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# Distribution, environment and biology of batoid fishes off Argentina, Uruguay and Brazil. A review.

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**Abstract:** Information on the distribution, environment and biology of batoid fishes occurring off Brazil, Uruguay and Argentina is summarized and reviewed for sixty species. The Magellanic fauna is a well-defined biological unit. Conversely, the northern fauna changes gradually from the temperate Bonaerensean District off northern Argentina, Uruguay and southern Brazil, to a subtropical and tropical fauna along most of the Brazilian coast. Within the area studied, rajids are the dominant batoid family, with a large number of rhinobatids and myliobatoids to the north. An analysis (Jaccard) of distribution patterns, results in nine groups largely corresponding with biological and distributional information: Group I of Magellanic species, Group II of three Magellanic species extending into the Bonaerensean District, a small Group III formed by the deep water skates *Bathyraja schroederi*, *Amblyraja frerichsi* and *Dasyatis cf. pastinaca*, another small Group IV of species with uncommon distributions, Group V of Bonaerensean species, Group VI of relatively rare deep water species, Group VII of northern migrants into the Bonaerensean District, Group VIII of Brazilian species occurring in both the South Brazilian and Brazilian districts, and a completely different Group IX of Northern Brazilian species with their southern distributional limit usually at Rio de Janeiro. Information is available also on depth and temperature of occurrence and in many cases reproduction and feeding. Preliminary evaluations of abundance have been obtained for a few species only, but the risk of overfishing is documented for some of them. An odd taxonomic - geographic situation is the status of *D. cf. pastinaca*, and a peculiar type of cloacal gestation has been described for *Benthobatis* (similar to that in *Squatina*). Studies at community ecology level are discussed and full references provided, including many reports only published as meeting summaries.

**Key words:** Batoids, zoogeography, batoid biology, Argentina, Brazil.

Biology of batoid fishes along the Atlantic coast of South America has been - as Ishiyama (1958) once said of the Rajidae - a neglected area, and our biological knowledge of this group is less than that of sharks (Menni, 1986). Many studies are only by-products of general approaches to other groups, or result from personal interest of researchers. In spite of this, a bulk of taxonomic, biological, geographic and ecological information is available. This information is often fragmentary or has not been properly published. The aim of this review is to summarize available data after a critical analysis, and provide a complete list of references. The use of available zoogeographic schemes in batoid distribution is discussed.

Off Argentina, batoid fishes used to be of low economic importance. Catches ranged from 2468 tons in 1970, to 4213 tons in 1968 and to 2612 tons in 1977, being about 0.72 % of the catches of teleostean fishes. However, during the last two years, catches increased to 12000 tons (Chiaramonte, 1998).

Batoid landings are utilized for fishmeal industry, but often material is discarded at sea. As an example, during a fishing cruise off Rio Grande do Sul, Brazil, large sharks, angel sharks (*Squatina*) and the guitarfish *Rhinobatos horkelii* were kept. An amount of but 8170 kg of skates (including *Zapteryx brevirostris*, *Rioraja agassizi*, *Atlantoraja cyclophora*, *A. castelnaui*, *Sympterygia acuta* and *Psammobatis spp.*) and 1955 kg of smaller sharks were discarded, making up with the discarded bony fishes a 21% discard of the total catch (Haimovici & Pérez Habiaga, 1982). In the pink-shrimp fishery off Ubatuba (São

Paulo), the catch per unit effort of discarded batoids (4.6 kg $h^{-1}$), is about three times higher than that of the shrimp (1.4 kg $h^{-1}$) (Amorim *et al.*, 1997).

The classification adopted here follows McEachran *et al.* (1996), with the Batoidea at superorder level, with six orders, namely Torpediniformes, Pristiformes, Rhiniformes, Rhynchobatiformes, Rajiformes and Myliobatiformes. Instead, Nelson (1994) lumped all rays and skates under one order Rajiformes equally ranked with eight order of sharks, with all nine orders forming the Superorder Euselachii under the subclass Elasmobranchii for all species of sharks, rays and skates. In contrast, Eschmeyer (1998) used a total of eleven orders under the class Elasmobranchii, with the additional two orders being Pristiformes and Torpediniformes among the rays and skates. McEachran & Dunn (1998) introduced new combinations of scientific names for rajid species. These authors firstly subdivided the family Rajidae into two subfamilies Rajinae and Arhynchobatinae, and secondly they elevated all former subgenera of *Raja* and *Gurgesiella* to generic rank. Authors worldwide have followed this concept already, and we have also adopted it for this paper. Hence, the former subgenera of *Raja*, namely *Amblyraja*, *Atlantoraja*, *Dipturus*, *Rajella*, *Rioraja*, and the nominal subgenus *Gurgesiella*, are being used here at generic rank for the specific names of southwestern Atlantic rajid species.

The first comprehensive systematic work on Argentine batoids is Norman (1937), but he included only Patagonian species. To date, the Argentine batoid fauna is composed of 38 species of 6 families (including Rhinobatidae) (Table 1), of which by far the largest is the Rajidae (Ringuelet & Arámburu, 1960; Stehmann, 1970, 1978; Menni, 1972b, 1973; McEachran, 1983; Menni *et al.*, 1984).

The Brazilian batoid fauna is composed of 44 species of 7 families (Table 1) (Fowler, 1941; Bigelow & Schroeder, 1953; Figueiredo, 1977; Rincón *et al.*, 1997). The largest family also there is Rajidae. Species of Urotrygonidae and of genera *Benthobatis*, *Diplobatis*, *Gurgesiella*, *Rajella*, *Aetobatus*, *Rhinoptera* and *Manta* are found off Brazil but do not occur in Argentine waters (Menni *et al.*, 1984).

## ZOOGEOGRAPHIC CONTEXT

The main patterns of distribution and ecology of Argentine marine fishes in general, and

Table 1. Distribution of southwestern Atlantic batoid species from southern Argentina to northern Brazil. Zoogeographic provinces and districts according to López (1963). Magellanic Province: PT= Patagonian District. Argentina Province: BD= Bonaerensean District, SBD= Southbrazilian District. Indian Province: BR= Brazilian District. (Fig. 1). *= Also Chile. **=Also Perú (Numbering of species as in the text).

| | PT | BD | SBD | BR |
|---|---|---|---|---|
| 25. *Bathyraja griseocauda** | x | | | |
| 26. *Bathyraja macloviana** | x | | | |
| 27. *Bathyraja magellanica** | x | | | |
| 28. *Bathyraja multispinis* | x | | | |
| 29. *Bathyraja papilionifera* | x | | | |
| 30. *Bathyraja scaphiops* | x | | | |
| 23. *Bathyraja albomaculata** | x | | | |
| 35. *Psammobatis normani** | x | | | |
| 36. *Psammobatis parvacauda* | x | | | |
| 37. *Psammobatis rudis* | x | | | |
| 24. *Bathyraja brachyurops** | x | x | | |
| 12. *Ambyraja doellojuradoi* | x | x | | |
| 14. *Dipturus flavirostris** | x | x | | |
| 22. *Atlantoraja platana* | x | x | x | |
| 4. *Discopyge tschudii** ** | x | x | x | |
| 16. *Dipturus trachyderma** | x | | x | |
| 31. *Bathyraja schroederi* | | x | | |
| 47. *Dasyatis cf. pastinaca* | | x | | |
| 13. *Amblyraja frerichsi* | | x | | |
| 40. *Sympterygia acuta* | | x | x | |
| 41. *Sympterygia bonapartei* | | x | x | |
| 11. *Zapteryx brevirostris* | | x | x | |
| 32. *Psammobatis bergi* | | x | x | |
| 39. *Rioraja agassizi* | | x | x | |
| 20. *Atlantoraja castelnaui* | | x | x | |
| 33. *Psammobatis extenta* | | x | x | |
| 51. *Gymnura altavela* | | x | x | |
| 1 *Torpedo puelcha* | | x | x | |
| 54. *Myliobatis freminvillei* | | x | x | |
| 55. *Myliobatis goodei* | | x | x | |
| 34. *Psammobatis lentiginosa* | | x | x | |
| 38. *Psammobatis rutrum* | | x | x | |
| 8. *Rhinobatos horkelii* | | x | x | x |
| 21. *Atlantoraja cyclophora* | | x | x | x |
| 6. *Pristis pectinata* | | x | x | x |
| 5. *Narcine brasiliensis* | | x | x | x |
| 44. *Dasyatis centroura* | | x | x | x |
| 58. *Mobula hypostoma* | | x | x | x |
| 5. *Dipturus leptocauda* | | | x | |
| 19. *Rajella sadowskii* | | | x | |
| 18. *Gurgesiella dorsalifera* | | | x | |
| 2. *Benthobatis sp.* | | | x | |
| 10. *Rhinobatos percellens* | | | x | x |
| 43. *Dasyatis americana* | | | x | x |
| 46. *Dasyatis guttata* | | | x | x |
| 48. *Dasyatis say* | | | x | x |
| 52. *Gymnura micrura* | | | x | x |
| 53. *Aetobatus narinari* | | | x | x |

| | PT | BD | SBD | BR |
|---|---|---|---|---|
| 56. *Rhinoptera bonasus* | | x | x | |
| 49. *Dasyatis violacea* | | x | x | |
| 9. *Rhinobatos lentiginosus* | | | | x |
| 17. *Gurgesiella atlantica* | | | | x |
| 7. *Pristis perotteti* | | | | x |
| 3. *Diplobatis pictus* | | | | x |
| 45. *Dasyatis geijskesi* | | | | x |
| 50. *Dasyatis sp.* | | | | x |
| 42. *Urotrygon microphthalmum* | | | | x |
| 57. *Rhinoptera brasiliensis* | | | | x |
| 60. *Manta birostris* | | | | x |
| 59. *Mobula rochebrunnei* | | | | x |

batoids in particular, are clearly related with the two main zoogeographic provinces in the western South Atlantic. These are the Magellanic Province to the South and the Argentine Province to the North, with the border between them at about 42°S (Fig. 1). The Argentine Province includes a northern section, the South Brazilian District, and a southern one, the Bonaerensean District. It is a common usage among regional biogeographers to characterize the species according to their occurrence in one or the other province or dominion (Krefft, 1968; Menni, 1981). The definition of the provinces is enhanced because of the cold temperate (subantarctic) character of the former, and the warm temperate (subtropical) character of the latter. Menni & Gosztonyi (1982) and Menni & López (1984) stated that the classic division in a Bonaerensean and a Magellanic fauna is extremely consistent and zoogeographically convenient, as noted by many authors (Balech, 1962, 1964; López, 1963, 1964; Krefft, 1968). Within these faunas, further associations of lower level (Fager, 1957; Margalef, 1984) are identified (Boschi *et al.*, 1981; Menni & Gosztonyi, 1982; Ishino *et al.*, 1983; Menni & López, 1984; Diaz de Astarloa *et al.*, 1999). Literature on Brazilian chondrichthyans usually does not refer to a formal zoogeographic concept, but instead uses the country division into north, northeastern, southeastern and southern coastal states (Fig. 2). As stated above, the Southbrazilian and the Bonaerensean Districts form the Argentine Province (an old name from Cook), with the southern limit at about 34°S. The Southbrazilian District reaches northward to Rio de Janeiro (23°S). The latitude of Rio de Janeiro consistently appears to be a faunistic border. López (1963) considers the rest of the Brazilian

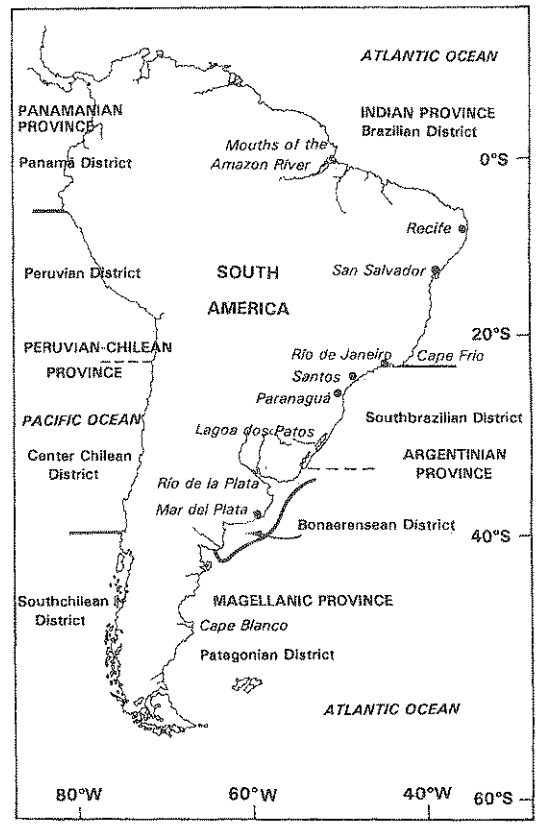


Fig. 1. Zoogeographic zones along the Atlantic coast of South America, including localities mentioned in the text. Redrawn from López (1963, 1964).

Sea a Brazilian District of the Indian Province. The Paulista and Tropical Provinces of Palacio (1982) coincide with López's (1963) districts.

## SYNOPSIS OF SPECIES

Superoder BATOIDEA
Order TORPEDINIFORMES
Suborder TORPEDINOIDEI
Family TORPEDINIDAE

1. *Torpedo puelcha* Lahille, 1926

This species was named in a paper on the brain of a 104 cm length specimen found off the coast of the Buenos Aires province. Lahille (1928) provided morphology data, the dental formulae (22-1-22/25-1-9), measurements and other data on internal organs. A cast, probably of this specimen, is in the exhibition at the Museo Argentino de Ciencias Naturales (Buenos Aires).

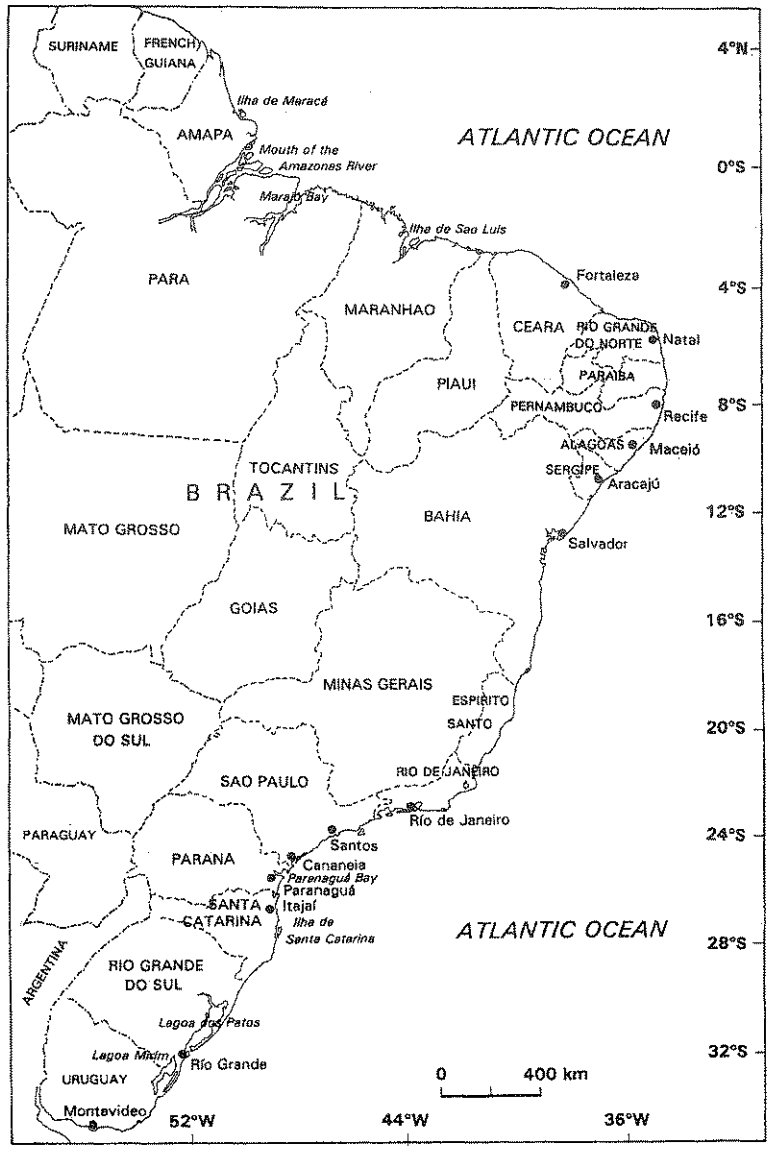


Fig. 2. Eastern South America showing Brazilian states and localities, including those mentioned in the text. International boundaries: —·—·— , Brazilian states borders: — — —.

Cousseau & Bastida (1982), based on two females from Mar del Plata measuring 103 and 104 cm, provide a detailed redescription of *T. puelcha* comparing it with *T. nobiliana*. The first specimen weighted 16 kg and was immature. The stomach content was composed of fish remains, and the liver weight was 22.5 % of the specimen's weight.

This species may rarely be found in coastal waters off Argentina, because it inhabits deeper water, as Krefft (1968) found it at 36°S at 600 m depth.

The species occurs off Brasil at Santa Catalina and Rio Grande do Sul (Figueiredo, 1977). Vooren & Betito (pers. com.) obtained a single specimen of 2.8 kg weight in November 1983 at 33°23'S, 52°08'W, depth 49 m, temperature 12.5°C, salinity 29.3 ‰.

**Other references**: Lahille, 1928 (description). Pozzi & Bordalé, 1935 (36 to 39°S on

sand and mud bottom to 30 m depth). Bigelow & Schroeder, 1953 (key). Ringuelet & Aramburu, 1960 (list). Menni *et al.*, 1984 (key, list).

Family NARCINIDAE

2. *Benthobatis sp.*

A new species of this genus (Rincón *et al.*, in press), was bottom trawled from localities along the South Brazilian coast: 27°25S, 47°06'W and 29°47'S, 47°48'W at 524 and 470 m depth respectively (Rincón & Vooren, 1993). The original sample includes 38 females from 103 to 260 mm and 40 males from 92 to 208 mm TL, but actually there were more specimens from totally 3 stations. This species had been found earlier during the German FRV «Walther Herwig» cruise 1968, also off Brazil, at 485 m depth, 9.79°C (479 m) bottom temperature and 34.890 ‰ salinity.

**Reproduction.** Males over 150 mm TL were mature. A 220 mm female had 2 embryos retained within the cloaca. This is a new type of gestation described by Sunyé & Vooren (1997) in *Squatina*. Exogenous statoliths were found in the adults.

