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Implications of consumption and ecological knowledge on the management of marine turtles on the Northern coast of São Paulo, Brazil

Implicações do consumo e percepção ecológica para o manejo de tartarugas marinhas no litoral norte de São Paulo

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ABSTRACT

Traditional fishing communities usually have an ecological understanding of the resources they exploit, even if they are not the main target of fishing. Given that cultural and individual features of the sources of information could influence the consumption of the catch and the related understanding, it is expected that the older fishermen have a greater ecological understanding and a more ingrained eating behavior. The goal of this study was to gather information in five fishing communities in *Ubatuba* (SP) where marine turtles are commonly caught in gill nets, in order to answer the following questions: i) is there a difference in turtle eating among communities? ii) is turtle consumption influenced by socioeconomic characteristics; and iii) does the ecological perception depend on the socioeconomic characteristics of the interviewees / sources of information? It was found that turtle consumption was different and inversely related to reports of turtle entanglement presented to Tamar - the Marine Turtle Conservation Project (Pearson $r=-0.9$; $p<0.05$) and seems to be determined by the distance from the coast where entanglement occurs, by turtle mortality and the duration of entanglement (and not by socioeconomic features). Age, level of education and length of fishing experience influenced ecological knowledge of marine turtles. This result is contrary to the premise that older and more experienced fishermen should have greater ecological wisdom. This knowledge, greater for younger and more educated fishermen, was principally concerned with turtle feeding, since *Ubatuba* is mainly a feeding ground for marine turtles and is not an area of reproduction.

Key words: Marine turtles. By-catch. Ecological knowledge. Incidental catch.

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RESUMO

Comunidades pesqueiras tradicionais, em geral, possuem conhecimento ecológico sobre os recursos explorados, ainda que eles não sejam alvo da pescaria. Uma vez que características pessoais e culturais podem determinar o consumo das capturas e o conhecimento a ela relacionado, espera-se que pescadores mais velhos possuam maior conhecimento e hábitos de consumo mais arraigados. Esse trabalho objetivou coletar informações em cinco comunidades de pescadores do litoral norte de São Paulo, onde existe o emalhe de tartarugas marinhas para testar se: i) há diferença no consumo de tartaruga marinha; ii) características socioeconômicas determinam este consumo; e iii) a percepção ecológica depende de características socioeconômicas dos entrevistados/informantes. O consumo de tartarugas marinhas é distinto e inversamente correlacionado ao relato do emalhe das tartarugas ao Tamar (Pearson r=-0,9; p<0,05) e parece ser influenciado pela distância da costa em que a captura deste animal ocorre (e não por fatores socioeconômicos). A idade, escolaridade e anos de pesca determinaram o conhecimento ecológico sobre as tartarugas marinhas, de forma que pescadores mais jovens e com mais anos de estudo conhecem mais sobre alimentação, visto que Ubatuba é área de forrageio desta espécie e não de ciclos reprodutivos. Esse resultado contrariou as premissas de que os pescadores mais velhos com mais anos de pesca teriam maior conhecimento ecológico. Embora haja o emalhe de tartarugas nas redes de pesca em todas as comunidades, no Itaguá e Cedro este emalhe caracteriza um by-catch, *já que os animais capturados são soltos após registro pela equipe do Tamar.*

Palavras-chave: *Tartarugas marinhas. By-catch. Conhecimento ecológico. Captura acidental.*

INTRODUCTION

Traditional communities usually display few influences from modern society or current technology and are likely to live in areas of high diversity and exploit natural resources for their livelihood (Primack & Rodrigues, 2001). The direct exploitation of the natural environment allows these populations to acquire knowledge about natural history, behavior, classification and the availability of natural resources in the regions where they live (Johannes, 2000).

Studies of traditional communities and the exploited natural resources draw attention to the ecological knowledge they have accumulated and it may be a guide to the use and preservation of resources (Gadgil *et al.*, 1993; Carvalho, 2002). Furthermore, it may support the implementation or assessment of pre-existing management strategies, as well as the identification of local practices where ethno-knowledge does not result in ethno-conservation (Diegues, 2005).

