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A TALE OF TWO DOLPHINS: INTRODUCTION TO THE SPECIAL VOLUME ON THE BIOLOGY AND CONSERVATION OF NEOTROPICAL DOLPHINS OF THE GENUS *SOTALIA*

Introduction

The neotropical genus *Sotalia* includes two currently recognized species inhabiting coastal marine and freshwater ecosystems of South and Central America (Figure 1). The Guiana dolphin *Sotalia guianensis* (Van Bénédén, 1864) is widely distributed along Atlantic and Caribbean coasts, from southern Brazil through northern South America and northward to Honduras in Central America (da Silva and Best, 1996; Flores and

da Silva, 2009). The freshwater tucuxi *Sotalia fluviatilis* (Gervais and Deville *in* Gervais, 1853)¹ is found in many of the rivers and lakes of the Amazon River basin (da Silva, 1994; da Silva and Best, 1994; 1996). The taxonomic status of these dolphins has a complicated history. At times they have been regarded as subspecies of *S. fluviatilis* but recent morphologic (Monteiro Filho *et al.*, 2002) and genetic (Cunha *et al.*, 2005; Caballero *et al.*, 2007) analyses have unequivocally demonstrated that the Guiana and tucuxi dolphins are separate species.

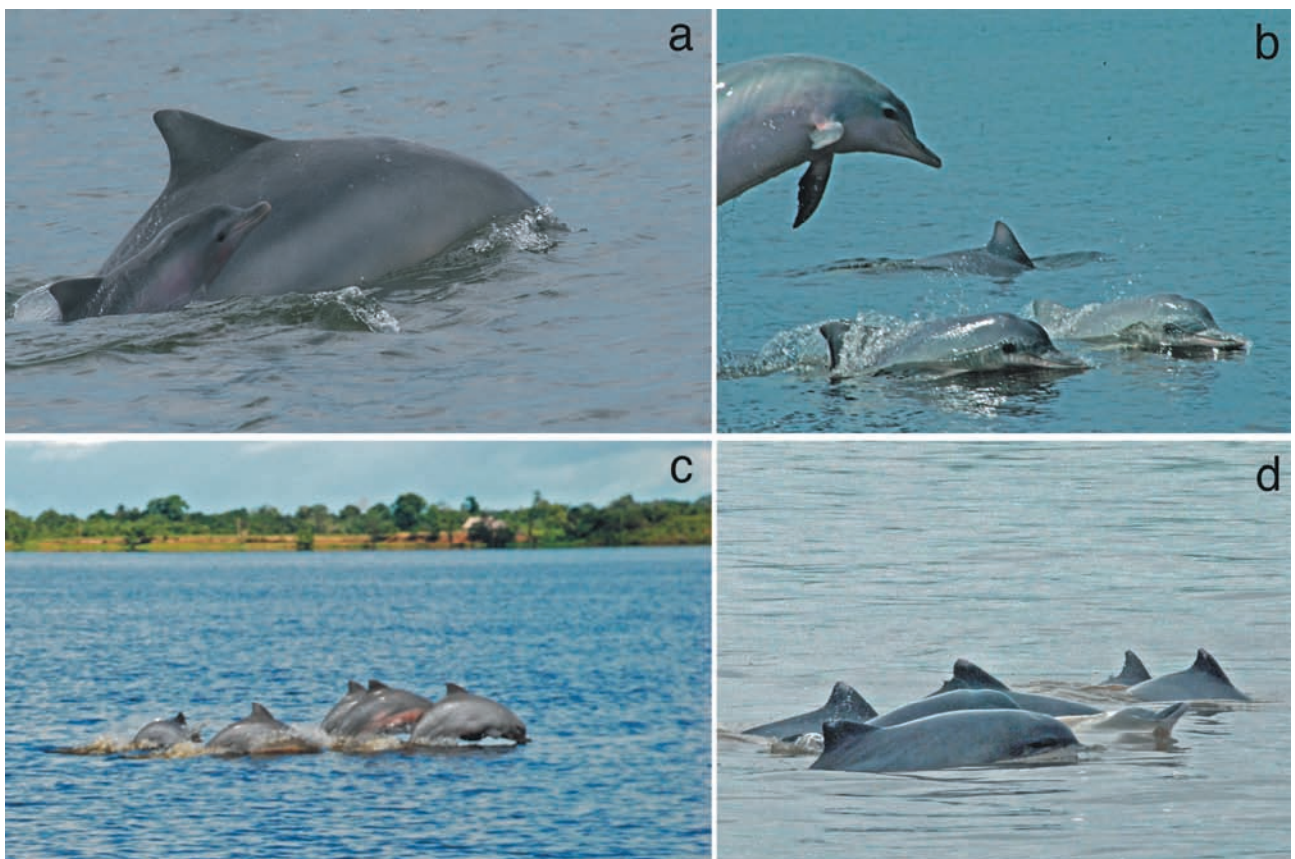


Figure 1. (a) A very young Guiana dolphin (*Sotalia guianensis*) surfaces next to its mother in the Cananéia Estuary, Brazil, in August 2007 (Photo: Marcos C. O. Santos). (b) An active group of Guiana dolphins socializing at the surface in the Cananéia Estuary, in July 2007 (Photo: Marcos C. O. Santos). (c) A tight, fast-moving group of tucuxis (*Sotalia fluviatilis*) in the Caballo Cocha Lake, Peru, upper Amazon River, January 2008 (Photo: Catalina Gómez-Salazar). (d) A surfacing group of tucuxi in the confluence of the Loreto Yacu River with the Amazon River near the town of Puerto Nariño, Colombia, December 2008 (Photo: Catalina Gómez-Salazar). Notice in (c) the variation in body coloration pattern among individuals and in (d) the large nicks on the trailing edge of the dorsal fin and the whitish scarring on the tips.

¹ Although the naming of *Sotalia fluviatilis* is commonly credited to 'Gervais and Deville, 1853' in the recent literature, this is incorrect. The name *Delphinus fluviatilis* first appears in Gervais (1853) in a footnote on p. 148 referring to one of two freshwater dolphin species known to inhabit the tributaries of the Amazon in Bolivia and Peru (the other species being the boto, *Inia*). In this footnote Gervais states that in another work commenced by himself and Émile Deville they have