Seasonal Changes in a Sandy Beach Fish Assemblage at Canto Grande, Santa Catarina, South Brazil

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ABSTRACT

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A shallow-water fish assemblage, over a soft, sandy bottom, at Canto Grande, Santa Catarina, Brazil, was sampled with a beach seine. Sampling was undertaken at 3 h intervals over 24 h on a bimonthly basis between April 1996 and February 1997. There was a seasonal variation in the number of species, density of fishes and biomass with the highest values in February (38 species, 257.6 fish 1000 m^{-2}, 2286.4 g 1000 m^{-2}). A total of 67 species, belonging to 56 genera and 33 families were collected and the assemblage was dominated by seven species belonging to three families: *Atherinella brasiliensis* (Atherinidae); *Brevoortia pectinata, Harengula clupeola* and *Sardinella brasiliensis* (Clupeidae); *Anchoviella lepidontostole, Cetengraulis edentulus* and *Lycengraulis grossidens* (Engraulidae). Species diversity (*H′*) and equitability (*J′*) were medium to high throughout the year due to the low dominance. The largest change in the assemblage structure occurred between winter months (July and August) and the other seasons. None of the dominant species can be classified as a resident. Main predators were *Pomatomus saltator* (winter) and *Trichiurus lepturus* (summer). Most of the species observed were either juvenile fish or small pelagic and strongly gregarious species.

ADDITIONAL INDEX WORDS: *Fish assemblage, seasonal variations, sandy beach, Santa Catarina, south Brazil.*

INTRODUCTION

Seasonal variations of fish assemblages in shallow-water sandy beaches have been studied by several authors, mainly in the Atlantic and Indian Oceans (*e.g.* NASH, 1988; WRIGHT, 1988; ALI and HUSSAIN, 1990; SANTOS and NASH, 1995; NASH and SANTOS, 1998; LAZZARI *et al.,* 1999). The general ecology of sandy beaches was thoroughly and comprehensively described by BROWN and McLACHLAN (1990). According to BEYST *et al.* (2001) temporal variation of epibenthic surf-zone fish fauna is well documented. However, the factors that influence or control these variations are still unclear (CLARK *et al.,* 1996). Fish aggregations in sandy beaches include a high richness in species (between 27 and 71). Some of these are numerically dominant due to the fact that they occur in large schools (BROWN and McLACHLAN, 1990). Biomass structure, however, tends to be more equilibrated since solitary species generally occur as adult, bigger individuals. Nevertheless, seasonal and annual fluctuations in species richness and composition seem to be typical of fish communities of sandy beaches (*e.g.* BROWN and McLACHLAN, 1990; HOOK, 1991).

Shallow water areas are known to constitute important feeding and nursery grounds for many fish species (Mc-ERLEAN *et al.,* 1973; BENNETT, 1989; BROWN and MAC-LACHLAN, 1990; SANTOS *et al.,* 1994) and have been studied in several places (*e.g.* SANTOS and NASH, 1995; VARGAS and SIELFELD, 1997; ARAÚJO and COSTA DE AZEVEDO, 2001).

The southern Brazilian State of Santa Catarina has many sandy beaches interspersed with rocky shores. Beaches are either sheltered or exposed but are generally heavily exploited by tourism, urbanisation and shellfish farming. The fish communities of Santa Catarina's sandy beaches were never described or analysed in their multiple components. Our objectives were: i) to describe the fish community of this particular sandy beach, since it is characteristic of Santa Catarina's littoral and may be important as a nursery and feeding ground for an important group of species; ii) analyse temporal variations in the community and the influence of main abiotic factors such as temperature and salinity, which are known to be important regulating factors in fish assemblages from sandy beaches (LAZZARI *et al.,* 1999).

This study provides a description of the seasonal fluctuations in a shallow-water, sandy beach fish assemblage, comparing this with other studies undertaken elsewhere in the Atlantic Ocean.
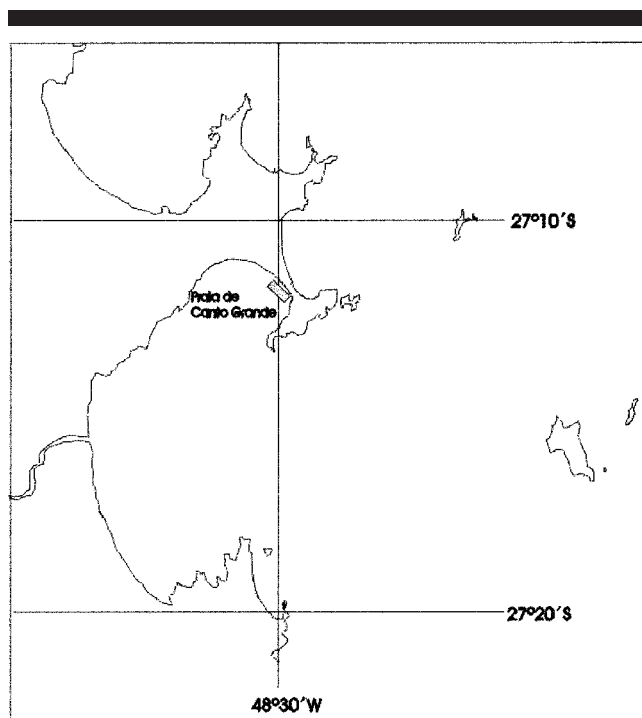
Figure 1. The beach of Canto Grande, Santa Catarina, Brazil.

