# 6.14
# Demersal and Benthic Teleosts

M. Haimovici

Over the past few decades, the search for new fishery resources stimulated several surveys of demersal and benthic teleost fish over the southern Brazilian shelf and slope (Nakamura 1963; Vazzoler and Iwai 1971; Menezes 1971; Roux 1973; Yesaki 1973; Vazzoler 1975; Yesaki et al. 1976; Vooren et al. 1988). Today, over 200 species from more than 100 families have been identified (Menezes 1971; Benvegnu-Lé 1973; Figueiredo 1977; Figueiredo and Menezes 1978, 1980; Menezes and Figueiredo 1980, 1985; Haimovici et al. 1994a; Appendix).

## Seasonal Patterns of Species Richness and Abundance

The demersal ichthyofauna of the southern Brazilian shelf, transitional between tropical and temperate zones, is part of the Argentine zoogeographic province, which extends between 22° and 42° S (Figueiredo 1981). The fauna can be divided into species with tropical and temperate water affinities of both the northern and the southern hemisphere. Most species are eurybathic and eurythermal, and few endemics are found. Although the species composition varies little with the seasons, annual variations of species richness and relative abundance follow annual bottom temperature variations in coastal waters (>10°C) and at the shelf break (4-5°C), as a result of the latitudinal oscillation of the Subtropical Convergence between the warm Brazil Current (BC) and the cold Malvinas Current (MC; Miranda et al. 1973; Haimovici et al. 1996). In winter, the highest biomass at 40-60 m (*Micropogonias furnieri*, *Umbrina canosai*, *Cynoscion guatucupa* = *Cynoscion striatus*) coincides with the northward flowing cold waters of the coastal branch of the MC, though the relative abundance decreases from coastal to deeper waters. In contrast, at the end of the summer, abundance increases from the inner shelf towards the shelf break, probably owing to the existence of vortices and to partial upwelling of subtropical water (Podestá 1990; Lima and Castello 1995). The total number of species varies little between seasons. The greatest species richness over the shelf break is probably a result of both different types of substrate and different water layers, whilst a pronounced decrease in total species number over the slope below 350 m appears to be associated with the poor benthic invertebrate fauna (Capítoli, Sect. 6.11).