**Feeding**. Polychaetes, the isopod *Metacirolana cf. riobaldoi*, *Pherusa sp.*, *Bathygnathia curvirostris* and amphipods were found in the stomachs. Polychaetes were ingested with the tubes and isopods in a whole. *Benthobatis sp.* is an infauna feeder (Rincón & Vooren, 1997).

3. *Diplobatis pictus* Palmer 1950

This species was described from off Georgetown, British Guiana. Fechhelm & McEachran (1984) revised the genus with detailed anatomical and phylogenetic studies. *D. pictus* is represented in Brazil by the type subspecies *D. pictus pictus* occurring north of the Amazon mouth from 2 to 130 m depth (Fechhelm & McEachran, 1984).

4. *Discopyge tschudii* Haeckel, 1846

This is the only common torpediniform species ocurring in Argentine waters. *D. tschudii* inhabits waters off Perú and Chile and off northern Argentina and southern Brazil. Gosztonyi (1981) found the species in 13 stations off southern Argentina between 36 and 120 m depth, with surface temperatures from 13.3 and 16.9°C and bottom ones from 6.5 to 15.7°C. Other data on environment and abundance can be seen in Cotrina *et al.* (1976) and Bellisio *et al.* (1979).

Table 2. Argentine batoids. Groups of species related to areas (groups of stations). Species listed according to UPGMA cluster analysis from a Jaccard matrix. Columns are numbers of stations occupied by a given species in an area as a percentage of the total number of stations within the same area (Modified from Menni and López, 1984). Areas A to F as in Fig. 3.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| **Widely distributed species** | | | | | | |
| *B. brachyurops* | — | 11.7 | 14.7 | 41.1 | 14.7 | 17.6 |
| *D. flavirostris* | 17.6 | 11.7 | 14.7 | 38.2 | 11.7 | 5.8 |
| *B. macloviana* | — | 10.7 | 7.1 | 50.0 | 21.4 | 10.7 |
| **Magellanic species** | | | | | | |
| *B. albomaculata* | — | 7.6 | 11.5 | 38.4 | 19.2 | 23.0 |
| *B. griseocauda* | — | 4.5 | 22.7 | 27.2 | 18.1 | 27.2 |
| *A. doellojuradoi* | — | 13.3 | 13.3 | 20.0 | 20.0 | 33.3 |
| *B. scaphiops* | — | — | 11.1 | 44.4 | 22.2 | 22.2 |
| *B. magellanica* | — | — | — | 42.8 | 42.8 | 14.2 |
| *B. multispinis* | — | — | 37.5 | 25.0 | 12.5 | 25.0 |
| **Inner shelf mixed fauna** | | | | | | |
| *R. agassizi* | 80.0 | 20.0 | — | — | — | — |
| *M. goodei* | 88.8 | 11.1 | — | — | — | — |
| *A. cyclophora* | 80.0 | 20.0 | — | — | — | — |
| *S. bonapartei* | 100.0 | — | — | — | — | — |
| *D. tschudii* | 71.4 | 14.2 | 7.1 | 7.1 | — | — |
| **Bonaerensean species** | | | | | | |
| *A. castelnaui* | 100.0 | — | — | — | — | — |
| *D. cf. pastinaca* | 100.0 | — | — | — | — | — |
| *A. platana* | 100.0 | — | — | — | — | — |

Table 3. Temperature and depth range of batoid species associations off Argentina. (Modified from Menni and López, 1984).

| Species | Temperatures (°C) 2 3 4 5 6 7 8 9 10 11 12 | N | Depth (m) |
|---|---|---|---|
| **Widely distributed** | | | |
| *B. brachyurops* | | 34 | 82-104 |
| *D. flavirostris* | | 34 | 58-435 |
| *B. macloviana* | | 28 | 82-505 |
| **Magellanic** | | | |
| *B. albomaculata* | | 26 | 105-815 |
| *B. griseocauda* | | 22 | 89-941 |
| *A. doellojuradoi* | | 15 | 51-642 |
| *B. scaphiops* | | 9 | 115-505 |
| *B. magellanica* | | 7 | 51-137 |
| *B. multispinis* | | 8 | 115-284 |
| **Inner shelf mixed fauna** | | | |
| *R. agassizi* | | 5 | 22-89 |
| *M. goodei* | | 9 | 22-89 |
| *A. cyclophora* | | 5 | 42-89 |
| *S. bonapartei* | | 8 | 51-72 (181) |
| *D. tschudii* | | 14 | 22-119 |
| **Bonaerensean** | | | |
| *A. castelnaui* | | 3 | 42-58 |
| *D. cf. pastinaca* | | 1 | 42 |
| *A. platana* | | 1 | (181) |

Menni & Gosztonyi (1982) considered it a Magellanic form and included it in their «Inner shelf mixed fauna», with a temperature range from 8.5 to 12.5°C (N= 12) at depths between 47 and 85 m (N= 13) based on data of two surveys. Menni & López (1984) assigned it to the same faunal association, with temperatures from 6 to 11°C at 22 to 119 m depth (N= 14) (Tables 2 and 3). Quoted statements indicate either general scarcity or disjunct distribution of *D. tschudii* in the southern southwestern Atlantic.

Vooren & Betito (pers. com.) obtained *D. tschudii* off Brasil between 33°45' and 33°56'S at 27 to 35 m depth, with temperature ranging from 11.6 to 13.5°C and salinities from 32.3 to 33.0 ‰. According to these authors, this electric ray is a cold-water species entering south Brazilian waters from the South in small numbers during winter, but not spreading farther north than 33°S.

Menni *et al.* (1981) provided complete Argentine references and biological data on material captured from 22 to 119 m (plus one capture at 181 m) at 6 to 11°C. Larger catches yielded 43.5 and 53.9 kg. Sexual segregation was evident. Mature males between 350 and 460 mm TL (N= 44) were observed with testes from 25 to 30 mm. Females with embryos were observed from 275 mm TL onward.

García (1984) studied the biology of *D. tschudii* and, based on 558 specimens, found that males attain a size (540 mm) much larger than females (390 mm). This is a sexual dimorphism opposite to that found in most chondrichthyans (but the same as in the catshark *Schroederichthys bivius*, see Menni *et al.*, 1979 and Menni, 1986). *D. tschudii* is an aplacental viviparous species (ovoviviparous). Number of oocytes per ovary was 1 to 9. Females become sexually mature from 275 mm and males from 320 mm TL onward. The number of embryos was 1 to 12 per female, with mostly 4 and 5 found. Length at birth was from 85 to 92 mm TL. Sexual ratio for embryos was found 1:1. Disc width related to total length is larger in males. García (1984) also provided the length - weight relationship for males and females and the growth of clasper length related to total length. *D. tschudii* feeds mainly on polychaete worms and gammarid amphipods.

**Other references:** Berg, 1895 (first Argentine reference). Evermann & Kendall, 1907 (Buenos Aires market). Lahille, 1921. Devincenzi & Barattini, 1926 (Uruguay). Pozzi & Bordalé,

1935 (listed, 38 to 39°S). Norman, 1937 (Patagonia). De Buen, 1950 (Uruguay). Ringuelet & Aramburu, 1960 (listed). Nani, 1964 (fish meal industry, Mar del Plata). Nani & G. Alberdi, 1966 (abundance). Krefft, 1968 (occurrence in Magellanic Province). Olivier *et al.*, 1968 (ecological type). Cervigon & Cousseau, 1971 (Mar del Plata). Odemar & Silvosa, 1971 (abundance). Iwai *et al.*, 1972 (Patagonia). Castello & Tapia Vera, 1973 (reference). Gosztonyi & Menni, 1978 (localities). Stehmann, 1978 (key). Menni & Lopez, 1979 (occurring with *Polyprion americanus*). Cousseau & Bastida, 1982 (reference). Iraldi *et al.*, 1984 (electroplate ultrastructure). Menni *et al.*, 1984 (list, key).

5. *Narcine brasiliensis* (Olfers, 1831)

There is only a reference by Lahille (1928) for Argentina from Isla Verde environs, Buenos Aires Province. Remaining Argentine references are all nominal. In recent times, the species has been reported from off several localities along the Brazilian coast, including Rio Grande do Sul (Vooren & Betito, pers. com.), Paraná State (Charvet & Moreira, 1993; Charvet, 1995), Cananeia (Gonzales, 1995), Ubatuba (Cunningham, 1989), Bahia State (Queiroz *et al.*, 1993), Pernambuco State (Guedes *et al.*, 1989), Paraíba State (Gadig, 1993), Maranhão State (Lessa, 1986) and Pará and Amapá States (Alves de Oliveira, 1973).

Vooren & Betito (pers. com.) characterized *N. brasiliensis* off southern Brazil as "a warm water species", with the lower temperature limit being 16°C. When there is an inshore-offshore temperature gradient at depth less than 60 m, it concentrates at the depths with highest temperature. This species migrates into the mentioned area in November and December presumably from the North, with only few spreading beyond 32°S, and individuals leave the area in May and June. Temperatures to the south of latitude 32°S at depths between 10 m and 60 m ranged between 19.0 and 25°C from January to May, and in January 1982 the salinity in that depth range varied from 24 to 36 ‰ throughout the study area. Therefore the temperatures alone does not explain the scarcity of the species beyond 32°S in summer. Possibly the hydrographic conditions around the mouth of Los Patos lagoon constitute a barrier limiting the southward migration of this shallow water species.

**Feeding**. Specimens collected with otter trawl off Ubatuba (near São Paulo, Brazil) had polychaetes and callianasid crustaceans in their stomachs, with lower incidence of isopods and carideans (Torres & Goitein, 1987). Other observations at the same locality showed that *N. brasiliensis* had fed on polychaetes (85%), fish (29%) and crustaceans (14%), with a peak of feeding activity at midnight and dawn (Costa, 1997).

**Reproduction**. Off the northern part of the Paraná State, 50% of specimens showed near term embryos, as also those of *Rhinoptera sp.* and *Mobula sp.* (Charvet & Moreira, 1993).

**Other references**: Lahille, 1921 (nominal). Pozzi & Bordalé, 1935 (39°30' S, sand and mud to 30 m depth). Bigelow & Schroeder, 1953 (key, references). Ringuelet & Aramburu, 1960 (list). Stehmann, 1978 (key). Cousseau & Bastida, 1982 (reference). Menni *et al.*, 1984 (list, key).

Order PRISTIFORMES
Family PRISTIDAE

6. *Pristis pectinata* Latham, 1794

The only information for Argentina on this species is by Lahille (1906, 1921), who (1921) obtained it at Mar del Plata twice: «The first specimen, with a total length of 1.80 m has 25 rostral denticles in one side and 27 in the other. The second specimen, measuring 2.05 m has 31 pairs of rostral denticles». These figures fall exactly within the range given by Bigelow & Schroeder (1953). A saw of this species, collected off Argentina, is exhibited at the Museo Argentino de Ciencias Naturales in Buenos Aires (H.P. Castello, pers. com.).

Besides references gathered in Bigelow & Schroeder (1953), *P. pectinata* is reported from Brazil by Figueiredo (1977), by Alves de Oliveira (1975) from the Pará and Amapá states between 1° and 4°30'S, and by Gadig, 1998 from São Paulo State.

**Other references**: Pozzi & Bordale, 1953 (list). Ringuelet & Aramburu, 1960 (list). Menni *et al.*, 1984 (key, list). Rincón *et al.*, 1997 (list). Rosa, 1997 (threatened species).

7. *Pristis perotteti* Müller & Henle, 1841

Bigelow & Schroeder (1953) stated that off Brasil this sawfish has been reported from Santos, Rio de Janeiro environs, Bahia, Natal and Marajó Island, as well as from the Amazon River. *P. perotteti* was also reported from Maranhão (Lessa, 1986) among the chondrichthyans obtained with gillnets between 6 to 37 m depth, but it appears to be a very rare species (Garrido Martins Juras *et al.*, 1987; Stride *et al.*, 1992; Lessa & Menni, 1994). It has been also reported from São Paulo, at 8 to 40 m depth (Gadig, 1998). A saw of this species is exhibited at the Museo

Argentino de Ciencias Naturales (H.P. Castello, pers. com.). It is considered a threatened species (Rosa, 1997).

Order RHYNCHOBATIFORMES

*Incertae sedis*, formerly in family RHINOBATIDAE

8. *Rhinobatos horkelii* Müller & Henle, 1841

The first Argentine reference to a species of *Rhinobatos* is from Berg (1895), who quoted *Rhinobatus undulatus* from Mar del Plata (Argentina), and Montevideo and Maldonado (Uruguay). He stated that "this species enters also the Río de la Plata and reaches the Buenos Aires harbor, where it has been fished at several occasions". Due to environmental changes, the species is no longer found at the latter locations.

Probably following Bigelow & Schroeder (1953), Ringuelet & Aramburu (1960) reported *R. percellens* for Argentina. Refi (1973) noted that the *Rhinobatos* species occurring there is referable to *R. horkelii*, already reported from southern Brazil (Sadowsky, 1971).

Bigelow & Schroeder (1953) stated that nothing was known of the species' habits. Refi (1973) described material from Mar del Plata (3 females, November 1970, and 3 females, January 1971). Her data included a 1187 mm female, so that *R. horkelii* is the largest guitarfish in the western Atlantic.

Along the Brazilian coast, the species has been reported from Rio Grande do Sul (Vooren & Lessa, 1981 a,b; Haimovici & Pérez Habiaga, 1982; Carneiro & Vooren, 1986), Itajaí (Kotas *et al.*, 1995), the estuarine complex of the Paranaguá Bay (Barletta & Correa, 1989), the Paraná State (Charvet, 1995) and Ubatuba in the São Paulo State (Cunningham, 1989; Cunningham *et al.*, 1991), but not further north.

*R. horkelii* is found among the by-catch fauna captured together with the shrimp *Pleoticus muelleri* in the Bonaerensean District. Bottom water temperature and salinity in the fishing area ranged from 20.1 to 22.9°C and from 30.06 to 33.7 ‰ at depths from 5 to 20 m (Boschi & Scelzo, 1967). Gosztonyi (1981) observed this species at 38°58.8'S at 44 m depth and a bottom temperature of 17.7°C. It is fished round the year off Mar del Plata (Nani, 1964), where it behaves as a bottom dwelling fish burrowing in the ground (Olivier *et al.*, 1968).

**Feeding habits.** *R. horkelii* feeds on *Octopus tehuelchus*, on the decapod crustacean *Pleoticus muelleri*, other Natantia decapods, isopods and polychaetes (Refi, 1973), and is one of twelve fish species that fed on the squid *Loligo sanpaulensis* (Castellanos, 1967). Specimens between 30 and 130 cm TL permanently inhabit coastal areas feeding on juvenile and adult *Engraulis anchoita* but not on its larvae (Angelescu, 1982).

Off Rio de Janeiro (Brazil), most frequent prey groups were crustaceans and annelids, followed by lancelets, mollusks and fish. Mature females have a wider food range than immature ones, without large seasonal differences. In contrast both, mature and immature males have similar trophic habits, though mature males preferred crustaceans especially during spring. No significant differences were observed between males and females (Batista, 1984). In the same area at Cabo Frio environs, 122 fishing vessels 8 to 15 m long using mainly gillnets made 377 landings. The total catch was 16,506 kg, of which 342 kg were rays, over half of these *Rhinobatos sp.* (Pimenta *et al.*, 1993). Specimens collected with otter trawl off Ubatuba (Brazil) had fed mysidaceans, caridean and penaeids crustaceans (Torres & Goitein, 1987, pers. com.).

**Reproduction.** Lessa & Vooren (1982) stated that mating, ovulation, gestation and birth of *R. horkelii* off southern Brazil (30 - 34°S) take place in the shallow coastal waters from November to March, because the high summer temperatures (22 - 24°C) are essential for embryonic development.

The coastal fishery catches *R. horkelii* at a critical point in its life cycle, exploiting almost exclusively the females at a late stage of pregnancy, when these form dense and vulnerable concentrations in shallow water. In view of the low individual fecundity (6 - 12 pups), the stock of this species will only sustain the present level of adult female mortality (instantaneous rate Z= 0.72), if the juvenile mortality maintains a low level (instantaneous rate M= 0.24) (Lessa & Vooren, 1982). Trawl fishing between 34°10' to 31°50'S and 28°40' to 31°50'S at 108 to 530 m obtains 17 species of sharks and 12 of skates and rays. If this fishery fails to catch *R. horkelii* and the deep migration hypothesis is excluded, the low abundance is due to high fishing mortality and a serious problem of overexploitation become obvious (Vooren *et al.* pers. com.). The species has recently been included in the IUCN Red List as "critically endangered" (Lessa & Vooren, 1998; Shooton, 1999).

Applying the Beddington model, with age of first recruitment TR= 4 years, fishing mortality F= 0.6 and natural mortality M= 0.2, the result is a Spawning Stock Biomass of *R. horkelii* off southern Brazil having decreased to 15 % of the initial biomass (Lessa, 1989).

Nani (1964) examined a 1213 mm TL immature female of 8 kg weight. Refi (1973) reported a female of 1187 mm TL and 6.9 kg weight with two embryos in the left uterus and four in the right one. Eight ova reached 15 mm diameter. The maximum sustainable yield off the Bonaerensean coast is estimated at 2700 tons (Otero *et al.*, 1982).

Lessa (1982) has provided a full account on the species in Brazilian waters. Females appeared as deep as 100 m depth off Rio Grande do Sul during 1981. Both ovaries were found functional. Gestation is aplacentary with large yolk sacs (lecitotrophic). Vitellogen follicles appear first at female size over 90 cm TL. From that size onward, the nidamental gland grows allometrically and shows seasonal size variation related to ovulation, with larger sizes from December to March. Females were found pregnant from 91 cm total length onward, and all females over 119 cm TL reproduced only once a year. The duration of the reproductive phase of females is 5 years, the accumulated offspring (number) is 30. Ovarian development and gestation happen simultaneously; the largest size of oocytes is found between September and February. The number of oocytes is definitive by November, and ovulation takes place during following April. During this month, littering, mating, ovulation and fertilization, as well as the beginning of gestation, take place in a quick sequence in coastal waters at 5 to 15 m depths. Gravid females disperse after mating to beyond 50 m depth. Uterine eggs remain unevolved until the following December, when females return to coastal waters and development of embryos starts to be completed by the following April. The period from fertilization to birth is almost 12 months, but embryonic development itself takes only 4 months (See details in Lessa *et al.*, 1986, and Lessa *et al.*, 1997). Largest size off Brazil was 129 cm in 1981 (Lessa, pers. com.). Vooren (1992) discussed reproductive strategies of eight viviparous elasmobranchs from Brazil, including *R. horkelii*, stating that in lecitotrophs, fecundity and relative body size at birth were inversely correlated, due to limited annual production of reproductive biomass.

