confluence on two days in April 1993 and was photographed near the Tacshacocha ranger station, just downstream of the confluence, 22 July 1993 (top: S. Leatherwood), and in Atun Cocha, July 1994 (bottom: Tamara Crosby). These three sites are within 10 km of one another.

(Reeves *et al.*, 1993) are embodied in the new CSG action plan.

The initial plan (Perrin, 1988) called on national and regional development agencies to consider the protection of river dolphins and other associated river fauna as a priority. The new plan identifies five CSG projects that explicitly relate to this same concern. We have proposed that a permanent position be created and funded, perhaps in a Washington-based nongovernmental organization, to monitor development projects potentially affecting river dolphins and to ensure that the effects on aquatic mammals (including dolphins and otters) and reptiles (especially threatened crocodilians) are given appropriate attention in environmental impact assessments. We also plan to convene a symposium on the impacts of dams on river dolphins (see Perrin & Brownell, 1989; Reeves & Leatherwood, 1994b), with the ultimate goals of raising awareness about river dolphins among politicians, planners, and engineers, and improving the state of knowledge about the problems and potential solutions.

Three proposed CSG projects in the Indian subcontinent are centered on dams and other river-modification schemes:

(1) Farakka Barrage, built in the lower Ganges during the 1970s to make more water available in the Hooghly River, a tributary that flows past Calcutta, is positioned near the center of the susu's historic range. In addition to having partitioned the susu population and blocked the upstream migrations of other aquatic species (Ahsan *et al.*, 1992), this barrage has had a severe impact on the Sundarbans downstream, where the consequent saline encroachment has destroyed huge tracts of mangrove forest (Rahman, 1986). One project is to investigate ways of restoring damaged river-dolphin habitat above and below Farakka Barrage.

(2) The Flood Action Plan (FAP) in Bangladesh was a humanitarian response to cyclone damage. As formally adopted in 1989, the plan would involve an elaborate network of embankments intended to 'tame' the flood waters of the Brahmaputra, Ganges, and Meghna rivers. Some analysts predict that the FAP cannot possibly achieve its promise of making the lives of Bangladeshis more secure because any benefits in the form of flood control are likely to be offset by losses in fishery and agricultural production (Rogers *et al.*, 1989; Dalal-Clayton, 1990; Custers, 1992; Pearce, 1992; Sklar, 1992). There is, in any event, a critical need for evaluating and, if possible mitigating, the adverse effects on dolphins and other river fauna. The CSG advocates focused study of such factors as the depletion of native prey species, erosion of important physiographic features, altered flow and temperature regimes, population fragmentation, human disturbance related to geotechnical feasibility studies and construction activities, and degradation of water quality, particularly as they relate to the conservation of susus in Bangladesh and India.

(3) In Nepal it is feared that viable numbers of dolphins may remain only in the Karnali River, one of the four systems within the country that were inhabited by susus as recently as the 1980s (Shrestha, 1989). The Karnali population moves freely across the Indian border (where the river's name changes to Ghaghara) but is at least semi-isolated by a barrage at Kailashpuri, some 20 km south of the international border. The early stages of construction have begun for a high dam in Chisapani Gorge, below which the fast-flowing Karnali meets the Gangetic plain and fans out to provide the braided channels suitable for river dolphins. Smith (1993) outlined the ways that Chisapani Dam threatens the Karnali's remnant dolphin population (Figure 5). A CSG project, as envisioned in the new action plan, would investigate the downstream effects of this high dam and, hopefully, find ways to mitigate some of the more serious ones.