| Genera and Species | Family | | Absolute FO | Warm Season % | Cold Season % |
|---|---|---|---|---|---|
| *Menticirrhus littoralis* | Sciaenidae | * | 25 | 61 | 39 |
| *Paralonchurus brasiliensis* | Sciaenidae | | 103 | 49 | 51 |
| *Macrodon ancylodon* | Sciaenidae | * | 83 | 53 | 47 |
| *Peprilus paru* | Stromateidae | * | 103 | 89 | 11 |
| *Micropogonias furnieri* | Sciaenidae | * | 172 | 52 | 48 |
| *Urophycis brasiliensis* | Gadidae | * | 201 | 58 | 42 |
| *Netuma sp.* | Ariidae | * | 83 | 64 | 36 |
| *Conger orbignyanus* | Congridae | * | 108 | 40 | 60 |
| *Cynoscion guatucupa* | Sciaenidae | * | 222 | 50 | 50 |
| *Trichiurus lepturus* | Trichuridae | * | 231 | 64 | 36 |
| *Balistes capriscus* | Balistidae | * | 41 | 68 | 32 |
| *Umbrina canosai* | Sciaenidae | * | 190 | 47 | 53 |
| *Prionotus punctatus* | Triglidae | | 164 | 57 | 43 |
| *Paralichthys patagonicus* | Bothidae | * | 136 | 55 | 45 |
| *Porichthys porosissimus* | Batrachoididae | | 151 | 48 | 52 |
| *Cynoscion jamaicensis* | Sciaenidae | * | 88 | 76 | 24 |
| *Ctenosciaena gracilicirrhus* | Sciaenidae | | 87 | 72 | 28 |
| *Trachurus lathami* | Carangidae | * | 120 | 42 | 58 |
| *Saurida caribbaea* | Synodontidae | | 44 | 74 | 26 |
| *Thyrsitops lepidopoides* | Gempylidae | | 58 | 38 | 62 |
| *Pagrus pagrus* | Sparidae | * | 40 | 50 | 50 |
| *Prionotus nudigula* | Triglidae | | 60 | 55 | 45 |
| *Merluccius hubbsi* | Merluccidae | * | 135 | 31 | 69 |
| *Mullus argentinae* | Mullidae | * | 74 | 50 | 50 |
| *Paralichthys isosceles* | Bothidae | | 56 | 23 | 77 |
| *Lophius gastrophysus* | Lophiidae | * | 39 | 45 | 55 |
| *Zenopsis conchifera* | Zeidae | | 59 | 47 | 53 |
| *Antigonia capros* | Caproidae | | 21 | 45 | 55 |
| *Synagrops spinosus* | Acropomatidae | | 64 | 52 | 48 |
| *Urophycis mystacea* | Gadidae | | 60 | 36 | 64 |
| *Lopholatilus villarii* | Branchiostegidae | * | 5 | | 100 |
| *Genypterus brasiliensis* | Ophidiidae | * | 30 | 44 | 56 |
| *Bembrops heterurus* | Percophidae | | 24 | 30 | 70 |
| *Benthodesmus elongatus* | Trichiuridae | | 18 | 33 | 67 |
| *Ariomma bondi* | Ariommatidae | | 31 | 48 | 52 |
| *Synagrops bellus* | Acropomatidae | | 16 | 19 | 81 |
| *Helicolenus lahillei* | Scorpaenidae | | 25 | 42 | 58 |
| *Argentina striata* | Argentinidae | | 19 | 42 | 58 |
| *Polyprion americanus* | Polyprionidae | * | 10 | 77 | 23 |
| *Diaphus dumerilii* | Myctophidae | | 15 | 40 | 60 |
| *Polymixia lowei* | Polymixiidae | | 29 | 41 | 59 |
| *Malacocephalus occidentalis* | Macrouridae | | 17 | 47 | 53 |
| *Coelorinchus marinii* | Macrouridae | | 20 | 50 | 50 |


**Fig. 6.14.1.** Most common teleost species in bottom trawl surveys (1981-1987) from the southern Brazilian shelf and upper slope with absolute frequency of occurrence (*FO*) in 315 hauls. Occurrence of species (*black* >50%, *dark gray* 25-50%, *light gray* <25%) during northward (cold season) and southward (warm season) shifts of the Subtropical Convergence (* commercially important species)

## Composition and Depth Distribution

The wide and gently sloping southern Brazilian shelf is predominantly covered by soft-bottom substrates (Zembruski et al. 1972; Furtado 1973). As a result, the gradual substitution of species is largely associated with depth (Benvegnu-Lé 1978; Haimovici et al. 1994a; Fig. 6.14.1). Over the shelf down to 120 m depth, the families with the larger number of species are Sciaenidae, Carangidae, Clupeidae, Bothidae, and Serranidae. Based on percent catch per unit effort (CPUE), Sciaenidae (80.9%) and Trichiuridae (14.5%) have the highest relative abundance. Four species alone (*Micropogonias furnieri*, *Cynoscion guatucupa*, *Umbrina canosai*, *Trichiurus lepturus*) are responsible for 71.9% of the total biomass and together with another 11 abundant species (*Macrodon ancylodon*, *Prionotus punctatus*, *Merluccius hubbsi*, *Peprilus paru*, *Ctenosciaena gracilichirrus*, *Paralonchurus brasiliensis*, *Cynoscion jamaicensis*, *Trachurus lathami*, *Urophycis brasiliensis*, *Porichthys porosissimus*, *Balistes capriscus*) represent as much as 95.5% of the biomass (Haimovici et al. 1996). The generally low abundance of small Anguilliformes and Pleuronectiformes may be a result of inefficient sampling (Arena et al. 1992), whilst the low abundance of *Pagrus pagrus*, *Pogonias cromis*, and *Netuma barba* reflects the depletion of their stocks between 1970 and 1990 (Haimovici et al. 1989a; IBAMA 1993). Over the outer shelf between 120 and 180 m, *Trachurus lathami*, *Trichiurus lepturus*, and juveniles of *Cynoscion guatucupa*, *Umbrina canosai*, and *Scomber japonicus* are the dominant species and together total 83% of the teleost biomass. Over the shelf break (180-249 m depth), *Trichiurus lepturus* and *Thyrsitops lepidopoides* are abundant, whilst in areas with irregular coralline substrates *Antigonia capros* and *Priacanthus arenatus* occur, which together represent 63% of the biomass. The demersal fish fauna of upper slope regions (250-587 m) with extensive irregular bottoms is largely composed of Serranidae, Macrouridae, Trichiuridae, and Myctophidae. The monospecific families Ariommatidae and Polyprionidae are most abundant, with *Ariomma bondi*, *Helicolenus dactylopterus*, and *Polyprion americanus* making up 77% of the total biomass (Haimovici et al. 1994a).

