COASTAL-MARINE DOLPHIN *SOTALIA* GRAY, 1866 (CETACEA, DELPHINIDÆ) SOCIO-ENVIRONMENTAL REVIEW TOWARDS INTEGRATED CONSERVATION STRATEGIES

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Abstract - Notwithstanding the fact that they are found in similar locations coastal-marine and riverine dolphins are not intimately related to 'true' river dolphins. They have been classed within the oceanic dolphin family (Delphinidæ), where the salt and brackish water variety or subspecies has been provided its own genus, *Sotalia* Gray, 1866. *Sotalia* is a Neotropical endemic genus whose range spans from the western South Atlantic to the Central America Caribbean Sea. It is found in shallow inland and coastal wetlands and near-shore waters as small 'resident' populations (one to 30 individuals or eventually more). Although found close to shore and in spite of its perceived abundance, no precise population estimates are available. As a top-level carnivore, *Sotalia* almost certainly depends on the consistently high productivity of tropical coastal wetlands which are cores of primary production. Tropical coastal wetlands, including mangrove ecosystems, are among the planet's most productive yet highly threatened systems. A particular concern highlighted in the recent Millenium Ecosystem Assessment (MEA) Report is that many wetland-dependent mammals listed in the IUCN Red List as threatened are in outright decline. Among the conservation policies that must be adopted to halt this decline are: (i) elimination of subsidies that encourage transformation, overexploitation and degradation of coastal habitats; (ii) encouragement of sustainable practices including those directed at decreasing man-induced climate change; (iii) greater involvement of stakeholders in policy-making, and better transparency and accountability of government performance; and (iv) critical engagement of coastal dwellers for developing, promoting and implementing policies that recognize the need to safeguard the integrity of coastal marine resources. The conservation of wide-ranging coastal dwelling small marine mammals requires consideration of their habitat needs throughout their range while judiciously focusing efforts on critical habitats where full and effective protection can be afforded through effective Integrated Coastal Zone Management (ICZM).

Resumo – Não obstante o fato de ocorrerem em águas rasas de ambientes marinho-costeiros e fluviais semelhantes, não pertencendo em termos taxonômicos, ao mesmo gênero dos golfinhos de água doce. Estes cetáceos (Família Delphinidæ) de águas salobras e salgadas são classificados juntamente com os golfinhos oceânicos, constituindo o gênero *Sotalia* (Gray, 1866). *Sotalia* é endêmico da Bioregião Neotropical, com distribuição geográfica do Mar do Caribe ao Atlântico Sul ocidental. Embora abundantes e de hábito costeiro, não se dispõem de dados quantitativos sobre o tamanho e a estrutura das populações de *Sotalia*.Indivíduos desse gênero podem ser encontrados como residentes (de um a 30 indivíduos, eventualmente até algumas centenas), em águas rasas costeiras tropicais associadas a áreas úmidas. Áreas úmidas costeiras tropicais, incluindo manguezais, ao mesmo tempo em que se encontram entre os sistemas mais produtivos do planeta, constituindo base de várias cadeias alimentares, também encabeçam a lista dos mais ameaçados. Recente Diagnóstico do Milênio sobre os Ecossistemas (MEA) destaca que a maioria dos mamíferos aquáticos, dependentes de áreas úmidas, seguem em declínio e aumentando a Lista Vermelha da IUCN de espécies ameaçadas. Medidas a serem adotadas para conservação desses cetáceos incluem: (i) eliminação de subsídios que favoreçam transformação, sobre-explotação e degradação dos ambientes costeiros tropicais; (ii) estímulo à medidas dirigidas a reduzir ações antropogênicas com influência sobre as mudanças climáticas; (iii) maior envolvimento dos 'stakeholders' nos processos de tomada de decisão, ademais de tornar mais transparentes os resultados das ações governamentais; e (iv) engajamento das comunidades tradicionais costeiras visando

desenvolvimento, promoção e implementação de políticas que reconheçam a necessidade da integridade dos recursos naturais dos ambientes marinho-costeiros. A conservação de populações de pequenos mamíferos marinhos, com ampla distribuição latitudinal, requer sejam consideradas as reais necessidades quanto a integridade dos hábitats em suas diversas áreas de ocorrência, e que seja garantido efetivo cumprimento de ações prioritárias em áreas consideradas críticas a serem implementadas por um Gerenciamento Costeiro Integrado (ICZM).