given this name to the dolphin resembling ordinary dolphins but smaller and with a more indented beak (relative to *Inia*), which was discovered by Deville and Francis de Castelnau during their 1843 expedition to South America. A publication by Gervais and Deville apparently did not materialize, possibly due to Deville's death in 1853, and the formal description of *Delphinus fluviatilis* appeared instead in Gervais (1855), where he credits 'P. Gerv. et Deville, in P. Gerv., *Bull. de la Soc. d'agric. de l'Hérault*, p. 148.' as the naming source.

Modern studies in the wild on the two species began in the 1980s, but it was not until the late 1990s that systematic efforts became widespread throughout their range. This Special Volume represents the largest effort ever undertaken to synthesize all information available on the biology and conservation of the genus *Sotalia*, while at the same time presenting the latest contributions from both established researchers and students. But before delving into the heart of the matter of this Special Volume, we considered it useful to take a brief glance at the most important historical developments that have shaped the current state of the knowledge and conservation status of the two species.

Historical Perspective

Discovery and description of the two species took place during the naturalist era of the 18th and 19th centuries. Alexander von Humboldt is credited with having been the first to observe *Sotalia* dolphins in expeditions undertaken between 1799 and 1804 on the Orinoco River, in present-day Venezuela and Colombia (Hershkovitz, 1963). Although he may have seen *Inia* as well, von Humboldt's notes of the behavior, characteristically small body size and the well-developed dorsal fin led Hershkovitz (1963) to conclude that von Humboldt had encountered *Sotalia*. Following this first discovery, at least five species, later relegated to synonyms, were attributed to *Sotalia*. Between 1853 and 1856, three riverine species were described based on specimens collected in the Amazon: *Delphinus fluviatilis* and *Delphinus pallidus* from Peru by François Louis Paul Gervais (Gervais, 1853; Gervais, 1855) and *Steno tucuxi* from Brazil by John Edward Gray (Gray, 1856). At around the same time, Pierre-Joseph Van Bénédén described two marine species: *Delphinus guianensis* from specimens collected at the mouth of the Marowijne (or Maroni) River, on the border between Suriname and French Guiana, and *Sotalia brasiliensis* from Guanabara Bay, Brazil (Van Bénédén, 1864; Hershkovitz, 1963).