**Other references**: Devincenzi, 1920 (Uruguay). Lahille, 1921 (list). Marelli, 1924 (list). Devincenzi & Barattini, 1926 (Uruguay). Marini, 1929 (list). Pozzi & Bordale, 1935 (list). López, 1947 (anatomy). Castello, 1971 (photograph, reference). Browneel *et al.*, 1973 (off Uruguay). Ringuelet, 1975 (occasionaly entering fresh water). Lessa, 1982 (biology in Brazil). Otero *et al.*, 1982 (fishery biology) Menni *et al.*, 1984 (key, list)

9. *Rhinobatos lentiginosus* Garman, 1880

Bigelow & Schroeder (1953) stated a distribution of *Rhinobatos lentiginosus* from Yucatán to Cape Lookout, North Carolina, and said this species were not likely to have been overlooked, because of its color pattern, if also occurring off Brazil. Lessa (1986) reported it first from the State of Maranhão. Only an immature male of 55.8 cm TL and 0.51 kg weight was found there in October 1995, the species thus being the least frequent of 19 species (Lessa & Menni, 1994; Menni & Lessa, 1998). The species has frequently been caught in coastal waters from Pernambuco to Ceará (Lessa *et al.*, 1995; Lessa *et al.*, 1999).

10. *Rhinobatos percellens* Walbaum, 1792.

Bigelow & Schroeder (1953) stated that this species, described originally from Brazil, ranged from northern Argentina to the Caribbean. As said above, the common *Rhinobatos* species occurring off Argentina is *R. horkelii*. Off Brazil, *R. percellens* was reported from the Paranaguá Bay, other localities in the Paraná State (Barletta & Correa, 1989; Charvert & Moreira, 1993; Charvet, 1995 -doubtful-), Cananeia in the State of São Paulo (Gonzalez, 1995), San Salvador de Bahia (Queiroz *et al.*, 1993), the State of Pernambuco (Guedes *et al.*, 1989), Paraiba (Gadig, 1993) and the northern states of Pará and Amapá (Alves de Oliveira, 1975).

11. *Zapteryx brevirostris* (Müller & Henle, 1841)

Nani (1964) reported *Zapteryx brevirostris* first time for Argentina. Before, it was only known from Rio de Janeiro environs and Bahia, Brazil (Bigelow & Schroeder, 1953). The species does not occur farther south than the Bonaerensean District. Gosztonyi (1981) reported it between 37°01.6' and 38°S and from 56°02.2' to 56°58.5' W at bottom temperatures from 9.8 to 18.8°C and 26 to 136 m depth.

Along the Brazilian coast it has been reported from Rio Grande do Sul (Figueiredo, 1977), the State of Paraná (Charvet, 1995; Charvet & Moreira, 1993), and in the State of São Paulo from Cananeia (Gonzales, 1995) and Ubatuba environs (Cunningham, 1989; Cunningham *et al.*, 1991).

Nani (1964) sampled a female of 657 mm TL and 1.97 kg with four embryos and a mature male of 1.27 kg at Mar del Plata, where the species is absent in July and August (winter). Castello (1971) examined 31 females and 47 males, also from Mar del Plata, and provided a detailed

redescription, based on 7 males and 3 females with total length from 550 to 600 mm and 1.15 to 1.56 kg weight. He counted 134 and 135 total vertebrae. Based on his own and unpublished data from Nani, he reported total lengths for both sexes between 429 and 661 mm. The largest male measured 635 mm and weighted 1.465 kg, the smallest one was 505 mm and 0.77 kg. The largest female measured 661 mm and weighted 1.924 kg, the smallest one 429 mm and 0.65 kg.

**Feeding habits.** Most of 57 analyzed specimens showed a full stomach. Small Reptantia decapods were observed with 64.9 % frequency, polychaete worms with 61.4%, Natantia decapods with 40,3%, lancelets (*Branchiostoma platae*) with 38.6%, amphipods with 28% and isopods with 24.5%. Percentage of fishes was low (15.7%) and included *Prionotus sp.* and *Pinguipes sp.* (Castello, 1971).

In the Rio de Janeiro (Brazil) littoral, more frequent groups in the food of *Z. brevirostris* were crustaceans and annelids, followed by lancelets, mollusks and fish. Mature females have a wider range of prey items than immature ones, without large seasonal differences. In contrast both, mature and immature males have similar trophic habits, though mature males preferred crustaceans especially during spring (Batista, 1984).

**Reproduction and maturity.** Ponz Louro & Rossi-Wongtschowsky (1991) reported data from 72 otter trawls performed during 2 years at 15, 30 and 50 m depth off the Ubatuba coast in the São Paulo State, Brazil. Eighty-six females of 13 to 54 cm TL were examined. This viviparous species has both ovaries functional and reaches 50% maturity at 44 cm TL. A group of 4 oocytes, each of 10 to 30 mm diameter, developed in each ovary during a single reproductive cycle. A mean of 3 eggs and/or embryos developed in each uterus, with 6 specimens per litter and cycle. Gravid females were found during the sampling period toward the northern localities, where the mean water temperature was 18.91°C. Young specimens occurred at 35 m depth, with a mean water temperature of 19.41°C. Both groups were captured over fine sand bottoms.

Within the same area, maximum sizes were 53.6 cm for males and 99.2 cm for females. Monthly average size (cm) of newborn individuals were 13.6 (July), 15.1 (August), 16.6 (September), 17.7 (October), 18.1 (November) and 22.9 (January) Amorim *et al.* (1997).

**Parasites.** The following intestinal parasites have been reported: a pleurocercoid of *Phyllobotrium*, *Echinobotrium pigmentatum*, *Acanthobotrium zapterycum* and *Acanthobotrium sp.* (Cestods) (Ostrowsky de Nuñez, 1971).

**Other references:** Refi, 1973 (Rhinobatoids key). Menni *et al.*, 1984 (key, reference). Batista, 1987 (length-weight relationship).

Order RAJIFORMES
Family RAJIDAE
Subfamily RAJINAE

12. *Amblyraja doellojuradoi* (Pozzi, 1935)

This rather common species in Magellanic waters, was described by Pozzi (1935, 1936) from 39°2'S and 56°W. Norman (1937) provides good illustrations and material catch data from 45°45' to 52°53' S and 59°35' to 64°19' W. Table 4 shows environmental parameters for the species. Krefft (1968) reported it from the slope (600 m) at 37°S. Menni & Gosztonyi (1982) found it only once at 152 m depth and bottom temperature of 4.5°C.

Table 4. *A. doellojuradoi*. Environmental data. A: Iwai *et al.* (1972), B: Menni & Gosztonyi (1978), C: Cotrina *et al.* (1976), D: Gosztonyi (1981), E: Menni *et al.* (1981). * Along the slope from Buenos Aires Province to the Burwood Bank.

| Ref. | Temperature (°C) Surface | Bottom | Depth (m) | Locality | N |
|---|---|---|---|---|---|
| A | – 9.2 | 5.6 – 6.1 | 164 – 180 | 51°04´ 51°39´S 60°08´61°42´W | 2 |
| B | – | – | 203 – 281 | 43°36´48°47´S 60°58´61°04´W | 2 |
| C | – | – | – 95 | 40°16´S54°44´W | 1 |
| D | 5.8 – 16.3 | 3.8 – 8.0 | 87 – 695 | * | 18 |
| E | 4.4 – 8.0 | 2.5 – 6.8 | 51 – 642 | 40°30´51°30´S 56°30´68°25´W | 15 |

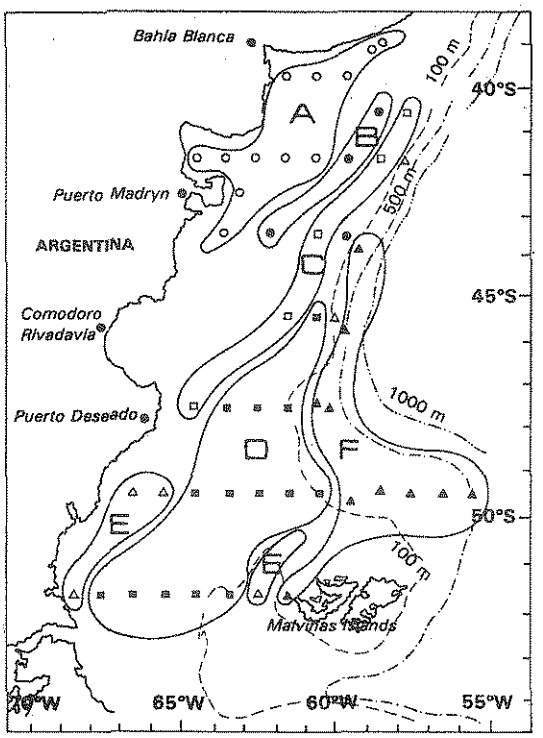


Fig. 3. Areas occupied by elasmobranch communities (Table 2) in the Argentine Sea. Cluster analysis (UPGMA) from a Jaccard matrix of data from the 1978 "Shinkai Maru" cruise (From Menni and López, 1984).

In the same paper they consider a «Kaiyo Maru» sample where *A. doellojuradoi* appears closely associated with other Magellanic species south of 45°S. Results from Menni & Lopez (1984) agree with this (Tables 2 and 3).

Of six areas considered by Menni & López (1984) (Fig. 3), *A. doellojuradoi*, *Bathyraja albomaculata* and *B. griseocauda* were found in five, *B. scaphiops* and *B. multispinis* in four and *B. magellanica* in three, always within the Magellanic group. Bellisio *et al.* (1979) found it from 38°30' S to the Burdwood Bank (55°S) mainly at the edge of the shelf.

**Other references:** Bigelow & Schroeder, 1953 (key). Ringuelet & Aramburu, 1960 (list). Stehmann, 1970 (subgeneric assignment). Iwai *et al.*, 1972 (distribution). Cotrina *et al.*, 1976 (distribution). Gosztonyi & Menni, 1978 (distribution). Stehmann, 1978 (key). Gosztonyi, 1981 (distribution). Menni *et al.*, 1981 (distribution). Menni *et al.*, 1984 (key, list).

13. *Amblyraja frerichsi* (Krefft, 1968)

This species was described from the slope off Argentina, from 35°43' S and 52°43' W at 1000 m depth. Depth range is from 600 to 1000 m (mean 800 m, N= 6, «Walter Herwig» 1966 expedition).

**Other references:** Stehmann, 1970 (subgeneric assignment). Stehmann, 1978 (key). Menni *et al.*, 1984 (key, list).

14. *Dipturus flavirostris* (Philippi, 1892)

Norman (1937) provided a redescription, figures and distribution data of this species under the widely used combination *Raja flavirostris*. Stehmann (1970) proposed the subgeneric assignment. Pequeño (1985), following De Buen (1959), used for this species the name *D. chilensis* (Guichenot, 1848). We consider this practice inadequate under Article 23c and Article 79b of the ICZN.

*D. flavirostris* is a species with a wide distribution in the Argentinean Sea, where it is found at least from 34°35'S (Menni, 1983; Menni & Gosztonyi, 1982; Menni & López, 1984) to the southern tip of Argentina and also off Chile. According to Bellisio *et al.* (1979), it is the most abundant rajid species. Table 5 provides environmental parameters. Agreeing with this, Menni & Gosztonyi (1982) placed *D. flavirostris* in their Group IV "Widely distributed species", stating that the species spreads to the north to the latitude of Mar del Plata (38°S). Data from 58 stations (Japanese R/V "Orient Maru I", November- December 1976 cruise) provide a bottom temperature range from 4 to 13.5°C and a depth range between 46 and 235 m. Another 34 observations (Japanese R/V "Shinkai Maru" August-September 1978 cruise) give a bottom temperature range from 3.5 to 11°C at depths from 58 to 435 m (Menni & López, 1984). Menni (1973) reported it from the Bonaerensean District with temperatures from 8.21 to 8.38°C and salinity from 33.53 to 34.33 ‰, respectively.

**Other references:** Bigelow & Schroeder, 1953 (key). Angelescu *et al.*, 1958 (accompanying fauna of *Merluccius hubbsi*). Ringuelet & Aramburu, 1960 (list). López, 1963 (distribution). Nani, 1964 (Mar del Plata). Nani & G.Alberdi, 1966 (Mar del Plata). Hulley, 1966 (differences to *D. batis*). Olivier *et al.*, 1968 (ecology, feeding). Krefft, 1968 (Magellanic fauna). Hulley, 1970 (differences to *D. pullopunctatus*). Menni, 1971 (clasper). Iwai *et al.*, 1972 (distribution). Hulley, 1972 (pelvic bar). Menni, 1972 (list, clasper). Castello & Tapia Vera, 1973 (reference). Krefft & Stehmann, 1974 (reference). Cotrina *et al.*, 1976

Table 5. *D. flavirostris*. Environmental data. A: Iwai *et al.* (1972), B: Menni & Gosztonyi (1977), C: Gosztonyi (1981), D: Menni *et al.* (1981). *Sout of Buenos Aires to 53°S

| Ref. | Temperature (°C) | | Depth (m) | Locality | N |
|---|---|---|---|---|---|
| | Surface | Bottom | | | |
| A | 8.4 – 15.5 | 5.3 – 8.3 | 80 – 188 | 45°23´51°17´S | |
| | | | | 59°40´66°51´W | 3 |
| B | – 8.2 | – 4.0 | 270 – 281 | 47°43´S61°02´W | 1 |
| C | 7.8 – 18.4 | 4.5 – 18.8 | 28 – 311 | * | 51 |
| D | 5.6 – 11.5 | 4.5 – 11.0 | 55 – 435 | 39°30´51°30´S | 34 |

(distribution). Menni & Gosztonyi, 1977 (accompanying fauna of *D. trachyderma*). Stehmann, 1978 (reference). Bellisio, 1982 (reference). Menni *et al.*, 1984 (key, list). Gosztonyi, 1979 (Tierra del Fuego). Menni & Lopez, 1979 (captured with *Schedophilus griseolineatus*). Gosztonyi, 1981 (distribution). Menni, 1981 (distribution). Menni *et al.*, 1981 (distribution). Angelescu & Prenski, 1982 (captured with, and predator of *M. hubbsi*). Lloris & Rucabado, 1991 (taxonomy, distribution).

15. *Dipturus leptocauda* (Krefft & Stehmann, 1975)

This species was described from a small juvenile holotype only from off southern Brazil (24°21'S, 43°54'W) at 500 m depth, with a bottom temperature of 9.56 °C and 34.673 ‰ salinity.

16. *Dipturus trachyderma* (Krefft & Stehmann, 1975)

This species was described from 49°S and 52°W, between 195 and 200 m depth and a bottom temperature of 5.7°C. Menni & Gosztonyi (1977) reported the species from three stations placed between 47°36' to 49°05' S and 60°45' to 61°12 W. Surface temperatures ranged from 7.5 to 8.2°C and bottom ones from 4.0 to 5.5°C at depths from 191 to 281 m. The 1978 R/V «Walther Herwig» cruise captured *D. trachyderma* from 45°35.1' to 51°06.8'S and from 62°24' to 66°43.8'W at 98 to 185 m (Menni *et al.*, 1984).

Off Brazil, *D. trachyderma* has been reported from Rio Grande do Sul to Rio de Janeiro at depths from 100 to 500 m (Rincón *et al.*, 1997; Gadig, 1998; Haimovici *et al.*, 1998 and Picado & Gomes, 1999). The species appears to change depth to maintain itself within a low temperature range.

The species occurs also in Chile (Leible, 1987). Leible & Stehmann (1987) presumed that the species (like *D. flavirostris*), is continuously distributed in Patagonian waters on the Atlantic, as well as on the Pacific side.

**Other references:** Stehmann, 1978 (key). Menni, 1981 (distribution). Menni & Gosztonyi, 1982 (associations). Lloris & Rucabado, 1991 (taxonomy, distribution).

17. *Gurgesiella atlantica* (Bigelow & Schroeder, 1962)

This species occurs in the equatorial Atlantic along the northeastern coast of South America from Venezuela to about the Amazon mouth (Hulley, 1972).

18. *Gurgesiella dorsalifera* McEachran & Compagno, 1980

This species was described from off Rio de Janeiro and Florianópolis (23°44´S-42°08´W, 23°50'S-42°W, 24°28'S-43°43'W, 30°03'S-47°44'W). Depths ranged from 500 to 800 m, bottom temperatures from 4.99 to 8.10°C and salinity from 34.247 to 34.540 ‰ It was reported later from nearby localities at 21°31.42´S, 40°06.83´W and 23°46.73´S, 42°10.05´W (Seret & Andreata, 1992).

**Reproduction and Feeding**. Both ovaries were functional, with maturing eggs 3 to 4.7 mm diameter in a female 207 mm DW and 365 mm TL, with nidamental gland 14 mm width. A 375 mm TL female was immature. No mature males were observed, the largest individual was 340 mm TL. Vaske *et al.* (1997) consider that *G. dorsalifera* become sexually mature around 365 mm TL.

Vaske *et al.* (1997) also reported the capture of 8 and 4 individuals respectively at 27°25'S, 47°07'W and 29°47'S, 47°48'W between 470 and 524 m depth. Stomach content of 4 males and 6

females, with 115 to 207 mm DW, included *Urophysis brasiliensis*, other teleosts, the copepod *Bradydius plinioi* and decapod and mysidacean crustaceans.

19. *Rajella sadowskii* (Krefft & Stehmann, 1974)

This species was described from the continental slope off southern Brazil between 22°30' and 28°34'S and 40°07' and 46°53'W at 800 to 1200 m. Bottom water temperatures were 3.28 to 4.89°C and salinity 34.287 to 34.558 ‰. Two juvenile males 542 mm and a female 582 mm TL were reported from 21°24'S and 39°56'W at 1360-1320 m (Seret & Andreata, 1992).

Subfamily ARHYNCHOBATINAE

20. *Atlantoraja castelnaui* (Miranda Ribeiro, 1907)

Miranda Ribeiro, who previously (1903) considered it as a variety of *R. agassizi*, described this species in 1907. Reported by Devincenzi (1924) from the Rio de La Plata, most references can be found in Menni (1973).