## Ecology of Principal Species

*Macrodon ancylodon* occurs in shallow coastal waters between Venezuela (10° N) and Argentina (40° S). The species is most abundant over the southern Brazilian shelf, and the local stock mixes little with northern populations (Yamaguti 1979). Spawning occurs in late spring and summer in coastal areas adjacent to the Patos Lagoon mouth (32° S), followed by migration to more northern latitudes (28° S) in winter (Santos and



Yamaguti 1965; Yamaguti 1979). Intense exploitation of *Macrodon ancylodon* in southern Brazil has altered the density and consequently the growth and age structure of the stock. Prior to 1970, first sexual maturity was reached between 3 and 4 years and at 25 cm total length of maturity ($Tl_m$; Yamaguti 1967), with a maximum age of adults around 12 years (45 cm; Yamaguti and Santos 1966). At the end of the decade, older age classes (>5 years) were absent, but the length of age classes had increased (Martins Juras 1980; Haimovici 1988a), and first sexual maturity was reached at 1-2 years ($TL_m$ females 27.4 cm, males 21.5 cm; Juras and Yamaguti 1989). Subadults and adults of *Macrodon ancylodon* feed preferentially on shrimp (*Artemesia longinaris*), cephalopod (*Loligo sanpaulensis*), and fish (*Paralonchurus brasiliensis*, *Macrodon ancylodon*), but fish become more important in the diet as size increases (Juras and Yamaguti 1985).

*Micropogonias furnieri* is widely distributed along the Atlantic coast of South America down to 40° S (Isaac 1988; Vazzoler 1991). Although genetically distinct populations are absent from southeastern and southern Brazilian waters (Maggione et al. 1994), the exchange between stocks from southern (29-34° S), southeastern (22-29° S), and northeastern (<22° S) latitudes is limited (Vazzoler 1971; Valentini et al. 1991a; Haimovici and Umpierre, unpubl.). However, stocks which reproduce south of this region (34° S) migrate into southern Brazilian waters during the winter, following the coastal branch of the MC. Maximum spawning in southern Brazilian waters occurs in the spring and summer in coastal water under the influence of freshwater runoff from the the Patos Lagoon (Vazzoler 1971), and the estuary of the lagoon constitutes an important nursery ground (Weiss 1981; Barbieri 1986; Castello 1986; Pereira 1994). Although some juveniles reach first sexual maturity at 18-20 cm $TL_m$ in the estuary, most mature at 30-40 cm after leaving the estuary (Vazzoler 1971; Haimovici, unpubl.). Subadults (<30 cm TL) of *Micropogonias furnieri* occur throughout the year near the coast, whilst adults disperse over the shelf, where they feed on polychaetes, crustaceans, molluscs, ophiuroids, and fish (Tanji 1974; Vazzoler 1975). During the fall and winter, adults concentrate in waters of up to 100 m depth and migrate from Uruguay to southern Brazil. In contrast, during the summer they are seen in shallower waters (<50 m; Haimovici 1987; Haimovici et al. 1996) and migrate southward (Vazzoler 1991; Reis 1992). In southern Brazilian waters *Micropogonias furnieri* attains over 70 cm TL. Age determinations, based on scales (Vazzoler 1971; Castello 1986) and transverse cut of otholits (Schwingel and Castello 1990; Haimovici and Umpierre 1996) show a correspondence between the number of scale rings and opaque otholit bands for individuals younger than 5 years (Haimovici 1977). Although the age of individuals frequently exceeded 30 years prior (1980) to intensive exploitation (Schwingel and Castello 1990), today individuals more than 20 years old are rarely found.