The first meeting of the Asian River Dolphin Committee took place in Hong Kong in December 1994. This committee, comprised of members from the range states (for *Platanista gangetica* and *P. minor*) as well as representatives of the CSG and relevant funding agencies, is expected to carry on the work begun at the seminal river dolphin workshop in Wuhan, China, in 1986 (Perrin *et al.*, 1989) and the Delhi meeting in 1992 (Reeves *et al.*, 1993). It is expected that this group will make progress in implementing two other long-standing CSG projects—one to achieve as complete a survey of the susu's range as possible so that the species' overall status can be assessed, the other to develop standard methods for surveying river dolphins. The latter project will eventually require the convening of a workshop, with the object of producing a manual for field use. We recognize that river dolphins live in systems that are at once dynamic, with large within-year changes in water levels, and complex, with highly variable geographic and hydrologic characteristics. Thus it would be unrealistic to expect a single approach or methodology to be equally applicable for all of the species, areas, and circumstances. It is nevertheless essential to achieve a certain degree of standardization if there is to be any hope of analyzing population trends.

Brian Smith, a California-based aquatic biologist, is in the process of launching a Program for Conservation of Aquatic Wildlife and Fisheries Development, centered in the Karnali and Narayani rivers of Nepal. Part of the novelty in his approach is the collaboration of several

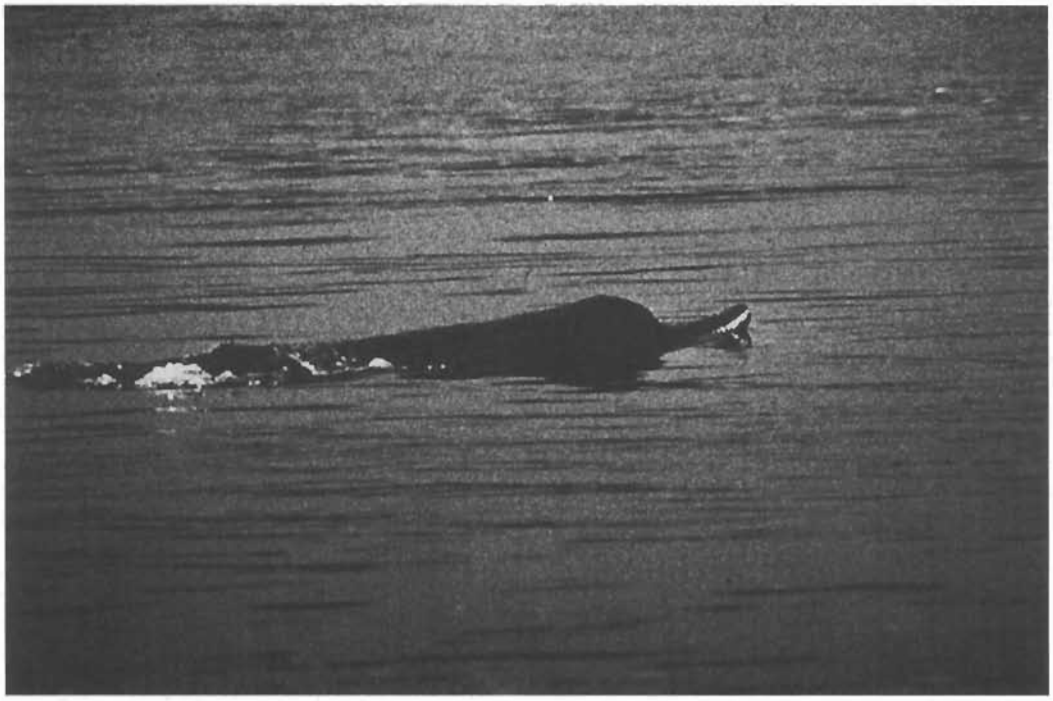

**Figure 5.** An adult female susu in the Karnali River, Nepal, exhibiting the fearsome-looking teeth that line the long, narrow snout. (Manau Ghat, 26 March 1990; Brian Smith.)

taxon-based SSC specialist groups. Susu conservation is the primary interest of the CSG. The Otter Specialist Group is expected to provide expertise on the three otter species known from Nepal, and the Crocodilian Specialist Group, on the gharial and mugger crocodiles. This multifaceted initiative would promote integrated river basin development. The survival of several wild species would be tied to shared life-supporting processes and ecosystem integrity, rather than being consigned to separate compartments. Smith's program would also make human welfare an essential part of the conservation equation, with enhanced fish resources benefitting artisanal fishermen as well as aquatic carnivores such as dolphins, otters and crocodiles. Nature tourism, carefully considered in order to ensure that the benefits to local people and wildlife outweigh any associated impacts, is another element of this ambitious project.