Fishery is an activity involving the exploitation of natural resources and provides the global market with 70% of catch, involving 38 million people (Food and Agriculture Organization, 2006). In Brazil, despite the diffuse number of fishermen, marine extractive fishery supplied half of the total catch in 2006 (*Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis*, 2008). This traditional artisan fishery develops ecological knowledge or sometimes local management practices (Poizat & Baran, 1997). Since some fishing equipment is not selective, sometimes the species catch does not depend on the target species. Accordingly, non-target catches increase pressure on fishing resources and cause undesirable impacts on marine species such as mammals, sharks, birds and turtles, even with traditional fishing activities.

Caiçara populations are an example of these traditional societies who live on the southeastern coast of Brazil, in the Atlantic Forest region, and who descend from indigenous people, European colonizers or African slaves. An important characteristic of the *Caiçara* culture is the use of natural resources, such

as flora extraction, art crafts and artisan fishing, which is currently a prominent economic activity (Diegues, 2004). However fishery is prone to the accidental catch of marine turtles and, given that high, seasonal concentration of turtles instill the false perception that there is an inexhaustible source of meat, eggs and carcass (Tamar, 2000; IAC Secretariat, 2006), some species may, potentially, be consumed, in spite of the their endangered status.

Marine turtles are long life-cycle migratory species which take up to 30 years to reach sexual maturity and can be up to 2m in length. Out of 7 species of marine turtle worldwide, 5 can be found in Brazil: *Caretta caretta* (loggerhead turtle), *Chelonia mydas* (green sea turtle), *Eretmochelys imbricata* (hawksbill turtle), *Lepidochelys olivacea* (olive ridley turtle) and *Dermochelys coriacea* (leatherback turtle). Currently *E. imbricata* and *D. coriacea* are severely endangered. *C. caretta* and *C. mydas* have endangered status while *L. olivacea* is considered vulnerable (Lutz & Musick,1997; Gallo et al., 2000; International Union for Conservation of Nature, 2010).

In this study, ethno-biological and socioeconomic information, from five fishing communities which accidentally catch marine turtles, was used with the aim of answering: i) are there any differences in the volume of marine turtle consumption between the communities? ii) do the socioeconomic characteristics of interviewees determine marine turtle consumption? and iii) does ecological perception depend on socioeconomic characteristics?

METHODS

Fishing communities studied

The sampled communities are situated in the town of *Ubatuba*, on the northern coast of the state of *São Paulo* (23°26'S and 45°05'W) where many of the beaches are occupied by traditional communities for whom artisan fishing has, historically, been the main source of income (Sales *et al.*, 2003). Five artisan fishing communities were visited: *Cedro, Barra Seca, Camburi, Maranduba* and *Itaguá*.

The *Camburi* community (23°37'09"S and 44°72'19"W) is the farthest from downtown *Ubatuba* (46km) and it comprises 17 fishing families, living mainly near the beach, 2km from the BR 101 highway. It is accessible via a dirt road and the community has had a municipal bus service and electricity since 2007.

The community of *Maranduba* (23°54'98"S and 45°23'04"W) is located at the mouth of the *Maranduba* River, 25km from downtown *Ubatuba*. Most of the 20 fishing families live near to *Maranduba* beach which is a busy shoreline during the tourist season and is served by a small, local marina.

Barra Seca community (23°41"47"S and 45°03"45"W) comprises eight fishing families which live by the beach, which is located 5km from downtown.

The community of *Cedro* (23°27"34"S and 45°21"80"W) is 6 km from downtown *Ubatuba* and is easily accessible. There are no houses near the beach in this community, just a kiosk and a fishing shelter. It is the smallest community amongst those surveyed, with only four fishing families.

Itaguá fishing community (23°44'78"S and 45°06'66"W) comprises 15 fishing families and is located in downtown *Ubatuba*, on *Itaguá* beach, therefore it is the most urbanized beach.

