The use of a conceptual model to describe the conservation scenario of the estuarine dolphin within the *Baía Norte* (North Bay), Southern Brazil[1]

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SUMMARY

This paper presents a simple method for the development of a conceptual model applied to the conservation of animal populations. Wishing to describe a complex conservation scenario, impacts that influence such scenario are identified, as well as the human activities that cause them and the necessary practical actions to revert. The impacts are ordered according to their magnitude and their reversibility through conservationist actions. To demonstrate the use of this method in the preservation of animal populations, the estuarine dolphin, *Sotalia guianensis*, in the *Baía Norte* (North Bay) in the state of Santa Catarina has been used. Six main impacts have been identified: accidental entangling in fishing nets, direct human disturbance, habitat loss, chemical and/or organic pollution, noise pollution and boat collisions. At least eight human activities are responsible for causing these impacts on site. The use of conceptual models have the great potential of describing as close as possible to reality, and less subjectively, a complex conservation scenario, increasing the effectiveness of conservationist actions and the application of resources.

Keywords: cetacean, impacts, planning, *Sotalia guianensis*

INTRODUCTION

In conservation biology, combined scenarios are common, mixing natural ecosystems with human societies, resulting in extremely complex systems (Salafsky *et al.*, 2002). Thus, in the cases in which such scenarios must be changed, first they should be understood quite simply (Salafsky *et al.*, 2002). One of the ways of understanding a complex scenario is through the development of a conceptual model, which may be defined as a diagram that establishes the relation between the facts that influence or lead to a certain whished situation (Margoluis & Salafsky, 1998). Among the advantages of developing models for the conservation of specific targets (*e.g.* geographical areas, species, populations) a reduction of the random factor in conservationist actions can be highlighted, offering a common language through which people with different perspectives may discuss a same situation (Salafsky *et al.*, 2002). This model shall serve as the base for the conception, management and monitoring of any conservationist project or development (Margoluis & Salafsky, 1998). There are different methods for the development of conceptual models (see Margoluis & Salafsky, 1998; IUCN, 1999; Kristensen & Rader, 2001).

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The purpose of this paper is to present a simple method for the development of a conceptual model applied to the conservation of animal populations, including the disposition of the impacts to define priorities in conservationist actions. As an example, the results of the application of this method on the resident population of estuarine dolphins, Sotalia guianensis are presented, a species that live in the South boundary of its distribution and suffer great anthropogenic pressure.

CONCEPTUAL MODEL AND ITS DEVELOPMENT

Adapted from the Kristensen & Rader (2001) method for the conservation, the simplified conceptual model has four main components: an ideal scenario, impacts, human activities that cause impacts, and practical actions for the conservation (**FIGURE 1**).

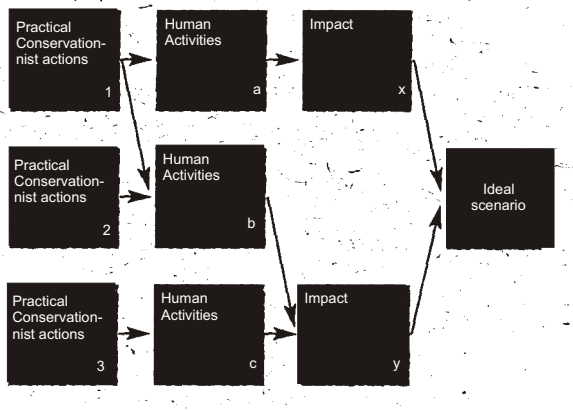

Figure 1: An example of the relation among the different components of a conceptual model intended for the conservation of a certain target

This way, the impacts influence or cause direct or indirect effects on the current condition, avoiding that a desirable condition (or ideal scenario) sets in. These impacts are caused by human activity, which, in turn, may be changed by another kind of human activity, this one called practical action for the conservation. These two kinds of human activities act differently upon the impact, one of them increasing and the other decreasing its magnitude, and therefore, they have different denominations (**FIGURE 2**).

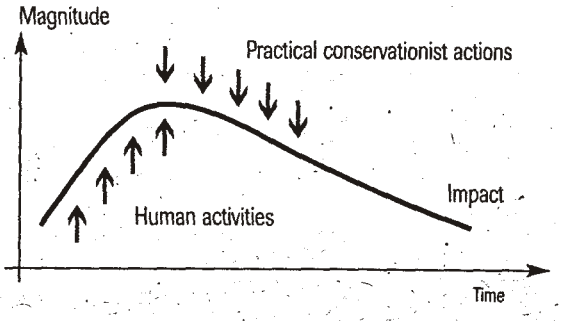

Figure 2: Graphic representing how an impact is molded by two kinds of human activities, of distinctive nature

Each human action that causes an impact also has one or more social players responsible for its existence. These players have different interest degrees in the activities, going from purely economic ones to subsistence or purely cultural ones. The impacts also have different effects on the ideal scenario, being able to cause, for example, the direct death of animals from the target-population, or only behavior changes, as the increase of vigilance, socialization decrease or the distance among individuals of a social group. So, other components may be introduced in the description of the complex scenario, allowing for the conceptual model to describe this scenario with more detail.