### Bhulan

The bhulan, as the river-dwelling people of Pakistan call the blind Indus dolphin (Figure 6), survives only as a metapopulation totalling perhaps 500–600 individuals. Gated dams, or barrages, constructed throughout the Indus Basin to channel water into an enormous network of irrigation canals, block the dolphins from travelling freely up- or downstream. Only five or six subpopulations survived in the early 1990s, and only two of these had more than a few tens of dolphins.

Although dolphins are occasionally killed illegally or accidentally in fishing nets, exploitation is not regarded as a serious threat at present. Rather, the bhulan is most obviously and immediately threatened by degradation of its already-shrunken habitat. Reeves *et al.* (1991) estimated that the species currently occupies only about 20% of its 19th century range (in terms of river length). In a short note presented to the 1992 river dolphin meeting in Delhi, A.H. Mirza, chief conservator of the Sind Wildlife Management Board in Karachi, called attention to the fact that the bathymetry and physiography of the Indus within the Sind dolphin reserve (between Sukkur and Guddu barrages) has changed markedly since the reserve was created in the mid-1970s (Mirza, 1992). He also suggested that river dolphins are present below Kotri Barrage, which could mean that animals are moving downstream through the barrages when the water level is high, only to have their return upstream blocked by either the barrage gates or the strong flood-stage current when the gates are open.

Since the publication of the first CSG action plan in 1988, we have learned that there are more

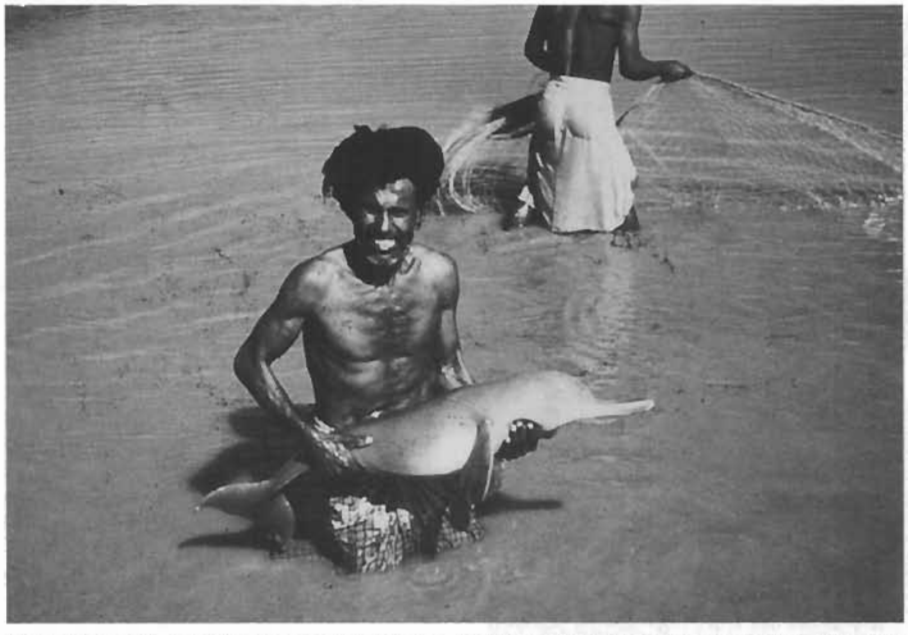

**Figure 6.** Several dolphins were live-captured in the Indus River, Pakistan, during the 1970s and transported to oceanaria in the United States and Switzerland. This classic photograph shows one of the animals taken from what is now a river dolphin reserve in Sind Province. (G. Pilleri.)

dolphins in Punjab province than previously believed. A. A. Chaudhry and colleagues of the Pakistan Wildlife Research Centre in Faisalabad have conducted annual counts of dolphins in Punjab (Chaudhry & Chaudhry, 1988; Chaudhry & Khalid, 1989), with the highest number thus far reported being 173 in November 1992 between Chashma and Guddu barrages (A. A. Chaudhry, *in litt.*, 14 December 1992). While it cannot be said conclusively from their results that the Punjab population is growing, it is at least safe to conclude that the situation is better than Khan & Niazi (1989) anticipated that it would be.