Introduction

Sotalia (Gray, 1866) is a Neotropical endemic dolphin genus whose range spans from the South Western Atlantic Ocean to the Caribbean Sea in fresh, brackish, and marine habitats in small groups of individuals (one to 30 or occasionally more). They are considered within the oceanic dolphin family (Delphinidæ Gray, 1821). Cunha *et al*. (2005) based on mitochondrial DNA and cytochrome *b* sequence data have concluded that marine and riverine *Sotalia* are two different species. Cunha *et al.* (*op. cit.*) based on priority criteria the revalidation of the name *Sotalia guianensis* (van Bénéden, 1864) for the marine animals, while the exclusively riverine Delphinid is considered as retaining the species name of *Sotalia fluviatilis* (Gervais, 1853).
Human populations are growing rapidly in most coastal areas and the threats to *Sotalia* and other small marine mammals in many parts of its range are also expected to increase (Fruet *et al*., 2005). Shallow coastal areas cover <10% of the surface of the global oceans (26 x 106km^2), but estuarine areas are much smaller (1.4 x 106km^2). *Sotalia* is found associated with protected shallow water areas (shallow inland, coastal wetlands, estuaries, inlets) and near-shore waters. These habitats are particularly vulnerable to transformation, nutrient pollution resulting from increased fluxes of wastewater, agricultural fertilizers, and aquaculture, and loss of habitat quality. The last decades have seen steep rises in coastal pollution and degradation of habitats (Yogui *et al*., 2003). Metabolic characteristics in marine mammals make them one of the most vulnerable organisms with regard to long-term toxicity by man-made chemicals (Tanabe *et al*., 1994; Fossi *et al*., 1997; and Santos *et al*., 2002 *in* Yogui *et al*., 2003).

Adult marine tucuxi most commonly feeding involve active fishing for pelagic Clupeids as well as demersal Scianids, Teleost fish and neritic Cephalopods (Silva and Best, 1996; and Nowak, 1999 *in* Shalu, 2001; Simão and Poletto, 2002). Calves are rarely observed feeding, but they usually stay in the same area where adults forage, and juveniles may feed in small groups. Dolphin foraging-behavior associated with birds has been reported by Monteiro-Filho (1992 *in* Geise *et al*., 1999). Multispecific feeding interaction between the marine tucuxi and Brown Booby (*Sula leucogaster*), Magnificent Frigatabird (*Fregata magnificens*) and Cayenne Tern (*Sterna eurygnatha*), has been observed in the proximity of the Cedro Island, Paraty Bay, Rio de Janeiro, Brazil (Projeto Golfinhos). As a top-level carnivore, and shallow water dweller, *Sotalia* depends on the environmental quality of its habitat (Santos *et al*., 2002 *in* Yogui *et al*., 2003) they have been considered 'ecological sentinels' of environmental health by Siciliano and Hacon (2006 *pers. comm.*). They depend on the consistently high productivity associated with tropical coastal wetlands which are centers of primary production and locations of active and passive outwelling

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of inshore production by tidal and biological diffusion. Tropical coastal wetlands (including mangrove ecosystems and associated wetlands) are among the planet's most productive yet most highly threatened systems.

This document is intended to support national governments and international conservation agencies, in developing conservation and management programs for the Western Atlantic Ocean small marine mammal communities and populations (Cetacea, Sirenia and Pinipedia).

