



Report of the Working Group on Ethnobiology and Environmental Education related to *Tursiops truncatus* in the Southwest Atlantic Ocean

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Ethnobiology

Ethnoscience aims to study the knowledge of human populations about the natural world, its taxonomy and classification. This science compares the knowledge practiced by the communities and the knowledge described by the academic literature (Roué, 2000; Farias and Alves, 2007). Ethnoecology, as a branch of Ethnoscience, allows the study of human groups, their practices and beliefs in relation to the ecosystem whereas Ethnobiology studies the taxonomic systems of flora and fauna described by different cultures. The latter also integrates the scientific knowledge with the popular knowledge (Berlin, 1992; Diegues, 2000; Pasa, 2004).

In areas where there is a well-established tradition of fishing, researchers, managers and local authorities should promote thorough analyses of local perception and improve suggestions of alternatives in order to reduce social disruption (Aragón-Noriega *et al.*, 2010). Ethnobiological studies conducted on fishing communities are important because these may justify the inclusion of local fishermen in management decisions for co-management of marine protected areas, and re-discovery and re-implementation of traditional knowledge-based management schemes (Paz and Begossi, 1996; Narchi *et al.*, 2014). This local knowledge must be recognized as a source of valuable information for the management of aquatic mammals (Chilvers *et al.*, 2005; Fisher and Young, 2007; Souza and Begossi, 2007; Zappes *et al.*, 2009; 2013) and of artisanal fishing. Co-management schemes in marine areas might benefit from the adoption of a 'knowledge-building' approach, in concurrence with local knowledge, instead of one that uses 'knowledge-using' during this process (Gerhardinger *et al.*, 2008).

Results of previous studies

Ethnobiological studies related to the perception of fishing communities on common bottlenose dolphins (*Tursiops truncatus*, Montagu, 1821), are still incipient in the Southwest Atlantic Ocean (SWAO) (04°N-56°S, 25°-67°W). In general, studies related to artisanal fishermen and the bottlenose dolphins are rare.

In Argentina, such studies are absent. However, in Brazil, ethnobiological studies are reported for the states of Rio de Janeiro (RJ) (Zappes *et al.*, 2010; 2011a), São Paulo (SP) (Souza, 2007; Souza and Begossi, 2007), Santa Catarina (SC) (Simões-Lopes, 1991; Simões-Lopes and Daura-Jorge, 2008) and Rio Grande do Sul (RS) (Simões-Lopes, 1991; Zappes *et al.*, 2011b; 2013; 2014). In Cagarras Archipelago (RJ), southeastern Brazil, a study aimed to identify the possible interactions and conflicts between the bottlenose dolphins and fisheries through the traditional knowledge (Zappes *et al.*, 2011a). Artisanal fishermen were interviewed and they described the negative interactions between bottlenose dolphin and artisanal fishing as 'scare the shoal' (n = 15; 88.2%), 'rip the gillnet' (n = 1; 5.9%) and 'get caught in the net' (n = 1; 5.9%). The negative interaction 'scare the shoal' directly affects the fisheries, as the fishermen cannot catch fish as a result. According to the fishermen, this interaction occurs mostly when fishermen choose the location based on the presence of the shoals, as dolphins approach the boat while the nets are prepared to be set. As during such an interaction feeding behavior is observed by the fishermen, the interaction is classified as 'negative' or 'antagonistic'.

For those fishermen, the interaction 'scare the shoal' causes greater damage than the incidental capture of animals

by gillnets, as there is a combined effect on the effort of the crew, and the resources invested in fuel and food for the crew while at sea. Conversely, when a dolphin is accidentally captured only the artifact is damaged (Zappes *et al.*, 2011a). In Cagaras Archipelago, the fishermen (n= 17) described behavioral ethnocategories for the bottlenose dolphin. The ethnocategory 'approach and follow the boat' was most often drawn to issues of behaviors displayed in front of the boat (n= 16; 66.7%) and at night (n= 3; 37.5%). During daytime the most frequent behavior was 'searching for food' (n= 8; 32%). In relation to feeding, the higher frequency was related to the behavior 'encircles the school of fish, slaps the tail on the water, throws the fish up and catches it' (n=12; 75%), characterized as a foraging behavior in group and observed only during daytime.

