SEGURANÇA
alimentar e nutricional

A segurança alimentar de comunidades pesqueiras do Sudeste do Brasil: dimensões complementares e um exemplo com o robalo

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Este estudo inclui aspectos complementares da segurança alimentar através da ênfase na importância da trajetória do recurso, dentre outros. Os locais de estudo são Copacabana (Rio de Janeiro) e Paraty (RJ), bem como Bertioga (SP). Três exemplos (casos) ilustram esse estudo: 1) a escolha alimentar de populações da costa; 2) a extração de recursos marinhos considerados vulneráveis; e 3) a compreensão da biologia/ecologia dos recursos, ilustrada aqui através de dados primários sobre o robalo (*Centropomus undecimalis*). A escolha alimentar inclui a importância do tempo de manipulação no alimento (espécies de peixe, nesse caso). Peixes com menos espinhas são preferidos para consumo e venda; esses possuem também alta demanda no mercado. A extração de recursos vulneráveis é ilustrada através da pesca da garoupa (*Epinephelus marginatus*). Indivíduos imaturos de garoupa compõem a maioria da pesca de pequenas comunidades pesqueiras e demandas do mercado influenciam as decisões dos pescadores. O último caso, a extração de peixes que utilizam ambientes diversos, para reproduzir e para completar os seus ciclos de vida, é exemplificado através do peixe estuarino robalo (*C. undecimalis*), com base em dados primários. A importância do conhecimento sobre a reprodução de peixes no sentido de manter as comunidades pesqueiras e trabalhar na direção da segurança alimentar é uma conclusão desse estudo.

Palavras-chave: comunidades pesqueiras, dieta, garoupa, robalo, segurança alimentar.

The food security of coastal fisheries in SE Brazil: complementary dimensions an example with snook (Robalo)

This study includes complementary aspects of food security by emphasizing the importance of the traceability of the resource, among others. Study sites are Copacabana (Rio de Janeiro) and Paraty (RJ) as well as Bertioga (SP). Three examples (cases) illustrate this study: 1) the food choice by coastal populations; 2) the extraction of marine resources that are endangered; and 3) the understanding of the biology/ecology of the resources, illustrated here by showing primary data on common snook (robalo) (*Centropomus undecimalis*). The choice of food includes the importance of food manipulation time (fish species in this case). Less bony fish are preferred for consumption and for sales; less bony flesh has also a high market demand. The extraction of endangered marine resources is illustrated by the fishing of groupers (*Epinephelus marginatus).* Immature individuals of groupers compose most of the catch in the small scale fisheries studied. Market demands influence fishers' decisions. The last case is the extraction of fish that need diverse environments, to reproduce and complete their life cycles. It is exemplified through the estuarine common snook (*C. undecimalis*), based on primary data. The importance of the knowledge

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of fish reproduction in order to maintain the fishery and to work towards food security is one conclusion of this study.

Key-words: fishery, diet, grouper, snook, food security.