The species occurs in the Southbrazilian and Bonaerensean districts, where it is the largest and one of the most common rajid species (Menni, 1973; Menni, 1981). Its peculiar reddish spots on a yellowish brownish background make it unmistakable. It is common off southern Brazil, with females and juveniles inhabiting more coastal areas, and fish being the main food item (N= 25) (Tomas & Tutui, 1991).

Menni *et al.* (1981) found the species from 38°53' to 39°31'S and from 58°35' to 59°33'W at depths between 41 and 59 m, with surface temperatures ranging from 10.1 to 11.2°C and bottom temperatures from 9.6 to 10°C.

Menni & Gosztonyi (1982) included it in the «Bonaerensean fauna», based on data from four localities north of 41°S, with bottom temperatures between 12.5 and 13.5°C at depths from 46 to 52 m. Menni & Lopez (1984) also included it within their Group VI of "Strictly Bonaerensean fauna", with data from three stations between 42 and 58 m at temperatures from 9.6 to 10°C.

Material trawled between 30°40' to 34°30'S at 10 to 100 m depth (southern Brazil), indicated the occurrence in the area throughout the year and egg-laying from January to October, with a peak in January (Peres & Vooren, 1993).

Barbosa & Gomes (1998) discussed morphology of juveniles of this species, *A. cyclophora*, *A. platana* and *R. agassizi*. They suggested that darker color in Brazilian *A. platana* and *A. cyclophora* could be related with depth.

**Other references:** Bigelow & Schroeder, 1953 (key). Ringuelet & Aramburu, 1960 (list). Krefft, 1968 (Argentinean province). Menni, 1972 (subgenus *Atlantoraja*, list). Briggs, 1974 (zoogeography). Stehmann, 1978 (key). Menni *et al.*, 1984 (key, list).

21. *Atlantoraja cyclophora* (Regan, 1903)

This species was described from Rio de Janeiro (Brazil), and occurs in both the Southbrazilian and Bonaerensean districts. Pozzi & Bordale (1935) reported it for the first time from Argentina. Off southern Brazil, it was found from 30 to 120 m, with a larger biomass below 50 m (but depth varies regionally), with crustaceans as the main diet (Tomas & Tutui, 1991). The species has been considered characteristic of the warm-temperate zone (Briggs, 1974), and is rather common off the Bonaerensean coast (Menni, 1981). Gosztonyi (1981) found it off the Buenos Aires Province, north of 39°04'S at depths from 26 to 71 m, with surface temperatures from 17.3 to 18.5°C and bottom ones from 13.5 to 18.8°C. Menni *et al.* (1981) captured it within the same area at 42 to 89 m depth at surface temperatures from 10.3 to 11.2°C and bottom ones from 6.8 to 9.6°C.

Menni & Gosztonyi (1982) found it at three stations with bottom temperatures from 12.5 to 13.5°C between 46 and 50 m. They grouped the species as to belonging to the "Bonaerensean fauna", with a high degree of fidelity. Menni & Lopez (1984) labeled it as a Bonaerensean species within the "Inner shelf mixed fauna". They found it at 42 - 89 m, with bottom temperatures from 6.8 to 9.6°C. The species spreads to north Patagonia during summer (Bellisio *et al.*, 1979). During German investigations *A. cyclophora* was found at 200 m depth, with 13.6°C bottom temperature at 33°50S 51°21W (FRV "Walther Herwig" 1966 cruise).

*A. cyclophora*, that was trawled off southern Brazil between 30°40' and 34°30' S from 10 to 100 m depth, lays eggs throughout the year, with peaks in January and April (Peres & Vooren, 1993). From 19° to 28°S was reported by Amorim *et al.* (1995, bottom longline). Other data show that off Brazil the species occurs from Rio Grande do Sul to the State of Rio de Janeiro, at depths from 30 to 500 m (Lessa, pers. com.).

A reference by Uyeno *et al.* (1983) from off French Guiana and Suriname makes this species, if correctly identified, by far the most northward reaching South Atlantic species.

**Other references**: Miranda Ribeiro, 1907 (description, illustration). Ringuelet &

Aramburu, 1960 (list). Nani, 1964 (Mar del Plata). Nani & G. Alberdi, 1966 (Mar del Plata). Krefft, 1968 (Argentinean Province). Hulley, 1972 (reference). Menni, 1972b (subgenus *Atlantoraja*, list). Menni, 1973 (description, clasper). Stehmann, 1978 (key). Menni *et al.*, 1984 (list, key). Bellisio *et al.*, 1979 (distribution, abundance). Amorim *et al.*, 1997 (off Ubatuba, São Paulo). Rincón *et al.*, 1997 (list). Gadig, 1998 (São Paulo).

22. *Atlantoraja platana* (Günther, 1880)

This species was described based on a specimen obtained by the R/V «Challenger» at 35°02'S and 55°W (off Montevideo, Uruguay) at 26 m depth (Günther, 1880). Sadowsky & Menni (1974) examined material captured at 11 localities from 29°13' to 34°S and from 49°35' to 52°29'W (off Brazil and Uruguay), also providing anatomical information and characteristics of the holotype. Depths ranged from 19 to 149 m with 10 stations deeper than 92 m, on clay (dominant), mud and sand bottoms. Temperatures ranged from 10.96 to 23.21°C (mean= 18.6°C), with salinity from 32.58 to 36.03 ‰. *A. platana* occurs within the San Matias Gulf (41°10.6' to 42°S and 64° to 64°58.8' W) at 60 to 149 m depth, with a surface temperature of 14.1°C and bottom ones from 12.6 to 13.5°C (Zaro, 1979). It was found at the same Gulf at 181 m depth with surface and bottom temperatures of 11.5 and 11°C respectively (Menni *et al.*, 1981). *A. platana* is a member of the "Strictly Bonaerensean fauna" association (Menni & Lopez, 1984) in Argentina, but occurs off southern Brazil at Santos (Tomás & Tutui, 1991) and at least to 23°S (Stehmann & Menni, pers. obs.). The species is trawled off southern Brazil between 30°40' and 34°30'S from 10 to 100 m depth throughout the year. It has an annual reproductive period, laying eggs from January to September with a peak in January (Peres & Vooren, 1993). In the same area *A. platana* is rare north of 26°S, and occupies a niche similar to *A. cyclophora* (Tomas & Tutui, 1991). During the FRV «Walther. Herwig» 1966 cruise it was obtained at 32°45S, 53°12W (75 m depth, 21.6°C bottom temperature) and 34°37, 52°15W (120 m depth, 15.5°C temperature).

**Feeding habits.** Food of *A. platana* is composed of fish remains, penaeid crustaceans and small quantities of cephalopods (Peres & Vooren, 1993). The myctophid fish *Lampanyctus australis*, the shrimp *Artemesia longinaris* and the squid *Loligo sanpaulensis* were identified in the stomach content.

**Other references:** Lahille, 1895 (Punta Lara, near La Plata. Though this old report may be correct, meanwhile the species no longer occurs there, since the location became a polluted area). Ringuelet *et al.*, 1967 (occasionally in fresh water, probably based on Lahille report). Stehmann, 1978 (key). Menni *et al.*, 1984 (listed, key). Rincón *et al.*, 1997 (list).

23. *Bathyraja albomaculata* (Norman, 1937)

This species was obtained by the R/V «Discovery» from an area between 51°44' to 53°30'S and 58°27' to 64°19'W at 137 to 403 m (Norman, 1937). It is a Magellanic species in the classical sense of the "Region of Patagonia and Malvinas" (Norman, 1937). Menni & Gosztonyi (1982) and Menni & Lopez (1984) included it in the Magellanic fauna together with *B. griseocauda*, *B. macloviana*, *B. magellanica*, *Macrourus holotrachys*, *Salilota australis*, *Micromesistius australis*, *Macruronus magellanicus*, *Cottoperca gobio*, *Dissostichus eleginoides* and species of *Notothenia*. Menni & Gostonyi (1977) found it with the same accompanying species, plus *Dipturus flavirostris*, *D. trachyderma* and *Merluccius hubbsi*.

The distribution of the species covers all the width of the shelf between 52 and 54°S, waters around Malvinas and the Burdwood Bank. North of 52°S, it occurs on the edge of the shelf to 41°S (Bellisio *et al.*, 1979). See environmental data in Table 6. Off Chile, *B. albomaculata* has been reported from Isla Guamblin, Aysen (45°04'S, 75°27'W) (Lamilla G., 1986).

**Other references:** Ringuelet & Aramburu, 1960 (list). Far Seas Res. Lab., 1976 (description, color photograph). Iwai *et al.*, 1972 (distribution). Cotrina *et al.*, 1976 (distribution). Stehmann, 1978 (generic reallocation, key). Menni & Gosztonyi, 1978 (distribution). Gosztonyi, 1981 (distribution). Menni *et al.*, 1981 (distribution). Menni *et al.*, 1984 (list, key). Stehmann, 1986 (generic morphotypes) Lloris & Rucabado, 1991 (morphometry, distribution

24. *Bathyraja brachyurops* (Fowler, 1910)

This species was first reported from Argentina by Günther (1880) *sub Raja brachyura* (*nec* Lafont, 1873). Fowler (1910) assigned the replacement name and Menni (1973) proposed the present combination.

*B. brachyurops* is a widely distributed species in the Argentine Sea, as shown by data from the «Kaiyo Maru» (Otaki *et al.*, 1971), the «Orient Maru I» (Menni & Gosztonyi, 1982) and «Shinkai

Table 6. *B. albomaculata*. Environmental data. A: Iwai *et al.* (1972), B: Cotrina *et al.* (1976, C: Menni & Gosztonyi (1977), D: Menni & Gosztonyi (1978), E: Gosztonyi (1981), F: Menni *et al.* (1981), G: Menni & Gosztonyi (1982), H: Menni & López (1984). * Most captures between 100-200 m, only seven in the slope.

| Ref. | Temperature (°C) | | Depth (m) | Locality | N |
|---|---|---|---|---|---|
| | Surface | Bottom | | | |
| A | – 6.5 | – 4.7 | – 212 | 54°17′S 61°30′W | 1 |
| B | – | – | 430 – 470 | 54°34′S 55°22′W | 1 |
| C | – 8.2 | – 4.0 | 281 – 270 | 47°36′S 60°58′W | 1 |
| D | – | – | 86 – 281 | 45°31′ 51°03′S | |
| | | | | 60°42′ 68°15′W | 16 |
| E | 8.1 – 16.0 | 4.5 – 8.8 | 80 – 730* | 41°00′51°00′S | 20 |
| F | 5.3 – 8.0 | 2.8 – 6.8 | 82 – 222 | 40°30′51°31′S | |
| | | | | 57°30′67°35′W | 26 |
| G | 4.0 – 7.0 | – | 86 – 281 | 47°00′50°00′S | 15 |
| H | – 2.8 | – 6.8 | 105 – 815 | 40°30′51°30′S | 26 |

Maru» (Menni & Lopez, 1984). These papers provided frequencies of occurrence of this species in different areas characterized by defined ranges of temperature and depth (Table 7).

Though being a Magellanic species, *B. brachyurops* occassionally occurs at the coasts of the Buenos Aires Province and southern Brazil (Menni, 1973; Figueiredo, 1977; Menni, 1981; Menni & López, 1984). It is also found off Chile from Valdivia to the Strait of Magallanes (Mann F., 1954). Pequeño & Lamilla (1985) reported it from 51°00'06"S, 75°44.2' W at 122-124 m.

**Other references**: Norman, 1937 (description, distribution, figures). Ringuelet & Aramburu, 1960 (list). Iwai *et al.*, 1972 (distribution). Menni, 1972 (reference). Far Seas Res. Lab., 1976 (iconography). Menni & Gosztonyi, 1977 (captured with *Lamna nasus*). Stehmann, 1978 (key). Menni & Gosztonyi, 1978 (distribution). Stehmann, 1978b (comparison with *B. meridionalis*). Bellisio *et al.*, 1979 (distribution, abundance). Menni & Lopez, 1979 (captured with *Schedophilus griseolineatus*). Gosztonyi, 1979 (Tierra del Fuego). Gosztonyi, 1981 (distribution). Menni *et al.*, 1981 (distribution). Menni *et al.*, 1984 (key, list). Stehmann, 1986 (generic morphotypes). Lloris & Rucabado, 1991 (taxonomy, distribution).

25. *Bathyraja griseocauda* (Norman, 1937)

This species was described from material captured by the R/V «Discovery» between 45°45' to 52°29'S and 57°to 64°19'W at 137 to 313 m (Norman, 1937). Stehmann (1970) proposed the generic reallocation. Table 8 provides environmental parameters of capture localities for *B. griseocauda*. This species is typically Magellanic. As such it was included in the «Magellanic Fau-

Table 7. *B. brachyurops*. Environmental data. A: Iwai *et al.* (1972), B: Menni & Gosztonyi (1978), C: Gosztonyi (1981), D: Menni *et al.* (1981), E: Menni & Gosztonyi (1982), F: Menni & López (1984).

| Ref. | Temperature (°C) | | Depth (m) | Locality | N |
|---|---|---|---|---|---|
| | Surface | Bottom | | | |
| A | – | – | 116 – 132 | 51°01′51°24′S | |
| | | | | 59°40′61°18′W | 3 |
| B | – | – | 90 – 187 | 44°07′52°33′S | |
| | | | | 62°45′67°32′W | 15 |
| C | 6.3 – 16.3 | 4.5 – 12.5 | 28 – 281 | | 44 |
| D | 4.4 – 9.2 | 3.3 – 8.0 | 51 – 604 | 40°30′51°34′S | |
| | | | | 57°30′68°25′W | 22 |
| E | – | 4.0 – 7.5 | 90 – 187 | | 14 |
| F | – | 3.0 – 7.0 | 82 – 104 | 40°30′51°30′S | 34 |

Table 8. *B. griseocauda*. Environmental data. A: Iwai *et al.* (1972), B: Menni & Gosztonyi (1978), C: Menni & Gosztonyi (1978), D: Gosztonyi (1981), E: Menni *et al.* (1981), F: Menni & Gosztonyi (1982), G: Menni & López (1984). * 57% captures between 100 and 200 m.

| | Temperature (°C) Surface | Bottom | Depth (m) | Locality | N |
|---|---|---|---|---|---|
| A | – | 8.4 – 5.3 | 116 | 51°01´S 59°40´W | 1 |
| B | 7.5 – 8.1 | 5.5 | 191 – 216 | 48°47´49°05´S 60°45´61°04´W | 2 |
| C | – | – | 92 – 239 | 47°02´52°22´S 59°57´67°40´W | 24 |
| D | 5.8 – 16.3 | 3.0 – 8.0 | 83 – 730* | | 23 |
| E | 5.3 – 8.0 | 3.3 – 6.8 | 82 – 435 | 40°30´51°30´S 57°23´66°31´W | 22 |
| F | – | 4.0 – 7.5 | 92 – 268 | 39°00´54°20´S | 24 |
| G | – | – 2.5? | 89 – 941 | 40°30´51°30´S | 22 |

na» by Menni & Gosztonyi (1982). It was not found north of 43°S on the shelf, but Krefft (1968) reported it from 37°S at 300-600 m. A similar pattern was obtained from «Kaiyo Maru» samples (Bellisio *et al.*, 1979; Menni & Lopez, 1984). A reference from Antarctica (Springer, 1971) at about 64°S, 62°W, 94 m, 1°C, does not refer to *B. griseocauda* but to an undescribed species (Stehmann, 1985).

**Other references**: Ringuelet & Aramburu, 1960 (list). Iwai *et al.*, 1972 (Patagonia). Menni, 1972a (reference). Menni & Gosztonyi, 1977 (accompanying fauna of *Dipturus trachyderma*). Menni & Gosztonyi, 1978 (distribution). Stehmann, 1978 (key). Stehmann, 1978 (comparison with *B. meridionalis*). Menni *et al.*, 1981 (distribution). Menni, 1981 (distribution). Gosztonyi, 1981 (distribution). Bellisio, 1982 (distribution). Menni *et al.*, 1984 (list, key). Stehmann, 1986 (distribution, generic morphotypes). Lloris & Rucabado, 1991 (taxonomy, distribution).

26. *Bathyraja macloviana* (Norman, 1937)

Described by Norman (1937) from localities between 45°45' to 52°23'S and 59°35' to 64°45'W at 151 to 311 m, the present combination was proposed by Stehmann (1978). Table 9 shows environmental parameters from capture localities. This is a Magellanic species (Menni & Gosztonyi, 1982) widely distributed within the province (Menni & Lopez, 1984). It also occurs at 39°40'S on the outer shelf (Menni *et al.*, 1981; Bellisio *et al.*, 1979; Menni & Lopez, 1984).

The first confirmed records from Chile were at 51°00'06"S, 75°44.2'W, 122-124 m and 52°29.6'

Table 9. *B. macloviana*. Environmental data. A: Iwai *et al.* (1972), B: Menni & Gosztonyi (1978), C: Menni *et al.* (1981), D: Menni & Gosztonyi (1982), E: Menni & López (1984).

| Ref. | Temperature (°C) Surface | Bottom | Depth (m) | Locality | N |
|---|---|---|---|---|---|
| A | 8.7 – 9.2 | 5.5 – 6.1 | 164 – 177 | 51°50´ 51°39´S 61°44´64°08´W | – |
| B | – | – | 83 – 197 | 47°26´52°22´S 60°50´68°16´W | – |
| C | 5.6 – 9.2 | 3.5 – 7.3 | 53 – 509 | 40°02´51°34´S 57°23´68°25´W | 26 |
| D | – | – 4.7 | 80 – 201 | South of 44°S | 11 |
| E | – | 3.5 -> 7.0 | 82 – 505 | 40°30´51°30´S | 28 |

S, 67°18.3'W, 139-140 m (Pequeño & Lamilla, 1985).

**Other references:** Ringuelet & Aramburu, 1960 (list). Iwai *et al.*, 1972 (distribution). Menni & Gosztonyi, 1978 (distribution). Gosztonyi, 1981 (distribution). Menni *et al.*, 1984 (list, key). Stehmann, 1986 (generic morphotypes)

27. *Bathyraja magellanica* (Steindachner, 1903)

This species was originally described from Punta Arenas, Chile. Thompson (1916) found it at the eastern mouth of the Magellan's Strait, this being the first report from Argentina. Stehmann (1978) assigned its generic position. Norman (1937) provided a good description and illustrations from material captured between 40°30' to 52°53'S and 61 to 65°01'W. Table 10 summarizes environmental characteristics of capture localities. Bellisio *et al.* (1979) found it between 48 and 54°S, including the Burdwood Bank. Data from this author, Menni & Gosztonyi (1982) and Menni & Lopez (1984) show that *B. magellanica* has a somewhat more reduced distribution than other Magellanic species. Distribution of SW Atlantic skates is a good example how different species' distribution patterns within a family may be within the same general area (Table 2). During the 1978 cruise of the RV "Shinkai Maru", *B. magellanica* appeared only in six stations within a restricted temperature range of 3.5 to 5.5°C at depths from 51 to 137 m (Menni & Lopez, 1984). Krefft (1968) found it in deeper water (600 m) at 37°S, which documents the presence of Magellanic fish at that latitude but only in deeper waters, a general pattern also observed in other organisms.