Since these initial descriptions the taxonomic status of *Sotalia* has been unresolved, in large part because the descriptions were based on only a few specimens from single locations at a time when almost nothing was known about these dolphins' ranges. Those early diagnoses were incomplete and full of inconsistencies. As a consequence, several redefinitions at the genus and species levels have occurred over time. For example, the genus *Sotalia* was proposed by Gray in (1866) to apply to the riverine species found in South America that were originally included in the genus *Delphinus*. Following suit, in 1883 William Henry Flower reassigned the specimens from marine localities to *Sotalia* (Flower, 1883). Separation into two species, *S. fluviatilis* occupying the Amazon River basin and *S. guianensis* found in coastal marine habitats, was extensively used up to the 1970s (True, 1889; Rice and Scheffer, 1968; Cabrera, 1961). From the 1970s to the

1990s, the argument was advanced that the subtle differences between them simply represented phenotypic variation and therefore the two forms came to be regarded as conspecific ecotypes (*e.g.* Mitchell, 1975; Leatherwood and Reeves, 1983; Borobia, 1989; Rice, 1998). In the 2000s, quantitative studies of skull morphology (Monteiro Filho *et al.*, 2002) and genetic markers based on large numbers of specimens (Cunha *et al.*, 2005; Caballero *et al.*, 2007) provided definitive evidence for the separation of the genus into two species.

Starting in the 1950s, the nascent public display industry in North America and Europe prompted several expeditions to capture South American cetaceans like *Inia* and *Sotalia*. The process of scouting for suitable locations and specimens generated early information on occurrence and behavior of the species in their natural environment (Layne, 1958; Bössenecker, 1978). Tucuxis captured in the Brazilian Amazon near Manaus were displayed briefly at the Aquarium of Niagara Falls (Spotte, 1967) and at Marineland of Florida, USA (Caldwell and Caldwell, 1970), while Guiana dolphins captured in Cispatá Bay, Colombia, were on display in several facilities in Europe including the Antwerp Zoo in Belgium and the Nuremberg and Münster Zoos in Germany (Bössenecker, 1978; Terry, 1983). Most animals died shortly after capture, but captive studies during that time generated information about behavioral traits and trainability (Terry, 1983; 1986), as well as sonar (Caldwell and Caldwell, 1970) and electroreceptory (Czech-Damal *et al.*, 2011) capabilities. Two captive display facilities featuring Guiana dolphins were established in Colombia near the coastal cities of Santa Marta and Cartagena in 1965 and 1980, respectively (Figure 2). Studies of sonar (Kamminga *et al.*, 1993), electrocardiography (Rodríguez-Arias, 1993), and karyology (Romero-Ochoa and Cadavid-Ceballos, 1994) were conducted at these facilities. The birth of an intergeneric hybrid *Sotalia guianensis* x *Tursiops truncatus* in captivity was reported (Caballero and Baker, 2010).

Some of the earliest biological information on the genus was reported in the 1960s and early 1970s, including details of external and internal morphology, stomach contents (Carvalho, 1963), and reproductive organs (Harrison and Brownell, 1971). Scientific expeditions to the Amazon and Orinoco River basins (Norris *et al.*, 1972; Kasuya and Kajihara, 1974; Pilleri and Pilleri, 1982; Kamminga *et al.*, 1993; Herman *et al.*, 1996) and to Lake Maracaibo (Casinos *et al.* 1981) during this time yielded new information on the two species. But it was not until the 1980s that Latin American scientists became engaged in the study of *Sotalia*. Initially, these studies consisted mainly of analyses of diet (da Silva, 1983; Borobia and Barros, 1989), reproductive parameters (Best and da Silva, 1984), and heart anatomy (Rodríguez-Arias, 1993).

