ARTISANAL FISH-TRAP FISHERY AROUND SANTA CATARINA ISLAND DURING SPRING/SUMMER: CHARACTERISTICS, SPECIES INTERACTIONS AND THE INFLUENCE OF THE WINDS ON THE CATCHES

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ABSTRACT

Artisanal spring/summer fish-trapping around Santa Catarina Island is described from 282 landings monitored in three localities (Praia dos Ingleses, Barra da Lagoa and Pântano do Sul) between November and March of 2000 and 2001. Despite the high number of species caught, the fishery was based on only three species: the cutlassfish (*Trichiurus lepturus*), the squid (*Loligo plei*) and the blue runner (*Caranx crysos*). The fishery was characterized by few traps operating in close proximity to the fishing communities, short trips, few fishermen engaged in the fishery and highly variable yields. The composition of the catches appeared to be highly influenced by the abundance of the cutlassfish, whereas wind conditions had no direct effect on the landings.

Key-words: artisanal fish-trapping; *Trichiurus lepturus*; *Loligo plei*; *Caranx crysos*; Santa Catarina Island; southern Brazil

PESCA ARTESANAL COM CERCO FLUTUANTE NO ENTORNO DA ILHA DE SANTA CATARINA DURANTE A PRIMAVERA/VERÃO: CARACTERÍSTICAS, INTERAÇÕES INTER-ESPECÍFICAS E INFLUÊNCIA DOS VENTOS NAS CAPTURAS

RESUMO

A pesca artesanal com cerco flutuante no entorno da Ilha de Santa Catarina é descrita a partir de 282 desembarques monitorados nas localidades de Praia dos Ingleses, Barra da Lagoa e Pântano do Sul nos períodos de primavera e verão de 2000 e 2001 (Novembro−Março). Apesar do grande número de espécies capturadas, a pescaria é sustentada por apenas três espécies, a saber: o peixe-espada (*Trichiurus lepturus*), a lula (*Loligo plei*) e o “manezinho” (*Caranx crysos*). A pescaria caracterizou-se pelo uso de poucos aparelhos operando nas cercanias das comunidades, viagens curtas, poucos pescadores envolvidos na atividade e rendimentos altamente variáveis. A composição das capturas parece ser fortemente influenciada pela abundância do peixe-espada. As condições de vento não afetaram diretamente os desembarques.

Palavras-chave: cerco-flutuante; *Trichiurus lepturus*; *Loligo plei*; *Caranx crysos*; Ilha de Santa Catarina; sul do Brasil

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INTRODUCTION

Fish-trapping is a conspicuous artisanal fishing activity that typically takes place in coastal areas around Santa Catarina Island (southern Brazil), where fish-traps are set-up in bights and bays by local fishermen (PEREZ *et al*., 1999; MEDEIROS, 2001). The fish-trap fishery is of social and economic importance to the artisanal fishermen, and has been responsible for 70% of the landings in Pântano do Sul Bight between 1998 and 1999, one of the most productive artisanal fishing grounds off Santa Catarina coast (MEDEIROS, 2001). The traps operate year round in the Bight, except for the May−June period when they are removed to avoid interference with the culturally and economically important mullet (*Mugil platanus*) beach seining season (MEDEIROS, 2001). Little is known about the origins of this fishing practice in the region, but probably it has been spread from northern São Paulo coast following the introduction of this fishing gear by Japanese immigrants in the 1920's (MUSSOLINI, 1980).

Fish-traps (Japanese type, "kaku-ami"; BEGOSSI, 2001) are characteristically multispecific and unselective due to their small sized mesh (36−70 mm), and target both pelagic and demersal fish. They are elliptical structures, made of worn seining nets, normally with 6–8 m height, 40 m maximum diameter and 126 m perimeter anchored in shallow (<20 m) bights and bays, with a leader running to the shore which herd the fish toward the trap (GAMBA, 1984). Mesh size and trap dimensions, however, may vary among the localities (for examples see MEDEIROS, 2001 and BLANK, 2002). The traps work passively, entrapping inshore moving/migrating fish and squid, and up to three collections are taken per day (PEREZ *et al*., 1999; MEDEIROS, 2001; MARTINS and PEREZ, 2007).