INTRODUCTION

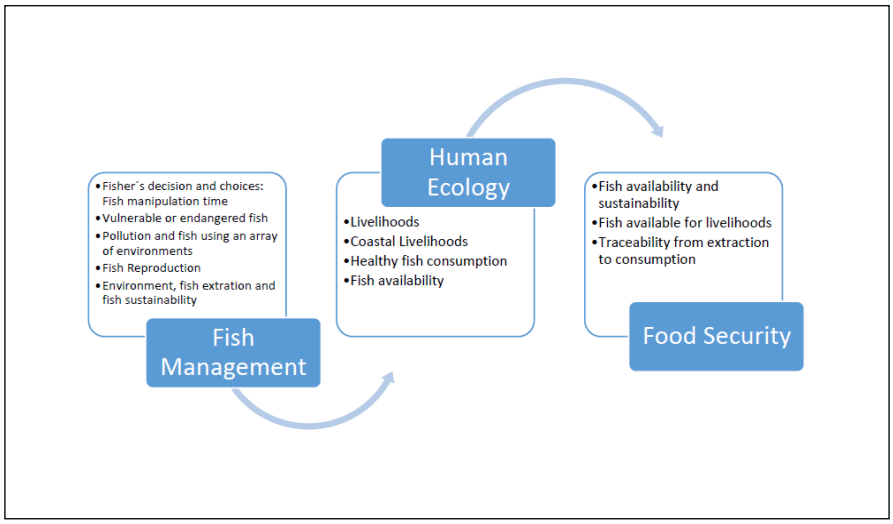
Fish is known by its nutritional features, such as a relative high protein content, as well as other features, such as: micronutrients, such as EPA (omega-3 fatty acid eicosapentaenoic) and DHA (docoahexaenoic), because it's a good source of vitamins B, A and D as well as of minerals (calcium, phosphorus, copper, selenium, iron, and iodine in case of salt water fish), and due to its high digestibility [1]. Fish is very important in the consumption of coastal livelihoods in Brazil, being often the main protein consumed by them, representing about 50% of the source of protein consumed by coastal communities [2,3,4]. For example, studies in Atlantic Forest coastal communities, using the 24 hours recall method and including 2,921 meals, showed fish as more than 50% of the protein source [5]. Small-scale fisheries in Brazil, such as the coastal Atlantic Forest fishers, are responsible for about 50% of the total country fish production [6]. In 2010, marine extraction accounted for 42% of production in Brazil [7]. The *per capita* consumption of fish in Brazil was estimated as about 4kg/year; however, if SE Brazil account for 5,4 kg/*per capita*, NE Brazil has a figure of 38,1 *per capita* (here both marine and freshwater fish are taken together) [1].

Food security concepts have important sources from Europe and thereafter through international programs at ONU and FAO; in 2001 a World Forum at Cuba emphasized the sovereignty aspects of the access to food resources by Third World countries [8]. A food security definition from the Second National Conference of Food Security in Brazil is, roughly, the right/access of all, regularly and permanently, to food in terms of its quality and quantity; it includes food practices that respect cultural diversity being sustainably social, economic and environmentally [9]. This last definition is very close to the ecological aspects of food security, including food extraction, one of the subjects of this study.

In that regard, we suggest, in this study, a link among ecology, human ecology and food security (Figure 1). We operationalize that link by showing examples of other three complementary dimensions in the approach of food security. Such complementary dimensions are also inspired by approaches by the European Commission and by FAO approaches that link the traceability of food, from its source (extraction) to consumption (see Figure1). For example, in 2007, the European Commission defined food traceability as the ability to track feed, food-producing through all stages of production, processing and distribution in a way to respond to risks [10]. Similarly FAO approaches, taken them from *Codex Alimentarius Commission* defined traceability as the ability to follows the movement of food through specified stage(s) of production, processing and distribution [11]. Traceability is thus an important link to the requirements to a sound and sustainable form to extract resources that can lead to food certification as well.

Our objective in this study is to address three dimensions of food security, associated to food extraction and to food choices. Three cases from the Atlantic Forest coast in SE Brazil illustrate this study, and they show that the need for managing biodiversity is entangled with social and economic needs that relates to food security. A special attention is given in the third case or example, about the snook, in which we use original data and we discuss the importance of the knowledge on fish biology, ecology and ethno ecology to attain proper management and food security (Figure 1).

Figure 1. Three examples are shown in this study: food manipulation, extraction of endangered species, such as *Epinephelus marginatus*, and the illustrative detailed example of snook, *Centropomus undecimalis*. These cases show the need for managing biodiversity which is entangled with social and economic needs that relates to food security (especially when approaching rural or coastal livelihoods).



The three cases show that the need for managing biodiversity is entangled with social and economic needs that relates to food security (Figure 1). Especially when approaching rural populations that live close (or inside) protected areas, the need to protect biodiversity commonly does not encompass economic and social needs of the local population. However, how to deal with such tricky and related issues, such as fish management, food consumption and subsistence/economic needs, deserves detailed and special attention. The examples analyzed here are: a) food choices in Paraty; b) the study of endangered species, such as *Epinephelus marginatus* (grouper), and c) the importance of knowing about the ecology and ethno ecology of fish, illustrated with results on common snook, *Centropomus undecimalis* in Copacabana (RJ) and Bertioga (SP).