Material and Methods

The BDT (2000) Report was the principal source used to address the terms of reference for this document. That Report is a comprehensive assessment of coastal and marine biodiversity conservation needs and priorities. Using BDT (*op. cit.)* as underpinning we directed our search using *Google*™ as a probing tool to search for additional information related to ongoing small cetacean research found in Brazil by governmental, academic and NGOs institutions (ranging from DNA analyses, pathology and field work results from long-term monitoring projects. Particularly valuable information was obtained from 'Projeto Atlantis' (PA), and the Projeto Golfinhos' web sites. PA has been surveying the southern coast of São Paulo State (25°S) for marine mammal strandings since 1995. Significant facts and figures were also obtained from the Cetacean Society International (CSI), the Whale & Dolphin Conservation Society (WDCS), the International Wildlife Law and Policy, the Earth Watch Institute, and The Humane Society of the United States web sites. Current information about the present taxonomic references of *Sotalia* was kindly provided by Dr Sheila Simão (*pers. comm.).*

Results

Taxonomy - *Sotalia* common names in English, French, German, Portuguese, and Spanish are shown in Table 1. Cunha *et al*. (2005) reports that the marine dolphin *S. guianensis* population shows a strong subdivision in individual characters along the Brazilian coast, specifically along the north, northeastern and south/southeastern units.

Distribution - *Sotalia* has a geographic latitudinal distribution range restricted to the tropical and subtropical Western Atlantic region. The reported range encompasses the region from the Caribbean Sea perhaps as north as 15°58'N, 085°42'W, near Trujillo, Honduras (Borobia *et al*., 1991 and Silva and Best, 1994; 1996 *in* Geise *et al*., 1999). Others report its northern latitudinal limit to be near 13°40'N, 082°30'W, at the Cayos Miskito Reserve, Nicaragua (Edwards and Schnell, 2001). Its range extends from the Caribbean Sea to the western South Atlantic Ocean near Santa Catarina Island (27°35'S, 048°34'W), Brazil (Simões-Lopes, 1988 *in* Geise *et al*., 1999; Culik, 2003).

Population abundance - *Sotalia* has been reported as common in Guanabara Bay (Rio de Janeiro, Brazil) by Geise (1991 cited by Silva and Best, 1994 *in* Culik, 2003) who first estimated the

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population at 418 individuals forming about 109 groups. Eight years later using more sophisticated techniques estimates were revised downwards to about 69-75 individuals for the same region (Pizzorno, 1999 cited by Flores, 2002 *in* Culik, 2003). The area around Cananéia Island (São Paulo State, Brazil) has been reported to maintain 2829 resident individuals (Santos, 2004 *in* PA). These aggregate into groups of about 10-15 individuals (and occasionally up to 30) that swim in tight-knit groups. This behavior suggests a well developed social structure (Wikipedia, s.d.). In Sepetiba Bay (Rio de Janeiro, Brazil) where small cetacean population studies have been conducted since 1993 there are 2 to 200 resident individuals (Erber and Simão, 2004). Unusually large aggregations (up to near 450 individuals) were observed in the region of Paraty Bay, Rio de Janeiro, Brazil by Lodi and Hetzel (1998 *in* Andriolo and Engel, 2002).

Population estimates - In spite of its perceived abundance and near shore habits precise population estimates are not available for this species (IWC, 2000 *in*: Culik, 2003). Further investigation on reproduction patterns are needed in order to confirm possible characteristics along its distribution range for the marine tucuxi as for franciscana dolphin (Santos *et al*., 2002).

Feeding behavior - *Sotalia* behavior is found to be most vigorous in early morning or late afternoon (Shalut, 2001). In Cananéia (São Paulo, Brazil) leisurely travel patterns were observed next to inshore locations whereas fast travel and porpoising were seen exclusively in the middle of channels or at greater depths (Geise *et al*. 1999).

Major threats - Small cetaceans face a wide range of threats all over the world, but their survival in the western Atlantic Ocean is highly threatened due to the critical situation of their highly vulnerable habitats.

Direct catch - Takes place in some of Brazil's coastal areas (Silva & Best, 1996 *in* Shalu, 2001; Siciliano, 1994 *in* IUCN, 2004). Reports on intentional dolphins capture for trade has increased dramatically (Culik, 2003). The number of wild-caught animals being traded internationally for aquaria, 'dolphinaria', circuses or traveling shows in many parts of the world has increased notably in Latin America (including Mexico and the West Indies), the Middle East, China and Southeast Asia (Fisher and Reeves, 2005). Particular concerns have been raised on the validity of export permits and the credibility of non-detriment findings (NDF), particularly where dolphins are removed from poorly studied populations (Fisher and Reeves, *op.cit*.). The credibility of non-detriment findings where there are no accurate ecological and biological data to evaluate possible impact on their populations is dubious. (Dizon *et al*., 1992; 1997; O'Brien, 1994; Avise, 1997; and Crandall *et al.*, 2000 *in* Cunha *et al*., 2005).