Despite the local socioeconomic importance of this fishing activity, little information is currently available on artisanal fish-trapping. PEREZ *et al*. (1999) analyzed the production, structure and dynamics of fish-trapping in Santa Catarina State from historical data collected by the Brazilian Institute of Environment and Renewable Natural Resources−Centre for Fishery Research of the Southern Coast (IBAMA−CEPSUL) between 1989 and 1998, but their work focused on squids only. MEDEIROS (2001) surveyed basic fishery, economic and social aspects of fish-trapping as part of a general human ecology study at Pântano do Sul Bight. Aside from Santa Catarina State, artisanal fish-trapping has been studied by SECKENDORFF *et al*. (2000) and BLANK (2002) at Anchieta Island (Ubatuba), off northern São Paulo State coast and BEGOSSI (2001) identified fish-traps operating at dos Búzios Island (an islet near São Sebastião Island, also off northern São Paulo State coast) as well as at Grande Island and da Gipóia Island (off southern Rio de Janeiro coast).

In this study we (a) describe the spring/summer fish-trapping fishery and its dynamics around Santa Catarina Island, (b) examine the abundance relationship among the most important species in the landings and (c) the possible influence of the winds on the catches, with the aim of better understanding the factors underlying this fishery.

MATERIALS AND METHODS

Data were gathered one to three times per week during the monitoring of squid landings in Pântano do Sul, Barra da Lagoa and Praia dos Ingleses (Figure 1) in two consecutive austral springs and summers (November−March; 1999/2000 and 2000/2001) (MARTINS and PEREZ, 2007), totaling 146 records. Fishermen were interviewed, and data collected included the type and size of boat utilized, power of the engine (in HP), number of fishermen per boat, fish trip duration, fish traps depth, daily frequency of visits to the fish-traps and time spent collecting fish from the traps. Fish species were identified *in situ* and unknown species were either collected or photographed, and identified according to FIGUEIREDO (1977), FIGUEIREDO and MENEZES (1978, 1980, 2000) and MENEZES and FIGUEIREDO (1980, 1985). In addition, fish production data were obtained from the sales records (n = 136) of a fish-trap owner at Praia dos Ingleses, in 2001.

Landings of each species were visually estimated by the number of fish boxes produced at each landing, considering that a full fish box corresponds to ~ 20 kg (MARTINS, R.S., Marine and Coastal Management/ University of Cape Town, personal observation). Due to the fragmentary nature of the data obtained, and the fact that landings often accumulated the catches of more than one trap, all analyzes were conducted with pooled data of the three localities surveyed. Landing data were converted to catch rates (in kg h^{-1}) and the relationships between catch rates of the species were investigated by calculating Spearman's rank correlation coefficient between paired data sets, according to ARKHIPKIN and MIDDLETON (2002). Because the number of species captured was high, but most of them were poorly represented in the landings, only the most abundant and frequently occurring species (cutlassfish, *Trichiurus lepturus*, squid, *Loligo plei* and the blue runner, *Caranx crysos* — see Results) were included in this analysis.

In order to investigate the influence of the winds on the catches, the catch rates of the two most important species (i.e., cutlassfish and squid) plus the incidental catch rate were tested in relation to the wind quadrant with Kruskall−Wallis test (ZAR, 1996). It was assumed that winds would provide a realistic clue to the thermal structure of the water column, as N−NE winds are known to cause water thermal stratification and upwelling, whereas S wind quadrants would homogenize the water column (CARVALHO *et al*., 1998; MARTINS *et al*., 2006). Wind direction was recorded during the landings, and gaps and eventual inconsistencies were corrected from additional data provided by the Santa Catarina State Meteorological Research Centre (CLIMEHR) station of São José/Florianópolis.