METHODS

Study Site

Santa Catarina has a 390 km long shoreline which is characterized by many sheltered bays with sandy beaches interspersed with rocky formations. Several rivers outflow to the shores, thus creating important estuaries and mangrove forests. Tourism and shellfish culture are widespread industries and greatly modified substantial parts of the littoral. This study was carried out in Canto Grande beach (CG) (Figure 1). This is a 600 m long sandy beach, sheltered and intensively used by tourism and for shellfish culture (*Perna perna, Ostrea puelchana* and *Crassostrea rizophorae*), and has the most important human settlement of the area. The beach is located at the southernmost tip of the Bombinhas peninsula (27°08′ S, 48°30′ W), facing south, approximately 30 km north of Santa Catarina island and is representative of Santa Catarina's seashore. Canto Grande beach is formed by fine grain sand and important deposits of shellfish. Both east and west borders of the beach are rocky. The maximum tidal range is 1 m and maximum depth is 3 m. Although there is a substantial lack of data on pollution and eutrophication of Santa Catarina's shores, it is known that metals (Cu, Cr and Zn) are found in Canto Grande's mussels as a result of the increase of human settlement. These values are, however, below the legal limits (ROQUE and KUROSHIMA, 2000).

Collection of Data

Sampling was undertaken with a 30 m beach seine, 2 m high in the tips and 3 m high in the middle. The mesh is 10 mm. The beach seine was fitted with 50 m hauling ropes and set parallel to the shore. Each haul had an effective fishing area between 3 m depth and the shore, allowing for efficiency at the wings of about 1036 m² (according to the calculation method of KUBECKA and BOHM, 1991). Three hauls (3108 m²) of the beach seine were made at 3 h intervals for 24 h on each sampling date, coinciding with high, mid-falling, low and mid-rising tide (diel and tidal changes in the fish community will be treated elsewhere—BARREIROS *et al.,* in prep.). Sea-surface temperature and salinity were measured during all sampling dates, immediately before each collection.

The total number of individuals and total weight for each species was recorded. The total lengths (to the nearest mm) and individual wet weights (to the nearest g) (using a sub-sample of up to 200 individuals when necessary) were recorded for each sample. The three samples at each sampling time were summed to give one total following the methodology used by SANTOS and NASH (1995). Average catches were calculated as the number and grams (g) of fish 1000 m^{-2}.

Species diversity was measured from the number of species and the Shannon diversity index (H') (LUDWIG and REYNOLDS, 1988):

$$H' = -\sum_{i=1}^{s} (\text{pi log epi}),$$

in which

Pi = n_i/N (the proportional abundance of the ienth species),
n_i = total number of individuals in the ienth species, and
N = Total number of individuals from all species.

The impact of dominant species was analysed with the Berger-Parker index (d) (BERGER and PARKER, 1970):

$$d = n_{max}/N,$$

in which

n_{max} = total number of individuals from the most abundant species and
N = total number of individuals from all species.

Inverse dominance (1/d) was calculated for it allows better interpretation of the Berger-Parker index.

Equitability between species was measured with Pielou's evenness function (J') (PIELOU, 1977):

$$J' = H'/\log_e (S),$$

in which

H' = Shannon's diversity index and
S = total number of species.

Differences over the year between biomass, number of individuals, (H') and (J') were tested with paired t-tests.

The percent similarity between successive months was calculated using the Jaccard Coefficient (C_J) by comparing pairs of samples based on the presence and number of species in each sample (MAGURRAN, 1988):

$$C_J = j/(a + b - j)$$

in which,

j = number of species from both samples,
a = number of species from sample A and
b = number of species from sample B.

All ecological analyses were performed using the software Biodiversity Professional® v. 1997. All statistics (t-tests and Spearman rank correlations) were performed using Statistica® for Windows®, vs. 3.0.