Thus in the new action plan we have listed a re-investigation of the status of dolphins in the Sind Dolphin Reserve, between the Sukkur and Guddu barrages, as a high priority. This project is to include an evaluation of habitat condition, population trends, adequacy of protective measures, and downstream 'escapement' from the reserve via the barrage at Sukkur. Another project seeks to ensure continuation and further refinement of the provincial government's monitoring and protection program in Punjab.

## Baiji

Of all the living cetaceans, the baiji is probably the closest to extinction; only the small marine porpoise of Mexico's Gulf of California, the vaquita (*Phocoena sinus*), and the right whales in the North Atlantic and North Pacific are possible rivals for the dubious distinction. At the Wuhan meeting in 1986 it was concluded that about 300 baiji remained and that the number was declining (Perrin & Brownell, 1989). The Chinese had already begun development of 'semi-natural reserves' and 'oceanaria' to function as warehouses for the fast-shrinking gene pool (cf. Ralls, 1989; Ridgway *et al.*, 1989; Figure 7). Reports emanating from China in the years since 1986 have consistently indicated further declines in the wild baiji population (Zhou & Wang, 1992; Chen & Liu, 1992; Zhou, 1992; Zhou & Gao, 1993). Protective laws, public-awareness initiatives, and development of 'natural reserves' in the Yangtze mainstem, as envisioned in the 1986 workshop report (Perrin & Brownell, 1989), appear to have been ineffective. Although illegal, the widespread use of 'rolling hooks' to catch bottom fish continues to kill baiji (Zhou, 1992; Figure 8).

As a result of the apparent failure to arrest the species' decline, discourse among conservationists within and outside China during the last several years has increasingly moved away from *in situ* and toward *ex situ* conservation strategies. The continued decline of the giant panda, in spite of the high-profile and intensive international campaign to reverse its fortunes (Schaller, 1993), has cast a pall over the drive to save the baiji.

**Figure 7.** A finless porpoise surfaces in the oceanarium at Tongling, China. The 'semi-natural reserve' for baiji is in the background. (June 1993; S. Leatherwood.)

It has proven extremely difficult to obtain even the most basic population-level data on the baiji (Ellis *et al.*, 1993). Surveys have not been conducted with sufficient rigor to yield good estimates of absolute abundance, nor have the results been precise enough to give statistically powerful evidence of population trends (cf. Taylor & Gerrodette, 1993). Photo-identification efforts begun in 1986 (Hua *et al.*, 1990) have provided little useful information (Zhou & Gao, 1993). Radio-tracking of baiji proposed during the late 1980s (Würsig & Tershy, 1989) has not been conducted, although finless porpoises were successfully tracked within Shishou 'semi-natural reserve' in October/November 1993. Unfortunately, seven of the 12 finless porpoises in the reserve at the time were killed during capture operations (Wang Ding, pers. comm., September 1994). To reduce the risk of similar disasters with baiji, it is critical that experienced, well-trained dolphin collectors be involved in any attempt.

While we recognize that scientific understanding of the baiji's status is inadequate, we are nevertheless convinced that the situation is grave and that the species is rapidly approaching extinction. When one contrasts the findings reported at the 1986 workshop (Perrin *et al.*, 1989) with those reported in 1993 at an international baiji workshop in Nanjing (Ellis *et al.*, 1993) and more recently by Chinese investigators who have tried to find dolphins in the Yangtze (Hua Yuanyu, Dong Min Li,

**Figure 8.** As the heavy clothing of the children in the photograph suggests, river dolphins are not necessarily tropical animals. The baiji, shown here, and some susus live in areas with a temperate climate. (Courtesy Zhou Kaiya.)