Incidental catch - Take place in many parts of its geographic range. Accidental mortalities may occur by entanglement in fishing nets used in the large commercial coastal fishery operations (Siciliano, 1994; and Vidal *et al*., 1994 *in* IUCN, 2004; Fruet *et al.,* 2005) by-catch fisheries-related, and gill-nets entanglements (Shalu, 2001; Ramos *et al*., 2001; Culik, 2003, and ref. therein; Cetacean Specialist Group 1996 *in* IUCN, 2004; WDCS, 2006),

Habitat degradation - Includes habitat transformation and direct losses, water quality degradation, and chronic disturbance from motor boats, boat's propeller and jet-skis (Santos *et al*., 2002; WDCS, 2006).

Pollution - Small cetacean can be affected by direct effect of pollutants due such as oil and pesticides and toxic or hazardous substance discharges (Yogui *et al*., 2003 and ref. therein; Caballero, 2005).

Man-induced - Increasingly popular are programs that offer physical contact with small cetaceans, including the opportunity to feed, pet, and swim with them and the proliferation of facilities that offer 'dolphin assisted therapy' to treat human illness or disability (Fisher and Reeves, 2005) are activities although well intentioned must be well regulated to protect cetaceans as well as people.

Conservation measures - (i) Of 38 marine Cetacean species identified in Brazilian waters, four are of high concern due to their conservation status along the whole geographic distribution range. These are: *Eubalæna australis* (Southern Right Whale); *Megaptera novæangliæ* (Humpback Whale); *Pontoporia blaivillei (*franciscana dolphin); and *Sotalia fluviatilis* (marine tucuxi). *Trichechus manatus* (manatee) which is subject to significantly high human pressure has been classified as an endangered species, Table 2; (ii) Twenty-five aquatic mammals priority conservation action areas have been identified (Table 3), and rated as *A* (extremely biologically important), *B* (of very high biological importance), *C* (high biological importance), or *D* (probably of high biological importance), in Table 2; (iii) Any successful conservation action must include all the small marine mammals (Cetacea, Sirenia and Pinipedia) which depend on the integrity of inshore and shallow coastal and marine environments (BDT, 2000).

Emerging diseases - The death of hundreds of dolphins and thousands of fish off the Florida Panhandle in early 2004 has brought attention to the rising number of emerging diseases in marine mammals (Reidarson, 2004). An increasing incidence of disease has been detected in marine mammals and organisms such as turtles, corals, mollusks, and echinoderms over the past three decades (Harvell *et al*., 2004). Among the major unresolved problems and priorities for future research are the detection of diseases in marine and coastal environments, identification of causes, reservoirs and the tracing of pathogens from land to sea as well as the adoption of epidemiological models to the analysis of marine diseases (*op. cit.).* Because of logistical difficulties many marine mortality events very likely go undetected, or remain poorly understood. A number of environmental factors are contributing to greater susceptibility to developing diseases (Reidarson, *op. cit.*). Exposure to chemicals and other contaminants in terrestrial runoff may compromise the immune systems of marine mammals and make them more susceptible to disease (Reidarson, 2004). Dr. Tom Reidarson has indicated that a common thread linking the emergence of diseases like distemper, brucellosis, toxoplasmosis, sarcocystosis, papillomavirus (*e.g.* in wild and captive manatee), and West Nile virus infections is runoff from coastal areas. In addition, factors that facilitate the introduction and dispersal of diseases are on the rise due to global trade, the accidental or intentional introduction of exotic species, and the discharge of untreated ballast water from shipping.