In the 1980s through the early 1990s, pioneering field studies on wild populations of the two species began in southeastern (Geise and Borobia, 1987; Geise, 1989; Monteiro Filho, 1991; Schmiegelow, 1990; Geise 1991;

Borobia *et al.*, 1991; Lodi and Hetzel, 1998; Pizzorno, 1999; Santos 1999) and southern Brazil (Simões-Lopes, 1988; Flores, 1992) as well as in the Colombian (Trujillo, 1990) and Brazilian Amazon (Magnusson *et al.*, 1980), providing some of the first information on habitat use, activity budgets, behavior, population size, social structure, movement patterns, and home range. These studies continued into the 2000s (*e.g.* Trujillo, 1992; 1995; 1997; Flores, 1999; 2003; Flores and Bazallo, 2004; Santos *et al.*, 2000; 2001; 2002; 2003; Azevedo *et al.*, 2004; 2007; Lodi 2002; Martin *et al.*, 2004) and new ones began in other parts of Brazil (*e.g.*

Rossi-Santos *et al.*, 2006; 2007; Cremer, 2007; Batista, 2008; Flach *et al.*, 2008) as well as portions of the Peruvian (Leatherwood, 1996; Leatherwood *et al.*, 2000; Zuñiga, 1999; McGuire, 2002; McGuire and Henningsen, 2007), Colombian (Galindo, 1997), and Ecuadorian Amazon (Zapata-Rios and Utreras, 2004). In the late 1990s and early 2000s, field studies on Guiana dolphins began in the Caribbean Sea off Colombia (Avila, 1995; García, 1998; García and Trujillo, 2004), Costa Rica (Acevedo-Gutiérrez *et al.*, 2005), and Nicaragua (Carr and Bonde, 2000; Edwards and Schnell, 2001a; 2001b).



Figure 2. Guiana dolphins (*Sotalia guianensis*) performing alongside common bottlenose dolphins (*Tursiops truncatus*) in Colombian facilities: at the 'Oceanario Islas de Rosario' near Cartagena in 1991 (top) and at the 'Acuario del Rodadero' near Santa Marta in 1992 (bottom) (Photos: Daniel M. Palacios).

Because of their coastal-estuarine and riverine distribution, *Sotalia* dolphins frequently interact with artisanal fishing gear, especially gillnets, and this results in entanglement and drowning. Incidental mortality of Guiana dolphins and tucuxis was first documented in the late 1980s and early 1990s at various localities along the coast of Brazil (Lodi and Capistrano, 1990; Barros and Texeira, 1994; Siciliano, 1994) and in the Colombian Amazon (Beltrán and Trujillo, 1992²). Since then, few systematic efforts have been made to estimate the scale of this mortality or assess its impact on the dolphin populations (Beltrán, 1998; Rosas, 2000; IWC, 2008; Sidou, 2008). In certain localities *Sotalia* dolphins are hunted for use as fish bait (Siciliano, 1994). In the Amazon the market for dolphin reproductive organs and eyes as aphrodisiacs, while primarily involving *Inia*, may also involve *S. fluviatilis* (Beltrán and Trujillo, 1992²; IWC, 2007).

By the early 2000s, the high number of strandings and incidental captures reported for the two *Sotalia* species was a growing concern among researchers working in Latin America, as was the increasing pollution and deterioration of coastal habitat (IWC, 2007). While the number of communications at scientific meetings, stemming mainly from studies on Guiana dolphins, had been increasing dramatically, there continued to be few scientific publications. Given that situation, it seemed high time to get more of the available information organized, peer-reviewed, and published.

A *Sotalia* Workshop in 2006

During discussions at the 5th Congress of the Latin American Society of Aquatic Mammal Specialists (SOLAMAC) held in Quito, Ecuador, in October 2004, consensus was reached among *Sotalia* researchers on the need to address the status of these dolphins, given not only the growth in research efforts, but also the increase in anthropogenic pressures on coastal zones and riverine environments. It was agreed that SOLAMAC should organize a workshop with the objective of reviewing the systematics, biology, and conservation of the genus *Sotalia*. After a short period of consultation, an Organizing Committee was established to convene the 'Workshop on Research and Conservation of the genus *Sotalia*,' consisting of Salvatore Siciliano, Monica Borobia, Nélio B. Barros, Fernanda Marques, Fernando Trujillo, and Paulo A. C. Flores.

The Workshop was held in the seaside resort town of

Armação dos Búzios, Rio de Janeiro, Brazil, between 19 and 23 June 2006. The five-day workshop brought together 45 invited participants, including researchers from most countries where *Sotalia* occur (Brazil, Colombia, Ecuador and Venezuela), as well as researchers from the USA and Argentina, and stakeholders representing the management and conservation sector (see Figure 3 and Appendix 1). The aims of the workshop were to generate new information and data, guide the development of new lines of research, and identify future conservation priorities for the two species. The specific objectives of the Workshop were to: a) assess the current status of *Sotalia*; b) identify data gaps; c) make recommendations for further research, legislative and management measures, and conservation programs; and d) contribute and further the implementation of international and national conservation and management action plans of relevance to the species.

