

Scientific Note

Stomach contents and notes on the reproduction of the Onefin Skate *Gurgesiella dorsalifera* (Chondrichthyes: Rajidae) off Southern Brazil

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The Brazilian endemic deep-water onefin skate (*Gurgesiella dorsalifera*) is a rare small species recently described in the 80's. No biological information is available on this species and its extremely restricted geographic distribution has been used to classify it as a vulnerable species under IUCN red list criteria. Twenty four specimens (115 to 207 mm disc width) were captured off southern Brazilian coast at the region of Cape Santa Marta Grande (State of Santa Catarina) by deep-water otter trawl (430-524 m). The analysis of stomach contents revealed an apparent opportunistic predation on juveniles of *Urophycis brasiliensis* (IRI = 6944), with an average total length of 21 mm, followed by mysidaceans (IRI = 2938), unidentified teleosts (IRI = 1969), the copepod *Bradyidius plinioi* (IRI = 393), and decapod crustaceans (IRI = 297). One mature female with 207 mm DW had two egg cases in its uteri.

A raia endêmica brasileira de profundidade *Gurgesiella dorsalifera* é uma espécie rara e de pequeno porte recentemente descrita nos anos 80. Não há informações disponíveis sobre a sua biologia e sua distribuição geográfica extremamente restrita tem sido utilizada para classificá-la como uma espécie vulnerável sob os critérios da Lista Vermelha da IUCN. Vinte e quatro espécimes (larguras de disco entre 115-207 mm) foram capturados na costa do sul do Brasil na região do Cabo de Santa Marta Grande (Estado de Santa Catarina) por arrasto de fundo de profundidade (430-524 m). A análise dos conteúdos estomacais revelou um aparente oportunismo predatório sobre juvenis de *Urophycis brasiliensis* (IRI = 6944) com comprimento total médio de 21 mm, seguido por crustáceos misidáceos (IRI = 2938), teleósteos não identificados (IRI = 1969), o copépode *Bradyidius plinioi* (IRI = 393) e crustáceos decápodes (IRI = 297). Uma fêmea adulta com 207 LD apresentava dois ovos, um em cada útero.

Key words: Elasmobranch, Deep-water, Batoidea, Rajiformes.

The skates of the genus *Gurgesiella* are poorly known and most of the literature is about occurrence reports in occasional deep-water surveys or in taxonomic reviews and species descriptions (McEachran & Compagno, 1980; McEachran, 1984; Rey-Carrasco & Acero, 1988; Seret, 1989; McEachran & Miyake, 1990). This genus comprises three small sized species, *Gurgesiella atlantica* (Bigelow & Schroeder, 1962), *G. dorsalifera* McEachran & Compagno, 1980 and *G. furvescens* de Buen, 1959, with an amphi-South America distribution (McEachran & Miyake, 1990). The two Atlantic species (*G. atlantica* and *G. dorsalifera*) are considered sister species and the sister group of the eastern South Pacific species (*G. furvescens*) (McEachran & Compagno, 1980).

Gurgesiella dorsalifera was described by McEachran & Compagno (1980) based only on eight specimens and no further biological information was provided. This species is known

only for the south-southeastern Brazilian upper continental slope at depths of 500-600 m (Séret & Andreato, 1992; Menni & Stehmann, 2000; Bernardes *et al.*, 2006), and although it is frequently captured by the deep-water shrimp otter trawl fishery off southern coast, the only biological information on this species so far was provided by Menni & Stehmann (2000).

Twenty four specimens of *G. dorsalifera* were captured off Santa Marta Grande Cape region (SC-Brazil) by deep-water otter trawl in the past twenty years. Here we present the results on the analysis of the stomach contents of this rare species aiming to identify their probable trophic relationships and to describe some aspects of its reproductive characteristics and activity on the continental slope of Brazil.

In August of 1986 and September and October of 1991, twenty four specimens of *G. dorsalifera* were captured in three one hour sets of otter trawl in depths of 430 to 524 me-