METHODS

Study sites

The areas studied are located in the coast of Rio de Janeiro (Paraty and Copacabana small-scale fisheries) and in the coast of São Paulo (Bertioga). These areas, along with other areas of the coast, have domestic sewage that flows into the streams of Atlantic forest villages and communities as well as to the sea or to mangrove areas. Such a system involve all the coast, including communities close to more urbanized areas, such as Bertioga, close to Santos; Copacabana, located in the city of Rio de Janeiro, and also Paraty, located in the coast midway between Rio de Janeiro and Santos.

Procedures

This study was based on previously published data (Cases 1 and 2) [12,13,14] and original data (Case 3). Original data on snook fishery were collected at fish landings sites in the fishing communities of Copacabana (Rio de Janeiro) and Bertioga (São Paulo), during 16 months in 2006 and 2007. The fish collected from fishermen´s catches (mostly bought from fishers at landing points, which are also local fish markets) were examined for analyses of gonad development and stomach contents. The methods for gonad analysis were based on a macroscopically evaluation of the gonads (visible/not visible) as well as on their volume (mL) measured in the landing sites. Fish was also measured in total length; stomach contents were classified qualitatively. These methods were already described [15].

Gonad volumes were measured for 111 individuals of *C. undecimalis*: 70 collected in Bertioga and 41 collected in Copacabana. GSI (gonadossomatic indexes) were calculated as [gonads weight/body

weight] × 100. Weights of gonads were defined through their volume assuming the average density of fishes flesh to be 1.065. Measurements of gonads volumes of *Centropomus undecimalis* in the landing sites were accomplished within the period from February, 2006 till November, 2007, through 12 fieldwork visits in Bertioga, and 10 visits in Copacabana. Other studies using GSI are available in the literature [16,17].

Interviews with fishers were performed with the fishers' found at landing points following the criteria of more than forty years of age and a minimum of 10 years of residence and fishing experience.

RESULTS

Food Choices in Paraty (Case 1)

Food choices [12]: the main goal in this study was to analyze some variables associated with fish choice in the fishing communities of Praia Grande and Tarituba, Paraty, RJ. These places are also local market points for fishers. The ecological model of optimal foraging theory provided the conceptual framework for this analysis. A fishers' dilemma between consuming, or selling their catch was already been observed in fishing communities from other sites in the southeastern Brazilian coast [3]. Species considered as target in coastal fishing communities of this area have high market prices, considered 'noble fish' [18]. The fish most cited as chosen for consumption in both communities was sand drum, *Micropogonias furnieri* (Sciaenidae) and for commerce was snook (*Centropomus* spp.). Bony fish had the lowest preference as food, whereas the most appreciated fish were less bony. Time spent manipulating a food is important and optimal foraging theory predicts that a long time of manipulation should decrease preference for food, since it increases consumption efforts. The results shown here are important in terms of food security and issues are highlighted here, as follows:

a) Food security should be looked in more detail when analyzing human populations that depend upon the extracted or exploited resources, especially those associated to subsistence or local economy.
b) The detection of variables that determine the output (fish consumed) from the yield obtained (fish caught) may vary and several preferences can determine such an output. There are differences in the choice of fish to be eaten and to be sold.
c) When tracing management and conservation plans, attention should be taken not just to local preferences, but to the causes of those preferences, too (such as prices and market demands).
d) We agree that food security are close associated to management and conservation, as previously proposed [19], and this association may have implications to the resilience of the system. We understand as resilience the capacity of the system to continue existing in a sustainable form (Figure 1).

Grouper, an endangered species (Case 2)

In this section, we analyze how to manage fisheries in order to sustain fishing communities that depend upon endangered species for a living towards food security. Studies were carried out [13,14] in Bertioga (SP), Copacabana (Rio de Janeiro) and Paraty (RJ). The grouper, *E. marginatus,* is considered as threatened and classified as endangered on the IUCN redlist [20].