*Netuma barba* is a slow-growing species with a calculated life span of 23.1 years and a mortality of 0.13, though adults may occasionally attain 36 years of age and a total length of 98 cm. Sexual maturity of females (41.5 cm) and males (43 cm) is reached at about 7 years. At the end of the winter *Netuma barba* migrates into the Patos Lagoon estuary. Gonad maturation and reproduction, with low female fecundity (32-272 intraovaric oocytes of 12-19 mm), take place in early spring in the estuary followed by spawning in the coastal waters. The males incubate the eggs for up to 2 months in the buccal cavity (Reis 1986a,b). Between spawning seasons, adults disperse over the entire shelf (Haimovici et al. 1996). The first juveniles (6 cm TL) appear in late summer near the Patos Lagoon inlet and also in the estuary, where they feed on pereiopods of *Callinectes* spp. and polychaetes (Araújo 1984). The diet of adults is composed of molluscs and polychaetes in the estuary, epibenthic crustaceans in adjacent coastal waters, and principally sciaenid fish in both environments.

Although *Pogonias cromis* ranges from 45° N to 40° S (Fischer 1978), information on the species from the Southwestern Atlantic is scarce. Over the southern Brazilian shelf the species occurs at less than 40 m depth near the inlet of the Patos Lagoon, and juveniles of 1-2 years are commonly found in the estuary. Between the end of the spring and summer, the gonads of females reach an advanced stage of maturity, and partial spawning takes place. Growth appears to be rapid, since a total length of more than 1 m is reached after 10 years, though the age of adults (TL 140 cm, 40 kg) may exceed 40 years (Haimovici et al. 1989a; Haimovici, unpubl.). Juveniles feed on *Heleobia* (*Litoridina*), *Erodona*, and *Balanus improvisus* in the estuary, whilst the diet of subadults and adults in coastal waters is composed of molluscs (*Mactra patagonica*, *Mactra isabelleana*, *Glycymeris longior*, *Corbula* sp.), gastropods (*Buccinanops gradatum*), and crustaceans (*Hepatus pudibundus*, *Loxopagurus loxochelis*, *Libina spinosa*).

*Cynoscion guatucupa* (=*C. striatus*) is a demersal-pelagic sciaenid between the latitudes 22° and 40° S. The species is most abundant from 29° to 40° S where it appears to belong to one stock (Vargas-Boldrin 1980; Vieira 1990). Adults of *Cynoscion guatucupa* occur at depths of less than 50 m, especially between the spring and fall. In southern Brazilian shelf waters, multiple spawning peaks coincide with the spring and the end of the summer or the beginning of the fall. Principally during the summer and fall, small juveniles (<10 cm) are restricted to shallow coastal waters, whilst larger juveniles and subadults (10-30 cm) are abundant throughout the year at depths between 25 and 100 m. First sexual maturity of females (32-35 cm) and males (29-31 cm) is reached at about 4 years, and the maximum age approaches 15 and 13 years, respectively (Vieira 1990; Vieira and Haimovici 1993). The diet preference of *Cynoscion guatucupa* changes with age. Juveniles preferentially feed on planktonic crustaceans (hiperiid amphipods, euphausids, copepods, mysidaceans), whilst adults ingest a



diet composed of fish (*Anchoa marinii*, *Engraulis anchoita*, *Paralonchurus brasiliensis*, *Macrodon ancylodon*, *Cynoscion guatucupa*) and shrimp (*Artemesia longinaris*, *Pleoticus muelleri;* Vazzoler 1975, Vieira 1990).