Through the fishermen's reports, it is possible to identify which animal interacts with fishing gear during dolphin foraging behaviors. As such, boats are often used as barriers and the nets as an aid in capturing the fish. Thus through this cultural perception it was possible to identify the influence of artisanal fishing on the species behavior in Cagaras Archipelago (Zappes *et al.*, 2011a).

Parental care was also described by fishermen, in which calves follow their parents or only the mother, and also calves are followed by adults, mainly by the mother. The observation of nursing behavior enables fishermen to identify who the mother is and thus to understand the group structure, sex ratio, the hierarchy of its members, and possibly the rate of annual births (Zappes *et al.*, 2010).

In São Sebastião (SP) a study about the popular taxonomy of cetaceans indicated that the bottlenose dolphin is classified by fishermen as part of the genus *boto* and/or *golfinho*, belonging to the ethnospecies *boto-caldeirão* and/or *golfinho-flíper* (Souza, 2007; Souza and Begossi, 2007).

In the region of Laguna (SC), southern Brazil, Simões-Lopes (1991), Simões-Lopes *et al.* (1998) and Peterson *et al.* (2008) report human-dolphin cooperative fishing; the bottlenose dolphin, known as '*boto*', helps fishermen casting fishing nets by cornering shoals of mullet (*Mugil* spp.) on the beach. Local stakeholders carefully observed the behavior of these animals, and figured out that cooperative fishing starts upon a signal initiated by the *botos*, named 'head signal'; after this signal, fishermen cast their nets on the exact location shown by the dolphins where the shoal of fish can be caught. In this area fishermen described the bycatch of calves in nets and the presence of 'bad *botos*' that don't show the location of the fish shoals (Peterson, 2005). As in Cagaras Archipelago, fishermen of Laguna also described the behavior of bottlenose dolphins throwing the fish out of water and slapping the fluke on the surface (Peterson, 2005).

In Imbé/Tramandaí region (RS) cooperative fishing was also observed (Pryor *et al.*, 1990; Simões-Lopes, 1991; Zappes *et al.*, 2011b). Fishermen stand knee- or waist-deep in waters off the Imbé/Tramandaí river mouth. In this area the

fishermen also await the 'head signal' from animals to assume their activities. Probably, these 'signals' are part of the pattern existing in the hunting behavior of these two populations of bottlenose dolphin (Laguna and Imbé/Tramandaí mouth). This ethnobiological information shows how fishermen of these regions observe in detail the animal's behavior and build, through the practice of fishing, the ethnoecological knowledge on this species (Zappes *et al.*, 2011b). In these areas, fishermen rarely fish with cast nets without the participation of dolphins.

Zappes *et al.* (2014) interviewed 44 fishermen of Imbé/Tramandaí and Patos Lagoon estuary (RS), describing and understanding the cultural perception of fishing behavior of animals as well as the relationship of cooperation between dolphins and fishermen; as a result, they reported the socio-economic influences that the species has in the fishermen's income. According to these interviews, this kind of fishing, marked by close interaction between humans and *botos*, allows nets to be cast fewer times and results in greater fish capture. It thus shows the cultural importance of cooperative fisheries for the communities and represents an important factor that may contribute to the conservation of bottlenose dolphins in these areas. Negative or antagonistic interactions were described for Imbé/Tramandaí related to: i) contention that dolphins 'steal fish from the cast nets', as they are able to lift the lead weights attached to the edges of the net, ii) occurrence of entanglement in the nets by calves, requiring fishermen to rip or damage their nets in order to free them, and iii) reports that some animals 'fool' fishermen by incorrectly identifying the location of a school of fish. The direct removal of fish from fishermen's nets is not an interaction that affects fishing. According to fishermen, the amount of 'stolen' fish is small when compared to the amount that dolphins help them catch. The incidental capture of bottlenose dolphin in fishing nets is not identified as a negative interaction in Imbé/Tramandaí mouth (n = 16; 72.7%).

In the Patos Lagoon estuary, 81.8% (n = 18) of the interviewed fishermen also reported net-based fishing aided by bottlenose dolphins (Zappes *et al.*, 2014). Similar to Imbé/Tramandaí, fishermen from the southern portion of the Patos Lagoon do not mention bycatch in gillnets as an antagonistic interaction of artisanal fisheries (n = 13; 59.1%) but recognize that the number of nets present in both areas has increased in recent years.

Along the Uruguayan coast, there has been only one study with ethnobiological approach as far as we know. Fishermen called the bottlenose dolphin "*tonina*" (n = 18) and did not describe or report any type of interaction with the fisheries. However, some fishermen (n = 3) reported accidental catches in fishing nets along the coast (Zappes *et al.*, 2014).