Grouper is a very important commercial target in small-scale fisheries of the coast of Brazil. It is also considered as being relatively scarce compared to other species, such as sand drum [21]. However, grouper is being caught by small scale fishermen of Bertioga (São Paulo coast), Copacabana and Paraty (Rio de Janeiro city and coast) at early and immature reproductive stages with total lengths of 300-500 mm [14]. Groupers, such as *E. marginatus*, are a protogynous species. Fish maturation size for this species in Brazil was estimated to be about 2 kg weight and 470 mm (Total Length). Immature individuals compose most landings in the three fishing communities studied. Moreover, protogynous stocks, such as of *E. marginatus*, may be far more vulnerable to fishing compared to other stocks [22]. Furthermore, grouper and other large reef fishes have slow growth, large size, a slow reproduction and are thus more susceptible to an increased fishing pressure [23,24].

A challenge is notable here: a 'noble fish' (grouper), highly prized in the market, is endangered, it is not as available as other fish are, it is caught at an immature stage by fishers, whom depend upon this resource for a living. Here is then a challenge for conservation and food security. Management should then work through an integrative and collaborative process among researchers, environmental agents and fishers.

In that particular example, drivers towards conservation and thus food security are needed to encourage fishers to protect this species. The driver suggested here, as already suggested in other studies, is a payment system, such as payments for environmental services [25]. Fishermen should receive a wage in the periods during which catches of *E. marginatus* should be forbidden, such as in Spring and Summer, a period where probably this and many other important species reproduce, such as snook [15].

Ecology and Ethnoecology of snook, *C. undecimalis* (Case 3)

This section is based on original data about snook collected at Bertioga (SP) and Copacabana (Rio de Janeiro, RJ) in 2007. Snook depend upon diverse environments, being an estuarine and coastal fish.

Brief background of snook, *C. undecimalis*

The example of the common snook is manifold, since it is a commercial target fish, whose meat is very appreciated, and it occupies diverse environments for growth and spawning. The common snook and other snook species (*Centropomus* spp.) are important fishes targeted in commercial, subsistence and recreational fisheries also in the coastal regions of Florida [26], Colombia [27] and Puerto Rico [28].

Common snook inhabits coastal waters, estuaries and lagoons, penetrating into freshwater; it forms aggregations in river mouths during the spawning season, but seasonal movements into freshwater are poorly understood [29]. It is a diadromous, stenothermic, euryhaline, estuarine-dependent species from the western Atlantic Ocean and its spawning season in Latin America and the Caribbean was described as from April/May-September/October [30,31]. Its development ranges from different habitats, as larvae are transported inshore, where juveniles colonize estuarine nursery grounds and habitat varies such as shallow waters, drainage areas, mangrove impoundments, seagrass beds, among others [32]. Common snooks are protandrous hermaphrodites: transitional sex-stage occurs at 515 mm length and 3.4 years; males can reach sexual maturity at 150–200 mm length [33].

In the Gulf of Mexico and coastal region of Florida, the common snook (*C. undecimalis*) migrates from estuaries and coastal areas to spawn in near-shore islands, which usually have strong currents and some kind of shelter (grass flats, mangroves, fallen trees) [30,33]. The common snook shows spawning site fidelity in the Florida's Gulf of Mexico: most adult fish spawn repeatedly in the same sites (barrier coastal islands), which may create a meta-population structure in this fish stock, making it more susceptible to environmental and anthropogenic changes in spawning grounds [33]. It has also been observed that at least some individuals of the common snook may show skipped spawning behavior, remaining in estuaries and not migrating to coastal spawning grounds in Florida's coast [26]. We unfortunately lack detailed surveys of the reproduction and migration of the common snook in the Brazilian coast, but these previous studies in Florida indicate that this fish species may have meta-populations linked to specific spawning grounds [33].

Therefore, the common snook may be negatively affected by degradation of spawning habitats, and positively affected by spatial conservation measures, such as marine protected areas (MPAs). For example, in an estuarine region of Colombia, the introduction of a new fishing technique (an encircling gill net), caused a drastic reduction in the abundance of the common snook and other fish predators [27], highlighting the risk of over-fishing of this fish species.