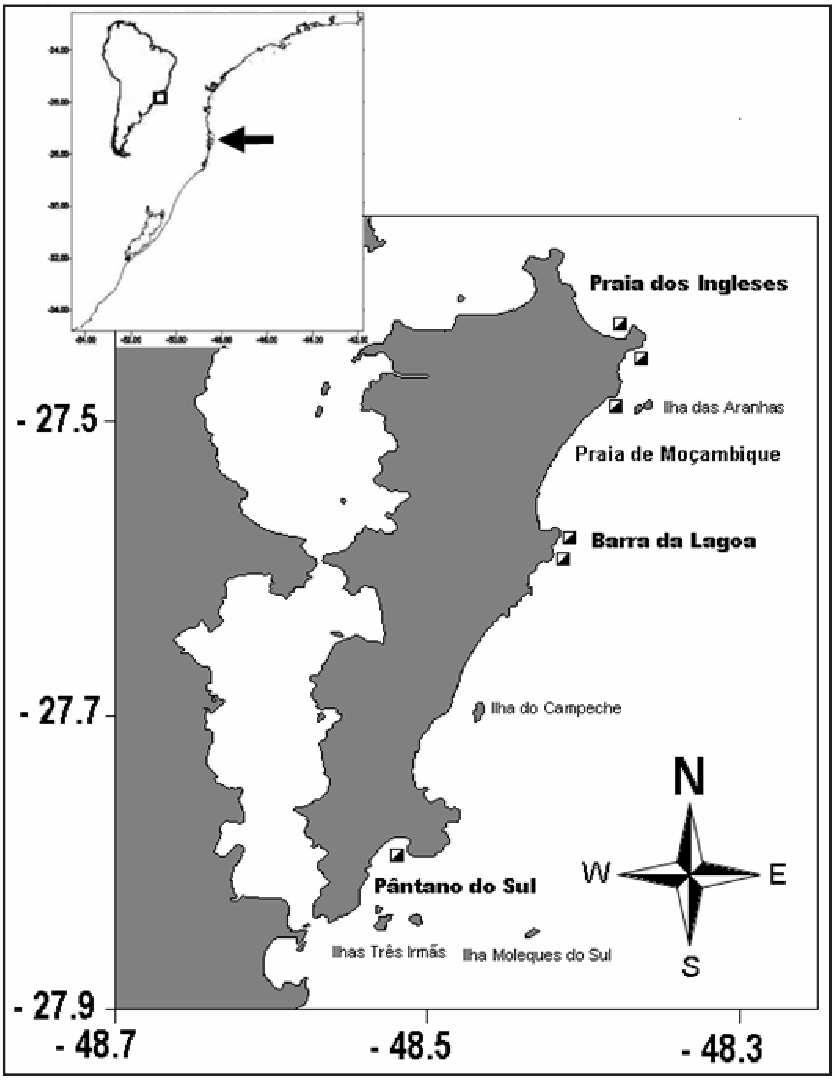

Figure 1. Study area, showing Santa Catarina Island and the localities where artisanal fish-trapping takes place. The arrow in the inset indicates the location of Santa Catarina Island on the Brazilian southern coast. Latitudes and longitudes are decimal transformed. ◪ : approximated location of the fish-traps.

RESULTS

Fish-trapping structure and dynamics

Fish-traps were set up generally in the vicinity of the fishing communities (Figure 1), often perpendicularly to rocky shores. The depth of fish-traps sites varied between 6 and 12 meters (Table 1). The highest number of traps (n = 7) were operated by the fishermen of Praia dos Ingleses, who also had a trap set at Moçambique beach, located slightly to the south (Figure 1). Comparatively, fish-traps in Barra da Lagoa (n = 4) and Pântano do Sul (n = 3) were located closer to the landing sites. The traps were changed once a month in all localities for cleaning and repair. The traps were often owned by a single fishing patron, who may or may not belong to the local fishing community. Each patron can have up to 1−3 traps, and employs either fellows (the so-called "camaradas") from the fishing community or relatives (uncles, sons, brothers, cousins, etc) to work in the fishery.

Table 1. Characteristics of the fish-trap fishery around Santa Catarina Island, southern Brazil, during two consecutive spring/summers (1999/2000 and 2000/2001). Number of observations (n), medians, percentiles 25%–75% and range are given.

Characteristics	Praia dos Ingleses							
	2000				2001			
	n	Median	Percentiles 25%–75%	Range	n	Median	Percentiles 25%–75%	Range
Boat length (m)	15	11	10–11	8−12	27	10	10–10	8−10
Power of the engine (HP)	9	24	24–24	11−24	24	24	24−45	24−45
Number of fishermen	13	6	5–6	4−8	33	6	5−6	4−10
Depth (m)	5	7	7–10	6−12	21	10	7−10	6−10
Duration of the fish trip* (h)	9	1	0.5–1.5	0.5−2.0	18	1.5	1.04−1.92	0.42−4.83
Cutlassfish landing (kg)	9	100	60–300	20−500	75	140	58−565	4−5,900
Squid landings (kg)	4	27	3.5–52.5	2−60	89	49	19−106	2−1,388
Blue runner landings (kg)	1	300	-	-	18	42.5	29.75−139.75	20−287
Incidental catch landings (kg)	4	16.5	12.25–20.75	10−23	55	48.5	20−197.5	2−1,135
Cutlassfish trap catch rate (kg h^{-1})	9	4.17	2.5–12.5	0.83−20.83	75	5.83	2.42−23.54	0.17−245.83
Squid trap catch rate (kg h^{-1})	4	1.13	0.15–2.19	0.08−2.50	89	2.04	0.79−4.42	0.08−57.83
Blue runner trap catch rate (kg h^{-1})	1	12.5	-	-	18	1.77	1.24−5.82	0.83−11.96
Incidental catch trap catch rate (kg h^{-1})	4	0.69	0.51–0.86	0.42−0.96	55	2.02	0.83−8.23	0.08−47.29