Until now, spatial competition between fishermen and bottlenose dolphins in ethnobiology studies has not been identified. Apparently their interaction is perceived with a feeling of respect and gratefulness towards the dolphins, as

they assist in the practice of artisanal fisheries in some areas. These fishermen, based on their observations on the species' ecology, have provided valuable information for marine mammal researchers and have passed this knowledge to the community. Therefore, it is believed that studies focused on the local knowledge of fishing communities can generate data to help establishing guidelines for management plans of natural resources in protected areas. The approach of researchers to fishing communities that operate in the SWAO will assist in monitoring activities and register bottlenose dolphin captures and/or strandings throughout the area. Studies with this approach should be conducted mainly in the areas along the southern coast of Brazil, and northern and northeastern coasts of Uruguay, and efforts should be devoted in Argentina where the cultural perceptions about the genus *Tursiops* are unknown.

Environmental education actions

The educational projects related to bottlenose dolphins performed along the SWAO are still scarce. Some initial educational activities have been carried out in specific regions of Brazil, Uruguay and Argentina. These activities have as main purpose to broadcast to the community information about the biology, ecology and conservation of the genus and its habitats. Within this approach, education becomes an important instrument in favor of the species' conservation (Zappes *et al.*, 2014).

In Cagarras Archipelago, an educational campaign related to bottlenose dolphins was performed involving groups of fishermen and canoers. It was intended to inform on the rules and appropriate procedures to establish a rational and controlled tourism in the area with educational foundations. This campaign included lectures and the distribution of brochures. In March 2010, the *Network of Collaborators of the Common Bottlenose Dolphin Project* was established aiming to increase the information about the occurrence of the species in Rio de Janeiro State¹.

In Laguna and Tramandaí, southern Brazil, an educational book about the bottlenose dolphin was elaborated, addressed to the young public of the local coastal communities (Simões-Lopes and Daura-Jorge, 2008). It responded to the need of returning the local and scientific knowledge accumulated in various studies, which started in the late 1980s, to these coastal communities. Through the publication of this book it was possible to spread the scientific knowledge about the species using an accessible language for the different social groups (*e.g.* students, teachers and fishermen).

The Patos Lagoon Bottlenose Dolphin project (Projeto Botos da Lagoa dos Patos), located at Rio Grande City, southern Brazil, aims to establish a link between the bottlenose dolphins and their interaction with the economic activities

of the region (*e.g.* port and fishing activities). Interactions between bottlenose dolphins and artisanal fisheries can help to understand the complexity of the relation among nature and the local society's culture and economy. This project is focused on education of both children and adults, and engages managers, politicians, associations and communities where it is possible to have contact with the society and to promote the construction of knowledge, sharing experiences and propagating the project proposals. In this way, the community can participate actively in the decision-making process related to the marine environment. In this sense lectures are offered for different local groups to disseminate the knowledge about bottlenose dolphins and their ecological importance to the region.

Along the Uruguayan coast, Toninas Project/Cetáceos Uruguay also approached educational institutions and the media with information about the biology and ecology of bottlenose dolphins. Particularly in Uruguay, a great confusion prevails about the identity of bottlenose dolphins; in this country, the species is known as *tonina*; this common name has generated a great public confusion, involving beach inhabitants like fishermen, lifeguards and also biologists. People think that *tonina* is not a dolphin or is a different kind of dolphin; in other words, they think that the *tonina* is not the bottlenose dolphin. When they understand *tonina* is the popular 'flipper', they react with happiness and amazement, realizing that this dolphin exists in Uruguay. This confusion prompted the launching of a small campaign called *¿La tonina es un delfin?* (Is the *tonina* a dolphin?) in order to highlight that there are dolphins in Uruguay and that *tonina* is the same species as the bottlenose dolphin. For this purpose, seven vinyl banners or posters (90 x 200cm) were designed based on photographs and explanations about morphology, coloration, behavior and ecology of bottlenose dolphin in Uruguay. These posters were exhibited, and sometimes accompanied by didactical talks, in many public events as in local art and cultural festivals, community education workshops, academic and television programs, as well as lifeguard posts and talks to tourists². Toninas Project also visited coastal schools (Cabo Polonio, Valizas, La Coronilla and Punta del Diablo localities) and worked with children using those didactical posters and other materials with the aim of emphasizing different values of its cultural identity³.