The southern Brazilian stock of the demersal sciaenid *Umbrina canosai*, which represents a major part of bottom trawl catches during the winter and spring, exhibits a clearly defined migratory cycle. Partial spawning initiates with larger females at the end of the winter as far north as 29° S and continues southward until the end of the spring. The large females are also the first to migrate to southern feeding grounds in Uruguay and Argentina, followed by males and smaller females during the summer and fall (Gonzalez Alberdi and Nani 1967; Haimovici and Cousin 1989). During their first year, juveniles remain over the southern Brazilian intermediate shelf (Zaneti Prado 1979; Haimovici 1982). Males and females reach first sexual maturity at 18.4 and 21.9 cm, respectively. At age II, 60% of the males and 27.4% of the females are sexually mature. Adult females tend to be larger than males and occasionally surpass an age of 20 years (Haimovici and Reis 1984), although intense exploitation of stocks caused a significant age-dependent average weight increase (Haimovici 1988b). *Umbrina canosai* displays its highest feeding activity during the summer (Haimovici et al. 1989b) and feeds principally on benthic organisms. Smaller individuals prefer a diet of amphipods and mysids, whilst larger individuals feed on polychaetes, ophiuroids, bivalves, gastropods, decapods, and juvenile fish (Vazzoler 1975; Haimovici et al. 1989b). Adaptive characteristics like high fecundity, prolonged spawning over a large area, great longevity, age-dependent partitioning of feeding areas, and migratory patterns appear to explain the abundance of *Umbrina canosai* in southern Brazil (Haimovici 1982; Haimovici and Cousin 1989).

The cosmopolitan *Trichiurus lepturus* is an abundant species over the southern Brazilian shelf (Haimovici et al. 1996), and the eggs and larvae of this species are common (Mafalda 1989). Under the influence of tropical waters in the summer, spawning females occupy areas near the coast, but they are also found over the shelf break throughout the year. First sexual maturity is reached at approximately 70 cm $TL_m$. The diet preference of *Trichiurus lepturus* changes from copepods to mysidaceans (*Promysys atlantica*), sergestids (*Lucifer faxoni*), and euphausids (*Eufausia similis*) during the early juvenile stages. Feeding diversity augments with increasing size, including juvenile sciaenids, *Engraulis anchoita*, benthic macro-crustaceans (*Artemesia longinaris*, *Squilla brasiliensis*) and cephalopods (*Loligo sanpaulensis*, *Illex argentinus;* Martins 1992).

Although only *Prionotus punctatus* is of some commercial importance, both *Prionotus punctatus* and *Prionotus nudigula* inhabit the southern Brazilian shelf and slope throughout the year, becoming more abundant during the spring. Both species reproduce and spawn from the spring to the fall. *Prionotus punctatus* reaches first sexual maturity at 26.2 cm, and adults

(40 cm TL) are restricted to depths of less than 135 m between 11 and 22.5°C. *Prionotus nudigula* matures sexually at 16 cm, and adults occur at depths of up to 378 m and bottom temperatures of 9.8-21.2°C. Although the diet of both species is largely composed of crustaceans, food preferences differ between species and change with size, depth, and season. *Prionotus punctatus* displays higher feeding activity during the afternoon and in the summer and ingests bottom dwellers of reduced motility. With increasing size, the diet preference changes from cumaceans, amphipods, *Leptochela serratorbita*, and mysids, over *Portunus spinicarpus*, other brachyurans, and *Pleoticus muelleri*, to larger brachyurans, stomatopods, and benthic fish (*Porychthys porosissimus*). *Prionotus nudigula*, on the other hand, also preys on organisms in the water column and, during the summer and fall, ingests *Munida* sp. and the fish *Bregmaceros atlanticus* at depths exceeding 100 m, but in the spring it feeds on *Euphausia similis* and amphipods in shallower depths (Teixeira and Haimovici 1989).

*Peprilus paru* is a less abundant species which seems to follow the displacement of the Subtropical Convergence. Although *Peprilus paru* is present throughout the year, it is less important in bottom trawl catches in the winter and spring, and juveniles only occur during the summer and fall. Multiple spawning occurs from the end of the spring to early fall, and females and males reach first sexual maturity at 120 and 130 mm fork length, respectively. Juveniles seem to feed principally on gelatinous organisms, like jellyfish and salps, but also on small crustaceans, polychaetes, and ascidians (Cerqueira and Haimovici 1990).