Characteristics	Barra da Lagoa							
	2000				2001			
	n	Median	Percentiles 25%–75%	Range	n	Median	Percentiles 25%–75%	Range
Boat length (m)	22	7	7–8.25	6−9	13	8	8–18	7−18
Power of the engine (HP)	18	11	11–18	9−22	9	18	11−18	11−18
Number of fishermen	21	5	5–5.25	4−7	10	5	4.5–6.5	4−11
Depth (m)	10	10	10–10	6−10	2	8	7–9	6−10
Duration of the fish trip* (h)	12	0.42	0.25–0.67	0.25−1	4	1	1–1.08	1−1.33
Cutlassfish landing (kg)	11	110	60–475	20−1,000	4	797.5	181.25–1,560	20−2,160
Squid landings (kg)	9	20	15–30	3−40	2	21.5	20.75–22.25	20−23
Blue runner landings (kg)	-	-	-	-	-	-	-	-
Incidental catch landings (kg)	4	30	23.75–32.50	5−40	-	-	-	-
Cutlassfish trap catch rate (kg h^{-1})	11	4.58	2.50–19.79	0.83−41.67	4	33.23	7.55–65	0.83−90
Squid trap catch rate (kg h^{-1})	6	0.83	0.63–1.25	0.13−1.67	2	0.90	0.86–0.93	0.83−0.96
Blue runner trap catch rate (kg h^{-1})	-	-	-	-	-	-	-	-
Incidental catch trap catch rate (kg h^{-1})	4	1.25	0.99–1.35	1.25−1.67	-	-	-	-

Characteristics	Pântano do Sul							
	2000				2001			
	n	Median	Percentiles 25%–75%	Range	n	Median	Percentiles 25%–75%	Range
Boat length (m)	52	5.5	5.5–5.5	5−6	13	5.5	5.5–5.5	5.5−6
Power of the engine (HP)	1	15	-	-	-	-	-	-
Number of fishermen	53	4	4–4	2−6	10	3	3–4	3−5
Depth (m)	45	6	6–6	6−10	3	6	6−6	6−10
Duration of the fish trip* (h)	53	0.5	0.5–0.5	0.25−1	13	0.5	0.5−1	0.67−1
Cutlassfish landing (kg)	32	50	13.75–156.25	20−1,000	6	33	8.5–72.5	1−300
Squid landings (kg)	19	5	3–8.5	3−24	5	6.25	2.50−12.25	1−100
Blue runner landings (kg)	10	35	11.25–207.50	8−1,300	1	80	-	-
Incidental catch landings (kg)	22	10	5.73–18.75	30−40	2	1.25	0.88–1.63	0.5−2
Cutlassfish trap catch rate (kg h^{-1})	32	2.08	0.25–6.61	0.83−41.67	6	1.38	0.35−3.02	0.04−12.50
Squid trap catch rate (kg h^{-1})	19	0.21	0.13–0.35	0.13−1.67	5	0.26	0.10−0.51	0.04−4.17
Blue runner trap catch rate (kg h^{-1})	10	1.46	0.47–8.65	0.33−54.17	1	3.33	-	-
Incidental catch trap catch rate (kg h^{-1})	22	0.42	0.24–0.78	1.25−1.67	2	0.05	0.04−0.07	0.02−0.08

* *includes the time sailing plus the time spent collecting the fish from the traps.*

The traps were checked for fish three times a day in all localities in the early morning (5:00−6:00h), at noon (12:00h) and mid to late afternoon (16:00−18:00h), with exception of the trap at Moçambique beach, which was visited only once a day, on early morning. As a result, the trips performed by Praia dos Ingleses fishers took longer than in the other two localities (Table 1). The time spent collecting the fish from the trap varied between 0.33 and 1.5 hours (average 0.54 h ± 0.35 h SD, n = 10), and was related to the magnitude of the catch at each occasion. As a rule, the whole catch was taken and there was no discard. The production is usually sold on the fishing community's beach as well as at local fish markets, or may be sent to be commercialized elsewhere, mostly at Florianópolis' public market.

Two types of boat were used in the communities: canoes and "botes". Both kinds of vessels are made of wood. Whereas "botes" were present at all three sites, canoes were utilized only at Praia dos Ingleses. These vessels are propelled either by paddle or low-power engines. The largest boats and the most powerful engines were utilized in Praia dos Ingleses (Table 1), possibly due to the larger number of traps and longer distances from the landing site. The smallest "botes" were utilized at Pântano do Sul, which are propelled mostly by rowing, although an engine of 15 HP was occasionally used (Table 1). The highest number of fishermen per boat was found at Barra da Lagoa and Praia dos Ingleses (Table 1), where the traps were often visited with two boats. In Pântano do Sul, 2−6 fishers normally checked the traps, and mostly one boat was employed (Table 1).