Conservation status, legal framework, and other instruments

Sotalia is considered endangered (Caballero, 2005) and has been included in CITES Appendix I since 1982 (ITIS, *in* Appendix II of CMS, and listed as 'Data Deficient' by IUCN). A recent concern highlighted in the recent Millennium Ecosystem Assessment (MEA, 2005) report is that many wetland-dependent mammals listed in the IUCN Red List as threatened are not only in outright decline but their habitat's integrity are declining as well. For example mangrove

ecosystems are highly threatened on a global scale by pollution and reclamation for coastal development. Marine tucuxi dolphins depend to a considerable extent on the productivity derived from mangrove ecosystems, as highlighted by the Cetacean Specialist Group 1996 (IUCN, 2004).

Along cetaceans distribution range in Brazil, Peru, and Colombia national legislation specifically protects the genus *Sotalia* (Shalu, 2001; Culik, 2003). According to the Brazilian laws 7643/87 and 9605/98, hunting whales and dolphins is outlawed in Brazilian waters, as well as any kind of deliberate molestation or harassment, such as chasing with vessels or swimming with or hand feeding (Santos *in* PA). The genus is indirectly protected by various legal frameworks in Ecuador, Venezuela, Guyana, and French Guiana as well. Specific information for Suriname is not available but nature reserves may protect their habitat (Reyes, 1991 *in* Culik, 2003).
Small cetaceans are supposedly protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which is part of the United Nations Environment Program. Cetacean conservation issues are also addressed by the Convention on Migratory Species-CMS (Fisher and Reeves, 2005). CMS has adopted a regional approach for cetacean conservation. CMS promotes regional agreements that aim to reduce threats to all cetaceans and to promote closer cooperation amongst its Parties with a view to conserving all cetacean species present in the area of the agreement. The International Convention for the Regulation of Whaling (ICRW) and the International Whaling Commission (IWC) has a Small Cetaceans Sub-committee. UNEP's World Conservation Monitoring Centre provides information services on conservation and sustainable use of the world's living resources, and helps to develop information systems about the status of living resources.

Discussion

The marine tucuxi dolphins is considered abundant in western Central and South America's Atlantic Ocean, but faces a variety of environmental challenges that range from habitat loss and degradation to direct toxicity by toxic wastes and foraging fish stock depletion. As with other small cetaceans they face direct exploitation and capture, by-catch in fisheries, habitat loss and degradation, contaminants and disturbance from increased vessel traffic. Threats are most intense for near-coastal species. However, despite the increasing human pressure on their habitats the marine tucuxi dolphin population stock's abundance and endangered status is not yet well established or recognized, although there are clear signs of population declines in some coastal areas (BDT, 2000). Regardless of their apparent abundance and ability to live in various habitats marine tucuxi dolphins are showing signs that they too are susceptible to human-induced changes in the coastal and marine environments (Flores and Bazzolo, 2004 *in* Earth Watch Institute, 2004). A number of factors raise conservation concerns about marine tucuxi dolphins: (i) its patchy (disjunct populations) restricted distribution; (ii) its apparent vulnerability to incidental captures and lack of reliable estimates of by-catch records; and (iii) the vulnerability to pollutants, boat traffic, and over-fishing of its coastal-estuarine habitats (Lodi, 2001). In addition, we suggest that our inability to determine the biological status of these populations reliably due to logistical factors requires a particularly guarded, proactive, and precautionary approach to their conservation.

Cunha *et al.* (2005) indicate that along the Brazilian coast there are three evolutionary significant units for the marine tucuxi, which should be managed separately. The speciation event that separated both lineages probably happened between 5 and 2.5My before present, during the

Pliocene (Cunha *et al*., *op. cit.*). They also highlight that a recent geographic-range expansion of *S. guianensis* towards the south appears to have taken place perhaps linked to the warming up of the Western Atlantic during the Holocene. Climate change has the potential to affect marine and coastal systems faster and more significantly than terrestrial systems. The emergence of novel diseases in fact, may be an outcome of the chronic loss of resilience of coastal systems, as well as the rapid propagation of diseases facilitated by marine dispersal mechanisms and the roaming nature of highly mobile species. Ecosystem simulations suggest that warming of the oceans will induce large regional changes in marine community structures and food webs.
However, we emphasize the need to think and act holistically and regionally anticipating potential impacts considering that we are facing a dramatic increase in cumulative habitat losses of critical habitats superimposed on a world-wide elevation in temperature that will affect marine mammals independently of stock size, abundance or biological conservation status. Conservation decisions must consider short as well as long-term impacts as revealed by our increasing understanding of ecological and oceanographic processes. Ocean and marine systems are more tightly coupled with atmospheric processes, and respond much faster than terrestrial systems.