Results on snook

Tables 1 and 2 show, that small-scale fishers from both Bertioga and Copacabana, catch common snook throughout the year. Sperm was visible in fish in most of the monthly samples and times of maximal gonad developments occurred in October-November in Bertioga and April-May in Copacabana (Table 3). GSI (gonadossomatic indexes) showed its highest peak in November at Bertioga and in May at Copacabana (Figure 2). With more detail, Figure 3 shows the gonad volume per size class of snook at Bertioga and Copacabana.

Table 1. Number of individuals of the *Centropomus undecimalis* sampled in different periods of 2006-2007 at Bertioga and Copacabana of the Brazilian coast.

Year	Season	Month	Bertioga	Copacabana, Rio	Total
2006	Summer	February	---	05	05
	Autumn	March	---	01	01
		April	---	01	01
	Spring	September	03	03	06
		October	22	01	23
		November	08	---	08
	Summer	December	---	13	13
2007	Summer	January	13	---	13
		February	10	01	11
	Autumn	March	02	18	20
		April	04	02	06
		May	09	02	11
	Winter	June	04	---	04
		July	14	---	14
		August	04	---	04
	Spring	November	---	03	03
Total			**93**	**50**	**143**

Table 2. Total snook collected, *C. undecimalis*, per season (2006/2007).

Season	Bertioga	Copacabana, Rio	Total
Autumn	15	24	39
Winter	22	NS	22
Spring	33	7	40
Summer	23	19	42

NS=not sampled (not collected).

Table 3. Number of individuals of *C. undecimalis* with/without visible eggs or sperms collected at Bertioga and Copacabana. Fieldwork from February to November 2007.

Month/ Season	Bertioga				Copacabana			
	visible	not visible	sperm	Total	visible	not visible	sperm	Total
March	---	---	02	02	04	---	14	18
April	---	01	03	04	01	---	---	01
May	02	---	07	09	02	---	---	02
June	---	01	03	04	---	---	---	---
July	---	09	05	14	---	---	---	---
August	---	04	---	04	---	---	---	---
November	---	---	---	---	---	---	03	03
February	---	10	---	10	---	---	01	01

Figure 2. (A) GSI (%) of *Centropomus undecimalis* collected at Bertioga during 2007. (B) GSI (%) of *Centropomus undecimalis* collected at Copacabana during 2007.

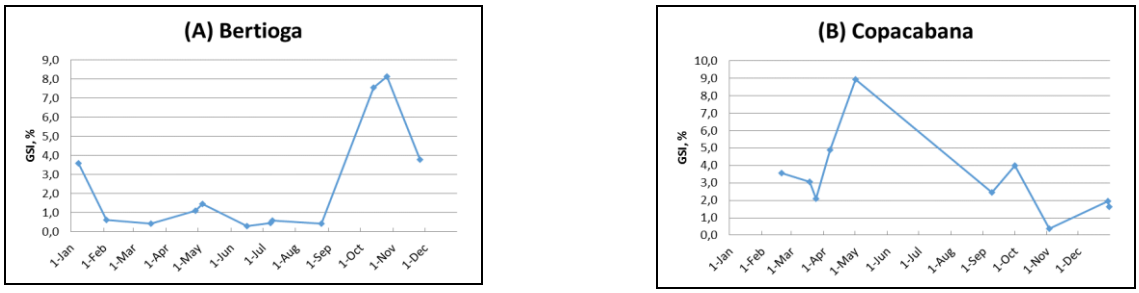
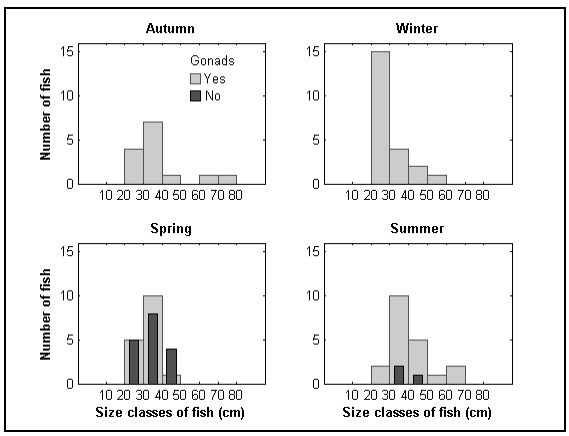
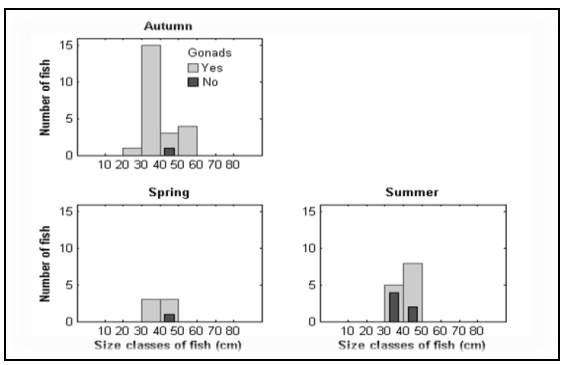