The organizing institutions of the Workshop were Escola Nacional de Saúde Pública/Fundação Oswaldo Cruz (Rio de Janeiro), Wildlife Conservation Society Brasil (Rio de Janeiro), and Instituto de Pesquisa e Conservação de Golfinhos - IPCG (Santa Catarina). Funding was generously provided by national and international organizations including: Petrobras/Projects Piatam Mar and Piatam Oceano (Brazil), MBR - Minerações Brasileiras Reunidas S.A. (Brazil), Humane Society International, Cetacean Society International (USA), and the United Nations Environment Programme through the Caribbean Environment Programme (Jamaica).

The first two days of the Workshop were dedicated to the presentation of 52 submitted abstracts (Siciliano *et al.*, 2006^{3,4}) and 28 working papers. In addition, six main topics were identified for discussion: 1) distribution, 2) abundance, 3) taxonomy, 4) natural history, 5) ecology, and 6) threats and conservation. For each one, a key presentation was made by an invited speaker, complemented by several additional presentations on the same topic. The following two days were spent with participants divided into six Working Groups that were tasked with reviewing all available information and consolidating it into reports dealing with each of the main topics. The main conclusions of each Working Group were presented in plenary on the final day, when consensus was reached that the findings should be prepared in the form of a Special Volume of the *Latin American Journal of Aquatic Mammals*.

² BELTRÁN, S. AND TRUJILLO, F. (1992) Mortalidad incidental y dirigida de *Inia geoffrensis* y *Sotalia fluviatilis* en la Amazonía y Orinoquía colombiana. Page 9 in Abstracts, 5th Reunión de Especialistas en Mamíferos Acuáticos de América del Sur, 28 September - 2 October 1992, Buenos Aires, Argentina.

³ SICILIANO, S., BOROBIA, M., BARROS, N.B., MARQUES, F., TRUJILLO, F., AND FLORES, P.A.C., EDS. (2006) *Workshop on Research and Conservation of the Genus Sotalia, Armação dos Búzios, Rio de Janeiro, Brasil, 19-23 June 2006*. Book of Abstracts. Rio de Janeiro, Brazil. 62 pp. <http://dx.doi.org/10.5597/lajam00147>