The monitoring of the landings showed that fish-traps at the three localities together produced 78,212 kg in the two seasons surveyed. Praia dos Ingleses was the most productive fishing ground, yielding 61,282 kg. Pântano do Sul and Barra da Lagoa produced 9,168 kg and 7,762 kg, respectively. Overall, the landings were dominated by the cutlassfish (*T. lepturus*) and squid (*L. plei*), both appearing in more than 85% of the landings (Table 2) and comprising 68.7% and 13.9% of the biomass caught, respectively. Of secondary importance was the blue runner (*C. crysos*), which was the third species in frequency (Table 2), comprising 5.6% of the total biomass.

The best yields and catch rates from all localities and seasons were found at Praia dos Ingleses, where maximum individual landings of nearly 5,900 kg of cutlassfish and up to 1,388 kg of squid (catch rates of 245.83 kg h^{-1} and 57.83 kg h^{-1}, respectively) were recorded in 2001 (Table 1). The traps of Barra da Lagoa yielded mostly cutlassfish, with few squid (Table 1). In comparison to the former two localities, traps in Pântano do Sul produced less cutlassfish and squid, although the largest landing (1,300 kg) and catch rate (54.17 kg h^{-1}) of blue runner were recorded there. Incidental catch was considerable only at Praia dos Ingleses in 2001 (Table 1).

The weekly production of the most important species is depicted in Figure 2. The records span 19 weeks, from November to early March. Consistent patterns were only noticeable for cutlassfish and squid, particularly in the 2001 season, which had more continuous data. However, it is remarkable that both species had peaks of abundance in the two seasons, and also worth to note is that those biomass peaks were mismatched temporally from each other. The blue runner appeared irregularly in short and isolated pulses in both seasons.

Species composition and inter-specific interactions

As expected for such a small-sized mesh fishing gear, a high number of species appeared in the catches. At least 43 fish and 4 cephalopod species were recorded (Table 2), and included bottom dwelling (Rajidae, *Paralichthys* sp., *Prionotus punctatus*, etc), demersal (Scianidae, Gerridae, Centropomidae, etc), demersal-pelagic (*Balistes capriscus*, *T. lepturus*, *Loligo* spp., etc) and truly pelagic (*C. crysos*, *Katsuwonus pelamis*, *Sardinella brasiliensis*, *Anchoa* spp., etc) organisms. Cleary, the traps were efficient at catching most of the nektonic fauna available in the area, although, as previously quoted; only three species (cutlassfish, *T. lepturus*, squid, *L. plei* and the blue runner, *C. crysos*) were important in the landings.

Of the three species analysed, a consistent inverse pattern was only found between the cutlassfish and the other two species, with negative correlation coefficients of − 0.306 (p = 0.000019) for the cutlassfish−squid pair and − 0.206 (p = 0.010444) for the cutlassfish−blue runner pair (Figure 3).

Influence of the winds

Although catch rates seem to have had a noticeable variability in different wind quadrants for all species, wind apparently does not affect the catches significantly (Kruskall−Wallis test, p > 0.05). The highest cutlassfish trap catch rates were associated with N−NE and E winds, whereas bulky squid trap catch rates occurred in southerly winds. Highest and lowest incidental catch rates were associated with southerly and easterly winds, respectively (Figure 4).

Table 2. Species caught with fish-traps in 282 monitored landings around Santa Catarina Island, southern Brazil, during two summers/sprimgs (1999/2000 and 2000/2001). F (%): frequency of occurrence in the landings. Local name: vernacular names for the species caught according to local artisanal fishermen (Praia dos Ingleses, Barra da Lagoa and Pântano do Sul), – : no local name. Occasional: < 0.01% occurrence in the landings.