Mann F. (1954) reported this species only from "Tierra del Fuego, Magallanes", but Pequeño & Lamilla (1985) and Lamilla (1986) recorded it at 42°48'S, 74°21'W, at 140 m depth, off Chile.

**Other references**: Ringuelet & Aramburu, 1960 (list). Menni, 1972 (reference). Iwai *et al.*, 1972 (description, Patagonia). Gosztonyi & Menni, 1978 (distribution). Bellisio *et al.*, 1979 (distribution, abundance). Gosztonyi, 1979 (Tierra del Fuego). Menni & Lopez, 1979 (occurring with *Schedophilus griseolineatus*). Gosztonyi, 1981 (distribution). Menni, 1981 (reference). Menni *et al.*, 1981 (distribution). Menni *et al.*, 1984 (list, key). Stehmann, 1986 (generic morphotypes). Lloris & Rucabado, 1991 (morphometry, distribution).

28. *Bathyraja multispinis* (Norman, 1937)

Described from 51°39'S and 62°01'W at 197 to 221 m, the present combination is from Stehmann (1978). Table 11 shows environmental data from capture localities. Distributional data from Bellisio *et al.* (1979) and authors quoted in the Table 11 legend suggest that *B. multispinis* has a more restricted distribution than other species. The species was captured in four of six areas in the Argentine Sea considered by Menni & Lopez (1984), whereas *B. albomaculata*, *B. griseocauda* and *Amblyraja doellojuradoi*, for example, were captured in six areas and in a larger number of stations. A subadult male 973 mm was reported from 50°09S, 55°44W, at 720-740 m depth, NE of Malvinas (Balushkin & Gushchin, 1991).

**Other references**: Ringuelet & Arámburu, 1960 (list). Gosztonyi, 1981 (distribution). Menni

Table 10. *B. magellanica*. Environmental data. A:Menni & Gosztonyi (1978),B: Gosztonyi (1981), C: Menni *et al.* (1981), D: Menni & Gosztonyi (1982), E: Menni & López (1984). *Most between 92 to 150 m off Santa Cruz Province, around Malvinas and over the Burwood Bank, south of 47°S.

| Ref. | Temperature (°C) Surface | Bottom | Depth (m) | Locality | N |
|---|---|---|---|---|---|
| A | – | | 79 – 235 | 47°39′ 52°35′S 59°57′68°16′W | 16 |
| B | 6.3 – 11.3 | 5.0 – 11.0 | 92 – 554* | 47°59′54°44′S 56°14′65°57′W | 14 |
| C | 4.4 – 7.0 | 3.5 – 5.7 | 51 – 157 | 49°29′51°34′S 61°27′68°25′W | 7 |
| D | | 5.5 – 6.8 | 79 – 235 | South of 44°S | 15 |
| E | – | 3.5 -> 6.0 | 51 – 137 | 40°30′51°30′S | 7 |

Table 11. *B. multispinis*. Environmental data. A: Iwai *et al.* (1972), B: Menni & Gosztonyi (1978), C: Gosztonyi (1981), D: Menni *et al.* (1981), E: Menni & Gosztonyi (1982), F: Menni & López (1984).

| Ref. | Temperature (°C) Surface | Bottom | Depth (m) | Locality | N |
|---|---|---|---|---|---|
| A | 8.8 – 9.2 | 5.5 – 5.6 | 180 – 188 | 51°04´S 51°17´S 61°42´W | 2 |
| B | – | – | 148 – 152 | 47°45´47°49´S 61°19´61°35´W | |
| C | 10.0 – 12.3 | 4.5 – 5.6 | 115 – 281 | 43°00´47°00´S | 6 |
| D | 5.7 – 8.0 | 4.0 – 6.0 | 82 – 285 | 40°30´51°31´S 57°31´67°35´W | 8 |
| E | | 4.0 -< 5.0 | 147 – 152 | 44°00´54°30´S | 2 |
| F | – | 4.0 – 6.0 | 115 – 284 | 40°30´51°30´S | 8 |

*et al.*, 1981 (distribution). Menni *et al.*, 1984 (list, key). Iwai *et al.*, 1972 (distribution). Gosztonyi & Menni, 1978 (distribution). Gosztonyi, 1981 (distribution). Menni *et al.*, 1981 (distribution). Menni & Gosztonyi, 1982 (associations, environmental characteristics). Stehmann, 1986 (generic morphotypes). Stehmann, 1987 (comparison with *B. meridionalis*).

29. *Bathyraja papilionifera* Stehmann, 1985

This species was described based on three specimens obtained in June 1978 from localities around 40°S and 56°W, on the slope off Argentina. Stehmann (1985) considered it as a deep water species («Transitional type» in Stehmann, 1986). As the three types were immature, it can be considered that the adults occur at larger depths. Temperature and salinity of type localities ranged between 3.03 to 4.09°C and 34.137 to 34.170‰ salinity. Stehmann & Schulze (1996) reported a fourth specimen from the 1971 "Walther Herwig" expedition, taken north of the type localities at 1000 m. This species is relatively abundant, with mature specimens at greater depth at Malvinas, and fished for commercially among other species, as *B. meridionalis* (J. Pompert, pers. comm.)

**Other references:** Stehmann, 1987 (comparison with *B. meridionalis*).

30. *Bathyraja scaphiops* (Norman, 1937)

Described by Norman (1937) from 45°45' to 52°29'S and 57° to 59°35'W at 146 to 347 m, its generic assignment was by Stehmann (1970). This species is a component of the Magellanic fauna in the classic sense of Norman (1937) and as defined by Menni & López (1984). Within the large area occupied by the Magellanic fauna off Patagonia, *B. scaphiops* is most abundant about the center of the shelf, from 104 to 159 m depth between bottom temperatures between 4.5 to 6°C. Table 12 provides environmental data for this species.

**Other references**. Ringuelet & Aramburu, 1960 (list). Stehmann, 1978 (key). Stehmann,

Table 12. *B. scaphiops*. Environmental data. A: Menni & Gosztonyi (1978), B: Gosztonyi (1981), C: Menni *et al.* (1981), D: Menni & Gosztonyi (1982), E: Menni & López (1984).

| Ref. | Temperature (°C) Surface | Bottom | Depth (m) | Locality | N |
|---|---|---|---|---|---|
| A | – | | 149 – 194 | 49°21´ 50°50´S 60°38´63°54´W | 2 |
| B | 5.8 – 11.7 | 3.9 – 7.6 | 109 – 383 | South of 45°S | 17 |
| C | 5.6 – 7.2 | 3.8 – 5.4 | 115 – 509 | 45°30´51°30´S 57°23´64°31´W | 9 |
| D | – | 4.3 – 6.8 | 149 – 191 | South of 44° S | 2 |
| E | – | 3.8 – 6.0 | 115 – 505 | 45°30´51°30´S | 9 |

1978 (comparison with *B. meridionalis*). Gosztonyi & Menni, 1978 (distribution). Bellisio et al, 1979 (distribution, abundance). Gosztonyi, 1981 (distribution). Menni *et al.*, 1981 (distribution). Menni & Gosztonyi, 1982 (associations, environmental characteristics). Menni *et al.*, 1984 (list, key). Menni & Lopez, 1984 (associations, environmental characteristics). Stehmann, 1986 (generic morphotypes). Lloris & Rucabado, 1991 (taxonomy, distribution).

31. *Bathyraja schroederi* (Krefft, 1968)

This species was described from the slope off the Rio de la Plata mouth, at 35°04' to 35°48' S and 52°06' to 52°48' W between 800 and 1000 m. Krefft (1968) included the species in a community typically occurring in tropical and temperate waters, which at the province of Buenos Aires latitude occurs only on the slope. Seret & Andreata (1992) reported a newborn female 246 mm TL from 23°04'S and 40°19'W at 2370-2380 m depth. Apparently the species is ichthyophagous.

**Other references:** Stehmann, 1970 (new combination). Menni, 1981 (reference). Stehmann, 1978 (key). Menni *et al.*, 1984 (list, key). Stehmann, 1986 (generic morphotypes). Stehmann, 1987 (comparison with *B. meridionalis*).

32. *Psammobatis bergi* Marini, 1932

This species was described from the Atlantic southeast of Punta Piedras (Buenos Aires Province, Argentina). Considered a synonym of *P. extenta* (Garman, 1913) by Norman (1937), it was revalidated by Roux (1979). It was found off Uruguay and Argentina, from 23°43' to 38°25'S at 31 to 81 m (McEachran, 1983). A male specimen 132 cm TL captured with a dredge at 50 m depth off Rio de Janeiro (42°19'S, 22°59'W) (Lopez, P.R.D., 1987, pers. com.) seems to be the northernmost report. Its presence has also been reported from off southeast and south Brazil and Uruguay (Paragó & Carvalho, 1997).

**Other references**: Menni, 1972 (clasper anatomy, *sub P. scobina*). Stehmann, 1978 (reference). Menni *et al.*, 1981 (distribution). Gosztonyi, 1981 (distribution). Menni *et al.*, 1984 (list, key). Rincón *et al.*, 1997 (list).

33. *Psammobatis extenta* (Garman, 1913)

Paragó & Carvalho (1997) have questioned the status of this species, considered as a synonym of *P. rutrum* by McEachran (1983), but a senior synonym of *P. glansdissimilis* McEachran, 1983 by Carvalho & Figueiredo (1994). *P. glansdissimilis* McEachran, 1983 was described from the Southwestern Atlantic off Brazil, Uruguay and northern Argentina, from 29°52' to 40°S between 39 and 160 m depth. Carvalho (1991), when critically reviewing the diagnostic features, stated that the upper caudal were rather lower than second dorsal height, and the interorbital distance larger than orbital diameter, and subsequently Carvalho & Figueiredo (1994) considered *P. glansdissimilis* a junior synonym of *P. extenta* (see also under *P. rutrum*).

34. *Psammobatis lentiginosa* McEachran, 1983

This species occurs in the southwestern Atlantic off Brazil, Uruguay and Argentina, from 32 to 45°S at 84 to 160 m depth. Off southern Brazil it lives on sandy-muddy bottoms from 30 to 70 m, feeding on crustaceans (N= 20) (Tomas *et al.*, 1989; Tomas & Tutui, 1991).

35. *Psammobatis normani* McEachran, 1983

This is a Magellanic species living off Argentina from 40°22' to 50°10'S at depths from 70 to 145 m, and probably in the southeastern Pacific off Chile (McEachran, 1983).

36. *Psammobatis parvacauda* McEachran, 1983

This is a Magellanic species, described on a female collected northeast of the Malvinas Islands (51°15'S, 57°16'W) at 120 m depth. It is only known from the type locality.

37. *Psammobatis rudis* Günther, 1870

McEachran (1983) revalidated this species from the synonymy of *P. scobina* (Garman, 1913; Norman, 1937). It is distributed in the Southwestern Atlantic off Argentina from 41° to 52°45'S from 80 to 127 m.

Pequeño & Lamilla (1985) reported it for the Eastern South Pacific off Chile at 51°00'06"S, 75°44.2'W from 122 to 144 m. These authors correctly stated that species of *Psammobatis* reach more northern latitudes in the Atlantic than in the Pacific. McEachran (1983) and Pequeño & Lamilla (1985) consider that *P. scobina*, which morphologically is very much alike, does not occur in the Atlantic. Otherwise, Lloris & Rucabado (1991) stated that both species are found in the Beagle Channel.

38. *Psammobatis rutrum* Jordan, 1890

Replacement name as senior synonym of *P. extenta*, according to McEachran (1983), who also synonymised the following taxa with *P. rutrum*: *Raja erinacea* (*nec* Mitchill) Miranda Ribeiro,

1907; *Malacorhina cirrifer* Regan, 1914 and *Raja cirrifera* Miranda Ribeiro, 1923 (See on *P. extenta* above).

*P. rutrum* is found in the Southwestern Atlantic off Brazil, Uruguay and Argentina from 22°56' to 42° S between 37 and 100 m depth (McEachran, 1983).

39. *Rioraja agassizi* (Müller & Henle, 1841)

This species was reported for the first time from off Argentina and Montevideo (Uruguay) by Berg (1895). For full references and the use of *Rioraja* see Menni (1973). The species occurs in the Southbrazilian and Bonaerensean districts. Observations off southern Brazil show its occurrence at 50-55 m depth, with crustaceans as major prey (N= 25) (Peres & Vooren, 1993). It is characteristic of the warm-temperate zone (Briggs, 1974), and a common species within the Argentinean Province (Menni, 1973, 1981). Its absence off Patagonia has been confirmed (Bellisio *et al.*, 1979). Gosztonyi (1981) and Menni *et al.*, (1981) found it from 38° to 42°59'S and from 56°58' to 62°W at 22 to 89 m depth, with surface temperatures from 8 to 18.4°C and bottom ones from 6.8 to 18.8°C. Menni & Gosztonyi (1982) included it in their association or Group I «Bonaerensean fauna», since it was obtained exclusively in area A at a station with 13.5°C at 46 m depth. Menni & Lopez (1984) found a slightly wider distribution, namely at five stations with lower temperatures of 6 to 10.5°C from 22 to 89 m depths. Material trawled between 30°40' and 34°30'S from 10 to 100 m depth off southern Brazil shows that *R. agassizi* occurs in the area throughout the year and has an annual reproductive period, with egg laying from November to July peaking in January and February (Peres & Vooren, 1993).

**Other references**: Whitley, 1939 (subgenus *Rioraja*). Bigelow & Schroeder, 1953 (key). Menni, 1972 (key, list, clasper anatomy). Krefft, 1968 (zoogeography of the Argentine province). Brownell *et al.*, 1973. Sadowsky & Menni, 1974 (ocurrence with *A. platana*). Suriano, 1977 (parasites). Stehmann, 1978 (key).

40. *Sympterygia acuta* Garman, 1877

This species, endemic in the Argentine Province, was described with type locality «Buenos Aires». Full references, often under other names, have been compiled (Menni, 1973). Available data until the middle of the XX century were so insufficient that Ringuelet & Aramburu (1960) did not include the species in their catalogue of Argentine marine fishes. Nani & G. Alberdi (1966) recorded it from Mar del Plata, and Krefft (1968) mentioned it entering the Magellanic Province from the North. Menni (1972) described clasper anatomy. Menni (1973), based on the examination of the type material, stated that *Raja echynorhyncha* Miranda Ribeiro, 1923 were a junior synonym, as is also the reference of *Raja agassizi* (*nec* Müller & Henle) by Devincenzi & Barattini (1926). Off the Brazilian-Uruguayan border, the species was captured at temperatures from 13.9 to 22.5°C and salinities from 30.84 to 33.4 ‰. (Menni, 1973). Gosztonyi (1981) reported it from 39°04'S, between 25 and 28 m, with surface and bottom temperatures of 18.5 and 18°C, respectively.

*S. acuta* spends its entire life cycle in Southbrazilian shallow coastal waters (0-40 m depth), being one of the most abundant fish species of the shallow zone throughout the year (Lessa & Vooren, 1982). This suggests a center of abundance toward the north of its distribution range, as the species is by far not common off Argentina. *S. acuta* becomes rare again at about the latitude of Santos (Brasil) (24°S), occurring to 60 m depth and approaching the coast in summer, feeding on shrimp and fish (Tomas & Tutui, 1991). *Sympterygia acuta* and the following species, *S. bonapartei*, are reported as the most inshore ones among 17 rajiform species known from the Rio Grande do Sul shelf (Queiroz & Vooren, 1984). The two species live sympatrically, and occurred there throughout the year. Both were more abundant in number and weight between 10 and 20 m depth. In spring 1980 they made up between 14 and 21 % of the total elasmobranch catch. Lower percentages were found during autumn 1981. The authors cited suggested that abundance of both species were adapted to large seasonal variation of oceanographic conditions.

**Reproduction**. Ninety-one egg capsules with embryos at different development stages were collected in 1981 at the Cassino beach (Rio Grande) (32°10'S-52°05'W) (Queiroz, 1989). Duration of embryonic development and total length of young at hatching were evaluated by taking capsules from pregnant females and incubating them in aquarium. Observed embryonic stages were between 7 and 18 (*sensu* Clark) and L to Q (*sensu* Balfour). Embryonic development until hatching in aquarium took 90 days (mean). The embryo weight was = $1.4236\ 10^{-6}\ LT^{3.1778}$ with r= 0.94. In contrast, the correlation between the vitelline sac weight and the total length is low (r= 0.30).

*S. acuta* females with eggs were observed throughout the year, with a maximum peak in

winter, when *S. bonapartei* females with eggs are were also found. Deposited egg capsules were found attached to different bottom material, including remains of terrestrial plants and antropogenic material. Accumulations of up to 100 egg capsules were found (Queiroz, 1984).

**Feeding habits.** Queiroz (1984) studied about 1500 stomachs of *Sympterygia acuta* and *S. bonapartei* collected with beach trawlnets at the Cassino beach in Rio Grande do Sul. The species were found to be euryphagous, with the shrimp *Artemesia longinaris* composing more than 50 % of the diet. Other items were polychaetes, Amphipoda, Cumacea, Isopoda, decapod crustaceans (Hippidae, Diogenidae, Paguridae, Callianasidae, Portunidae, Majidae, Solenoceridae, Xantidae and Caridae), Mollusca (Bivalvia, Gastropoda and Cephalopoda) and teleost fish (Engraulidae, Sciaenidae and Cynoglossidae). Accidental items were atherinid eggs and Ostracoda. Both species of *Symperygia* appear near the coast in summer, feeding on shrimp and fish.

**Other references:** Menni, 1972b (list). Stehmann, 1978 (key). Menni, 1981 (reference). McEachran, 1982 (generic revision, anatomy, morphology and phylogeny). Menni *et al.*, 1984 (list, key).

41. *Sympterygia bonapartei* Müller & Henle, 1841

This species is very common at the Bonaerensean littoral, from where it has been frequently reported, under this name or, in the past, under its synonym *Psammobatis microps* (Günther, 1880). For the taxonomic history of the species see Menni (1973) and McEachran (1982).