**Figure 9.** A view of the eastern stream connecting the 'semi-natural reserve' at Shishou with the mainstem of the Yangtze, taken during the low-water season. The protective dike is being constructed at approximately this location. During the high-water season, the grassland in the background is flooded. (June 1993; S. Leatherwood.)

and Liu Renjen, pers. comm.), it is difficult to escape the conclusion that the scale of population figures may have shifted recently from the low hundreds to the high tens.

Both of the paradigms discussed by Caughley (1994) apply to the baiji. The small-population paradigm, with its relatively strong theoretical underpinning, can help explain the baiji's predicament, and it certainly identifies some of the pitfalls that could plague restorative strategies: inbreeding depression, genetic drift, environmental and demographic stochasticity, or the so-called 'extinction vortex'. This paradigm might, in fact, be useful in helping to decide whether there is any point in continuing to invest limited resources in efforts to prevent the baiji's extinction (environmental triage). But assuming that an effort of some kind must be made, this paradigm does not necessarily provide insights of immediate *practical* value to Chinese conservationists.

The declining-population paradigm, with its emphasis on the causes of decline and the search for solutions, is more immediately satisfying. There is, as yet, no evidence suggesting that baiji are inbred or that they are in some other way already doomed to extinction by genetic or demographic realities. It seems very likely that the main culprit in their approaching demise is the familiar first member of Diamond's (1989) 'evil quartet': overkill. Mortality from entanglement in 'rolling hooks' and other fishing gear, collisions with vessels, and dynamite used for construction and illegal fishing (Perrin & Brownell, 1989) could easily explain the population's chronic decline. Habitat degradation and fragmentation have undoubtedly contributed substantially as well (Chen & Hua, 1989; Zhou & Li, 1989), and one cannot yet rule out the possibility that 'chains of extinction' have somehow played at least a minor role in shaping the baiji's own extinction crisis. There is ample reason to fear that construction of a high dam at Three Gorges, in the upper Yangtze, will further reduce the river's suitability for baiji (Fearnside, 1988).

The conservation crisis with baiji is complex and divisive. Ellis *et al.*, (1993) concluded that the species cannot survive without intervention. In light of this, few conservationists would accept a hands-off strategy, especially within China where the baiji has been declared a national treasure and come to be a flagship species for rivers, much as the giant panda is for the forested highlands (Wang, 1989).

Following the Nanjing meeting (Ellis *et al.*, 1993), intervention was scheduled to proceed as follows: (a) Dikes would be completed at the entrances to the 'semi-natural reserve' at Shishou, and the fishing community there would be relocated (Figure 9). (b) Baiji would be captured to stock this reserve, in which an introduced population of ten finless porpoises produced six calves in three years. (c) The 'semi-natural reserve' at Tongling would be tested with finless porpoises for at least a year before stocking with baiji was allowed to begin there. (d) The oceanaria at Wuhan and Tongling would be stocked only with baiji that have been rehabilitated after stranding or being captured accidentally in fishing gear (Figure 10). (e) Efforts