Scientific name	Local name	F (%)
Trichiurus lepturus	Espada, Peixe-espada	72.85
Loligo plei	Lula	12.53
Caranx crysos	Manezinho, Canarinho, Amarelinho, Xerelete	4.40
Micropogonias furnieri	Corvina	2.91
Sardinella brasiliensis	Sardinha-verdadeira	2.19
Pomatomus saltatrix	Anchova	1.30
Chloroscombrus chrysurus	Palombeta	0.59
Eucinostomus spp.	Escrivão	0.48
Fam. Rajidae and *Myliobatis* spp.	Arraia and Arraia-jareva	0.39
Katsuwonus pelamis	Bonito, Gaiado	0.39
Balistes capriscus	Porco, Peixe-porco	0.34
Peprilus paru	Gordinho	0.33
Anchoa spp.	Boqueirão	0.32
Caranx hippos	Galo, Xaréu	0.13
Kyphosus spp.	Preguiça, Pixirica	0.12
Selene vomer	Galo, Peixe-galo	0.10
Centropomus spp.	Robalo	0.09
Scomberomorus sp.	Sororoca	0.09
Opisthonema oglinum	Sardinha-lage	0.08
Mugil curema	Tainhota	0.08
Oligoplites saurus	Guaivira	0.07
Chaetodipterus faber	Paru	0.06
Isophistus parvapinnis	Pescadinha	0.04
Seriola spp.	Olhete	0.03
Hyporhamphus sp.	Agulha	0.02
Trachinotus spp.	Pampo	0.02
Trachurus lathami	Xixarro	0.02
Rhizoprionodon lalandii	Caçonete	0.01
Archosargus rhomboidalis	Caranha	0.01
Diplodus argenteus	Marimbau	0.01
Fistularia sp.	–	occasional
Elops saurus	–	occasional
Genidens genidens and *Netuma barba*	Bagre	occasional
Sphyraena spp.	Bicuda, Barracuda	occasional
Prionotus punctatus	Cabrinha	occasional
Scomber japonicus	Cavalinha	occasional
Dactylopterus volitans	Coió, Voador	occasional
Paralichthys sp.	Linguado	occasional
Cynoscion sp.2	Pescada	occasional
Stephanolepis hispidus	Porco	occasional
Argonauta nodosa (empty shells)	–	occasional
Ommastrephes bartramii	Calamar	occasional
Loligo plei (sub-adults)	Lula	occasional
Loligo sanpaulensis (adults and sub-adults)	Lula	occasional

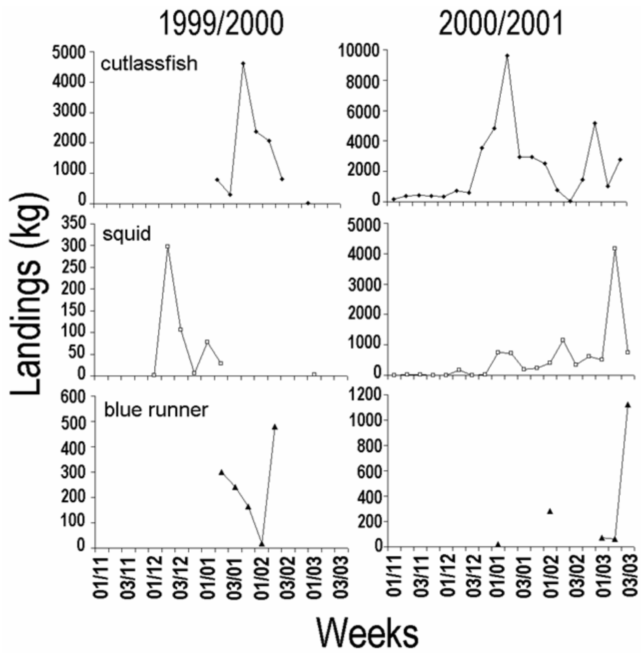

Figure 2. Weekly landings of cutlassfish *T. lepturus*, squid *L. plei*, and blue runner *C. crysos* by artisanal fish-trapping around Santa Catarina Island, southern Brazil, in 1999/2000 and 2000/2001 seasons.

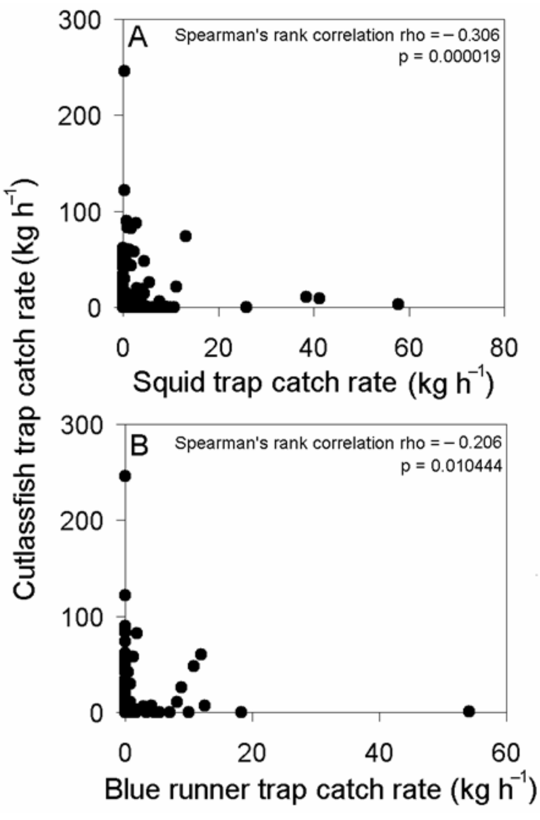

Figure 3. Relationships between cutlassfish *T. lepturus* trap catch rate and (A) squid *L. plei* trap catch rate and (B) blue runner *C. crysos* trap catch rates around Santa Catarina Island, southern Brazil.