⁴ The Book of Abstracts is reprinted as a supplement to this Special Volume

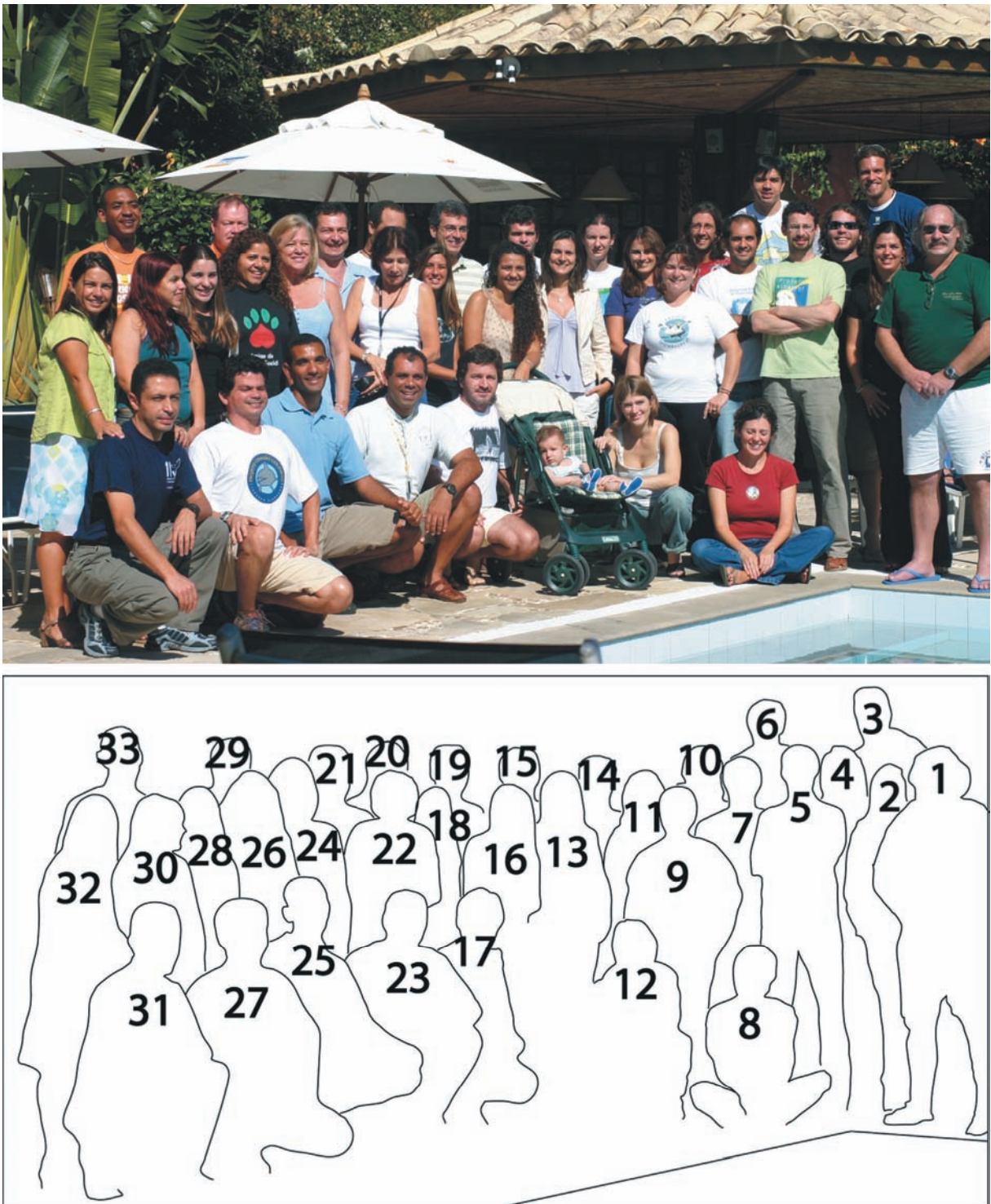


Figure 3. Participants of the Workshop on Research and Conservation of the genus *Sotalia*, held at Pedra da Laguna Inn, Armação dos Búzios, Rio de Janeiro, Brazil, between 19 and 23 June 2006: (1) Enrique Crespo, (2) Susana Caballero, (3) Marcos Rossi-Santos, (4) Ignacio Moreno, (5) Eduardo Secchi, (6) Marcos C. de O. Santos, (7) Alexandre Azevedo, (8) Laura Dias, (9) Gica Filla, (10) Leonardo Flach, (11) Marta Cremer, (12) Mariel Bazzalo, (13) Carolina Meirelles, (14) Juliana Marigo, (15) Fagner Magalhães, (16) Maíra Laeta, (17) Paulo Flores, (18) Mariana Alonso, (19) Fernando Rosas, (20) Paulo Ott, (21) Salvatore Siciliano, (22) Vera da Silva, (23) Nélío Barros, (24) Dana Wetzel, (25) Éderson Rodrigues, (26) Nívea Carmo, (27) Flávio da Silva, (28) Daniela Alarcon, (29) John Reynolds, (30) Renata Emim-Lima, (31) Victor Utreras, (32) Monica Borobia, (33) Jaílson de Moura. The following participants are not pictured: Jaime Bolaños-Jiménez, Cibele Bonvicino, Heloísa Borges, Thais Corrêa, Salomé Dussán-Duque, Adolfo Hubner, Valéria Guimarães, Helder de Queiroz, Yara Schaeffer-Novelli, Antônio Solé-Cava, Sheila de Souza, and Leonardo Wedekin.

Contents of the Special Volume

After the Workshop participants were invited to submit their working papers for publication in the Special Volume. Not all papers presented at the Workshop were submitted, while additional manuscripts from authors not present at the Workshop were considered where relevant. This Special Volume thus consists of the Reports from four of the Working Groups (the other two did not contain sufficient information to stand on their own and much of the information they covered was found in the other reports) followed by 16 contributed papers.