The distribution of *Merluccius hubbsi* ranges from the upwelling area of Cabo Frio (22° S) to the extreme south of the American continent (Fagundes Netto and Oliveira 1991). The southern Brazilian shelf, where the species occurs at bottom temperatures of 6.8-21° C between 22 and 490 m depth, appears to serve as a growth region for locally reproducing individuals and those which reproduce further south. Multiple spawning occurs during the winter and early spring, and first sexual maturity of both sexes is likely to be reached at the end of the third year (30-40 cm). Juveniles are present throughout the year but tend to be associated with subtropical water of the outer shelf and slope. In contrast, adults occur mainly in the winter. Both juveniles and adults are most frequently found at depths between 40 and 120 m. *Engraulis anchoita* is an important component of the diet, though juveniles of *Merluccius hubbsi* also ingest mysids and amphipods. Larger individuals prey on *Trachurus lathami*, *Merluccius hubbsi*, and cephalopods (*Illex argentinus*, *Loligo sanpaulensis;* Haimovici et al. 1993).

*Pagrus pagrus* is a hermaphrodite species which is widely distributed in the Atlantic and Mediterranean (Manooch and Hassler 1978). Based on growth rings, two groups of this species have been identified for southern Brazilian shelf waters. During the winter, individuals with well-defined



rings concentrate over the intermediate shelf south at 33° 40' S, whilst a group without obvious rings is less abundant and occurs over the entire southern shelf during the summer. Juveniles (<2 years) are rare over the southern Brazilian shelf. The growth of males and females is similar, but bisexual individuals tend to be smaller. Advanced stages of sexual maturity occur from late spring to the end of summer, and adults may exceed an age of 15 years. The diet of *Pagrus pagrus* is principally composed of fish (*Engraulis anchoita*, *Trachurus lathami*, *Umbrina canosai*, *Synagrops spinosus*, *Cynoscion guatucupa*) and squid (*Loligo sanpaulensis*), but in coastal areas this changes to predominantly benthic invertebrates (Capítoli and Haimovici 1993).

Despite slow growth, the serranid *Polyprion americanus* reaches a total length of 140 cm and up to 80 kg weight. In contrast to other serranids, the sexes of *Polyprion americanus* are separate, and reproduction occurs in the winter. Gonad maturation is common in females and males of more than 80-90 cm, and vitellogenesis of oocytes is restricted to May, July, and September. The diet of *Polyprion americanus* is largely composed of demersal fish (*Helicolenus dactylopterus*, *Merluccius hubbsi*, *Urophycis mystaceus*), but the squid *Illex argentinus* and to a lesser extend *Lycoteuthis diadema*, *Ancistrocheiros lesueuri*, and the deep water crab *Chaceon notialis* are also ingested (Peres and Haimovici, unpubl.).

Flatfishes of the genus *Paralichthys* are represented by *P. orbignyanus*, *P. patagonicus*, and *P. isosceles*. The first is largely restricted to the Patos Lagoon estuary, the second is most abundant over the shelf, and the third is the smallest species which occurs mostly over the outer shelf (Haimovici et al. 1996). All three species spawn during the spring and summer and are active predators on shrimp, fish, and cephalods (Kawakami 1975).

## 6.15 Early Life History of Silverside Fishes

G. Phonlor and J. C. B. Cousin

Several species of the family Atherinidae are abundant in southern Brazilian coastal nearshore waters (*Odontesthes incisa*, *Odontesthes argentinensis*) and the Patos Lagoon estuary (*Atherinella brasiliensis*, *Odontesthes* sp.), as well as in coastal freshwater bodies (*Odontesthes bonariensis*, *Odontesthes humensis*, *Odontesthes retropinis;* Kleerekoper 1945; Figueiredo and Menezes 1978; Chao et al. 1982; Bemvenuti 1987, 1993; Prodohl and Levy 1989; Phonlor and Vinagre 1990). Owing to a considerable morphological similarity between species, the taxonomy of the family is confused (Figueiredo and Menezes 1978). Furthermore, since marine representatives also invade and colonize brackish and freshwater environments, different phenotypes of the same species are common (Boyd and

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# Subtropical Convergence Environments

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With 66 Figures

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