Tamar Project - Marine Turtle Project has been in the center of *Ubatuba* since 1991. This marine turtle conservation project has the assistance of some fishermen who report the entanglement of marine turtles in nets, thus facilitating the recording, tagging and monitoring by the Tamar Project (hereafter referred to as Tamar).

Data sampling and analysis

Information was collected by way of a questionnaire comprising 22 closed questions (personal and socioeconomic characteristics) and open questions (which gathered data on catches and ecological knowledge of marine turtles). The

interviews were conducted in November and December 2007 and in December 2008 using the Snowball Method (Vera *et al.*, 1997). Age was the criterion used; only fishermen older than 18 years of age were interviewed.

The communities were assessed for differences in income, age, marital status, number of people in the household, education, number of children and income obtained from fishing through an Analysis Of Variance (ANOVA) using the communities and their distance from the city as factors, assuming that some communities could, for example, have older fishermen or larger families, and that distance could influence access to the study and to the commercialization of fish.

To test the null hypothesis that the proportion of marine turtle consumption was the same across all communities, a chi–square test was performed for more than two proportions by analysis of contingency tables (Zar 1996).

With the aim of verifying if socioeconomic characteristics determine whether the fisherman uses (1) or does not use (0) the accidentally caught marine turtles, a logistic regression was estimated (a=0.005). The dependent binary variable was turtle consumption or no turtle consumption, and socioeconomic information (such as income, age, education, number of children and number of people in the household) was used as independent variables.

Finally, in order to verify whether each fisherman's ecological knowledge was influenced by his socioeconomic characteristics, a simple linear regression model was performed. The number of correct answers, in respect of the ecological knowledge of marine turtles, was used as a dependent variable (out of eight questions asked) and socioeconomic variables (such as income, age, education and number of years fishing) were used as independent variables.

RESULTS

Overview of socioeconomic characteristics

A total of 35 fishermen from five fishing communities in *Ubatuba* (*Camburi, Barra Seca, Cedro, Maranduba* and *Itaguá*; Table 1) were interviewed. The community with fewest fishermen, subsisting only on fishing was *Barra Seca* and the lowest average income obtained from fishing occurred in *Camburi*, where more fishermen depend on fishing as their only income (Table 1). There was a correlation between being exclusively dedicated to fishing activity and being natives of *Ubatuba* (Pearson r=0.6; p<0.05) and there was also a high negative correlation between the age of the fishermen and average years of education, indicating that the older the fisherman, the less school education he had (Pearson r= –0.8; p=0.05).

The analysis of variance showed that there was a difference among the communities. Age was

Table 1. Socioeconomic characteristics of fishermen interviewed in November-December/2007 and December/2008 in five fishing communities: *Camburi, Barra Seca, Cedro, Maranduba* and *Itaguá*.

Characteristics	*Camburi*	*Barra Seca*	*Cedro*	*Maranduba*	*Itaguá*
Number of interviewees	12	7	4	8	4
Number of fishermen/community	17	8	4	20	15
Age	45.0 (DP=20)	41.0 (DP=15)	51.0 (DP=7)	35.0 (DP=8)	40.0 (DP=7)
Ubatuba natives (%)	83	71	100	75	75
Number of schooling years	4.1 (DP=2.1)	4.1 (DP=2.5)	2.3 (DP=0.5)	4.0 (DP=1.9)	2.5 (DP=1.3)
Number children	2.5 (DP=2)	1.7 (DP=2)	2.0 (DP=2)	0.75 (DP=1)	1.0 (DP=1)
Number people/household	4.0 (DP=2.4)	3.3 (DP=1.3)	3.0 (DP=0.8)	2.0 (DP=0.9)	3.5 (DP=1.6)
Exclusive fishermen (%)	83	28	75	75	25
Alternative income	Nursery	Mariculture	Kiosk	Sailor	Bricklayer
Income (R$; fishing)	214.0 (DP=156)	758.0 (DP=297)	570.0 (DP=380)	787.0 (DP=750)	525.0 (DP=106)

Values in parentheses refer to standard deviation.

significant in *Cedro* (p=0.04; t=2.11746) since *Cedro*'s fishermen were older, while fishing family size was significant in *Camburi* (p=0.01; t=2.68409; larger families) and *Maranduba* (p=0.01; t=–2.65670; smaller families). In *Maranduba*, the income obtained from fishing was also significant (p=0.030; t=2.36063) since it was higher than in the other communities.