Conservation considerations
Unfortunately, high-level international agreements are often poorly implemented at local levels. Small cetacean conservation cannot depend exclusively on these instruments which although they express high ideals, do not provide adequate resources for their implementation. In spite of the proliferation of these high level agreements since the 1960's the destruction of coastal habitats is still declining. There is paradoxically increasing awareness about the ethical and moral imperatives of conservation, and our responsibility to future generations amidst the large-scale degradation that we are witnessing. It is imperative to slow down the pace of destruction and degradation, and restoration start before unique resources, species or whole ecological processes are lost. Halting or avoiding the coastal landscape-level degradation processes that are taking place will require changing traditional ways of addressing and solving environmental problems. It will require developing a new paradigm based on the idea that it is a moral obligation to respect all forms of life and protect the health and integrity of natural systems. Without adopting such a paradigm sustainable development is unattainable, or merely will be a catch phrase to justify any project no matter what the environmental consequences are. We need to transform our way of thinking in order to make a breakthrough into a 'new order'. That is, we must adopt a view that transcends our current view of natural resources as mere assets to be managed for human use, to a belief that the maintenance of ecological sustainability is society's paramount goal. In fact, most proponents of ecosystem management agree that its ultimate purpose is sustainability.

Sustainability imposes that information must be transferred to the decision-making levels that are distracted by short-term benefits that obscure ultimate disaster in terms of loss of species, ecological services, and ways of life. Increasing awareness must include managing for resilience and for the need to act with foresight, precaution, and as responsible citizens and custodians of resources (see Box 1). The BDT (2000) report considers that among the conservation policies that must be adopted to reverse this loss are: (i) eliminate subsidies that encourage transformation, overexploitation, and degradation of coastal habitats; (ii) encourage of sustainable practices including those directed at decreasing or mitigating anthropogenic climate change; (iii) enforce curtailing nutrient loading; (iv) promote greater involvement of stakeholders in policy-making and better transparency and accountability of government performance; and (v) recognize that critical

engagement of coastal dwellers is essential for developing, promoting, and implementing policies that recognize the need to safeguard the integrity of coastal marine resources.

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Box 1 – Suggested small aquatic mammals management conservation principles.

1) Habitat vulnerability is the principal conservation issue for this species. Pervasive loss of the quantity and quality of coastal habitats is the principal threat to sustainability of populations. This we describe as ecological vulnerability. Decreasing population trends and population viability problems combine with specialized habitat needs and habitat vulnerabilities due to geomorphic and hydrographic characters and human-caused transformation and degradation.
2) Habitat in its broadest sense plays a crucial role in protecting these species and their food sources. The greatest potential conflict for protecting this species arises in those situations in which habitats are physically restricted and were large pressures exist for continued degradation. Such is the case in major ports and highly urbanized coastal environments (coastal embayments as estuaries and coastal lagoons). In these cases conservation efforts must be coordinated, incremental, and sequential including designation of mosaics of habitats based on ecological vulnerability, resource use, and local hydrodynamic processes. This includes zoning designations with varying levels of water quality regulation, designation of no-effluent discharge areas, or traffic restrictions.
3) Habitat ecological vulnerability suggests a major conservation and management effort is required in the collection, organization of data for inventorying habitats in order to perform rapid risk analysis and vulnerability assessments for shallow coastal environments habitats. A vulnerability and threat assessment evaluates how certain habitats are susceptible depending on habitat features and local threats.
4) Endangered species and critical habitats must receive the highest level of protection. Prohibitions must include any action that can result in the degradation, destruction or modification of designated critical habitats.
5) Critical habitats must be identified as a first step to implement Integrated Coastal Zone Management (ICZM) frameworks.
6) Species recovery efforts and recovery planning must be focused on the improvement of habitat quality and resilience. Species recovery efforts are bound to fail if habitats remain degraded.
7) The improvement of habitat quality increases the resilience of populations and provides protection against random environmental change and local catastrophic natural and/or man-induced events (*e.g*. terrestrial runoffs, oil spills, sugar-cane factories effluents).
8) The rate of degradation and loss of critical habitats is measured in years or decades. Policy implementation is likely to take decades. This suggests that a gap could persist between the rate at which habitats are being lost and the implementation of effective regulation for conservation. Incremental change brought about by education may be effective in reducing this gap. Efforts should be concentrated in developing simple, easily implemented measures rather than depending in complex policies that may be difficult to put into action, or may take years to implement (*e.g.* proposal of new legislations).
9) Education and development of constituencies is a crucial step in management of this species. These species are charismatic and their protection can result in broad secondary benefits in terms of overall environmental quality enhancement, including significant increase in values for aesthetics and recreation. Education plays a key role in reducing non-point sources degradation as well as for targeted efforts to raise awareness among those responsible for the control of specific discharges.
10) Tidal dynamics and the strong mixing processes typical of costal waters, as well as the dominance of phytoplankton and microbial/detrital food webs suggests that these systems have potentially high rates of self-restoration, and can quickly respond to effluent controls. That is, the self-restoration power of the near coastal environment is generally high, and is likely to be less than decadal if the measures taken are sustained and are designed to become increasingly effective.