Figure 3. Seasonal variation of *Centropomus undecimalis* over size classes (classes of length) with or without visible gonads. (Yes) or without (No) visible gonads. (a) Bertioga (Autumn n=15; Winter n=22; Spring n=33; Summer n=23); (b) Copacabana (Autumn n=24; Spring n=7; Summer n=19)

(a) Bertioga (Autumn n=15; Winter n=24; Spring n=33; Summer n=23)

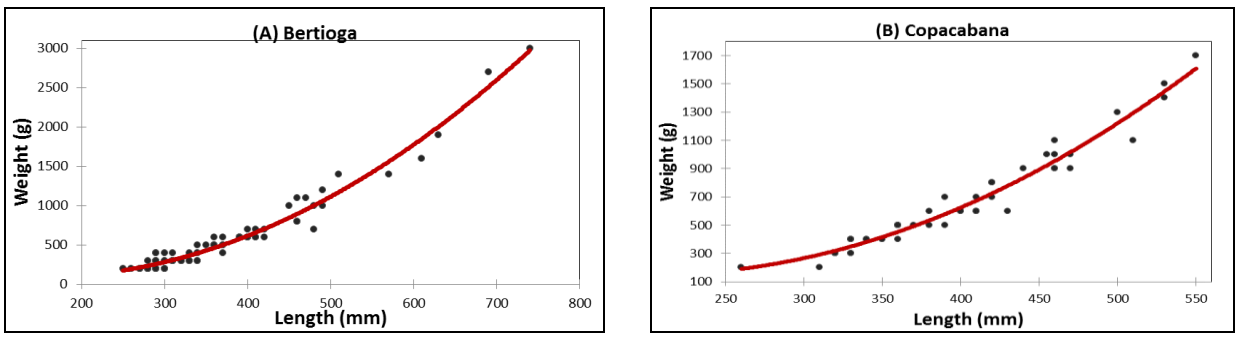


(b) Copacabana (Autumn n=24; Spring n=7; Summer n=19)



The sizes of the snook found and caught at both studied sites were relatively small. The possible reason is that small snook are quite more available and abundant as result of fishing than big snooks (Figure 4). The small size of most of the fish caught in the fisheries studied confirms that most of the individuals examined were males. Most common snook caught in these fisheries showed visible sperm and length ranging 200-500 mm approximately. Most of these males did not reach the length on which sex-reversal occurs.

Figure 4. Weight and length relationships of *C.undecimalis* at (A) Bertioga: W = 0.008 TL^2 -2.350 TL + 253.2; R^2 = 0.968; df = 92, N=93; (B) Copacabana: (b) W = 0.0119 TL^2 – 4.7597 TL + 622.29; R^2 = 0.9578; df = 49, n = 50.



Stomach contents

The stomach contents of *C. undecimalis* of both samples (Bertioga and Copacabana) show that shrimp and fish are the food most often eaten by the snook (Table 4).