Catching and consumption of marine turtles

There was consumption of marine turtles in some communities, in different proportions. This consumption, at the maximum, applies to a quarter of those interviewed, as in *Barra Seca* (29%; Table 2), however the estimated chi-square (c^2=2.604353) indicated that there was no difference in the proportion of turtle consumption between communities (estimated $c^2_{0.005,4}$=9.488; 0.999<p<0.90).

Additionally, socioeconomic variables tested in the *Logit* model were not significant in the computation of turtle consumption, most probably because there are no significant differences between the communities and this makes it unfeasible to detect such trends. However, consumption of marine turtles entangled in gillnets and the reporting of this catch to Tamar were strongly and negatively correlated (Pearson r=–0.9; p<0.05). Only in the communities of *Cedro* and *Itaguá* did all the fishermen report to Tamar the incidence of turtles entangled in gillnets, regardless of whether it was found dead or alive.

Most of the fishermen interviewed in the five communities (91%; n=35) stated that they find turtles in gillnets and many of them (81.3%; n=32) have no strategy to reduce the occurrence of this kind of catch. Only 6 fishermen (18.7%; n=32) stated they were accustomed to fishing in the open sea as a means to avoid turtle entanglement.

Even though few fishermen stated that they eat the turtle when it appears dead in their nets (11%) and that no recent reporting of marine turtle consumption has been recorded in the communities of *Cedro* and *Itaguá*, most of the fishermen interviewed (86%; n=35) informed us they had already eaten turtle meat, including fishermen from these two communities.

Table 2. Incidental catch and consumption of marine turtles in five fishing communities visited in *Ubatuba* (SP), Brazil.

Community	Report marine turtle entanglement (%)	Consume entangle marine turtles (%)
Cedro	100	0
Itaguá	100	0
Camburi	83	8
Maranduba	50	12
Barra Seca	14	29

Ecological perception regarding marine turtles

Only the variables of age (b_{AGE}=-0.05; p=0.003), literacy ($b_{LITERACY}$=0.168; p=0.027) and the number of years of fishing experience (b_{FISH}=-0.044; p=0.008) were a factor in the fishermen's ecological perception, although with a lower adjustment despite its significance (R^2=0.2; p=0.001).

Furthermore, almost all of the fishermen correctly answered the question concerning marine turtle diet and most of the fishermen were able to answer i) whether turtles reproduce on the northern coast of *São Paulo* or not; ii) the reason why turtles come to the region and iii) what is the marine turtle's main local predator. Correct answers to questions on growth, longevity and endangerment were fewer (Table 3).

Fishing activity

Most of the fishermen interviewed (71%; n=35) have been fishing for more than 15 years and almost half of them (48%) learned to fish from their fathers. The most common fishing tackle used was gillnets (74%), although the *cerco* (20%) and hand line (17%) were also used. Since the gillnet was the most used tackle and it does not require the assistance of others, 71% of the fishermen interviewed go

fishing alone. The *cerco* (Figure 1) was only used in *Camburi*, changing the community's fishing routine when this tackle is under water, since its use requires a different dynamic. It requires four or five fishermen working together when using the *cerco*, and in general, one of them is the owner and responsible for purchasing the material. In this case, he also gets a larger share of the total catch. The *cerco* site is permanent, meaning that the *cerco* owner also has ownership of the territory where it is set up. The period in which the tackle remains in the water depends on sea conditions, fishermen availability and interest. The area through which fish enter the *cerco* is called the *caminho* and the place where the fish are retained is called the *rodo*. One of the edges of the *caminho* is affixed to the coast and the other part to the *rodo*. In order to keep the *caminho* in the vertical position, stones are placed at the bottom of the sea and floating material is used along the upper part to mark its location. The *rodo* is delimited by a round cord that holds the net using buoys and it is affixed with anchors arranged around its entire circumference.