The first section of the Special Volume contains the Reports from the Working Groups on: Taxonomy and Genetics; Distribution, Habitat Characteristics and Preferences, and Group Size; Population Abundance and Density Estimation; and Threats and Conservation. The information retrieved from a fifth Working Group on Ecology was merged with that of the Working Group on Distribution. The Report of the Working Group on Taxonomy and Genetics (Solé-Cava *et al.*, 2010 this volume) provides an up-to-date description on the taxonomic status of the genus *Sotalia* focusing on molecular biology aspects. The Report of the Working Group on Distribution, Habitat Characteristics and Preferences, and Group Size (da Silva *et al.*, 2010 this volume) presents an updated and detailed description of where the two species of *Sotalia* occur, the characteristics of their habitat, and group sizes. The Report of the Working Group on Population Abundance and Density Estimation (Santos *et al.*, 2010 this volume) includes an assessment of available population estimates and remarks on the low number of studies on the topic relative to the number of research teams involved in field studies, which has been on the increase since the early 1990s. Finally, the Report of the Working Group on Threats and Conservation (Crespo *et al.*, 2010 this volume) provides a synthesis of what is known about threats to these dolphins. The main causes of concern for conservation of the two species such as incidental captures, habitat loss, contamination of environments, noise pollution and risk of collisions are explored in detail.

Following these working group reports there are 16 contributed papers (1 Review, 10 Articles and 5 Notes) covering natural history (Rosas *et al.*, 2010 this volume), genetics (Caballero *et al.*, 2010a; 2010b this volume), ecology and distribution (Meirelles *et al.*, 2010; McGuire *et al.*, 2010; Rossi-Santos *et al.*, 2010; Hardt *et al.*, 2010; Emin-Lima *et al.*, 2010; Gomez-Salazar *et al.*, 2010 this volume), contaminant loads (Alonso *et al.*, 2010 this volume), bioacoustics (May-Collado and Wartzok, 2010 this volume), stock identification (Ramos *et al.*, 2010; Laeta *et al.*, 2010 this volume), biopsy sampling (Cunha *et al.*, 2010 this volume), vernacular nomenclature (Flores *et al.*, 2010 this volume), and conservation (Santos *et al.*, 2010 this volume).

Rosas *et al.* (2010 this volume) review the state of knowledge of the natural history of the two *Sotalia* species. Caballero *et al.* (2010a this volume) describe the phylogeography and population structure of the two species based on samples collected along more than 9000km of their range, while Caballero *et al.* (2010b this volume) characterize the sequence variation at two genes of the major histocompatibility complex (MHC) using cloning and direct sequencing of amplified genomic DNA. Meirelles *et al.* (2010 this volume) provide an update on Guiana dolphin strandings along the coast of Ceará state, northeastern Brazil.

McGuire (2010 this volume) presents the results of investigations on the distribution, relative abundance, group size, reproductive seasonality, and conservation status of *S. fluviatilis* in Peru's Pacaya-Samiria National Reserve from 1996 to 2000. Rossi-Santos *et al.* (2010 this volume) describe habitat use of Guiana dolphins in the Caravelas River estuary, State of Bahia, Brazil, and Hardt *et al.* (2010 this volume) report the results of a study on the ecology of Guiana dolphins in Babitonga Bay, north coast of Santa Catarina State, southern Brazil.

Alonso *et al.* (2010 this volume) determined concentrations of organochlorine pesticides and polychlorinated biphenyls (PCBs) in the blubber of Guiana dolphins from São Paulo State, Brazil, finding PCB concentrations comparable to those reported from cetaceans in some of the most industrialized coastal regions around the world. May-Collado and Wartzok (2010 this volume) describe the acoustic repertoire of tucuxis in Ecuador and show that the structure of their whistles differs from that of other populations, suggestive of geographical variation.

Variations of body and skull morphology were used to test the hypothesis of a disjunct distribution of Guiana dolphins off the southeastern coast of Brazil in Ramos *et al.* (2010 this volume), which was based on samples collected from four geographic areas. Also using morphological features to investigate Guiana dolphin geographic variation, Laeta *et al.* (2010 this volume) compared the frequencies of developmental anomalies in vertebral cervical ribs and cleft neural arches using two skeletal collections from northern and southeastern Brazil, finding clear differences that support different populations.