The first step for the development of the conceptual model proposed herein consists of a bibliographic searching about existing data on the population of the target-animal. If there are no data for the target-population, some information may be extrapolated from scientific work done in other areas or with other species, preferably having taxonomic affinities. This kind of procedure may be criticized for lack of effectiveness when being applied to information extrapolated from other populations or areas, but it is important to point out that in many cases, getting quick information is necessary. Thus, such information extrapolation is a way of providing possible solutions for a problem, regardless of specific studies performed in the target area.

After this step, people with great knowledge about the target-population and its biology and the area's environmental problems, are identified. Researchers, employees of protected areas, and other local social players, somehow involved with the conservation of the target-population, are interviewed or involved in discussions. Several rounds of applied or directed discussions about the conservation of the target-population may take place or even, one only event (as a workshop). Among the issues discussed in such meetings there are: which is the ideal scenario we wish to achieve; which are the main impacts on the area's target-population, and which interfere directly with the scenario; which are the knowledge gaps related to the effects of the impacts or to the species' needs; and which practical actions may minimize each one of the impacts. Although these are directed questions, it is recommended that discussions take their course freely, with as little as possible critical analysis and interference, though attention should be paid as to focus loss.

The ideal scenario should be as most objective and direct as possible, for it guides the answers to the following questions. Examples of ideal scenarios are: "conserved mangrove of the Carijós Ecological Station; "minimum feasible black-fronted piping-guan population kept at the Serra do Tabuleiro State Park; or "conserved marine biodiversity of the Arvoredo Marine Biological Reserve.

Later, the impacts are grouped on a matrix and arranged by the players. The used criteria for placing the impacts in order, adapted from Margoluis & Salafsky (1998), are divided into two classes, according to its nature: impact magnitude criteria and reversibility criteria (or reversion viability). Each criterion (columns of the impact matrix), each impact (lines of the matrix) gets a grade from 1 to "n" ("n" being equal to the number of impacts identified), without repeating the grades. The bigger the impact magnitude in relation to a certain criterion, the higher the grade, and vice-versa. The magnitude criteria, that indicate which impacts have the biggest negative impact on the ideal scenario, are the following:

- players: each player involved, according to his subjective perception about the order of the impacts' magnitude, proposes his order or arrangement. The proposed orders by the different players are summed and, the impact that achieved the highest total sum gets the highest grade, and so forth;

- area: territorial extension of the impact. If the impact is present in the whole occurrence area of the animal population or only within a small part of it;

- intensity: the power or intensity with which the impact occurs on the analysis object; for example, if the impact causes the direct death of animals, decrease of the number of descendents or only behavior alterations;

- urgency: if the impact demands immediate action or not.

The reversibility criteria are those that indicate which are the easiest impacts to have their magnitude reduced through conservationist practices. They are:

- political: political feasibility of solving the impact, or if there are political interests involved with the human activities that cause the impact. It may also include sector-based economical interests, besides culturally and emotionally based ones;

- social: social feasibility of reverting the impact, or if there is a major dependence by the human communities related to the activities that cause it;

- organization: if there is organizational competence (governmental or not) of reverting the impact through surveillance, education and other activities.

After developing a final document containing the results, this one can again be submitted to the players' (who have been involved in the discussions) review. This final step aims at detecting any distortions or bias in the final document by the organizer.

APPLICATION OF THE CONCEPTUAL MODEL IN THE ESTUARINE DOLPHIN'S CASE IN SOUTHERN BRAZIL

The estuarine dolphin Sotalia guianensis is a small marine mammal that lives in estuaries, protected bays or strictly coastal areas along the South and Central America Atlantic coast (Borobia *et al.*, 1991; **FIGURE 3**). In Santa Catarina's *Baía Norte*, its southern distribution boundary, a resident population of this species can be seen all year long (Simões-Lopes, 1988; Flores, 1999), where it occupies a very defined area on the west side of the bay (Wedekin *et al.*, in the press). The species is classified as "insufficiently known" by the *IUCN* – World Conservation Union - (IBAMA/GTE-MA, 2001, within mono-specific vision of the *Sotalia* gender; however, see Monteiro-Filho *et al.*, 2002 for current taxonomic situation).