In province of Buenos Aires, Argentina, the Mundo Marino Oceanarium and the Mundo Marino Foundation promote and encourage the development of educational activities related to bottlenose dolphin since 1979⁴. The

²Laporta, P., Zamisch, V. and Trimble, M. (2009) Identifying critical areas of bottlenose dolphin populations: a coordinated regional conservation project. Toninas Project/Cetáceos Uruguay, Toninas Project Final Report. 49 pp. [Available from <http://www.ruffordsmallgrants.org/files/SM_Paula%20Laporta%20Detailed%20Final%20Report.pdf>]. Consulted on 10 November 2010.

³P. Laporta, pers. comm., 21 May 2010.

⁴S. Morón, pers. comm., 22 May 2010.

¹ L. Lodi, pers. comm., 24 March 2011

Foundation is conducting an intense training and teaching program at all educational levels. This extensive task of knowledge dissemination, aimed not only at professionals and students but also at the general public, was consolidated in 1993 when a series of original educational programs was created, responding to the curricular objectives of different education levels and most modern educational systems. The educational programs have been the result of a coordinated work in teams of interdisciplinary research, education and communication professionals, who have transmitted their experience through the most suitable teaching techniques for training the participants of these programs.

There is a basic premise that explains that no human can protect/defend his or her environment without knowing it. So, the general objectives of these programs are to introduce students of different ages to the basic features of sealife, with special emphasis on birds and marine mammals, and to transmit the basic concepts of environmental conservation. To meet these objectives, advanced audiovisual technology and modern teaching tools were put at the service of the teachers and scientists. Educational materials were created and edited (press releases and the booklet *The sea and marine mammals in Argentina*).

The Foundation also offers technical courses: Faunistic Resources, Wildlife and Exotic Animals Medicine, Veterinary Sciences Faculty, University of Salvador; Elective Course on Wildlife and Exotic Animals Medicine, Veterinary Sciences Faculty, La Plata National University; and Extra programmatic course on Biology, Medicine and Marine Fauna Conservation, Buenos Aires National University, Veterinary Sciences Faculty.

All these activities trained approximately 75 technicians and professionals from different areas through capacity-building courses, conferences and internships both for Argentinean and foreign people; the collection of biological data for several species and husbandry protocols for marine fauna. About nine million people were in contact with these educational tasks, more than 1150000 students, both elementary and high school, participated in those educational programs, and about 4500 university students and professionals assisted courses and conferences.

Finally, it is important to mention a recent experience on environmental educational activities carried out in Uruguay: *The Arenas Project*. This collaborative initiative of three organizations, Cetáceos Uruguay and non-governmental organizations Karumbé and Averaves, created an educational project directed to coastal state elementary school teachers. This project was not originally designed to deal with bottlenose dolphins; however, the purpose was broader, it was aimed to instruct state public elementary school teachers from the entire Uruguayan coast in matters involving the marine environment and its biodiversity, as well as the promotion and construction of educational practices engaging children⁵. Specifically, this project intended to stimulate teachers to work with environmental education, to train them on the

characteristics and functioning of the Uruguayan coastal ecosystem, and to elaborate educational material about those topics with an active participation of biologists and teachers. The book called *Marine Uruguayan Ecosystems: a guide for its knowledge* (Trimble *et al.*, 2010) is currently distributed among the state elementary schools of the Uruguayan coast, with the aim to generate a network of teachers working on marine ecosystems aspects.

In order to help future projects, proposals to implement studies related to ethnobiology and environmental education are presented below. Those can be adapted for areas where there are coastal populations of bottlenose dolphins along the SWAO (Malinowski, 1978; Schensul *et al.*, 1999; Ryan and Bernard, 2000; Dougherty, 2003; Zappes *et al.*, 2009; 2013):

Step 1 - Understand the issues of ethnobiology (this step allows to identify the language used by the local community and thus promote the approach of interdisciplinary researchers and government together with the community):

- 1) Through the method of participant observation, researchers can insert themselves into the community and observe the daily life of local stakeholders in order to raise important issues related to fishing and how the population sees the bottlenose dolphin;
- 2) Obtain information with the local stakeholders on the fishery in each region through the use of ethnographic questionnaires. This information can aid in understanding how the fisheries work;
- 3) Identify and understand how the fishing communities perceive bottlenose dolphins, the interactions between the fishing community and this species, as well as the conflicts that exist, through the application of ethnographic questionnaires specific to each area.