RESULTS

Sea-Surface Temperature

Over the sampling period temperatures varied between 16.3°C (July) and 26.2°C (December), which correspond to the averages verified in the northern part of Santa Catarina (SEGE, 1991).

Salinity

Salinity varied between a minimum of 27.4 (February) and a maximum of 33.8 (December). Intense rains and river outflow are interpreted as the cause for a drop in salinity verified in February.

Fish Assemblage

Sixty-seven species were caught yielding 9370 fish or 77943.55 g (Table 1). This constitutes a yearly average of 62.8 fish 1000 m^{-2} or 522 g 1000 m^{-2}. Over the sampling periods, estimated density was highest in February (257.6 fish 1000 m^{-2}) and lowest in December (60.9 fish 1000 m^{-2}). Biomass followed the same pattern with a maximum in February (2286.4 g 1000 m^{-2}) and a minimum in December (366.8 g 1000 m^{-2}).

The fish assemblage of CG was numerically dominated by *Lycengraulis grossidens* (21.5%), *Harengula clupeola* (11.6%) and *Atherinella brasiliensis* (11.1%). In terms of biomass, the most important species were *Trichiurus lepturus* (13.2%), *Brevoortia pectinata* (12.4%) and *Hemiramphus brasiliensis* (10.0%). Seven species, belonging to three families, corresponded to 70.4% of the number of fish caught: *Atherinella brasiliensis* (Atherinidae—11.1%); *Brevoortia pectinata, Harengula clupeola* and *Sardinella brasiliensis* (Clupeidae—26.4%); *Anchoviella lepidontostole, Cetengraulis edentulus* and *Lycengraulis grossidens* (32.9%). Most speciose families were: Carangidae (9 species), Sciaenidae (6) and Clupeidae (5).

Of the species caught only five can be considered as typical residents of sandy bottoms: *Mullus argentinae* and *Pseudopeneus maculatus* (Mullidae), *Citharichthys spilopterus* (Paralichthyidae) and *Synodus foetens* (Synodontidae). However, they occurred in very low numbers as these are bottom-dwelling species, and the sampling method was inadequate for such a category (see discussion).

As to biomass, nine species, belonging to six families, corresponded to 68.9% of all biomass obtained: *A. brasiliensis* (Atherinidae), *B. pectinata, H. clupeola, S. brasiliensis* (Clupeidae), *L. grossidens* (Engraulidae), *Hemiramphus brasiliensis* (Hemiramphidae), *Pomatomus saltatrix* (Pomatomidae), *Isopisthus parvipinnis* (Sciaenidae) and *Trichiurus lepturus* (Trichiuridae). Both density and average biomass of these most important species were low (Tables 2 and 3).

Number of Species

With the exception of the correlation with salinity (see below), no clear pattern in the number of species caught at CG was visible. February, with 38 species was the maximum and December, with 21, the minimum. In the other months, the number of species varied between 29 and 36. There was a negative and significant correlation between salinity and the number of species ($r_s = -0.890$, $p < 0.05$) (Figure 2).

Density and Biomass

The same pattern was observed for both density and biomass. Total number of individuals and total biomass was highest in February and lowest in December. Maximum density occurred just after the lowest value of December and just after the maximum temperature and salinity (Figure 3). However, the correlation between them was not significant. Biomass was negatively correlated with salinity ($r_s = -0.820$, $p < 0.05$) (Figure 4), and its February peak was due to high catches of *Trichiurus lepturus* during that period.

Although there were no significant differences ($p > 0.05$) between densities over the year, differences in biomass were significant (Table 4) in winter and spring months.

Seasonal Occurrence of Fish Species

Nine species were particularly important in the CG community and had a major influence in the total number of individuals occurring in each sample. April was dominated by *Atherinella brasiliensis* with an importance of 34.7% of the total. In July, the community was thoroughly dominated by *Lycengraulis grossidens* (40.5%) but with an isolated influx of the predator *Pomatomus saltator* (20.0%). August was dominated by *Harengula clupeola* (33.0%) and by *Lycengraulis grossidens* (26.6%) while October was dominated by *Brevoortia pectinata* (36.5%). Three species dominated the community in December: *L. grossidens* (18.5%), *Eucinostomus argenteus* (17.7%) and *H. clupeola* (17.6%). In February, newcomers such as *Cetengraulis edentulus* (21.7%) and *Anchoviella lepidontostole* (15.3%) and increased catches of *Sardinella brasiliensis* (19.2%) characterised the community. The only dominant species to occur in every month was *L. grossidens*.

Two species showed a significant correlation with temperature: *S. brasiliensis* ($r_s = 0.829$, $p < 0.05$) and *Trichiurus lepturus* ($r_s = 0.928$, $p < 0.01$). No significant correlation was observed between any species and salinity.