The economical, social and biological importance of the species in the Baía Norte, combined to the anthropogenic pressure that their habitats suffer, as well as the own species (Simões-Lopes & Paula, 1997), justify the conservationist concern about the species in that area (Wedekin, 2003). This scenario leads to the establishment of the *Área de Proteção Ambiental (APA) de Anhatomirim* (Environmental Protection Area of Anhatomirim) in 1992, whose main purpose was to protect the resident population of the estuarine dolphin within the *Baía Norte*.

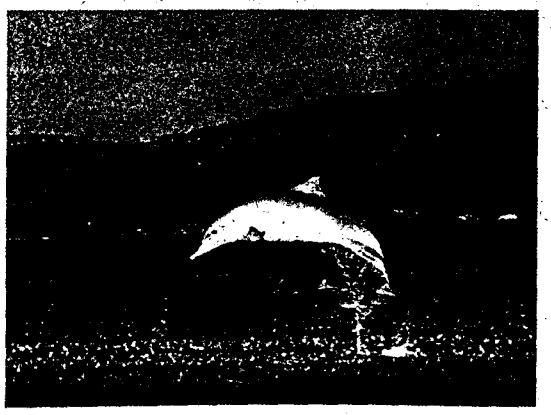

Figura 3: Adult estuarine dolphin *Sotalia guianensis*, within the Baía Norte in the Brazilian state of Santa Catarina. Photo by Vítor Q. Piacentini.

Despite research effort in the area, the impacts that fall upon this population, its magnitude and the human activities that cause them have never been identified and compiled. The lack of such information is common in the conservation efforts of animal populations. Many times, as in the development of environmental impact reports, or in other situations that involve decision making, it is crucial that a knowledge base, as close as possible to reality, is formed, and in time for the support of appropriate planning and environmental licensing. In other cases, there is not always a total absence of information, but a lack of organization of the available knowledge, or of the definition of researches and fundamental actions. In both situations described above, conceptual models may be useful for conservation.

The ideal scenario defined by the participants of the discussions at the beginning of the work was the conservation, on the long term, of the resident estuarine dolphin population. Other factors may also be incorporated to the scenario, as for example, recognizing the importance of the dolphins' image, which is understood when local communities are in favor and willing to help the cause of the dolphins' conservation.

During the discussions, already documented impacts for the estuarine dolphin inside *Baía Norte* have been identified, or, because of the existence of human activities which cause them, impacts that have been considered as existing, even though there are no specific studies about their occurrence at that site. The six main impacts and their effect upon cetacean are briefly described as follows (see details in Wedekin, 2003):

- accidental entangling in fishing gear: this impact causes the direct death of the animal and has already been documented for the estuarine dolphin from *Baía Norte* (Simões-Lopes & Ximenez, 1990);

- direct human disturbance: human activities present at *Baía Norte*, as the boat traffic and the presence of tourists (swimmers), may cause behavior reactions on the short and the long term, including abandoning the areas usually used by cetacean (Richardson & Würsig, 1997);

- habitat loss: mariculture or other alterations on the shore, as constructions, earthworks, drainages, may result in habitat modifications, making them inadequate for the estuarine dolphin;

- chemical and/or organic pollution: besides the alterations of the biotic conditions of a site, brought forth by the dumping of organic waste, some chemical compounds, as heavy metals from different origins, may accumulate on the cetacean tissues, causing reproductive and/or immunity disturbances (Reijnders, 1996);

- noise pollution: cetacean are highly dependent on sounds for communication and orientation, so that sound producing activities, such as the boat traffic, may cause behavior alterations of different kinds, starting with vocal repertoire changes until abandoning the areas (Richardson *et al.*, 1995);

- collision with boats: small coast cetacean may be prone to collisions with boats, causing injuries and possibly, the animals' death (Wells & Scott, 1997).

The impact, considered of major magnitude and of greater threat to the estuarine dolphin within the *Baía Norte*, according to the order of importance, was the accidental entangling in fishing nets (**TABLE 1**). In relation to the reversibility, the impact considered the easiest to be reverted, was the direct human disturbance, followed by the boat collisions. By adding the two sums of the criteria groups, it is possible to obtain a third order or arrangement (final), that will indicate which impact shall be priority for conservationist actions; in this case, they were the direct human disturbance and the accidental entangling in fishing nets.