Step 2 - Encourage the collective feeling:

- 1) Development of individual capabilities in order to value each social stakeholder and what he/she can offer to the group through his/her life experience;
- 2) Organizational strengthening through training of leadership groups that will be the intermediaries of the community in relation to outside groups (researchers and government).

Step 3 - After understanding the local language it will be possible to work the educational approach:

- 1) Work with educational programs related to the biological aspects and interaction between fisheries, bottlenose dolphins and communities in order to improve

⁵Trimble, M., Szephegyi, M., Ríos, M., Passadore, C., Nin, M., Laporta, P., García, F., Fagúndez, C. and Castiñeira, E. (2008) Desde niños a maestros: ampliando el alcance de la educación ambiental para la conservación de los ecosistemas costeros. Page 38 in Resúmenes, 13^a Reunión de Trabajo de Especialistas en Mamíferos Acuáticos de América del Sur, 13-17 October 2008, Montevideo, Uruguay.

the active participation of local stakeholders (*e.g.* biology and behavior of bottlenose dolphin to demystify the species, status and conservation of this dolphin, aquatic pollution, coastal and fluvial ecosystems, etc.);

2) Organize courses in order to train the local stakeholders so that over time they can transmit the knowledge about bottlenose dolphins within the community.

Requirements and concerns about the future of bottlenose dolphin can be summarized in the known quotation of the Senegalese naturalist Baba Dioum: ‘... For in the end, we will conserve only what we love. We will love only what we understand. We will understand only what we are taught’. Therefore we are all willing to teach but also learn from the fishing communities.

Conclusions

Ethnobiological studies identify a significant local perception about bottlenose dolphins in Brazil as compared with available data in the literature. Reinforcement of this kind of research in other areas of the SWAO (*e.g.* Uruguay and Argentina) is necessary in order to complement ethnobiological data with scientific data, as well as to develop effective environmental education in local communities where bottlenose dolphins occur. The combination of ethnoecological knowledge of local communities and the scientific knowledge generated by researchers can help in the development of public policies involving various social groups. In this aspect, it is important to foster cooperation between researchers and communities to construct conservation proposals for bottlenose dolphins as a model to be adapted in each location together with local stakeholders, social managers, biologists and government.

Conservation must be understood as a goal that can only be achieved with the participation of the local stakeholders and leaders, multidisciplinary researchers, private agencies and political governances, whose commitment and work depend on current actions, as well as their future projection for the benefit of the future generations (Chilvers *et al.*, 2005). There are no studies showing the impacts of educational activities involving bottlenose dolphin conservation in the SWAO. It becomes evident that educational actions in this area are preliminary, and do not go deeper into cultural questions and co-management in the regions where coastal populations of the species exist. It is necessary to define strategies with insertion of public policies that make use of communities’ knowledge for the conservation of these coastal populations. Only through the active participation of local stakeholders and the use of traditional local knowledge will it be possible to achieve an effective educational practice related to the co-management of the coastal populations of bottlenose dolphins throughout the SWAO. In this sense, the return of the information generated in bottlenose dolphin’s ethnobiological studies to the coastal communities is also important in educational processes.

Bottlenose dolphin environmental education projects or activities carried out in the SWAO are specific and isolated. Arenas Project experiences showed the importance of generating educational activities involving the entire coastal ecosystem and teachers, key stakeholders in the dissemination of information to children. The importance to concentrate educational activities on species or populations with conservation problems is out of the focus of this paper. However, the ecosystem-based approach, as well as the incorporation of conservation values and reinforcement of cultural identity of coastal communities, is essential to be applied in educational disciplines in order to generate positive results in creating a conservation consciousness in future human generations.

Recommendations

1. To stimulate ethnobiological research on the bottlenose dolphin;
2. To develop courses and train members of coastal communities in how to deal with dolphin entanglement in fishing nets;
3. To plan and implement educational campaigns for coastal communities related to bycatch of bottlenose dolphins, especially in Patos Lagoon estuary, where high bycatch rates in artisanal fisheries have been reported;
4. To generate coordinated educational activities along the SWAO related to coastal and marine ecosystem conservation involving an exchange of scientific and local knowledge;
5. Use the steps suggested in this document as guidance in studies involving ethnobiology and environmental education in areas where there are coastal populations of bottlenose dolphins in the SWAO.

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