Table 4. Stomach contents of *C. undecimalis* from samples of Bertioga and Copacabana, 2006-2007.

Content	Bertioga	Copacabana	Total
Empty	33	19	52
Shrimp	29	16	45
Fish	26	15	41
Squid	04	01	05
Not identified (rests)	02	01	03
Total	**94**	**52**	**146**

Ethnoecology: information from fishers on reproduction and stomach content

Interviews about the spawning and about feeding of the snook (robalo) were taken from 11 fishers at Bertioga and 10 at Copacabana (Table 5). The period of spawning was pointed as the Summer, at Bertioga; at Copacabana, interviews shows that spawning spreads out along the year (Table 6). Interviews about the feeding of snook are shown in Table 7, with shrimp, followed as fish, as the most important food for snook. Most interviewees said snook migrates (Table 5).

Table 5. Features of interviewed fishers about spawning of snook at Bertioga and Copacabana. Answers about snook migration.

Fishing community	Bertioga	Copacabana
Number of interviewed fishers	11	10
Minimum age	42	44
Maximum age	70	84
Mean age (years)	54	67
Mean fishing experience (years)	39	48
Migration of snook		
Migrate	09	05
Don't migrate	02	05
Factors influencing migration	---	---
Feeding	01	04
Reproduction	07	01
Don't know why this fish migrates	01	---

Table 6. Interviews about the spawning season of snook, at Bertioga and Copacabana.

Season [a]	Bertioga	Copacabana
Autumn [b]	---	---
Winter [c]	02	03
Spring [d]	01	02
Summer [e]	07	02
Don't know	01	03
Total fishers	**11**	**10**

[a] Data on spawning seasons include information from fishers regarding the season itself plus months on that season.
[b] Autumn: March, April and May.
[c] Winter: June, July and August.
[d] Spring: September, October, November.
[e] Summer: December, January and February.

Table 7. Interviews about the diet of snook from fishers of Bertioga and Copacabana.

Food item	Bertioga	Copacabana
Fish (General)	---	01
Sardinha (Clupeidae)	01	04
Manjuba (Engraulidae)	---	01
Shrimp	09	09
Squid	---	01
Mugilids	01	---
Other	02	---

DISCUSSION

The three examples from this study shows that: a) strategies of obtaining and separating food for consumption and commerce differ, and variables related to this decision-making include processing and manipulating time as proxy for effort; effort then affects decision-making on what to eat or sell; b) small-scale fisheries that depend on fish for a living can target endangered species, such as the grouper *Epinephelus marginatus*. A neglected management towards grouper may worsen ecological and economic problems, since immature individuals of this fish have been caught by fishers due to market demands; c) species that occupies a variety of environments for its development, such as the common snook (*Centropomus undecimalis*) are targeted in fisheries, and are twofold impacted: immature individuals are taken (as in case 2, groupers) and polluted areas may affect the development process of this species as well as of their food chain.

As observed in this study, in a previous study [34], fishers from the southeastern and northeastern Brazilian coast mentioned that other species of snook (*Centropomus paralellus*) migrates from the sea into coastal rivers and estuaries to spawn. Although we lack detailed studies on spawning sites and nursery grounds for snook species (*Centropomu*s spp.) in the Brazilian coast, a study in Puerto Rico [32] reports this pattern of estuarine spawning for *C. undecimalis*. Therefore, hypothesis elaborated from fishers' knowledge that the snook species depend on estuaries for spawning in the Brazilian coast can be considered as being of high likelihood, or highly plausible, and thus this information could be applied to improve fisheries management [35]. One possible application of this information would be to support the planning and establishment of MPAs that include at least some part of estuaries, to protect snook spawning sites.

Other potential application for snook management would be the establishment of spatiotemporal fishing closures, by prohibiting fishing of snooks (and may be of other similar fishes) in estuaries and during the spawning period. This recommendation follows the approach of seasonal fishing closures, or defeso [25], but it would be less restrictive and possibly better accepted by fishers, as fishing would be banned in estuaries only. Most of the attention directed to the establishment, monitoring and research of MPAs, either worldwide or in the Brazilian coast has been directed to coral reefs [36].