The conceptual model is the simplification of a complex conservation scenario, furnishing a general idea of how the different components relate (**FIGURE 4**).

Table 1: Impact arrangement matrix for the estuarine dolphin within the *Baía Norte*, according to magnitude and reversibility criteria. See text for details

	Magnitude Criteia						Reversibility Criteria					Total	
Impact	Players	Area	Intensity	Urgency	I	Arrangement	Policies	Social	Organizational	I	Arrangement	I Total	Final Arrangement
Accidental net entangling	6	6	6	5	**23**	**1**	5	1	3	**9**	**4**	32	2
Direct human disturbance	4	2	5	6	**17**	**2**	6	5	6	**17**	**1**	34	1
Habitat loss	5	4	3	2	**14**	**3**	2	2	1	**5**	**6**	19	5
Chemical and/or organic pollution	1	5	4	1	**11**	**4**	1	3	2	**6**	**5**	17	6
Noise pollution	3	3	2	3	**11**	**4**	4	4	4	**12**	**3**	23	3
Boat collisions	2	1	1	4	**8**	**6**	3	6	5	**14**	**2**	22	4

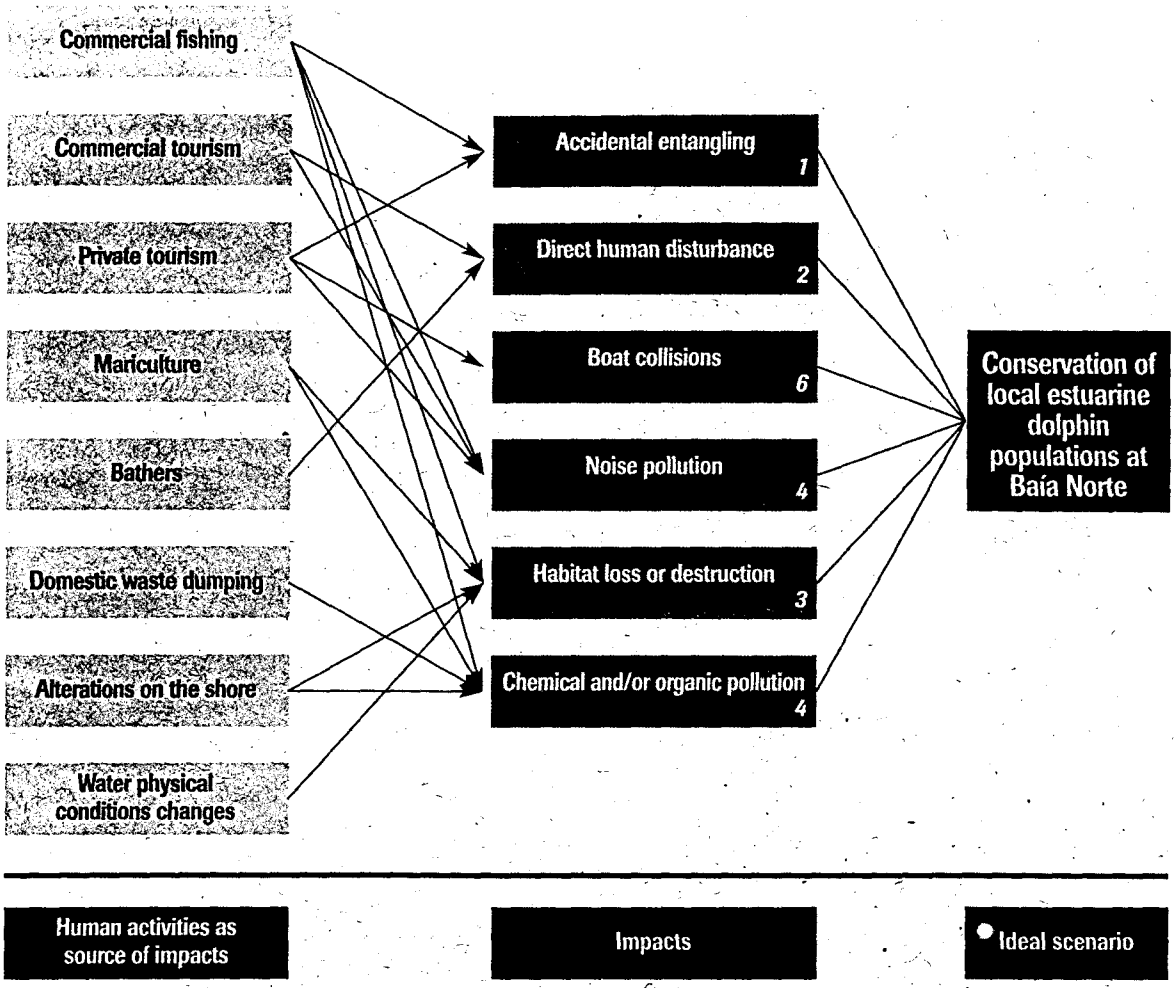

Figure 4: Simplified conceptual model about the conservation scenario of the estuarine dolphin within the Baía Norte. The numbers in italic on the lower right corner of each impact box, indicate the position of the impact according to the magnitude arrangement or order.