Emin-Lima *et al.* (2010 this volume) present a note on group size and behavior of Guiana dolphins in the estuary of the Marapanim River, Pará State, northern Brazil, finding seasonal differences in group size, likely related to an increase in the abundance of fish when the increase of freshwater discharge in the Amazon River flushes estuarine waters eastward towards the coast. Gómez-Salazar *et al.* (2010 this volume) present a detailed description of the freshwater distribution of *Sotalia* in Colombia, Ecuador, Peru, Venezuela and Suriname, including the enigmatic *Sotalia* inhabiting the Orinoco River basin, whose taxonomic status remains unresolved. The note presented by Flores *et al.* (2010 this volume)

makes an argument for 'Guiana dolphin' as the common name to be used for *S. guianensis*, and is the result of agreement among researchers in this long-standing debate. A note on the development of a biopsy system device for the remote collection of skin samples from *S. guianensis* is presented by Cunha *et al.* (2010 this volume). Finally, Santos *et al.* (2010 this volume) illustrate the involvement of stakeholders working together with scientists towards the protection of Guiana dolphins in the Cananéia Estuary, southeastern Brazil.

In addition to the significant new contributions to the knowledge of *Sotalia* contained in this Special Volume, authors were asked to critically assess and synthesize the information that has previously only been available in abstracts and proceedings of SOLAMAC's biennial conferences and other meetings, as will be evident to the reader from the large number of abstract citations in the footnotes of many of the manuscripts.

Final Remarks

The results of the 2006 Búzios Workshop, as reflected in this Special Volume, showcase the knowledge that has been gained about *Sotalia* in the last decade. This progress notwithstanding, the present IUCN status of *Sotalia* as 'Data Deficient' underscores the need for redoubled research efforts. Indeed, contained in the Reports of the Working Groups as well as in the contributed papers are a number of knowledge gaps, conservation issues and recommendations that have been identified and we encourage the reader to peruse the entire volume. Here we highlight a few select ones in the hopes of illustrating the type of information and initiatives that are needed to better manage and protect the species while their populations are still relatively healthy.

1. Species identity of *Sotalia* in the Orinoco River basin

The presence of *Sotalia* in the Orinoco River basin has been known since von Humboldt's 1800 expedition, yet the species identity of these dolphins remains a puzzle. Studies of external morphology and coloration, anatomy and genetics are urgently needed to clarify whether animals occurring in the middle Orinoco of Venezuela are coastal transients making incursions into the river, part of a riverine population that entered via the Amazon in the past, or perhaps another subspecies or species altogether.

2. Phylogeography and population units of *S. fluviatilis*

While the phylogeography of *S. guianensis* points preliminarily to eight population units, the limited genetic sampling for *S. fluviatilis* conducted to date does not indicate a similar level of structuring, suggesting connectivity among Amazonian populations and a high genetic diversity. In order to clearly establish population units for *S. fluviatilis*, coordinated sampling is needed in most tributaries of the Amazon River, including the Negro, Branco, Xingu, Tapajós, Madeira, Caquetá, Putumayo, Napo, Cuyabeno and Ucayali rivers. In

addition, the use of other tools such as contaminant loads, stable isotopes and skeletal morphology should be part of an integrated approach to identify population units.

3. Monitoring trends in abundance near human population centers

Despite the extensive distributional range of *Sotalia* in coastal waters of Central and South America and throughout much of the Amazon and Orinoco River basins, clear habitat preferences, site fidelity and residency patterns have emerged for the two species, implying an elevated vulnerability for populations occurring near centers of human activity. Robust population monitoring and abundance time series are needed in areas of heavy anthropogenic influence in order to detect significant trends that can be used as quantitative indices of population health.

In closing we wish to underscore the need for strengthened local and internationally coordinated efforts to continue making progress towards a sound understanding of the threats and their severity throughout the range of the genus. Robust vulnerability assessments and meaningful conservation measures over the long term will depend on this. Further, it is widely recognized today that for protective measures to be effective they require the active participation of government authorities, local communities, the private sector and other key stakeholder groups. This is essential if our goal is to translate research into management strategies that can withstand political changes and are able to persist in the long run. Finally, the development of mitigation measures needs to be tailored to local socio-economic contexts and realities and should include capacity building efforts and educational strategies to communicate the role *Sotalia* plays in its environment. Without such considerations mitigation measures may be less than effective.

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