*S. bonapartei* occurs from the Southbrazilian District to the north of the Magellanic Province (Krefft, 1968; Menni, 1972; McEachran, 1982). Tomas & Tutui (1991) stated that it occurs off Santos only south of 30°S, being more abundant at depth shallower than 50 m. Gosztonyi (1981) found it in numerous localities along the coast of the Province of Buenos Aires, Chubut and Santa Cruz (Argentina) to 51°S between 26 and 100 m depth, with surface temperatures from 8.8 to 18.5°C and bottom ones from 6.5 to 18°C. Menni (1973) reported several specimens from 33°47S, 53°16W with 13.95°C and 30.84 ‰ salinity.

Menni *et al.* (1981) reported it from eight stations (Japanese R/V "Shinkai Maru", V cruise August-September, 1978) between 39°30' and 43°30'S, with surface temperatures from 9 to 12°C and bottom ones from 7.55 to 11°C, with a continuous occurrence from 52 to 74 m depth, and also at a deeper station at 181 m. Menni & Lopez (1984), consider the species as a Bonaerensean element within the «Inner shelf mixed fauna», a criterion sustained by distributions reported by Gosztonyi (1981) and McEachran (1982).

Off Brazil the species is known from Rio Grande do Sul, São Paulo and Rio de Janeiro, where it has been collected with bottom trawl from 10 to 500 m (Vooren & Lessa, 1981; Almeida & Queiroz, 1985; Tomás & Tutui, 1991; Vooren, 1997; Rincón *et al.*, 1997 and Gadig, 1998).

**Feeding habits.** Barrera Oro & Maranta (1996) found that principal food items are benthic decapod crustaceans, mainly penaeids and brachyurans. Important preys were *Artemisia longinaris*, *Pleoticus muelleri*, *Corystoides chilensis*, *Coenophthalmus tridentatus* and *Leurocyclus tuberculosus*. A secondary prey group is composed of several fish species, including *Anchoa marini*, *Parona signata*, *Odonthestes incisa* and *Symphurus sp.* Off Brazil fishes has been reported as important in the diet (Almeida & Queiroz, 1985).

**Other references**: Berg, 1895 (first Argentine reference under this name). Lahille, 1895 (presence in freshwater). Ringuelet *et al.*, 1967 (presence in freshwater). Menni, 1972 (clasper). Menni, 1972b (list). Stehmann, 1978 (key). Menni *et al.*, 1984 (key, list).

Order MYLIOBATIFORMES
Suborder MYLIOBATOIDEI
Superfamily DASYATOIDEA
Family UROTRYGONIDAE

42. *Urotrygon microphthalmum* Delsman, 1941

This species was described from the Amazon mouth. It has been listed from northern Brazil at Paraíba (Gadig, 1993) and from between 1° to 4°30'S (Alves de Oliverira, 1975). There are recent reports from off the states of Maranaho, Pará and Amapá. The species was captured with bottom trawl and bottom gillnets between 8 and 25 m depth (Lessa, 1997, Almeida, 1999). Z. Almeida has been collecting this species during last years along the eastern coast of Maranhão, where it seems to be rather abundant (Lessa, pers. com.).

Family DASYATIDAE
Subfamily DASYATINAE

43. *Dasyatis americana* Hildebrand and Schroeder, 1928

This species ranges from New Jersey to Brazil (Bigelow & Schroeder, 1953). We found it at 25°56S, 48°07W at 25 m depth (FRV "Walther Herwig", 1968 cruise), somewhat south of San-

tos, from where it was reported also by Figueiredo (1977). It has been reported from Ubatuba (Cunningham, 1989) and from Ilha do Medo, Bahia (Queiroz *et al.* 1993a) and northward from Pará and Amapá (Alves de Oliveira 1975) and Paraíba (Gadig, 1993). So it occurs nearly all along the Brazilian coast. Mating behaviour has been observed at Fernando de Noronha islands (Mendes & Moura, 1999).

44. *Dasyatis centroura* (Mitchill, 1815)

This species was reported from Mar del Plata, Argentina, under this name by Nani & G. Alberdi (1966), but as *Dasibatis marina* from the Rio de La Plata (Devincenzi, 1925) and from the Uruguay River mouth and the Pocitos beach, Mercedes department, Uruguay (Devincenzi & Barattini, 1926) (Menni *et al.*, 1984). Most of these reports are from well inside the Rio de la Plata estuarine environment, but along its northern side with marine conditions prevailing. Castello (1973a) commented on its presence, based on specimens caught with line and hook on the beaches of Buenos Aires Province. A cast exhibited at the Museo Argentino de Ciencias Naturales is over 3 m TL.

Cervigon & Bastida (1974) provided data of a female 174 cm disc width and 328 cm TL obtained at Mar del Plata from mid-range offshore fishing, as well as jaws photographs and designs of the tubercular thorns. Their data agree with those given by Bigelow & Schroeder (1953). Castello & Carrera (1973) reviewed reports and informal data on the presence of this species in the South Atlantic, concluding that its distribution off Brazil, Uruguay and Argentina ranges from 23° to 38°30'S. They emphasize its antitropical distribution and provided good illustrations.

It has been reported from off southern Brazil (Carneiro & Vooren, 1986), Rio de Janeiro (Gomes *et al.*, 1995) and San Salvador environs (13°20'S, 39°04'W, Simões & Queiroz, 1997). The species appears to be relatively abundant between 50-90 m depth. During the 1966 "Walther Herwig" cruise a specimen of *D. centroura* 187 cm TL was captured at 35°S, 52°14'W (170 m depth, 16°C bottom temperature).

**Other references**: Pozzi & Bordalé, 1935 (reference). Refi, 1975 (reference). Menni, 1981 (zoogeography).

45. *Dasyatis geijskesi* Boeseman, 1948

The holotype of this species was a juvenile male 360 mm disc length and 340 mm disc width from Surinam, from were also reported by Uyeno *et al.* (1983). The species is very abundant off the Orinoco River mouth from 5.5 to 18 m, with a maximum size about 1 m disc width (Cervigón, 1966).

*D. geijskesi* was reported from off Maranhão in northern Brazil (Lessa, 1986; Garrido Martins - Juras *et al.*, 1987; Alves de Oliveira, 1975), but is not common there. Off Maranhão, an adult male 58 cm disc width, 219 cm total length and 4.2 kg weight, and three females 50, 77 and 98 cm disc width, with weights of 2.6, 15.3 and 14.1 kg, respectively, were captured in an artisanal fishery (Menni & Lessa, 1998). The largest female was at the beginning of maturity.

46. *Dasyatis guttata* (Bloch and Schneider, 1801)

Menni & Lessa (1998) provided a review of Brazilian reports and the biology of this species which ranges from Mexico and the West Indies to southern Brazil (Cervigón, 1966). Bigelow & Schroeder (1953) predicted that *D. guttata* is to be expected anywhere in suitable localities from Rio de Janeiro to the Caribbean. This is supported by many observations along the Brazilian coast, including coastal waters off Paraná, Cananeia, Rio de Janeiro environs, Bahia, Pernambuco, Paraiba, Pará and Amapá (Barletta & Correa, 1989; Gonzalez, 1995; Cunningham, 1989; Queiroz *et al.*, 1993; Guedes *et al.*, 1989; Gadig, 1993 and Alves de Oliveira, 1975).

Individuals about 26 cm total length were captured with gillnets during summer in the Marajó Bay. The species was dominant in the batoid fauna at the Araoca and Cumá Bays (Maranhão), where immature individuals measured 50 to 53 cm disc lengths (Lessa & Araujo, 1984).

**Reproduction.** Menni & Lessa (1998) stated that males from Maranhão become mature from about 51.5 cm disc width onward, with 3.4 kg weight. About a third of 15 females from 25 to 75 cm disc width were in the beginning of maturity between December and March (the rainy season).

**Feeding habits**. The diet of this species was studied at San Salvador de Bahia environs (Queiroz, *et al.* 1993b). In all 137 stomachs were analyzed, 83 (60.59%) with food and 54 (39.41%) empty. Most common food items were crustaceans of the families Alphaeidae, Penaeidae, Brachyura and Callianasidae, and polychaetes. Lesser amounts of Isopoda, Caridea, Mollusca, Stomatopoda, Xanthidae, Callapidae, and Teleostei were also found. The Alphaeidae has the larger value of Pinka's index.

47. *Dasyatis* cf. *pastinaca* (Linné, 1758)

It is noteworthy that the first Argentine references for this species, from Berg (1895) to Pozzi & Bordale (1935), used this name of a European/Eastern Atlantic species, in the same or different generic combinations (complete references in Refi, 1975). Apparently based on doubts for geographical reasons, the Argentine material since Ringuelet & Aramburu (1960) was referred to *D. say*, a Western Atlantic species common off Brazil.

Refi (1975) found that traits of Argentine material do not agree with those of *D. say*, but rather with the European species *D. pastinaca*, an observation she confirmed with (only female) material from the Mediterranean. Refi (1975) provided a good photograph, measurements and proportions of many specimens, and described the anatomy and morphology of the clasper. Capapé (1983) studied *D. pastinaca* from Tunis, and considering Refi's data concluded: "Malgre l'eloignement de ces secteurs maritimes, il n'existe pas de differences anatomiques remarquables au niveau de ces organes avec les specimens. Les variations intraspecifiques geographiques semblent ne pas apparaitre chez *D. pastinaca*". The occurrence of this European, East Atlantic species in the SW Atlantic is highly improbable, because it's not a proven pelagic migrator as *D. violacea*. This is a taxonomic problem still unresolved.

The species has been found at two stations off Buenos Aires Province at 26 and 44 m depth, with surface temperatures from 18.3 to 18.5°C and bottom ones from 18 and 17.5°C (Gosztonyi, 1981). The species belongs to the «Strictly Bonaerensean fauna» at 42 m depth with a temperature of about 10°C (Menni & Lopez, 1984).

Olivier *et al.* (1968) (*sub D. say*) considered the species within their ecological type «benthic - wanderer (swimming - digger)» occurring in winter off Mar del Plata. Angelescu (1982) considered it as a predator on adult *Engraulis anchoita*, suggesting a maximum size of 80 cm and a trophic habitat in coastal waters. Nani (1964) found the species off Mar del Plata except from July to October (winter), and Nani & G. Alberdi (1966) found 24 specimens in January (summer). Nani (1964) reported a maximum size of 927 mm TL for females, with a disc width of 565 mm and a weight of 9.5 kg. A male was 755 mm TL, with a disc width of 512 mm and 4.1 kg weight.

**Other references**. Devincenzi, 1920 (mouth of the Uruguay River; this is noteworthy or wrong, the locality being absolutely freshwater). Devincenzi & Barattini, 1926 (Uruguay). Menni *et al.*, 1981 (distribution). Menni *et al.*, 1984 (key, references, list).

48. *Dasyatis say* (Lesueur, 1817)

Bigelow & Schroeder (1953) suggested that this species ranges from New Jersey (from where it was described) and southern Massachusetts to southern Brazil and «perhaps Uruguay and northern Argentina». (References of this species off Argentina were given above under *D. pastinaca)*. Recent references show that off Brazil the species occurs from Ubatuba, São Paulo (Cunningham, 1989), throughout to Rio de Janeiro (Leite Gomes *et al.*, 1995), the states of Pernambuco (Guedes *et al.*, 1989) and Paraíba (Gadig, 1993) to Pará and Amapá (Alves de Oliveira, 1975).

We found the species at four stations off Brazil between 40 and 130 m depth, with bottom temperatures between 16.05 and 19.46°C. The southern limit appears to be at about 34°58'S ("Walther Herwig" cruise 1968).

49. *Dasyatis violacea* (Bonaparte, 1832)

This species, described from the Mediterranean, was captured off southeastern and south Brazil between 20 and 33°S and 40 to 50°W, together with a typical pelagic fauna captured with longline below 200 m depth (Sadowsky & Amorim, 1977; Sadowsky *et al.*, 1986).

The distribution of *D. violacea*, which occurs in the Western Pacific, the Indian and the Atlantic Oceans, became better known with the increase of longline fisheries throughout the world. It is currently considered the only pelagic species of the genus, though Nakaya (1982) reported captures made at 330-381 m depth, suggesting that it could be a bathybenthic species which sometimes comes up to surface layers. It is rather common off northern Brazil in the upper layers.

A female 49.3 cm disc width was reported for the first time from off northeastern Brazil at 8°24'S and 31°33'W and 48 m depth. Water temperature was 25.5°C at the surface and 25.74°C at 50 m depth. Other species in the capture were the sharks *Prionace glauca*, *Carcharhinus longimanus* and *C. falciformis* (Menni *et al.*, 1995). After this report, many individuals of *D. violacea* were captured off northeastern Brazil within the area from 2°30' to 8°30'S and from 30°30' to 32°30'W. Bottom depths at all these stations were well below 4000

m. Within the area, the species was not captured toward the northwest, where large submarine banks are a noticeable feature, and so depths are often less. Temperature at surface in these stations ranged between 26.5 and 28.5°C (mean= 27.75°C, N= 14), but considering the exposure depth of the hooks (calculated), *D. violacea* inhabits at temperatures ranging from 13.4 to 27.0°C (mean= 17.34°C, N=8).

**Feeding habits.** Vaske (1997) found that two hyperiid amphipods, *Phronima atlantica* and *Phrosina semilunata* composed together 88.5% in number of preys. Other items, including Tunicata, teleost remains, the cephalopod *Japetella sp.*, ommastrephid squids, decapod crustaceans and *Heterocarpus* appear in lesser percentages. Differences between sexes were not observed in feeding, in spite of marked sexual dimorphism in teeth.

50. *Dasyatis sp.*

The presence of a new species of *Dasyatis* off northeastern Brazil was reported by Gomes *et al.* (1995). The species has been described by Gomes *et al.* (2000). The paper indicates the name *Dasyatis macrophthalma* in the title and the name *Dasyatis marianae* in the rest of the text. As any choice we make should be considered a nomenclature act, we prefer to maintain the informal reference. This species occurs along the Brazilian coast between 0° and 20°S. "Adults... are apparently associated with coral or sandstone reefs of the northeastern Brazilian continental shelf, and in fact, the geographic distribution...is entirely coincident with that of major reef formations...Juveniles also occurred in sandy beaches and estuaries" (Gomes *et al.*, 2000).

Subfamily GYMNURINAE

51. *Gymnura altavela* (Linnaeus, 1758)

This species was reported first time for the Rio de la Plata by Devincenzi (1925) *sub Pteroplatea maclura*. Nani (1964) found it at Mar del Plata only from January to April (summer and beginning of autumn) and provided data of a female 1002 mm TL and 1502 mm disc width and a male 736 mm TL, 1100 mm disc width and 27.64 kg. Castello (1973b) commented upon three specimens captured at Mar del Plata environs and one from Puerto Quequén, which had white spots somewhat lateroposterior to the spiracles, on one side in some specimens and on both in others. In view of the relative large number of specimens with white spots (4 of 27) captured in the Southwestern Atlantic, and considering the absolute absence of such spots in North Atlantic specimens, Castello (1973b) suggested that the populations were genetically isolated. Stehmann (1974) studied the holotype of *G. binotata* Lunel, 1879 from Rio de Janeiro, Brazil, characterized by a small dorsal fin and two large white blotches on the dorsal surface. After a careful comparison of the three congeners occurring in the Atlantic (*G. altavela*, *G. hirundo* and *G. micrura*), Stehmann concluded that the white blotches of *G. binotata* were individual abnormality and this species identical with *G. altavela*.

Boschi & Scelzo (1967) reported an unidentified species of *Gymnura* captured off Buenos Aires Province between 4 and 20 m depth, with bottom temperatures from 20.1 to 22.9°C and salinity from 30.06 to 33.7 ‰. *Gymnura altavela* predates upon the squid *Loligo sanpaulensis* (Castellanos, 1967). Gosztonyi (1981) found it off Mar del Plata at 47 m depth, with a surface temperature of 18.4°C and a bottom one of 18.8°C. The species is irregularly common in demersal catches off Mar del Plata (pers. obs.). It has been reported also from Brazil off Rio Grande do Sul (Carneiro & Vooren, 1986) and Ubatuba (Cunningham, 1989).

**Other references:** Pozzi & Bordale, 1935 (listed). Ringuelet & Aramburu, 1960 (list). Menni *et al.*, 1984 (key, list, references).

52. *Gymnura micrura* (Bloch and Schneider, 1801)

This species apparently replaces *G. altavela* off the northern Brazilian coast. The southernmost record of *G. micrura* is from Cananeia (Gonzalez, 1995). It was reported from off the Pernambuco State (Guedes *et al.*, 1989), and Lessa *et al.* (1995) captured 7 specimens between 2 and 10 m depth at Recife beach. It was also captured off the Paraiba State (Gadig, 1993), Amapá and Pará states (Alves de Oliveira, 1975), and off Maranhão State (Lessa, 1986; Garrido Martins Juras *et al.*, 1987). It has also been reported from Surinam and French Guiana (Uyeno *et al.*, 1983).

Subfamily MYLIOBATINAE

53. *Aetobatus narinari* (Euphrasen, 1790)

This species has a wide distribution in tropical and warm water belts (Bigelow & Schroeder, 1953). These authors provided a detailed list of occurrences along the western Atlantic coast. Recent Brazilian reports included the northern littoral of Paranaguá (Charvet, 1995), Cananeia (Gonzalez, 1995), the State of Pernambuco (Guedes *et al.*, 1989; Lessa *et al.* 1995), the coast of Paraíba (Gadig, 1993), the coast of Maranhão

(Lessa, 1986; 1997; Stride *et al.*, 1992; Lessa & Menni, 1994; Menni & Lessa, 1998) and San Salvador de Bahia environs (Simoes & Queiroz, 1996). The species is scarce along the coast of Maranhão during both the rainy and the dry seasons, and the second in abundance among the batoids after *R. bonasus*, both about 0.6% of the total number of chondrichthyans. Six males from 110 to >153 cm TL were immature, and five females ranged from <75 to 163 cm TL (Menni & Lessa, 1998). Its presence at reefs off Brazil was reported by Motta *et al.*. (1999). It is also known from from the Archipelago Fernando de Noronha (Soto, 1997) and from the Atol das Rocas (Hazin *et al.*, 1997).

54. *Myliobatis freminvillei* Le Sueur, 1824

Ringuelet & Aramburu (1960) reported this species for the first time from Argentina. Refi (1975) rightly considered it scarce in the Bonaerensean littoral, where she only obtained two specimens in fifteen samples. Nani (1964) registered it in the area from September to April.