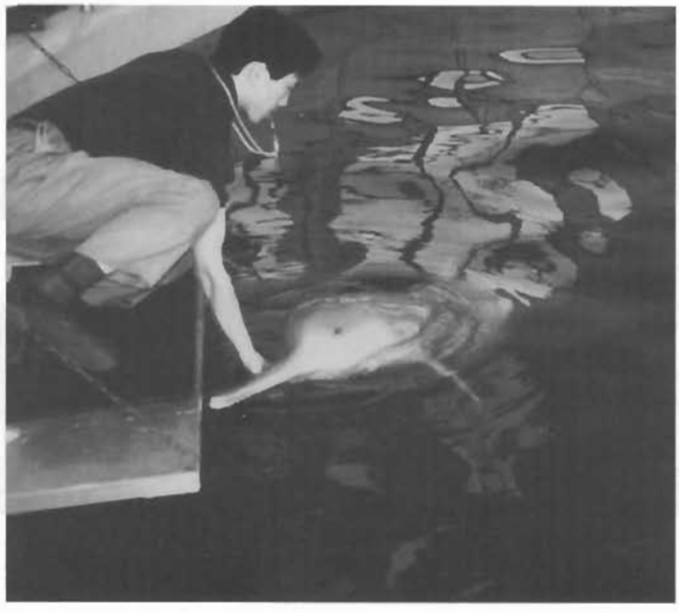

**Figure 10.** Dolphin training at the oceanarium in Wuhan, China. 'Qi Qi,' the only baiji currently in captivity (top), was rescued from a fishing net in 1980. Finless porpoises (bottom) are sympatric with baiji in much of the Yangtze. (May 1994; S. Leatherwood.)

to monitor trends in the wild population would continue.

The situation has been re-evaluated on the basis of information obtained during the year and a half following the Nanjing workshop. Although the design and conduct of surveys have continued to lack rigor, the low encounter rates reported during all vessel searches in 1993–94 suggest that the population is still declining. The 'semi-natural' reserve at Tongling has not been tested as recommended at Nanjing, so it is not ready to receive baiji. Cruises have been aimed primarily at capturing baiji, with plans to apportion animals caught among the four potential holding facilities—two 'semi-natural reserves' and two oceanaria. This approach may well maintain the baiji's high public profile and serve short-term political interests in China (cf. Schaller, 1993). However, the species' chances for survival may be better served by a strategy of stocking the Shishou reserve as rapidly as possible, and at the same time identifying and developing other 'semi-natural reserves' that can receive more baiji as Shishou's population approaches carrying capacity (Leatherwood, 1994). No captive population of cetaceans of any species, including the bottlenose dolphin (*Tursiops* sp.), is entirely self-sustaining. Thus, with the primary goals of protecting baiji from harm and permitting or enhancing population growth, it is difficult to justify capturing animals from the river and placing them in concrete pools, however close to state-of-the-art the construction, maintenance, husbandry, and veterinary care may be at these facilities.

Important lessons have already been learned from the experience with baiji. One is that captive breeding cannot serve a very useful role in the survival and recovery of endangered dolphins without rapid, major advances in know-how. Such progress would require stronger cooperation between the institutions that maintain animals and the disapproving animal-protection community. It would also require a greater commitment of resources toward the goal of ensuring that captive dolphin populations produce surpluses for restocking and reintroduction into safe natural habitat.

We find little cause for optimism in the scenario described by Dudgeon (1992) for Asia's large rivers. Put simply, these systems have been ravaged and impoverished by human overuse and misuse, leading to enormous losses, not only in terms of the abundance and diversity of their wildlife, but also in terms of the quality of life for people who depend on the watersheds. Dudgeon has challenged limnologists to consider the need for 'greater efforts to disseminate . . . knowledge of river ecosystems and communicate with those planning large-scale developments as well as those whose activities have a direct effect on the ecosystems at issue.' Surely this challenge applies equally to anyone concerned with the survival of freshwater mammals in a continent on the verge of ecological collapse. Unless more of us begin to venture, at least part-time, 'beyond the bailiwick of science' and to engage in 'wide-ranging discourse' (Dudgeon, 1992) with non-scientists about the importance of preserving what remains of intact forests, unimpeded rivers, and fecund marshes, there will soon be little left of wild nature throughout Asia.

## Other Species

By concentrating on the platanistoid river dolphins in this brief summary, we have not meant to ignore the serious conservation problems facing other cetaceans. Of the 51 discrete projects identified and described in the new CSG Action Plan, more than half relate primarily to non-platanistoids (see Table 1). Cetacean populations that inhabit coastal marine waters are especially vulnerable to hunting, by-catch in fisheries, vessel traffic, and noise and chemical pollution. Northern-hemisphere stocks of right whales, all of which were severely depleted by whaling, are in this category. While we have chosen to follow Perrin's (1988) lead by continuing, in our updated Action Plan, to emphasize projects related to the conservation of small cetaceans, we have included three right whale projects as well.