Notwithstanding the conservation value of biodiversity hotspots, such as coral reefs, this study indicated the need to carefully consider coastal rivers and estuaries in fisheries management and conservation planning.

The results of the biological analyses of gonads of individuals of snook caught by fishers in this study indicated that main spawning seasons would be during Autumn in Copacabana and from Summer to Winter in Bertioga. This information agreed partially with spawning season of snook, mentioned by the interviewed fishers in Bertioga, but fishers from Copacabana indicated that this fish would be spawning in all seasons, and they did not mention spawning occurring during the Autumn. This disagreement between fishers' knowledge and biological data on fish reproduction and spawning season is also reported in a study on bluefish, also in the southeastern Brazilian coast [17], possibly because these coastal fishers usually show less detailed knowledge about fish reproduction [34]. A study about the spawning of *C. undecimalis* in the Paraty Bay, southeastern Brazilian coast, shows that most reproductively active fish occur during the Spring-Summer [37], which reinforces our results. However, in Paraty bay the spawning season coincides with the main fishing season of this fish, according with local fishers [37], and this may be an obstacle to establish closed fishing seasons.

Literature confirms the diet observed and the diet mentioned by fishers [29]. It may be possible that fishers had overemphasized some food item, since they might associate their answers with the use of their bait (which are often shrimp or small fish, such as sardines). This coincidence between food items cited by fishers and baits has been observed in a previous study on fishers' knowledge about the diet of the bluefish (*Pomatomus saltatrix*) in Brazil and Australia [38]. However, as observed in a previous survey comparing stomach content analyses and fishers' knowledge on the diet of the bluefish [17], both of the two most cited food items (shrimp and fish) by the interviewed fishers were also observed in the stomach contents of the snook in the studied regions. A previous survey in an estuary of the Bertioga coast (southeastern Brazil) observed that juvenile snooks (*Centropomus parallelus*) feed mostly on crustaceans and the diet varied with fish size: larger fishes feed on shrimp, while smaller ones eat smaller crustaceans (tanaids) [39].

CONCLUSIONS

Especially when approaching rural populations that live close (or inside) protected areas, the need to protect biodiversity commonly does not encompass economic and social needs of the local population. How to deal with such tricky entangled matters such as fish management, food consumption and subsistence/economic deserves detailed and special attention.

The examples given here, through three study cases, highlight important aspects for strategies of obtaining food, including extracting endangered species, and the necessity to address information at different scales (fish, food, fishery) in order to move towards sound forms of food extraction.

Strategies of obtaining and separating food for consumption or commerce differ; variables related to this decision-making include processing and manipulating time as proxy for effort. Thus, such decision-making process is very important, since processing and manipulating time represents effort that should be taken into consideration when deciding on the dilemma consumption/commerce. These aspects are especially appealing when dealing with rural populations that live close or in protected areas, as are the small scale fisheries of coastal areas in Brazil.

Small-scale fisheries that depend on fish for a living can target endangered species, such as the grouper *Epinephelus marginatus*. A neglected management towards grouper can worsen ecological and economic problems. When neglected, as the grouper case shown, immature individuals continue to be taken from the fishery and market prices stimulate fishermen to keep exploiting this threatened fish. Collaborative processes between researchers and fishers could help to improve food security, as the knowledge of the traceability of groupers can work towards a more sound ecologically extraction.

Species that occupies a variety of environments (estuaries and coastal waters) for its development, such as the common snook (*Centropomus undecimalis*), also targeted in these fisheries, are twofold impacted: immature individuals are taken and polluted areas or mangrove degradation affect the development process of this species. MPAs and defeso periods are suggested for snook areas and for spawning periods.

Overall, we conclude about the importance of the knowledge of the ecological attributes of food towards food security, as well as on the importance of developing collaborative processes among fishers, researchers and environmental agents, including the use of local ecological knowledge as a complementary aspect of research.

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