Species Diversity (*H′*) and Evenness (*J′*)

Diversity showed a positive correlation with sea-surface temperature ($r_s = 0.943$, $p < 0.01$) (Figure 5). Highest diversity coincided with maximum values of temperature and salinity. This parameter was not correlated with the number of individuals. The low values of *H′* during the winter months (July and August) are due to low richness and to high dominance respectively from one to two species. This is also shown by the Berger-Parker analysis (Table 5) in which the abundance of the dominant species is clearly higher in winter months. The peak of December reflects an increase in the number of dominant species and the February decrease is

Table 1. *Biomass and number of specimens caught at Canto Grande, SC, Brazil (in alphabetical order of families).*

Family	Species	Biomass (g)	Percentual Importance (biomass)	Number of Specimens	Percentual Importance (numeric)
Albulidae	*Albula vulpes*	108.58	0.1	38	0.4
Atherinidae	*Atherinella brasiliensis*	5289.02	6.8	1041	11.1
	Odontesthes bonariensis	250,54	0.3	42	0.5
Belonidae	*Strongylura marina*	231,87	0.3	6	*
	Strongylura timucu	6.36	*	2	*
Blennidae	*Hypleurochilus fissicornis*	6.41	*	1	*
Carangidae	*Caranx latus*	88.8	0.1	6	*
	Chloroscombrus chrysurus	2.3	*	1	*
	Hemicaranx amblyrhynchus	2.91	*	5	*
	Hemicaranx sp.	42.41	*	1	*
	Oligoplites palometa	1.62	*	1	*
	Oligoplites saurus	447.38	0.6	49	0.5
	Selene vomer	325.33	0.4	5	
	Trachinotus carolinus	886.4	1.1	163	1.7
	Trachinotus falcatus	700.08	0.9	179	1.9
Chaetodontidae	*Chaetodon ocellatus*	1.96	*	1	*
Clupeidae	*Brevoortia pectinata*	9691.96	12.4	688	7.3
	Harengula clupeola	4443.85	5.7	1086	11.6
	Opisthonema oglinum	1107.97	1.4	233	2.5
	Pellona harroweri	156.55	0.2	5	*
	Sardinella brasiliensis	4038.70	5.2	705	7.5
Dactylopteridae	*Dactylopterus volitans*	415.17	0.5	1	*
Diodontidae	*Chilomycterus altringa*	714.07	0.9	25	0.3
Engraulidae	*Anchoviella lepidontostole*	919.11	1.2	442	4.7
	Cetengraulis edentulus	1403.25	1.3	625	6.7
	Lycengraulis grossidens	3703.77	4.8	2012	21.5
Ephippidae	*Chaetodipterus faber*	1.46	*	1	*
Exocoetidae	*Exocoetus volitans*	3.56	*	1	*
Fistularidae	*Fistularia petimba*	23.69	*	4	*
	Fistularia tabacaria	2.86	*	1	*
Gerreidae	*Diapterus rhombeus*	56.85	*	15	0.2
	Eucinostomus argenteus	1552.32	2.0	345	3.7
	Eucinostomus gula	1581.59	2.0	101	1.1
	Eucinostomus melanopterus	1840.78	2.4	124	1.3
Gobiesocidae	*Gobiesox strumosus*	14.15	*	2	*
Haemulidae	*Genyatremus luteus*	314.84	0.4	8	*
	Orthopristis ruber	1219.56	1.6	80	0.8
	Pomadasys corvinaeformis	1067.71	1.4	27	0.3
Hemiramphidae	*Hemiramphus brasiliensis*	7788.49	10.0	242	2.6
Lutjanidae	*Lutjanus synagris*	385.11	0.5	19	0.2
Monacanthidae	*Stephanolepis hispidus*	159.51	0.2	11	0.1
Mugilidae	*Mugil curema*	1340.63	1.7	25	0.3
	Mugil gaimardianus	996.06	1.3	58	0.7
	Mugil platanus	186.84	0.2	9	0.1
	Mugil sp.	14.71	*	58	0.7
Mullidae	*Mullus argentinae*	8.04	*	2	*
	Pseudupeneus maculatus	7.55	*	1	*
Paralichthyidae	*Citharichthys spilopterus*	138.65	0.2	46	0.5
Pomatomidae	*Pomatomus saltator*	3397.25	4.4	361	3.9
Sciaenidae	*Cynoscion leiarchus*	74.61	*	1	*
	Isopisthus parvipinnis	4965.21	6.4	65	0.7
	Menticirrhus americanus	12.47	*	1	*
	Menticirrhus littoralis	96.55	0.1	6	*
	Micropogonias furnieri	23.05	*	2	*
	Stellifer rastrifer	5.13	*	9	0.1
Scorpaenidae	*Scorpaena plumieri*	1.29	*	1	*
Serranidae	*Diplectrum radiale*	485.60	0.6	32	0.3
	Epinephelus niveatus	91.61	0.1	1	*
	Mycteroperca acutirostris	53.35	*	1	*
Sparidae	*Diplodus argenteus*	229.34	0.3	69	0.7
Sphyraenidae	*Sphyraena tome*	252.45	0.3	3	*
Syngnathidae	*Bryx dunckeri*	2.22	*	1	*
Synodontidae	*Synodus foetens*	599.23	0.8	13	0.1
Tetraodontidae	*Lagocephalus laevigatus*	2100.47	2.7	26	0.3
	Sphoeroides testudineaus	1484.39	1.9	48	0.5
Trichiuridae	*Trichiurus lepturus*	10265.61	13.2	159	1.7
Triglidae	*Prionotus punctatus*	122.12	0.2	21	0.2
Totals	67 sp.	77943.55	100	9370	100