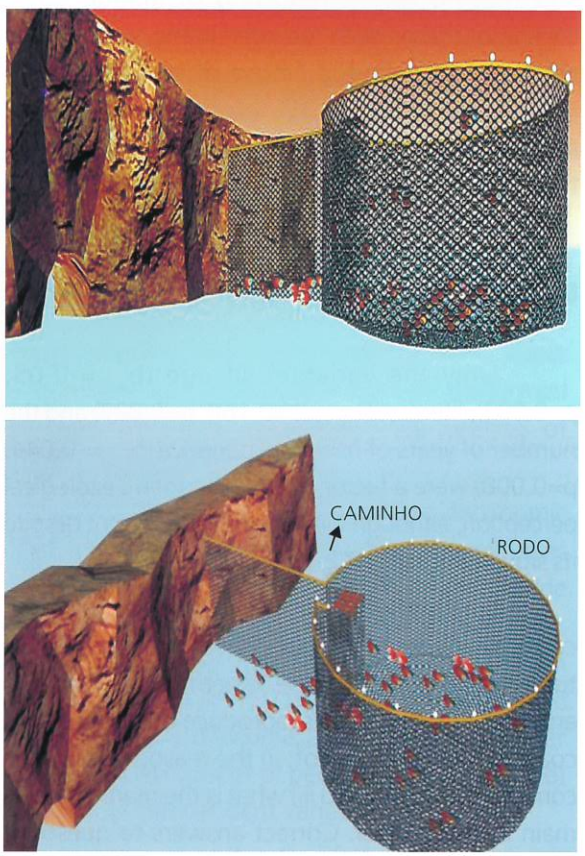

Figure 1. Scheme of *cerco*, the fishing gear used only by fishers from *Camburi*, in *Ubatuba* (SP) Brazil.

Two canoes are used when fishing with the *cerco*. One closes the *rodo* and other gathers the net until it concentrates all the fish in a single place called the *sacador*, from where the fish are thrown into the canoe which is blocking the mouth of the *cerco* (Tamar, 2000).

DISCUSSION

In the *Ubatuba* region, artisan fishing is no longer the only activity carried out by *Caiçaras* (Pupo *et al.*, 2006; Ramires *et al.*, 2007). However, in *Camburi*, almost all fishermen still rely exclusively on fishing. This is probably because *Camburi* is a *quilombola* community that keeps a traditional livelihood, with a culture of harvesting and subsistence

Table 3. Percentage of correct answers regarding marine turtle ecological knowledge from fishermen in five fishing communities in *Ubatuba on the* Northern coast of *São Paulo*, Brazil.

Questions	Correct (%)	Expected answer	Source
What does marine turtles eat?	94	Algae and invertebrates	
Does the marine turtle spawn here?	71	No	
Which animal is the marine turtle's predator?	57	Shark	
Why do marine turtles come to Ubatuba?	51	Feeding/migration	
What is the importance of marine turtles?	20	Ecosystem integrity	
How long does a marine turtle lives?	14	More than 100 yrs	
Are the marine turtles endangered?	11	Yes	IUCN (2008)
How long do marine turtles take to grow?	8	25 yrs	

(Schmitt *et al.*, 2002). The *Camburi* community also differs from the others in relation to the fishing tackle used, since it was the only community using the *cerco*, which is a variant on a fish cage. Fish cages are used for targeting tuna in the Mediterranean Sea, where tuna are caught and kept inside cages, constituting large fish farms in their natural environment for a longer period until reaching the desired tuna weight (Miyake *et al.*, 2003). The *cerco* on the other hand operates only on a temporary basis and despite the fact that the catch also takes place in natural environments, it is non-selective and the harvest occurs as soon as the *rodo* is full.