TABLE 1- *Sotalia*'s common names in English, French, German, Portuguese, and Spanish.

COMMON NAMES	IDIOMS	REFERENCES
Marine Tucuxi, Marine Tucuxi Dolphin, Gray Dolphin, Gray River Dolphin, Boto Dolphin, Estuarine Dolphin, Tucuxi, South American Dolphin, Guianian Dolphin	English	Culik (2003); IUCN (2004); http://www.cetaceen.de/sp39
Dauphin de l'Amazon, Sotalie	French	Culik (2003); IUCN (2004)
Amazonas-Sotalia	German	Culik (2003); http://www.cetaceen.de/sp39
Boto-cinza, Tucuxi, Golfinho, Golfinho-cinza, Boto, Boto-preto, Boto-comum, Boto-da-manjuva,	Portuguese	Lodi (2001); Simão & Poletto (2002); Projeto Atlantis.
Bufeo-negro, Bufo-negro, Bufo, Bufeo, Delfín gris, Lan	Spanish	Culik (2003); IUCN (2004).

TABLE 2 – Brazilian marine mammal species, their most common names and respective conservation status according to BDT (2000).

SPECIES	COMMON NAMES	CONSERVATION STATUS
Eubalaena australis	Southern Right Whale	Endangered
Megaptera novaengliae	Humpback Whale	Endangered
Pontoporia blainvillei	Franciscana Dolphin	Endangered
Stenella longirostris	Spinner Dolphin	
Sotalia fluviatilis	Marine Tucuxi	Highly human threatened; Population declining (probably endangered)
Tursiops truncatus	Bottlenose Dolphin	Endangered
Arctocephalus australis	South American Fur Seal	
Mirounga leonina	Southern Elephant Seal	Registered as North as Fernando de Noronha Archipelago (Western South Atlantic Ocean).
Otaria flavescens	South American Sea Lion	
Trichechus manatus	Manatee	Critically endangered

TABLE 3 - Brazilian small marine mammal species priority conservation areas (*A*, *B*, and *C*)* by coastal units and respective Brazilian coastal states symbols**, and main physiographic features (BDT, 2000).