* Indicates values inferior to 0.1%

Table 2. *Average density of most important species from Canto Grande, SC, Brazil n° fish 100 m⁻²) between April 1996 and February 1997.*

	April	July	August	October	December	February
Lycengraulis grossidens	0.01	0.03	0.01	0.01	*	0.02
Harengula clupeola	*	0.01	0.02	—	*	*
Atherinella brasiliensis	0.02	*	0.01	*	*	*
Sardinella brasiliensis	*	*	*	*	*	0.02
Brevoortia pectinata	—	—	—	0.02	*	*
Cetengraulis grossidens	—	—	—	—	—	0.03
Anchoviella lepidontostole	—	—	—	—	—	0.02

* Indicates densities lower than 0.01 fish 1000 m⁻¹

due to the large influx of both *Sardinella brasiliensis* and *Cetengraulis edentulus* into the community.

Evenness was generally moderately high (>0.4) which reflects the low level of dominance in the assemblage. Equitability was lowest in winter due to a decrease in the number of dominant species, and showed a perfect correlation with temperature ($r_s = 1,000$) (Figure 6).

Neither H' nor J' showed significant differences (p > 0.05) over the year.

Percent Similarity

Similarity between adjacent samples was always around 50% (Figure 7). The pairs April/February and October/December clustered more closely than the winter months (July/August). All months had a different set of species, which explains the low similarities recorded. The large influx of newcomers in February, namely *Anchoviella lepidontostole* and *Cetengraulis edentulus* and the increased catches of both *Sardinella brasiliensis* and *Trichiurus lepturus* were the main reasons for the differences then recorded.

DISCUSSION

The fish assemblage in Canto Grande beach is disturbed by human activities, especially in summer with a great increase in the number of visitors. Marine culture of shellfish (oysters and mussels) are a major disruption cause that adds significant quantities of organic matter to the environment and are known to cause a serious impact on the granulometry and physical characteristics of the substrate (SCHETTINI, 1997).

As seen in other similar beaches from the Atlantic (see SANTOS and NASH, 1995), CG undergoes a strong seasonal change in abundance and especially in biomass values. Our sampling strategy, while covering all tidal states and diel cycles, gives us a fairly good descriptor of the community.

Biomass and abundance in CG are inferior to those observed in more tropical regions (see ROSS *et al.,* 1987) but remain comparable to more temperate regions. In our site, greatest values of both biomass, abundance and richness are from summer months, as it happens in other temperate regions (*e.g.* NASH, 1988; WRIGHT, 1988; BENNETT, 1989; PESSANHA *et al.,* 1999). This is a known and expected fact—generally, greater abundances and diversity occur in late spring and summer (BROWN and MACLACHLAN, 1990) due to the influx of juveniles of both resident and transient species following their breeding seasons (GIBSON and YOSHIYAMA, 1999). On the other hand, the reduction in density and diversity verified in autumn and winter samples is probably a result of offshore migration of fish, as seen in most temperate regions (GIBSON, 1999). Although there is no a clear trend, this fish assemblage, being dominated by schools of pelagic species, shows a relatively high level of equitability throughout the year. As considered by SANTOS and NASH (1995) this is just the opposite of what generally occurs in shallow-water areas from temperate to subtropical zones.