Age was one of the socioeconomic characteristics that distinguished the communities since fishermen were older in *Cedro*. The higher fishing income recorded in *Maranduba* was probably due to the marina and the large influx of tourists. This permits the trading of fish at a lower cost since it is not necessary to travel to the main quay or use any intermediaries.

Education was the lowest among older fishermen and this was reflected in their ecological perception regarding marine turtles, because the younger fishermen, who were more educated, obtained better scores in questions concerning ecological knowledge of marine turtles. This result was contrary to the assumption (Gadgil *et al.*, 1993; Johannes, 2000) that older fishermen, with more years of fishing and consequently greater empirical perception of their environment and the species exploited, would have greater ecological knowledge in this regard.

It is possible that the focus on conservation programs and environmental education given in schools has had an influence on this result. Furthermore, the small sample size (n=35) and the few interviewees older than 50 (n=9) could have played an important role in this result. On the other hand, traditional knowledge may not have been a determining factor due to the reduced geographic scale of traditional knowledge (Vargas & Almeida, 2006), which makes the comprehension of the dynamic for species with a long life span and migratory habits more difficult (Lutz & Musick, 1997). Consequently, knowledge of marine turtles was higher mainly with regard to turtle feeding, since *Ubatuba* is a feeding ground for marine turtles.

Entanglement of marine turtles in fishing gillnets was common to all communities. However the proportion of reporting of this catch by fishermen in the communities was different. The collaboration of the fishermen by notifying the marine turtle catch to Tamar is an important action in the conservation of the species in *Ubatuba*, since in those communities where few fishermen reported the entanglement of marine turtles in gillnets, there was a higher consumption of turtles *(Maranduba, Barra Seca* and *Camburi)*. According to the fishermen, one of the constraints for collaboration with Tamar was that it takes time to return to the beach, leave the turtle and wait for someone from the Tamar staff to record the catch. Fishermen seem to be more likely to report marine turtle entanglement when it happens near the beach. However, if the turtle has died recently it may sometimes be consumed. For that reason, turtle consumption is apparently more associated with the distance at which the catch is recorded and if the animal is dead and for how long. Since this information was not precisely collected in this study, it was not possible to test it. This implies that consumption of the resource (marine turtle) would not depend on socioeconomic characteristics.

Thus, it is very likely that the frequent reporting of turtles caught by fishermen in *Itaguá* and *Cedro* (communities nearest to the downtown area) could be prompted by proximity to the Tamar base, which reduces the amount of time needed for staff from the project to get out to the communities to record the occurrence of turtles, and also allows fishermen and the Tamar team to have more frequent contact.

If indeed this proximity is a facilitator for reporting accidental catches, this would indicate a chance for improvement in fishermen's participation in the *Barra Seca* community, where few fishermen report marine turtle entanglement in fishing gillnets. However, it must be considered that many fishermen in *Barra Seca* had mariculture as their main

occupation and it keeps any incidental catch, influencing the low percentage of fishermen who report entangled marine turtles.

Generally the term 'by-catch' is used in reference to incidental catch plus discard catch while 'incidental catch' does not include any discard catch (Alverson *et al.*, 1994). In the *Cedro* and *Itaguá* fishing communities, when marine turtles are found caught in fishing gillnets, the catch is reported, the animals are tagged and released (or discarded without a tag when dead), characterizing a by-catch of marine turtles in these two communities. In the other communities, when a turtle gets entangled in fishing nets, it may eventually be consumed, which indicates the occurrence of incidental catches of marine turtles in the *Maranduba, Barra Seca* and *Camburi* fishing communities.

Although neither by-catch nor incidental catch was desirable, incidental turtle catch (and consumption) has a cultural component and it can easily become a common and widespread behavior. It is likely that consumption could be reduced through a program to encourage fishermen to report marine turtle entanglement. Furthermore, consumption could be reduced if there was an incentive for fishermen´s participation, particularly if members of the community were trained to tag and monitor the incidental catches, as has already been done by Tamar in marine turtle spawning sites (*Fundação Pró-Tamar*, 2000) and in the Olifants River in South Africa, where some members of the community monitor the incidental catch of linefish (Carvalho *et al.*, 2009).