Observing the above figure, it is interesting to point out that a conservation scenario generally has more than one negative impact acting upon the ideal scenario. Thus, one sole impact may not be enough to drive the population to extinction, but several impacts acting synergistically may cause this threat. It is clear that a great part of animal populations suffer the influence of more than one impact simultaneously, as is the case with the estuarine dolphin at the *Baía Norte*. These impacts are caused by different human activities, building a complex interaction net and players involved. A conservation program, in most of the cases, requires a multiple simultaneous conservationist actions approach, acting upon several impacts as well as on the respective human actions that generate them.

To revert the impact on the estuarine dolphin at the *Baía Norte*, four main operation lines and their respective actions have been identified (see details in Wedekin, 2003), as follows:

(a) local political strengthening of the conservationist cause: adoption of the conservationist cause by an organization; active participation of the different players involved in the conservationist actions; establishment of ties and partnerships; and getting financial resources .

(b) impact magnitude reduction over the dol-

phin population at Baía Norte: opportunity for open participation in the establishment of norms of the area's dolphin watching tourism activity; definition of the area for mariculture; concession of permits to operate the animal' watching tourism; establishment of norms and regulations for boat traffic; establishment of the aquatic zone for the Environmental Protection Area of Anhatomirim; and effective surveillance.

(c) dissemination of information and enhancement of the dolphins' image: ministering training courses to operators and tourist guides; implementing visitors and interpretation centers at the APA Anhatomirim; education and environmental information activities with fishermen; distributing information on the dolphins and the conservationist cause through the media; promoting courses to different public.

(d) monitoring the population: monitoring the dolphin's population parameters (such as abundance); to monitor stranding; monitoring the use of space; monitoring alterations of the shore and coast line; use of timeserving research and surveillance platforms; and monitoring of organic and chemical pollution levels.

SOME OF THE METHOD'S PRESUPPOSITIONS

One of the important presuppositions that have to be incorporated during the several data collecting steps about conservation, especially in the guided discussions, is the most complete involvement of the different players. This is of great importance to reduce the subjectivity of each individual, who many times has a restricted and contaminated vision of the local reality. All and every experience and knowledge of any social player is relevant, as long as weighted with the general view of the group of players, and qualified by the available biological knowledge. Within this context, an experienced mediator in the discussions is extremely important, allegedly neutral in the matter.

Another important premise is that a complex conservation scenario is dynamic and changes throughout time. An ancient impact may disappear and cease to be fundamental, or new threats may come up during the generation of new data or during a change of the reality. Therefore, the conceptual model and the planning have to be re-done again and periodically reviewed.

Finally, another issue that deserves attention is the distinction among impacts, their effects and the activities that cause them. The difference among these components of a conceptual model is very subtle, many times. A simple outline is the following: "human activities have impacts that cause negative or positive effects upon an animal population" (GBRMPA, 2000). The impact is the consequence of one or more human activities that produce some effect (as death, fertility decrease or behavior reactions) on the animal population.

FINAL CONSIDERATIONS

One may argue that developing conceptual models or the planning itself be unreal and its practical applications, limited. In fact, "no method is impartial", nor perfect, and what we have will always be gross approximations to reality. This description of the complex conservation scenario is a less random and subjective means of understanding it, therefore, useful for any planning applied to the conservation of populations or other targets. As to its practical limitations, the saying "you may lead the horse to the water, but you cannot make it drink" may illustrate them. The planning made for the estuarine dolphin at the *Baía Norte* served to set out a feasibility study for a business in the main concentration area of the estuarine dolphin at the APA Anhatomirim. It generated grounds for the businessman to abandon his original wish, to idealize a business whose potential impacts on the estuarine dolphin have been completely mitigated and, further, who now acts as a consultant and

a prepared spokesman for the activities at the APA Anhatomirim as a whole (Zellhuber *et al.*, 2002). It also resulted in a document that compiled information produced and available about the estuarine dolphin in that area. This kind of planning, among other things, may also serve to establish the priority of conservationist actions, resulting in greater effectiveness in the application of the generally scarce resources.

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