The fish assemblage of CG has a high number of species (67). BROWN and MACLACHLAN (1990) indicate that sandy beaches usually have between 27 and 71 species. As recorded for other areas, CG seems to have a number of species that is intermediate between colder temperate areas and tropical ones: *e.g.* 24 species in Scotland (GIBSON and EZZI, 1987), 20 species in Cape, South Africa (BENNETT, 1989), 18 species in Nova Scotia (BLACK and MILLER, 1991), 24 species in the Azores (SANTOS and NASH, 1995) and in a set of Belgian beaches (BEYST *et al.,* 2001), 75 species in Igarapés, northeastern Brazil (CASTRO, 1999), and 80 species in Sepetiba, south-eastern Brazil (PESSANHA *et al.,* 1999). However, as

Table 3. *Average biomass of most important species from Canto Grande, SC, Brazil (g 1000 m⁻²) between April 1996 and February 1997.*

	April	July	August	October	December	February
Trichiurus lepturus	0.07	—	—	0.04	0.04	0.26
Brevoortia pectinata	—	—	—	0.24	0.04	0.11
Hemiramphus brasiliensis	0.04	0.17	0.07	*	0.03	*
Atherinella brasiliensis	0.09	0.03	0.07	0.02	*	*
Isopisthus parvipinnis	0.03	—	—	*	0.01	0.15
Harengula clupeola	*	0.05	0.06	—	0.02	0.04
Sardinella brasiliensis	0.01	*	*	0.01	*	0.14

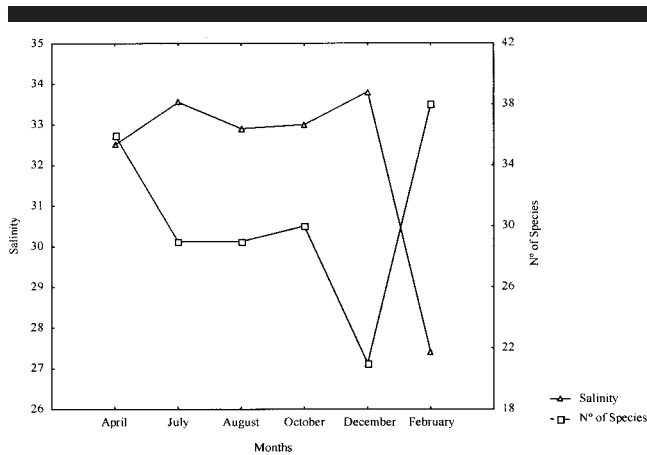* Indicates biomass lower than 0.01 g 1000 m⁻²

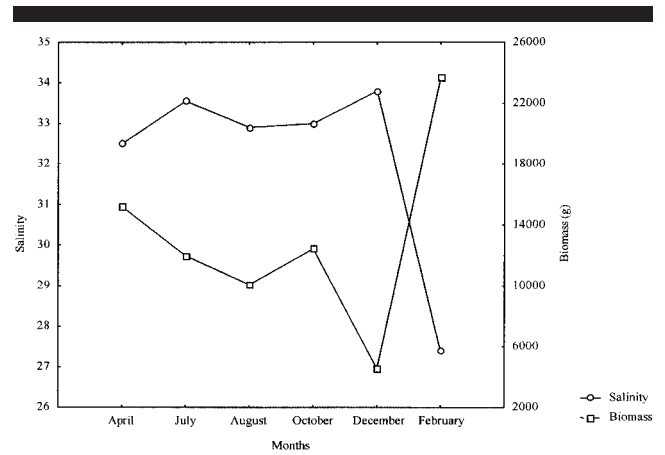Figure 2. Number of species and salinity in Canto Grande, SC, Brazil, between April 1996 and February 1997.

Figure 4. Total biomass and salinity in Canto Grande, SC, Brazil, between April 1996 and February 1997.

pointed out by BEYST *et al.* (2001) one must be careful when comparing sites since survey duration and depth have been recognised as confounding factors in such comparisons.

A relevant aspect of our results is the low numbers of benthic species. The presence of only one flatfish species and the complete absence of bathoids is perhaps unexpected when both flatfish species and skates are commonly caught and observed on sandy shores of Santa Catarina (J. P. BARREI-ROS, pers. obs.). The collection method is probably responsible for this fact since these fish are able to bury themselves in sand and thus evade capture. This fact can also explain the low numbers of *Synodus foetens*. As stated by KUIPERS *et al.* (1992), the catch density and the species richness will be a function of their distribution with depth and substratum type, their ability to avoid the gear and the mesh-size selectivity. Net efficiency and shoaling behaviour can increase the difficulty of interpreting the data (GIBSON *et al.,* 1993; LY-ONS, 1986; PIERCE *et al.,* 1990).
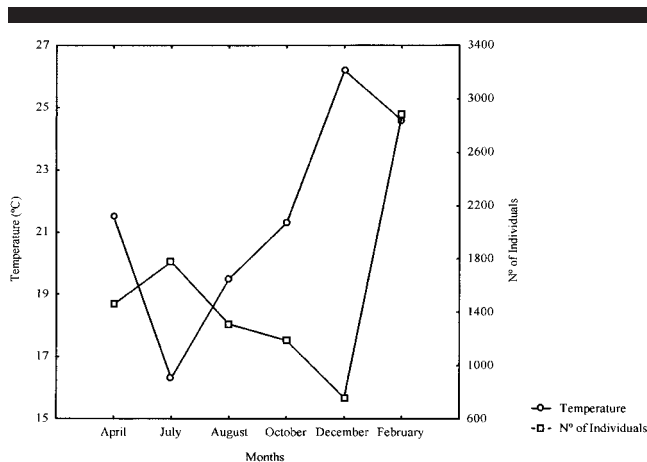
As noted by SANTOS and NASH (1995), unstressed fish assemblages should show a high species diversity with low similarities in species composition between seasons. The aggregation of CG has a low diversity but still has low similarities between samples. Human-induced pollution and high levels of anthropogenic activity may be the main cause for this situation although there is no data available to support this assumption.