In fact, an interest in a partnership between fishermen and Tamar has manifested itself in the *Cedro* fishing community. Since *Cedro* and *Barra Seca* are near the downtown area, these communities could be included in a pilot project to be disseminated to other communities. However, the trustfulness in the collaboration of fishermen relies on transmitting to them scientific knowledge regarding the turtles, which is lacking, and use their traditional knowledge as an input to the monitoring system (Silvano *et al.*, 2008). In this sense, improvements such as mapping the areas with the highest turtle entanglement rates could be done (discounting the effect of net density per area at each location). Having fishermen as key partners in the conservation could also be useful in terms of additional marine resource conservation, as they usually have unrecorded knowledge of ecological processes and they are able to develop and efficiently use traditional practices to manage natural resources (Berkes *et al.*, 2001; Benatti *et al.*, 2003). In this sense, some fishermen from *Maranduba* (n=5) and *Barra Seca* (n=1) have been trying to avoid turtles entangling in gillnets by fishing in the open sea. This could be another reason why the reporting of incidental catches was low in these communities, since, as described above, fishermen choose not to report the catch of marine turtles if it takes place far from the beach, because they take too long to go back and wait for the Tamar team to arrive. Regardless, fishing in the open sea as a strategy to avoid catching turtles depends on having suitable fishing tackle for such an environment, on skills for fishing in the open sea and on targeting different fish species, thus limiting the use of this practice by all fishermen.

Therefore, it seems reasonable to consider fishermen´s participation in marine turtle conservation projects (Pupo *et al.*, 2006) to enlighten other fishermen and community members on ecological, economic and social values involved in the preservation of this species. Furthermore, examples from literature have demonstrated that when users of natural resources understand the reasons behind conservation programs and the advantages in implementing them (for example, risk of extinction, loss of tourist attraction or key trophic group) and if they are involved in the process from its inception, there is an enhancement for collaboration and biological success (Fiorino, 1990; Ticheler *et al.*, 1998; Hauck & Sowman, 2003; Dalton, 2006; Carvalho *et al.*, 2009).

The difficulty in implementing community management in the scenario described herein lies in the fact that it is a conservation activity without a direct return being perceived by the users. Fishermen would not be acting to bring future financial benefits, as in the case of conservation of their target catch

species, but rather to increase the diversity of a species that apparently does not bring them any financial return. For that reason, scientific information and ecological training activities are essential to increase the chances of success with the conservation of this species, since the presence of turtles indicates a healthier ecosystem (Lutz & Musick, 1997; Gallo *et al.*, 2000) and attracts the greater interest of tourists. This could be a factor for increasing fish consumption and animal-watching tourism, which could be an advantageous activity, even carried out by the fishermen themselves and this does not exist in the region today.

CONCLUSION

The information gathered in the five fishing communities in *Ubatuba* (SP) indicated that in *Itaguá* and *Cedro,* turtle entanglement characterizes by-catch, since the animals caught were released after they were recorded by the Tamar team. Ecological knowledge of turtles differs between the communities and was more frequently related to items of turtle diet and feeding habitats, since *Ubatuba* is a foraging area for this species and not an area for reproductive cycles. This knowledge was greater among younger fishermen and those with more years of education.

Turtle consumption was inversely correlated to the reporting of turtle entanglement to Tamar. Reporting and consumption seem to be influenced by the distance from the coast where the animal was caught and if it was already dead and for how long (and not by socioeconomic characteristics).

Therefore, it would seem to be recommendable to implement community management programs for marine turtles in these communities involving community members and highlighting: a) The transmission of scientific knowledge about marine turtles so that fishermen understand the situation of these endangered species and enhance fishermen´s collaboration with marine turtle conservation; b) An incentive program to record the catching and marking of marine turtles caught incidentally; c) Training and empowerment of some fishermen or members of the community to monitor and mark the turtles themselves.

These may be effective alternatives for increasing fishermen's participation in the conservation program and achieving the conservation objectives proposed for these species.

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