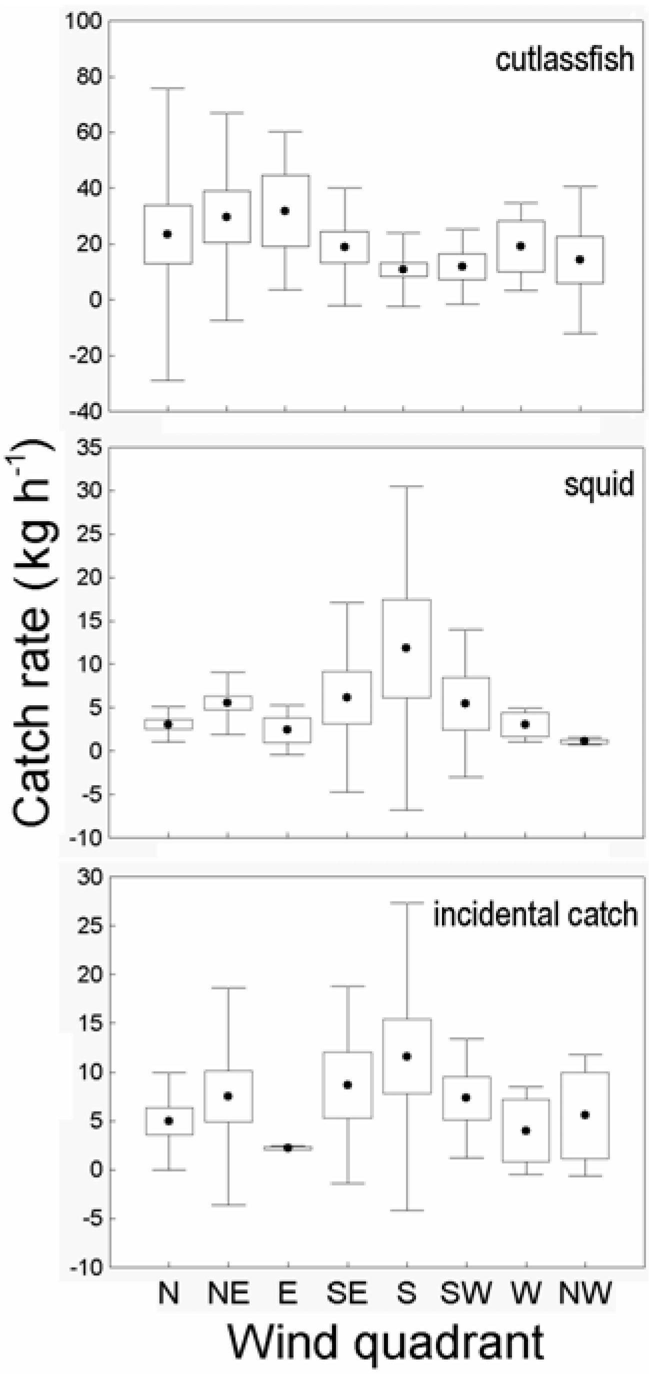

Figure 4. Box and whisker plots of fish-trap landings of cutlassfish *T. lepturus*, squid *L. plei* and incidental catch (miscellaneous species) in relation to the wind quadrant in 1999/2000 and 2000/2001 seasons, around Santa Catarina Island, southern Brazil. Points = average, boxes = standard error, whiskers = standard deviation.

DISCUSSION

Spring/summer artisanal fish-trapping around Santa Catarina Island was characterized by few traps operating in close proximity of the fishing communities, short trips and few fishermen engaged in the fishery. Despite the highly variable yields, fish-trapping have been showing to be a very effective, cheap and little labor fishing practice, yielding an acceptable catch of good quality fish that in turn provides a good return on investment. However, unlike other local artisanal fisheries (MEDEIROS, 2001), the profits are not collective, as most of the income is retained by the traps owners (PEREZ *et al.*, 1999).

The location of the fish-traps is strategic and related to (1) the presence of rocky shores in sheltered areas nearby, and (2) proximity to the landing sites. In addition, the traps appeared to be set-up in observance of IBAMA's regional policy for the activity, which states that fish-traps should be located away from channels and river and lagoon mouths, with a minimum distance of 300 m from other traps and at a maximum distance of 100 m from the shore (Portaria n°5-N, 27 de Janeiro de 1994; IBAMA, 1994). Sheltered rocky shores provide suitable and safe places and depths for the attachment of the leader net as well as for the traps themselves, preventing the potential problems with beach users, bad weather conditions and boat traffic. Moreover, the closeness with the landing site may ensure saving costs with fuel for the engines and less time exposing the fish to inappropriate conservation conditions. One exception was a fish-trap belonging to a group of fishers from Praia dos Ingleses which was set up at Moçambique beach. In this case the longer distance from the fishing community may be compensated by the exclusivity of the fishing spot.