The major changes in the species compositions in CG were due to: i) a decrease in the numbers of *Atherinella brasiliensis* from April to July, probably related to a decrease in water temperature which this species avoids (CERVIGÓN *et al.,* 1992) and an increase of *Lycengraulis grossidens* in July when this species migrates from estuaries to the sea (WHITEHEAD *et al.,* 1988); ii) July was also the month in which great numbers of *Pomatomus saltator* occurred, due to their characteristic winter migrations (see HARE and COWEN, 1993, 1996; JUANES and CONOVER, 1995); iii) the great abundance of *Brevoortia pectinata* in October, probably related to the beginning of its breeding season and consequent aggregation in shallow waters (see WHITEHEAD, 1985) and iv) the massive occurrence of *Anchoviella lepidontostole, Cetengraulis edentulus* and *Sardinella brasiliensis* in February, together with a great increase in the numbers of *Trichiurus lepturus*. The first three species are known to prefer warmer waters thus explaining their occurrence in summer (WHITEHEAD *et al.,* 1988). On the other hand, it is known that juveniles and

Figure 3. Number of individuals and temperature in Canto Grande, SC, Brazil, between April 1996 and February 1997.

Table 4. *Differences in biomass between monthly samples from Canto Grande, SC, Brazil (g 1000 m⁻²) between April 1996 and February 1997.*

Months	t-Value	P	P Variances
April	2.041	>0.05	0.689
July	2.440	0.040	0.954
August	2.729	0.025	0.720
October	2.404	0.042	1.000
December	3.515	0.007	0.124
February	1.159	>0.05	0.229
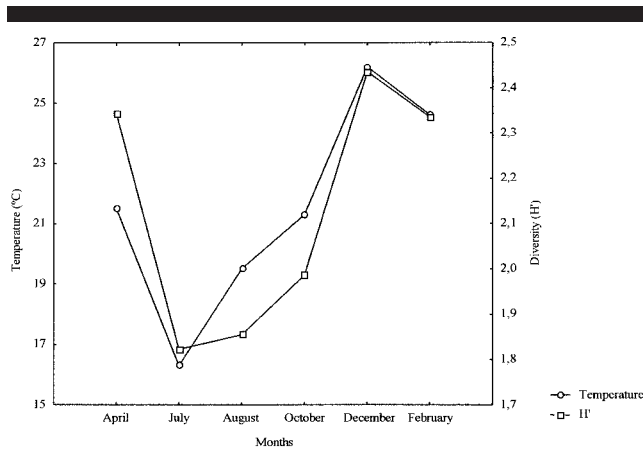
Figure 5. Diversity (H') and temperature in Canto Grande, SC, Brazil, between April 1996 and February 1997.

Figure 7. Percent similarity (Jaccard coefficient) between samples from Canto Grande, SC, Brazil (April 1996 to February 1997).

small adults of *T. lepturus* make nocturnal migrations to shallow waters whenever these are warm (MEYER and SMALE, 1991). In Canto Grande, as in most shallow water fish communities, a few species are dominant both in terms of numbers and biomass (ALLEN and HORN, 1975).

Nearby rocky shores apparently do not recruit fish to this sandy beach. None of the rocky shore's common species (*e.g. Epinephelus marginatus, Mycteroperca acutirostris, Abudefduf saxatilis, Bathygobius soporator* and many Blennidae species) were either present or were common in Canto Grande. As seen, the community is dominated by small pelagic species that use the area as a foraging ground and, for some cases, may recruit to the area for reproduction purposes (*e.g. Cetengraulis grossidens, Anchoviella lepidontostole*) (BARREIROS *et al.,* unpublished results).