Refi (1975) examined two females with 850 and 1062 mm disc width. The smaller one was immature and weighted 11.6 kg. A male of 608 mm disk width weighted 3.75 kg. She included complete Southwestern Atlantic references, provided descriptions and measurements of two specimens, indicated the presence of yellowish dorsal spots in fresh specimens and described and illustrated the dental plates and the clasper anatomy.

**Other references:** Stehmann, 1978 (key). Menni *et al.*, 1984 (key, references).

55. *Myliobatis goodei* Garman, 1885

Devincenzi & Barattini (1926) first mentioned this species for Uruguay. Off Argentina it is much more abundant than the former species and also than *Dasyatis* species. It occurs off Mar del Plata throughout the year and was found as far south as 46°59'S (Krefft, 1968; Castello, 1974; Gosztonyi, 1981). It is known from estuarine habitats, in Argentina in particular from the Ría de Ajó in the Samborombón Bay (a brackish water environment) (Refi, 1973; Menni, 1983). Many references for this species are quoted in Menni *et al.* (1981). These authors reported *M. goodei* from eight stations near the southern limit of the species' distribution. The surface temperature there ranged from 8 to 11.7°C and the bottom one from 6.8 to 11°C from 22 to 181 m depth. Total catch was 791.2 kg, with a single capture yielding 398 kg at 59 m depth. Gosztonyi (1981) found the species at ten coastal stations off Buenos Aires, Chubut and north of Santa Cruz provinces from 26 to 85 m depth, with surface temperatures from 13.3 to 18.8°C and 8.1 to 18.8°C at the bottom.

*M. goodei* has been reported from southern Brazil (Figueiredo, 1977), but samples of this species are composed of two morphotypes with different tooth morphology and biochemistry (Vooren, pers. com.; Levy & Conceiçao, 1989). A wide, apparently continuous variation of tooth morphology has been observed off Argentina (Refi, 1975).

**Feeding habits.** Refi (1975) provided data from numerous specimens and described the dentition and the clasper anatomy. She also indicated that *M. goodei* feeds on brachyuran decapods, stomatopods, isopods, synaptid holoturians, ascidians and polychaete worms of the family Goniadidae and of the genera *Glycera*, *Eunice* and *Piromis*. The species belongs to the ecological type «benthic-wanderer (swimmer-burrowing)» (Olivier *et al.*, 1968), and feeds upon adult *Engraulis anchoita* (Angelescu, 1982).

**Reproduction.** Six males were examined measuring 320 to 460 mm DL and weighting 2.7 to 4.64 kg. Three specimens showed well-calcified claspers, the larger with a testes size 70 x 15 mm. Eight females of 305 to 555 mm (DL) weighted 0.24 to 12 kg. Ovaries in females 410 to 555 mm DL measured 100 x 25 to 130 x 65 mm and contained oocytes of 3 to 25 mm diameters. Only one specimen showed stomach contents composed of a 35 mm holoturian and polychaete tubes (Refi, 1975).

**Other references**: Angelescu & Boschi, 1959 (*sub Leiobatus goodei*, captured with *Pleoticus muelleri*). Ringuelet & Aramburu, 1960 (listed). Nani, 1964 (Mar del Plata). Nani & G. Alberdi, 1966 (abundance, Mar del Plata). Castellanos, 1967 (predator on *Loligo sanpaulensis*). Boschi & Scelzo, 1967 (presence). Boschi & Scelzo, 1969 (listed). Cervigon & Cousseau, 1971 (listed, Mar del Plata). Odemar & Silvosa, 1971 (abundance at 42°S). Iwai et al, 1972 (Patagonia). Moly & Zaro, 1975 (accompanying fauna of *Menticirrhus americanum*). Menni & Gosztonyi, 1978 (distribution). Bellisio *et al.*, 1979 (distribution, abundance). Menni *et al.*, 1984 (list, key).

56. *Rhinoptera bonasus* (Mitchill, 1815)

This species has a wide distribution from southern New England to middle Brasil (Bigelow & Schroeder, 1953), whereas Mould (1995) gave a more restricted range from New York to Florida, northern Cuba and Venezuela to Brazil. The species has been reported southward from off the

mouth of the Río de la Plata (Vaz Ferreira *et al.*, 1999), Uruguay and Rio Grande do Sul (Brazil) (Vooren & Betito, pers. comm.), where it occurred from August to April (Figueiredo, 1977). Along the coast of Brazil to the north, the species has been reported from Paranaguá Bay and environs (Barletta & Correa, 1989), Cananeia (Gonzalez, 1995), San Salvador de Bahia (Queiroz *et al.*, 1993), Sergipe (Araujo *et al.*, 1995), Recife (Lessa *et al.*, 1995) and Maranhão (Lessa, 1986).

The species made up 8.3% of elasmobranch weight in the fishery off Paranaguá. It was captured at the coast of Recife between 2 and 10 m depth as the third most abundant batoid species in number (10 specimens) after *A. narinari* (150) and *D. guttata* (40) throughout a year's sampling (Lessa *et al.*, 1995).

Catches along the coast of Maranhão were made mainly during the rainy season in December 1984 and January 1985. Males were mature at 89.2 cm DW, with claspers calcified and testicles weighting more than 90 g. Females larger than 54 cm DW showed developing eggs in the ovary and evidence of previous ovulation. A considerable degree of sexual segregation was noted, and males were more abundant than females (5:1) (Menni & Lessa, 1998).

57. *Rhinoptera brasiliensis* Müller & Henle, 1841

For many years, the name *R. jussieui* was applied to Brazilian material of this species (Bigelow & Schroeder, 1953). Although these authors provided a good description and an easy diagnostic character (tooth morphology), the name *R. brasiliensis* was not used again until very recent times. Bigelow & Schroeder (1953) stated that the species occurred off Rio de Janeiro, Santos and Rio Grande do Sul. The presence of *R. brasiliensis* in Brazilian waters was confirmed by a detailed comparison of its cranial anatomy with that of *R. bonasus*, based on material from the Rio de Janeiro State (Gallo-da-Silva et al, 1997).

58. *Mobula hypostoma* (Bancroft, 1831)

The southernmost locality known for this species was Santos (Brazil) (Fowler, 1941), until Cousseau & Menni (1983) provided data of a specimen 364 mm DL captured at Mar del Plata (Argentina). This species is another example of the entry of the tropical and/or subtropical fauna within the Bonaerensean District (Cousseau & Bastida, 1976; Menni, 1981; García & Menni, 1982; Diaz de Astarloa *et al.*, 2000). The transitional character of this district and the difficulties of its geographical delimitation have been often discussed (Menni, 1981 and above).

Along the Brazilian coast, *M. hypostoma* has been recorded by Lessa (1986) and Garrido Martins Juras *et al.* (1987) from coastal areas of the Maranhão State (northern Brazil) and from shallow waters off Recife (Lessa *et al.*, 1995). Soto (1997) reported it from the Archipelago Fernando de Noronha.

Crustaceans of the families Caligidae and Chondrachantidae were found parasiting *M. hypostoma* captured off southern Brazil (Knoff *et al.*, 1993).

59. *Mobula rochebrunnei* Vaillant, 1879

This species was known only from the eastern Atlantic, until Barletta *et al.* (1989) reported a pregnant female from south of São Paulo, with disc 134 cm wide and 74 cm long, and 76/76 tooth rows were counted. The specimen was captured with a drift gillnet near the Palmas Island in front of the estuarine complex of Paranaguá Bay (25°31' S, 48°15' W). The embryo appeared close to birth, with a disc width and length of 57 and 30.5 cm, respectively. Both jaws bore teeth. This is the first report of the species from the Western Atlantic (Barletta *et al.*, 1989). A second specimen was reported by Charvet (1995) from off the Paraná State. *M. rochebrunei* is known from about Senegal to the Gulf of Guinea (Stehmann, 1981) off West Africa. Notwithstanding the reddish - black color of the flesh, other species of Mobulidae are consumed as food though the price at local markets is low. Normally their pectoral fins («wings») are dried and salted (Barletta *et al.*, 1989).

60. *Manta birostris* (Donndorff, 1798)

This pelagic species has a worldwide distribution between 30°N and 30°S (Last & Stevens, 1994), occurring most often in nearshore waters, near coral and rocky reefs and occasionally over deep water (Michael, 1993). Besides the report for Rio de Janeiro (Bigelow & Schroeder, 1953), the giant devil ray has recently been reported from the coast off Recife just below 10 m depth (Lessa *et al.*, 1995) and from Santa Catarina. The latter report (Mazzoleni *et al.*, 1995) refers to an adult female 474 cm DW obtained by a shrimp trawler. The stomach content of penaeid shrimps weighted 904 g. Besides, three other individuals were observed at the same place, one of which (captured) measured 3.5 m DW. The species has been also reported from the Archipelago Fernando de Noronha (Soto, 1997).

## BATOID DISTRIBUTION OFF ARGENTINA, URUGUAY AND BRAZIL

The batoid fishes occurring off Argentina are considered as Magellanic or Bonaerensean species (Table 1). These denominations imply clearly defined ranges of temperature (even salinity), depth and biological characteristics (Boschi, 1981; Menni & Gosztonyi, 1982; Menni & Lopez, 1984). Though 10 Magellanic species are endemic in the province (Table 1), there are no Bonaerensean endemics, except for *D.* cf. *pastinaca* if it is different of the European species.

Among the Bonaerensean species, *Bathyraja schroederi* is a deep slope species in temperate waters (Krefft, 1968); and among the Magellanic species, *B. papilionifera* apparently occurs only in deep waters, i.e., neither is a strictly neritic species (Stehmann, 1985). Nearly all batoid species from the Bonaerensean District occur to the north, off Uruguay and southern Brazil (Fowler, 1941; Bigelow & Schroeder, 1953; Figueiredo, 1977, Menni *et al.*, 1984; Vooren, pers. comm.). At least 5 species are known also from other areas. Only two species of *Bathyraja* occur in the northern Argentine Sea, one of them at slope depths. Of four species of *Psammobatis*, only one reaches northward to Uruguay. *Pristis pectinata* (see Lahille, 1921) and *Mobula hypostoma* (see Cousseau & Menni, 1983) are very incidental invaders from the North. The presence of occasional northern species of both, chondrichthyans and teleosts in the Bonaerensean District has been discussed (Menni, 1981; Garcia & Menni, 1982; Cousseau & Menni, 1983; Diaz de Astarloa *et al.*, 2000). Several families of chondrichthyans and osteichthyans do not appear south of the Río de la Plata mouth (Menni, 1981), namely: Orectolobidae, Ginglymostomidae, Rhinopteridae (at present *Rhinoptera* placed in subfamily Myliobatinae of Dasyatidae), Elopidae, Albulidae, Muraenidae, Argentinidae, Antennariidae, Ogcocephalidae, Bregmacerotidae, Belonidae, Holocentridae, Lophotidae, Peristediidae, Centropomidae, Grammistidae, Malacanthidae, Lutjanidae, Pempheridae, Ephippidae, Chaetodontidae, Opisthognathidae and Callionymidae, plus the urotrygonids and several genera mentioned in the Introduction. Fistulariidae was excluded from the original list because the report of *Fistularia petimba* by Figueroa *et al.* (1992).

Details of distribution and abundance of several species are given by Diaz de Astarloa et al (1999) from the coastal area from northern Uruguay (34°S) to 42°S, which is practically the Bonaerensean District. Samples were obtained during a winter bottom trawl survey at depths from 3 to 65 m, with a temperature range from 7.1 to 13.1°C and salinity range from 1.31 to to 34.2 ups. *D. pastinaca*, *D. tschudii*, *M. goodei*, *P. bergi*, *P. extenta*, *R. agassizi*, *A. castelnaui*, *A. cyclophora* and *Z. brevirostris* were obtained within a wide range of depth and salinity throughout the sampled area, though *D. pastinaca* and *D. tschudii* were more abundant southward and *Z. brevirostris* northward. *R. horkelii* was more abundant north of 36°30´S and *D. flavirostris* was found only south of that latitude.

A document on the elasmobranch fishes from the Río de La Plata and the Common Fishery Zone Argentino-Uruguayan (33°30´to 36°S, 52°30´ to 57°W) was edited by Arena & Rey (1999). Skates and rays were bycaptured in coastal trawling and pelagic fisheries, including mainly *D. flavirostris*, *S. acuta*, *S. bonapartei* and *R. agassizi*, but since 1993 they are subjected to directed fisheries. Annual captures increased from 127.6 tons in 1993 to 2341.5 tons in 1997. Those of *Myliobatis* spp went from 263.6 tons in 1995 to 840.4 tons in 1997.

Off Uruguay, larger biomasses of batoids were found between 51 and 100 m depth. Changes in mean size according latitude and/or depth were not observed, except for *D. flavirostris* that shows smaller sizes in spring with increasing depth. This species was more abundant between 75 and 125 m depth (Paesch, 1999).

Estimated batoid biomass ranged from 19762 tons based in data from the 1995 autumn to 67674 tons in the same season of 1998 (Paesch, 1999).

Captures of chondrichthyans in the Common Fishery Zone Argentino-Uruguayan decreased in summer. Captures of skates appear rather homogeneous along the Uruguay coast in winter, with larger abundance about 34°S in summer and from 34° to 35°S in spring. During autumn, larger concentrations were found on the Argentine coast from 35°30´ to 37°S (Meneses, 1999). According with decreasing densities, the most abundant skates in the area were (richest depth range between parenthesis) *S. bonapartei* (10 to 20 m), *A. castelnaui* (30 to 50 m), *S. acuta* (< 30 m), *R. agassizi* (> 20 m) and *A. cyclophora* (30 to 50 m). Species of *Psammobatis* occurred between 30 and 40 m depth.

A peculiar unresolved disjunction is shown by *Dasyatis* cf. *pastinaca*, which apparently also occurs in the Mediterranean.

The Magellanic batoid fauna is more monotonous at generic level. It is rich in species of *Bathyraja*, with nine species distributed in the province, including the Pacific Ocean section (Stehmann, 1986). One is a deep-water species, and three, as far as known, are Atlantic endemics. There are three Magellanic species of *Psammobatis*, one an Atlantic endemic (*P. parvacauda*), one occurring also off Chile (*P. rudis*), and one probably occurring there (*P. normani*). There are two Magellanic species of the genus *Dipturus* occurring both in the Atlantic and the Pacific (*D. trachyderma* reaches southern Brazil), and one of *Amblyraja*, only in the Atlantic. *Atlantoraja platana* enters the province from the north.

*Discopyge tschudii* is conventionally considered as a Magellanic species. It has a wide range of distribution from southern Brazil to middle Patagonia and along the Pacific Ocean coast to Perú. No differences have been found between Argentine and Chilean samples (García, 1984). In the Atlantic, *D. tschudii* clustered with species occurring near the border zone between the Argentine and Magellanic Provinces at about 42-43°S. This association is clearly recognizable in several faunistic reports and called «Inner shelf mixed fauna» (Menni & Gosztonyi, 1982; Menni & Lopez, 1984). Agreeing with this, Vooren (1997) considered *D. tschudii* a winter migrant to southern Brazil.

Menni & Lopez (1984) found that six areas (Fig. 3) can be considered in the Argentine Sea according to shared values of temperature and (less distinctive) depth. Computing the number of localities occupied by each species in each area, and displaying the data in the order obtained by clustering the species according to presence/absence data (Jaccard index, UPGMA), a detailed view of distribution is obtained (Tables 2 and 3). *Bathyraja brachyurops*, *Dipturus flavirostris* and *B. macloviana* (Magellanic species), have rather wide distributions, occurring in all or nearly all areas sampled.

*Amblyraja doellojuradoi*, *Bathyraja albomaculata*, *B. griseocauda*, *B. scaphiops*, *B. magellanica* and *B. multispinis* are members of the «Main Magellanic Fauna». They do not occur in northern areas, or their abundance is lower there but high in areas of deep and cool waters (Tables 2 and 3).

*Rioraja agassizi*, *Myliobatis goodei*, *Atlantoraja cyclophora* and *D. tschudii* are clustered in the «Inner Shelf Mixed Fauna». The first three species show high percentages of occurrence in area A and somewhat lower ones in area B. *D. tschudii* belongs to this group but has a wider distribution, except in deeper and cooler areas (E, F).

The last group is the «Strictly Bonaerensean Fauna» and comprises *A. castelnaui*, *D.* cf. *pastinaca*, *A. platana* (occurring somewhat south of the area here considered and also off southern Brazil), and *P. bergi* (a species of somewhat deeper water). The obvious agreement between the scheme reflected here and other data available (Boschi, 1979, decapod crustaceans; Ishino *et al.*, 1983, fishes; Angelescu & Prenski, 1987, fish stocks) clearly indicates a realistic approach to the major patterns of distribution. Table 3 shows temperature and depth ranges for Argentine fishes based on data from a research cruise made by the Japanese vessel "Shinkai Maru", listed according to the phenogram of Menni & Lopez (1984). Species are clearly grouping into those preferring lower temperatures (i.e. Magellanic species) and those preferring higher temperatures (Bonaerensean species). *D. flavirostris* is clearly eurythermic. Most species of the Inner Shelf Mixed Fauna occur at temperatures less than 9°C, whereas typically Bonaerensean species inhabit only warmer water. Other data on depth and temperature ranges of Argentine batoids are given in Table 13, based on results from the 'Walter Herwig' cruise 1966.

Species occurring off Brazil are arranged in Table 1 following López's (1963) scheme. Vooren (1997) gives depth ranges of most abundant demersal elasmobranch species off Rio Grande do Sul, Brazil. Landings of chondrichthyans at Rio Grande (Brazil) (Carneiro & Vooren, 1986) include *Dasyatis say*, *D. centroura*, *Gymnura altavela*, *Myliobatis goodei*, *M. freminvillei* and *Rhinobatos horkelii*. This batoid fauna is very similar to that occurring off northern Argentina. In contrast, the presence of *Carcharhinus obscurus* (southern limit off Uruguay at 35°54S, Meneses & Marín, 1999), *C. brevipinna* and *C. plumbeus* (rare off Argentina, Menni *et al.*, 1984), is a noticeable difference for the shark fauna, indicating steady conditions of bottom water but changes in surface waters off southern Brazil (See Calderón, 1994).