	SPECIES	SPECIES	*	BRAZIL'S COASTAL UNITS**	MAIN PHYSIOGRAPHIC FEATURES
1	Insufficient	data	*D*	Brazilian Northe coast (AP)	Extensive shallow western Atlantic Ocean coastal areas.
2	*Trichechus spp.*	*Sotalia spp.*	*A*	Amazonas River mouth /Marajó Island (PA)	Large brackish water embayment bordered with fresh, brackish and salt water vegetation.
3	*Trichechus manatus*	*Sotalia fluviatilis*	*A*	'Reentrâncias Maranhenses' (PA and MA)	Many fjord-like embayments bordered with mangroves.
4	*Trichechus manatus*	*Sotalia fluviatilis*	*A*	'Golfão Maranhense' (MA)	Large embayment bordered with mangroves.
5	*Trichechus manatus*		*A*	Piauí coastline (PI)	Marine-estuarine-deltaic sand dune and coral reef coastal formation.
6	High Cetacean	Diversity	*C*	Brazilian Northest Oceanic Zone (RN, PB, PE, and AL)	Brazilian Northeastern Oceanic Zone, between 05ºS and 10ºS, reaching 100nm off the coast, with depths around 200m.
7	*Stenella longirostris*		*B*	'Fernando de Noronha' Archiplago (open sea)	Atlantic volcanic rocky island formation off the Brazilian Northeast coast.
8	*Trichechus manatus*		*A*	Salt-evaporation-pan Region (CE and RN)	Cliffs, sandy beaches, estuaries and coral reefs, reaching 3nm off the coast.
9	*Trichechus manatus*		*B*	'Pipa' to 'Tibau do Sul' (RN and PB)	Cliffs, sandy beaches, estuaries, coastal lagoons and coral reefs.
10	*Trichechus manatus*		*A*	'Mamanguape' (PB)	Estuary bordered with mangroves.
11	*Trichechus manatus*		*A*	Northern Alagoas (AL)	Estuaries bordered with mangroves, coastal coral reefs and sea-grass beds (manatees southern latitudinal limit).
12		*Sotalia fluviatilis*	*C*	'Ilhéus' (BA)	Estuaries bordered with mangroves and sandy beaches.
13	*Megaptera novaengliæ*	*Eubalæna australis*	*A*	'Abrolhos' Bank Region (BA)	Large coral reef formation, being able to reach the 200m isobath off the coast.
14	*Pontoporia blainvillei*		*A*	Rio de Janeiro Northern coast (RJ)	Brazilian Oceanic Zone extending to the 1,800m isobath.
15		*Sotalia fluviatilis*	*B*	'Guanabara' Bay (RJ)	Large embayment bordered with mangroves, sandy and muddy shorelines
16		*Sotalia fluviatilis*	*B*	'Sepetiba' Bay (RJ)	Large embayment bordered with mangroves
17	High Diversity of	Marine Mammals	*B*	'Ilha Grande' Bay (RJ)	Large embayment bordered with mangrove, sandy beaches and rocky coasts
18		*Sotalia fluviatilis*	*B*	'Cananéia-Iguape' Estuarine System (SP)	Large estuarine-lagoon system
19	*Pontoporia blaivillei*		*C*	'Babitonga' Bay (SC)	Relatively closed large embayment.
20	*Pontoporia blainvillei*	*Sotalia fluviatilis*	*C*	'Anhatomirim' Island (SC)	Coastal island with rocky shores (*Sotalia*'s southern latitudinal limit).
21	*Eubalæna australis*		*A*	'Santa Catarina' Center-South coastline (SC)	Coastal embayments reaching the 50m isobath.
22	*Otaria flavescens*	*Arctocephalus australis*	*A*	'Lobos' Island (RS)	Rocky shore island extending trough a 500m radius.
23	*Tursiops truncatus*		*B*	'Laguna to Tramndaí' (SC and RS)	Lagoon-estuarine system, including river mouths and coastal lagoons.
24	*Pontoporia blainvillei*		*A*	'Santa Marta' to 'Chui' (SC and RS)	Shallow coastal open-sea areas, extending to the 35m isobath.
25	*Otaria flavescens*		*C*	'Molhe Leste', 'São Joaquim do Norte' (RS)	Artificial breakwater located at the entrance of the 'Patos' Lagoon.

**	**Brazilian Coastal States**	**	**Brazilian Coastal States**
AP	Amapa	PE	Pernambuco
PA	Para	AL	Alagoas
MA	Maranhao	BA	Bahia
PI	Piaui	RJ	Rio de Janeiro
CE	Ceara	SP	Sao Paulo
RN	Rio Grande do Norte	SC	Santa Catarina
PB	Paraiba	RS	Rio Grande do Sul