In conclusion, the fish community of CG is characterised by strong seasonality in which greater abundances, biomass, richness and diversity are found in summer months as normally found in other temperate to subtropical environments.
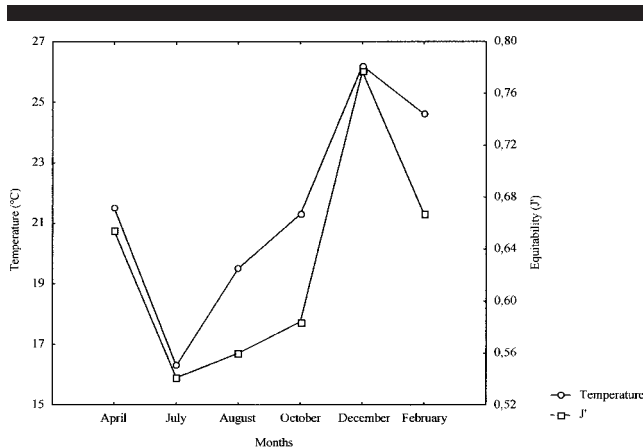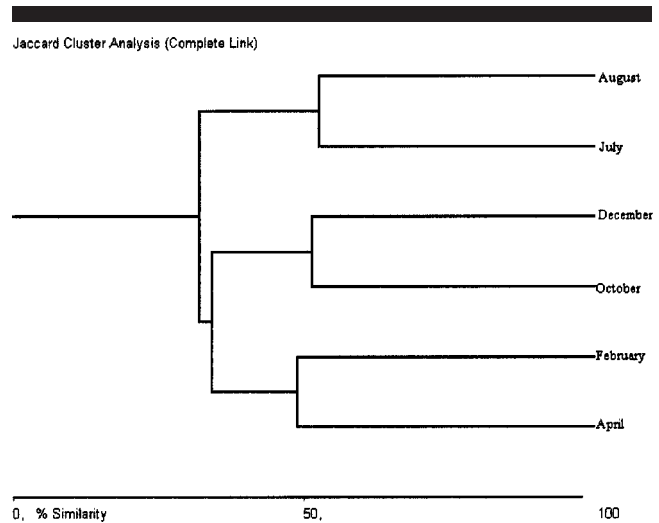
The community is dominated by pelagic and gregarious species and the presence of true residents is small but probably underestimated.

Further studies are needed in order to have a better understanding of soft sediment shallow areas in Santa Catarina, especially their nursery function. The intensive use of the littoral areas, especially of sheltered beaches such as Canto Grande may affect fish communities in many ways.

ACKNOWLEDGMENTS

Figure 6. Equitability (J') and temperature in Canto Grande, Brazil, between April 1996 and February 1997.

Table 5. *Berger-Parker index (d) and inverse (1/d) for the samples taken in Canto Grande, SC, Brazil.*

Months	d	1/d
April	0.347	2.882
July	0.405	2.469
August	0.330	3.030
October	0.448	2.232
December	0.185	5.405
February	0.153	6.536

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□ RESUMO □

Neste trabalho realizaram-se amostragens, com uma rede de praia, de modo a estudar a comunidade de peixes de substrato arenoso na enseada de Canto Grande, Santa Catarina, Brasil. As amostragens realizaram-se em intervalos de 3 horas durante períodos de 24 h, numa base bimensal, entre Abril de 1996 e Fevereiro de 1997. Verificou-se existir uma variação sazonal no número de espécies, densidade de peixes e biomassa, tendo os valores mais elevados ocorrido em Fevereiro (38 espécies, 257.6 peixes 1000 m^{-2}, 2286.4 g 1000 m^{-2}). Recolheu-se um total de 67 espécies, pertencentes a 56 géneros e a 33 famílias, sendo a comunidade dominada por sete espécies pertencentes a três famílias: *Atherinella brasiliensis* (Atherinidae); *Brevoortia pectinata, Harengula clupeola* e *Sardinella brasiliensis* (Clupeidae); *Anchoviella lepidontostole, Cetengraulis edentulus* e *Lycengraulis grossidens* (Engraulidae). Tanto a diversidade de espécies (H') como a equitabilidade (J') foram médias a elevadas ao longo do ano devido à baixa dominância. A maior mudança na estrutura da comunidade ocorreu entre os meses de Inverno (Julho e Agosto) e as outras estações. Nenhuma das espécies dominantes pode ser classificada como residente. Os principais predadores foram *Pomatomus saltator* (Inverno) e *Trichiurus lepturus* (Verão). A maior parte das espécies observadas foram ou peixes juvenis ou espécies pelágicas de pequeno tamanho e fortemente gregárias.

PALAVRAS CHAVE: *Agregação de peixes, variações sazonais, praias arenosas, Santa Catarina, sul do Brasil.*