Threats to small cetaceans are diverse in character and geographically widespread. The rapid growth of human populations has been accompanied by depletion of potential food supplies on land, in lakes and rivers, and increasingly at sea. As soils have been degraded and as sources of fresh water have become contaminated or depleted, our dependence on marine resources has grown. More intensive fishing has resulted in large by-catches of cetaceans, and in some regions (e.g. Peru, Sri Lanka, the Philippines) these catches have in turn led to the development of markets for cetacean meat. In other areas (e.g. Chile, Venezuela, Brazil), the flesh of small cetaceans is used as bait for catching fish and shellfish. Rarely, however, have cetaceans been included in national or regional management schemes, so such exploitation is unregulated and its impact unassessed.

Additional research is almost always desirable. Too often, however, the call for more 'studies' simply postpones actions needed to solve problems. In too many instances, critical time is lost as we try to marshal incontrovertible evidence about the nature and dimensions of a problem, even when common sense and circumstantial evidence should be sufficient to inspire and guide action.

Conservation requires the investment of money, time, and energy. The availability of such resources

**Table 1.** Status of the projects included in the 1994–1998 Action Plan of the IUCN/SSC Cetacean Specialist Group

| Project No. | Title | Status |
|---|---|---|
| CRITICALLY ENDANGERED SPECIES (Northern Right Whale, Vaquita, Baiji, Bhulan) | | |
| 1 | Investigate Cintra Bay Ground for wintering right whales | NP |
| 2 | Locate an additional 'nursery' for right whales in the western North Atlantic | O |
| 3 | Investigate the status of right whale population(s) in the western North Pacific | NP |
| 4 | Conduct comprehensive population surveys of the baiji | UD/PF |
| 5 | Compile individually-identifiable photographs of baiji | NP |
| 6 | Establish and maintain natural reserves for the baiji | O/PF |
| 7 | Establish and maintain 'semi-natural reserves' for the baiji | O/F |
| 8 | Develop a captive-breeding program for the baiji | NP |
| 9 | Monitor the populations of baiji in 'semi-natural reserves' | NP |
| 10 | Investigate distribution, abundance, and habitat quality of river dolphins in Sind, Pakistan | O/PF |
| 11 | Investigate continuing threats to river dolphins in Punjab, Pakistan | O/PF |
| OTHER PLATINISTOIDS (Susu, Boto, Franciscana) | | |
| 12 | Estimate river dolphin populations in the Ganges, Brahmaputra, Meghna, and Karnaphuli river systems | UD |
| 13 | Investigate ways of restoring river dolphin habitat in the vicinity of Farakka Barrage, India | NP |
| 14 | Assess the realized and potential effects of the Flood Action Plan on river dolphins in Bangladesh | NP |
| 15 | Establish a Nepal/India collaborative study and conservation program for small subpopulations of susus in Ganges tributaries | UD/PF |
| 16 | Evaluate the need for translocation to rescue (or augment) subpopulations of susus that are isolated by dams or otherwise at high risk from local fishing activities, pollution, etc. | NP |
| 17 | Develop a program of live capture, transport, maintenance, and captive breeding of platanistoid dolphins using individual susus that are judged doomed. | NP |
| 18 | Assess and monitor the killing of botos in all parts of their range where such killing is known or suspected to occur. | O/PF |
| 19 | Establish a system for handling photographs and tissues to be used in studies of Amazon and Orinoco dolphins | NP |
| 20 | Differentiate stocks of franciscanas | O/PF |
| 21 | Design and implement surveys to estimate population size of franciscanas | UD |
| NERITIC AND ESTUARINE SPECIES THAT ARE VULNERABLE BY VIRTUE OF THEIR PROXIMITY TO HUMAN ACTIVITIES | | |
| 22 | World review of the status and conservation problems of finless porpoises | NP |
| 23 | Investigate status and establish protected areas for pesut [Irrawaddy dolphin] in Indonesia | O/PF |
| 24 | Investigate status and conservation of Irrawaddy dolphins in southern Asia | O/PF |
| 25 | Investigate the ecology and conservation status of hump-backed dolphins in West Africa | NP |
| 26 | Assess the status of bottlenose dolphins and identify problem areas | NP |
| 27 | Investigate the status and develop a conservation strategy for bottlenose dolphins in the Mediterranean Sea | O/PF |
| 28 | Determine the status of populations of Commerson's dolphin and recommend appropriate conservation actions | NP |
| 29 | Determine the status of populations of the Chilean dolphin and recommend appropriate conservation actions | NP |
| REGIONAL PROJECTS | | |
| 30 | Assess illegal use of small cetaceans for crab bait in southern South America | O/PF |
| 31 | Determine the extent and effects of catches of small cetaceans off Venezuela and the 'Guyanas' (including Guyana, Surinam, and French Guiana) | NP |
| 32 | Conduct a survey of coastal fishery interactions in Brazil | O/PF |
| DOCUMENTATION AND MONITORING OF BY-CATCHES AND DIRECT CATCHES IN ARTISANAL FISHERIES | | |
| 33 | Continue monitoring by-catches and direct catches of cetaceans in Peru | O/PF |
| 34 | Continue monitoring by-catches and direct catches of cetaceans in Sri Lanka | NP |
| 35 | Continue monitoring by-catches and direct catches of cetaceans in the Philippines | O/PF |