The most important littoral mixohaline environment in southern Brazil, the Lagoa dos Patos (30° to 32°30'S), has a rich, mixed batoid fauna (Chao *et al.*, 1982) (Figs 1 and 2). Most abundant species are *S. acuta* and *R. horkelii*, which like *S. bonapartei*, *D. centroura*, *M. freminvillei*, *M. goodei* and *G. altavela* also occur off northern Argentina. In contrast, *R. percellens*,

Table 13. Environmental data for batoid species off Argentina. FRV "Walther Herwig" cruise 1966. N: number of observations.

| Species | DEPTH (m) Range | Mean | N |
|---|---|---|---|
| *B. griseocauda* | 90 - 600 | 327 | 63 |
| *B. macloviana* | 80 - 400 | 185 | 20 |
| *B. magellanica* | 75 - 400 | 167 | 24 |
| *B. multispinis* | 135 - 600 | 358 | 4 |
| *B. scaphiops* | 135 - 600 | 309 | 25 |
| *B. albomaculata* | 80 - 800 | 290 | 46 |
| *B. brachyurops* | 25 - 600 | 239 | 56 |
| *A. doellojuradoi* | 120 - 1000 | 359 | 40 |
| *D. flavirostris* | 50 - 600 | 237 | 64 |
| *A. platana* | 75 - 120 | 97 | 2 |
| *D. tschudii* | 55 - 100 | 81 | 11 |
| *S. acuta* | 70 - 160 | 115 | 2 |
| *M. goodei* | 25 - 100 | 62 | 12 |
| *T. puelcha* | 270 - 280 | 275 | 2 |
| *R. agassizi* | 45 - 600 | 235 | 3 |
| *G. altavela* | 45 - 170 | 96 | 3 |
| *A. castelnaui* | 40 | — | 1 |
| *S. bonapartei* | 50 - 160 | 87 | 7 |
| *A. frerichsi* | 600 - 1000 | 800 | 6 |
| *D. centroura* | - 170 | 170 | 1 |
| *A. cyclophora* | 40 - 200 | 83 | 6 |
| *B. schroederi* | 800 - 1000 | 850 | 4 |

| Species | TEMPERATURE (°C) Range | Mean | N |
|---|---|---|---|
| *B. griseocauda* | 4.13 - 7.6 | 5.59 | 37 |
| *B. macloviana* | 4.30 - 10.4 | 5.89 | 18 |
| *B. magellanica* | 4.70 - 7.6 | 5.97 | 18 |
| *B. multispinis* | - 6.5 | 6.50 | 1 |
| *B. scaphiops* | 4.26 - 6.5 | 5.41 | 18 |
| *B. albomaculata* | 4.28 - 10.4 | 5.73 | 29 |
| *B. brachyurops* | 4.13 - 11.0 | 6.03 | 42 |
| *A. doellojuradoi* | 3.96 - 6.5 | 5.39 | 24 |
| *D. flavirostris* | 4.26 - 11.1 | 6.48 | 52 |
| *A. platana* | 15.50 - 21.6 | — | 2 |
| *D. tschudii* | 6.40 - 11.9 | 9.40 | 10 |
| *S. acuta* | 11.10 - 11.9 | — | 2 |
| *M. goodei* | 6.40 - 18.5 | 11.49 | 11 |
| *T. puelcha* | no data | | |
| *R. agassizi* | 4.63 - 18.5 | 11.95 | 3 |
| *G. altavela* | 16.00 - 21.6 | | 3 |
| *A. castelnaui* | - 11.5 | 11.50 | 1 |
| *S. bonapartei* | 8.80 - 11.9 | — | 7 |
| *A. frerichsi* | no data | | |
| *D. centroura* | - 10.6 | 10.60 | 1 |
| *A. cyclophora* | 11.10 - 18.5 | 13.61 | 6 |
| *B. schroederi* | no data | | |

*N. brasiliensis*, *D. say*, and *R. bonasus* are members of the northern fauna.

Noteworthy is a record of the genus *Benthobatis* (Torpediniformes, Narcinidae) (Rincón & Vooren, 1993). This is based in an apparently undescribed dwarf species captured by bottom trawl off southern Brazil. The genus has also been found in deep waters off Patagonia (H.P. Castello, pers. com.).

Batoids are represented off Brazil between 28°40' and 34°34'S at 10 to 500 m depth by 25 species of rays and skates. From 1981 to 1983, demersal elasmobranchs' abundance (as catches of the commercial otter-trawl fishery) in that area at 10 to 100 depth ranged from 43,000 to 96,000 tons. Eighty percent of the bottom dwelling species biomass was composed by two angel shark species together with *Sympterygia acuta* and *S. bonapartei*, *Myliobatis* cf. *goodei* and *A. castelnaui* (Vooren, 1997).

Vooren (1997) stated that *Z. brevirostris*, *A. castelnaui*, *R. agassizi*, *A. platana*, *A. cyclophora*, *S. acuta*, *Myliobatis* cf. *goodei* and *G. altavela* were the dominant species occurring throughout the year off southern Brazil, thus indicating their complete life cycle there. *S. bonapartei* and *D. tschudii* were winter immigrants into the area, whereas *M. freminvillei*, *D. say*, *D. centroura*, *R. bonasus* and *N. brasiliensis* were summer immigrants.

Data are available about the batoid fauna from the west coast and the Enseada of Anchieta Island, the Enseada do Flamengo and the Fortaleza at Ubatuba in the northern littoral of São Paulo, Brazil (Cunningham, 1989) (Fig. 2). Four localities were fished during 1978-1979 with trawls obtaining *R. horkeli*, *R. percellens*, *Z. brevirostris*, *N. brasiliensis*, *R. agassizi*, *Dasyatis americana*, *D. guttata*, *D. say* and *G. altavela*. Spatial variation was observed with *R. agassizi* being dominant both, in weight and number west of Anchieta Island. Both species of *Rhinobatos* dominated at Enseada da Ilha, and *N. brasiliensis* was the most abundant at the Enseada do Flamengo and Fortaleza. During spring, *R. agassizi* and *N. brasiliensis* were numerically abundant but *R. horkelii* dominant in weight. However, the situation changed in the following spring. During autumn, *N. brasiliensis* dominated in number and weight, followed by *R. percellens*. *N. brasiliensis* and *R. agassizi* dominated in both, weight and number during winter.

Somewhat curious data, showing a drastic diminution of batoids in this area, were reported

by Cunningham *et al.* (1991). Samples were taken during two years since spring 1989, repeating the survey made during 1971-79 mentioned above. Chondrichthyans made up only 1% of the ichthyofauna. Only six batoid species were found namely *R. horkelii*, *R. percellens*, *Z. brevirostris*, *N. brasiliensis*, *R. agassizi* and *G. altavela*.

A commercial fishery for pink shrimp is carried out between Cabo Frio (Rio de Janeiro) and San Francisco do Sul (Santa Catarina) at 28 to 140 m depth. Several elasmobranch species were taken as by-catch (Tomas *et al.*, 1989). *Dasyatis sp.* plus *A. castelnaui* composed 23.56% in weight in the second place after *Squatina spp.* (52.69%). Ranking after several shark species, *R. percellens* reached 4.07%. *R. agassizi* was more common at depth less than 40 m, whereas *A. cyclophora* appeared deeper than 55 m. *Z. brevirostris* and *Psammobatis lentiginosa* were also captured.

The three species of *Rhinobatos* show largely separate distribution, with *R. horkelii* occurring from the State of São Paulo to northern Argentina, *R. lentiginosus* from Recife northward, and *R. percellens* from Paranaguá (though Bigelow & Schroeder, 1953 reported it from Uruguay) to northern Brazil off the states of Pará and Amapá.

A component of the Brazilian batoid fauna that does not occur off Argentina is the pelagic stingray *Dasyatis violacea*. Sadoswky and Amorim (1977b) first reported this species from southern Brazil. Off northeastern Brazil it is relatively abundant in a pelagic longline fishery (Menni *et al.*, 1995), in which the sharks *Carcharhinus signatus* and *C. falciformis* were dominant species.

At the northern littoral of the Paraná State (from 25°17' to 25°30'S and 48°05' to 48°15'W, Brazil) some tropical batoids begin to appear (Charvet & Moreira, 1993). Gillnets and drift nets were used between 10 and 50 m depth. One hundred twenty five specimens of 15 species were captured. Sixty eight percent of the catch was composed of *Rhizoprionodon porosus* and *R. lalandii* and another 7 species of sharks. The batoids taken were *A. narinari*, *R. percellens*, *Z. brevirostris*, *Rhinoptera sp.*, *Mobula sp.* and *N. brasiliensis*. Of the last three species, numerous females were found with near-term embryos. This and the abundance of juveniles suggest the zone is a recruitment area. This trait is enhanced by the fact that 80% of individuals captured in the estuarine-lagoons area are juveniles or newborn individuals (Charvet, 1995b).

Several types of gear (trawlnet, longline, bottomline) and diving, were used in the Bahia de Todos los Santos to identify the batoid fauna (Queiroz *et al.* 1993a). This comprised five species of four families, namely *R. bonasus*, *N. brasiliensis*, *D. guttata*, *D. americana* and *R. percellens*. As in other places north of Cabo Frio, the most frequent species was *D. guttata*.

At the latitude of Recife, Pernambuco (Fig. 2), the batoid fauna has already changed with the presence of tropical forms. The composition of the chondrichthyan fauna (Guedes *et al.*, 1989) was (in percent of number of specimens) 78% carcharhinids, 34% rhinobatids, 28% dasyatids, 14% triakids and 11% sphyrnids. Batoid species were *R. percellens*, *N. brasiliensis*, *D. guttata*, *D.say*, *G. micrura* and *A. narinari*.

Among species reported from the coast of Paraíba (Gadig, 1993), the only species also occurring off northern Argentina are *N. brasiliensis* and the widely distributed *G. micrura*. Remaining species were *R. percellens*, *Urotrygon microphthalmum*, *D. guttata* (which is rather common in the western equatorial Atlantic; see references in Lessa & Menni, 1994 and Menni & Lessa, 1998), *D. say*, the also common *Aetobatus narinari* and *Dasyatis americana*.

The batoid fauna off the State of Maranhão is composed of nine batoid species, namely *R. lentiginosus*, *P. perotteti*, *N. brasiliensis*, *M. hypostoma*, *D. geijskesi*, *D. guttata*, *G. micrura*, *A. narinari* and *R. bonasus* (Menni & Lessa, 1998). It should be noted that these data are based on an artisanal gillnet fishery directed to other species, and possibly the abundance of skates and rays is underestimated. Nonetheless, an exploratory fishing with several types of gear indicated a similar fauna (Stride *et al.*, 1992). *D. guttata*, *R. bonasus* and *A. narinari* were the most abundant batoid species in the area. Neither pregnant females, nor neonate individuals with umbilical scars were observed, but adult males of the former two species were found. Sexual segregation was strong in both *A. narinari* and *R. bonasus* but low in *D. guttata*. *Dasyatis geijskesi* was the only rare species of which mature males were observed (Lessa & Menni, 1986; Menni & Lessa, 1998).

The Marajó Bay is an important trophic and nursery area for at least 28 species of 14 families of freshwater and marine fish. This environment is part of the large estuary formed by the outflow of the Amazon and the Tocantín rivers. Salinity ranged from pure fresh water during the rainy season (January to May) to brackish during the dry season (June to December). Two batoid species are common in the bay. *Pristis perotteti*

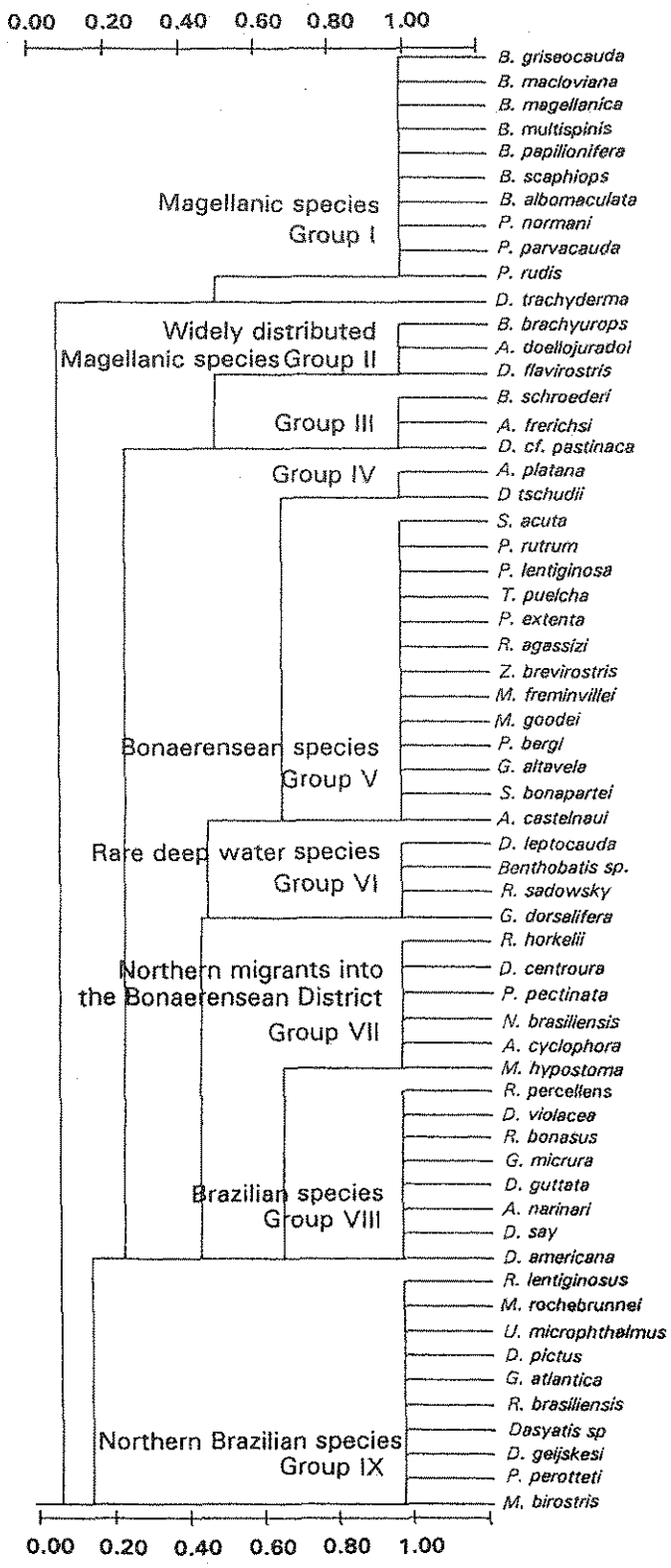


Fig. 4. Batoid fish communities along the Atlantic coast of South America. Cluster analysis (UPGMA) of a Jaccard matrix of data in Table 1.

occurs during the transition period and summer, and is captured with gillnets at juvenile stage (84 cm). Specimens 26 cm length of *D. guttata* were captured with the same gear in summer (Barthem, 1985).

*Pristis pectinata* and *P. perotteti* occur in the Amazon River, but it appears that the latter species does not occur in the Negro River and other Amazon tributaries with acidic waters. Though both species are euryhaline and are captured in the same estuaries and coastal lagoons, some ecological and/or physiological factor forces each species to enter freshwater systems at different seasons (Thorson, 1974).

If correctly identified, the northernmost record of an Argentine species is *A. cyclophora* off Guyana (Uyeno *et al.*, 1983).

We subjected data from Table 1 to a cluster analysis (UPGMA) applied to a matrix based on the Jaccard index (Fig. 4). This technique, based on the joint presence of species, provides groups of species and localities of great heuristic value (Menni & Gosztonyi, 1982; Menni & López, 1984). As to be expected, the Magellanic fauna (Group I) in the traditional sense of Günther (1880) and Norman (1937), is separated from all other groups, which are more related to each other than any of them with the Magellanic fauna (Lloris & Rucabado, 1991). *Dipturus trachyderma* appears associated with Group I at lower level, because of its presence in southern Brazil, with an aparent gap in northern Argentina. Group II (Magellanic species that spread into the Bonaerensean District) and Group III, formed by the deep-water skates *B. schroederi, Amblyraja frerichsi* and *D. cf. pastinaca,* appears related among them, but only at low level with other groups, and not at all with Group IX. Instead, the pair *A. platana* + *D. tschudii* (Group IV) is related with Bonaerensean species (Group V). Both species show uncommon distribution, the former a restricted one, the latter a very extensive one as already discussed.

A completely different group (IX) is composed of northern Brazilian species usually having their southern limit of distribution off Rio de Janeiro. According to the view that northern Argentina, Uruguay and southern Brazil are a large transitional zone (López, 1964; Balech, 1954; Menni, 1981, 1983), the rest of species sorted into 4 groups that also show clear distribution and ecological traits. Group V of Bonaerensean species includes those usually found north of 47°S off Argentina. Five species of this group (*S. acuta, R. agassizi, Z. brevirostris, G. altavela* and *A. castelnaui*), are considered "resident dominant" off Rio Grande do Sul, whereas *S. bonapartei* is a "winter migrant" and *M. freminvillei* a "summer migrant" (Vooren, 1997). These characterizations closely agree with the relative abundance of the species in the Bonaerensean District (Nani, 1964; Nani & G. Alberdi, 1966; pers. observ.). Group VI is composed of four relatively rare deep-water species. These species, *D. leptocauda, Benthobatis sp., R. sadowskii* and *G. dorsalifera* are slope especies (Stehmann & Menni, 1995). Three of them are considered "rare" off southern Brazil (Vooren, 1997).

The group VII of northern migrants into the Bonaerensean District is composed of species that occur all along the Brazilian coast, but spread with rather common abundance into northern Argentine waters. Two of them, *R. horkelii* and *A. cyclophora* are considered "resident dominant" along the southern Brazilian coast. *D. centroura* and *N. brasiliensis*, summer migrants into southern Brazilian waters, as well as *P. pectinata* are in contrast only very occasionally found off northern Argentina.

Group VIII, Brazilian species, is composed of species occurring in both the South Brazilian and Brazilian districts (Table 1), but not off northern Argentina (Bonaerensean District). Two of them, *R. bonasus* and *D. say* are more common in northern waters and "summer migrants" into the South Brazilian District (Vooren, 1997).

Northern Brazilian species of group IX occur off northern Brazil. From the species in this group, *Dasyatis sp., R. brasiliensis* and *D. geijskesi* spread southward to off Rio de Janeiro; *P. perotteti* to Santos, and *M. birostris* to Uruguay. In contrast, the southern limit of *R. lentiginosus* is Recife, and that of *U. microphthalmum*, Paraíba. *D. pictus* is only known from north of the Amazon mouth.

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