Despite the high number of species recorded in the catches during the surveyed period, the fishery was based on just three: the cutlassfish (*T. lepturus*), the squid (*L. plei*) and, to a lesser extent, the blue runner (*C. crysos*). Although previous year's data are not available, anecdotal information from local fishermen confirm that these three organisms have been the most common species caught during spring/summer for many years. This is in contrast with data reported from Anchieta Island (northern São Paulo State coast), where just two species, the blue runner and the Atlantic bonito (*Sarda sarda*), comprised most of the fish-trap spring/summer catches between 1980 and 1985, with squid being of minor importance and cutlassfish abundant only in 1980 (BLANK, 2002). Clearly, it seems evident that demersal-pelagic and pelagic schooling species are more vulnerable to the fish-traps than benthic or demersal ones (MUSSOLINI, 1980; SECKENDORFF *et al*., 2000), and that the most frequently caught species varies with geographic location.

The highly uneven distribution of the species in the landings suggests that the predominant species, mostly cutlassfish and squid, might influence the presence/absence of each other as well as the remaining organisms. Cutlassfish may affect squid either indirectly (by competing for prey) or directly (by feeding on squid). At this stage it is not possible to discriminate between these two mechanisms, because the diet of cutlassfish in coastal waters is unknown. However, the strong negative correlation between abundance of the two species suggests that cutlassfish may feed on the coastal concentrations of *L. plei*. This is partially supported by the mismatched peaks of abundance of the two species during the fishing season, and the fact that cutlassfish induce extreme avoidance by squid, at least at night under light attraction (MARTINS and PEREZ, 2006). On the other hand, it must be considered that the predatory impact of cutlassfish/squid on other fish species as well as between each other would take place inside the traps, when the organisms are enclosed in a restricted area without a way out and this certainly may affect the landings. The cutlassfish appeared also to affect the blue runner presence in the landings; however, given the low and sporadic frequency of this species in the seasons surveyed, this result may be biased.

Despite the noticeable variation in the catches in relation to the wind quadrant (and presumably the water column thermal structure), wind-driven environmental conditions apparently do not affect the landings of the most important species and the incidental catch. Thus, one may accept that any interpretation of the influence of the oceanography on the fish-trap fishery is difficult because the water column structure would take variable time to change in response to the wind, depending on its persistence, strength and quadrant (MANN and LAZIER, 1991). This situation is further complicated because the dynamic swimming behavior of cutlassfish and squid and maybe other fish species may introduce a considerable noise in the response of these organisms to environmental changes. In addition, unfavorable environmental conditions for a given species may take place when the organisms are enclosed within the traps, and therefore either unable to avoid these or seek more suitable areas.

Nonetheless, bulky cutlassfish-trap catches rates were associated with N−NE wind influences, which have been showed to cause coastal upwelling events (CARVALHO *et al*., 1998; MARTINS *et al*., 2006). Cutlassfish are ambushing predators, spending time just hovering nearly vertically in the water column (NAKAMURA and PARIN, 1993; MARTINS and PEREZ, 2006). Perhaps passive shoreward drift during these hovering periods at the onset of upwelling may increase encounter rates of cutlassfish with net leaders set at the coast, and hence the trap catches (TEMPLEMAN, 1966). Conversely, during the downwelling phase (southerly winds), the returning warmer water would drive the cutlassfish offshore (INGS *et al*., 1997). However, measurements of the strength of upwelling coupled with continuous landing data will be necessary to explore this hypothesis in future studies.

Unlike cutlassfish, highest squid trap catch rates were associated with S wind quadrant. In spite of this, ecological rather than physical factors may be underpinning these patterns. *L. plei* has showed to concentrate in early upwelling scenarios (i.e., cold bottom waters) when most of the jigging fishery takes place (MARTINS *et al*., 2006). The species, however, was present in all hydrographic conditions found around Santa Catarina Island (MARTINS and PEREZ, 2007). Hence, as previously discussed, bulky squid trap catches associated with southerly winds would simply reflect the squid schools occupying the bights and bays during the periods of low cutlassfish abundance. This could perhaps explain the apparently paradoxical switch over between hand-jigging and fish-trap squid catches observed by PEREZ *et al*. (1999) off Santa Catarina coast.

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