**Table 1.** (*Continued*)

| Project No. | Title | Status |
|---|---|---|
| 36 | Monitor and assess by-catches and direct catches (if any) of cetaceans in Indian coastal waters | NP |
| 37 | Estimate catches and status of populations of small and medium-sized cetaceans in Taiwan | N/PF |
| 38 | Investigate artisanal catches of cetaceans in the Lesser Antilles and estimate sizes of affected populations | NP |
| 39 | Investigate by-catches and direct killing of cetaceans in West Africa | O/PF |
| 40 | Improve statistics on cetacean mortality in Argentine fisheries | O |
| 41 | Survey the status of marine cetaceans in Chinese waters | U/PF |
| 42 | Assess the stocks of striped and common dolphins in the Mediterranean Sea | NP |
| 43 | Investigate current status of dolphins and porpoises in the Black Sea | NP |
| 44 | Investigate the status of coastal small cetaceans in Thailand | O/F |
| 45 | Investigate by-catches and directed hunting of cetaceans in Oman | O/PF |
| 46 | Assess cetacean stocks in eastern Russia | NP |
| TOPICAL PROJECTS AFFECTING SEVERAL DIFFERENT SPECIES, POPULATIONS, OR AREAS | | |
| 47 | Conduct a symposium on impacts of dams on river dolphins: problems and solutions | UD |
| 48 | Test the validity of folk beliefs about the properties of cetacean products and find substitutes, as appropriate | NP |
| 49 | Workshop on methods for surveying populations of coastal and riverine cetaceans | UD/PF |
| 50 | Promote increased consideration of river faunas in internationally funded developments | NP |
| 51 | Conduct a symposium and workshop on the effects of chemical pollutants on marine mammals | NP |

NP=No Progress; O=Ongoing; F=Funded; PF=Partially Funded; UD=Under Development.

seems to be ever-shrinking in relation to the number and severity of the problems. One purpose of the CSG Action Plan is to provide the basis for dialogue leading to clear priorities and efficient use of available resources. We have not attempted to rank projects, whether in terms of their cost, urgency, or feasibility. We expect potential investigators and sponsors to participate in the setting of priorities and in decisions about implementation. A major goal of the CSG, and presumably other SSC taxon-based specialist groups, is to ensure that 'our' taxa, in this case the world's whales, dolphins, and porpoises, receive serious consideration in local, national, regional, and international plans for the development and management of natural resources.

A colleague, Steve Katona, who has been studying humpback whales and working to conserve them for more than 20 years, recently provided the following admonition for anyone pursuing a conservation agenda:

> '... management of the humpback whale or of any endangered species cannot be regarded as a task to complete. While there may be some actions that need to be accomplished only once, for example designating certain locations as sanctuaries for the species, other actions may need to be overseen or repeated forever, or until a decision is taken that the species should not be protected' (Katona, 1991).

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