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ters near Cabo de Santa Marta Grande (Brazil) by the ORV "Atlântico Sul" (1986 - 31°01'S-49°19'W one specimen; 1991 - 27°25'S-47°07'W-eight specimens and 29°47'S-47°48'W-fifteen specimens) (Fig. 1). The material was first conditioned in formalin 4%, later transferred to ethanol 70% and deposited at the elasmobranch collection of Department of Oceanography at the Fundação Universidade Federal de Rio Grande (FURG-Laboratório de Elasmobrânquios e Aves Marinhas). Twenty two specimens (8 males and 14 females), with disc widths (DW) ranging from 115 to 207 mm, were analyzed for identification of their stomach contents. In order to detect ontogenetic variation of prey composition, all skates were grouped in four DW classes (group 1 - 110-139; group 2 - 140-169; group 3 - 170-199; group 4 - 200-229 mm DW) and averages were statistically compared by a one way ANOVA test ($\alpha = 0,05$) (Sokal & Rohlf, 1969). Statistical tests were performed by Statistica 5.4 software (STATSOFT). All items in the stomachs were identified to the lowest taxonomic level as possible, weighted to the nearest 0.001 gram, measured in millimeters and counted for the Index of Relative Importance (Pinkas *et al.*, 1971) analysis of the pooled data: $\%FO \times (\%W + \%N)$; where $\%FO$ is the percentage of frequency of an item, $\%N$ is the percentage of the number and $\%W$ is the percentage of its weight, which was used in the place of percentage volume of the original formula. Each item was partially dried using paper towel and weighted on a precision Marte scale, model 506. The fullness was also observed as: 0-empty, 1-a quarter; 2-half; 3-three quarters and 4-completely full. The reproductive system of a mature female was also described based on terminology of Hamlett & Koob (1999).

The results of stomach contents composition are expressed as an IRI diagram (Fig. 2) with the following order of importance: *Urophycis brasiliensis* (IRI = 6944), mysidaceans (IRI = 2938), unidentified teleosts (probably digested *U. brasiliensis*,

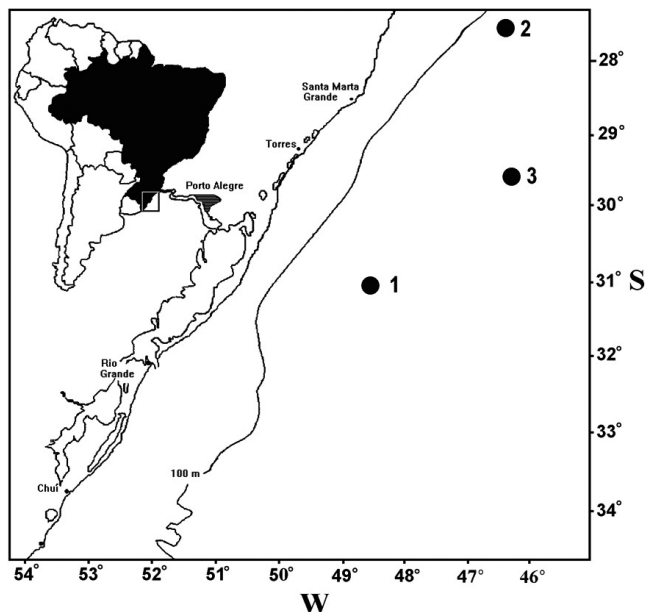


Fig. 1. Map of the study region with marks where specimens of *Gurgesiella dorsalifera* were captured: 1 - 1986 one specimen; 2 - 1991 eight specimens and 3 - 1991 fifteen specimens.

IRI = 1969), copepod *Bradydium plinioi* (IRI = 393), decapod crustaceans (IRI = 297), polychaetes (IRI = 3.1) and copepod *Parapseudocyclops giselae* (IRI = 2.6). Twenty stomachs were full or half full containing mainly juveniles of *U. brasiliensis* with an average size of 22 mm TL and two stomachs were empty. A single stomach had 14 *U. brasiliensis* with an average size of 21 mm TL. *G. dorsalifera* seems to be a piscivorous skate feeding mainly on juveniles of *U. brasiliensis* with an average total length of 22 mm. This teleost represented 66.1% of the weight, 33.1% of the number and 70% of frequency of occurrence. Mysidaceans were the second item in relative importance and represented 10% of weight, 35.2% of the number and 65% of frequency of occurrence. All the mysidaceans were represented by one single species that could not be identified, although very well preserved, and seems to be an undescribed species. Unidentified teleosts were the third item in relative importance and were 19.3% in weight, 16.5% in number and 55% of frequency of occurrence. The copepod *B. plinioi* was the fourth item in relative importance with 0.16% in weight, 7.7% of number and 50% of frequency of occurrence. Crustaceans were the fifth item in relative importance with 3.7% of weight, 6.2% of number and 30% of frequency of occurrence. Polychaetes and *P. giselae* had percentage numbers and weight of less than 1% and both were recorded by single occurrences.

Significant differences of average prey size were observed between the four groups of skate size classes (DW) (group 1 - 4) ($F = 4.35$; $p = 0.006$). However, no apparent tendency of relationship was evident on the scatterplot of prey size (TL) vs. predator size (DW) (Fig. 3). The use of DW or TL as predator size estimator had no effect on the analysis as TL and DW were linearly positive correlated ($F = 643.77$, $p = 0.00$) (Fig. 4). The relation between skate size (DW) and proportional prey size

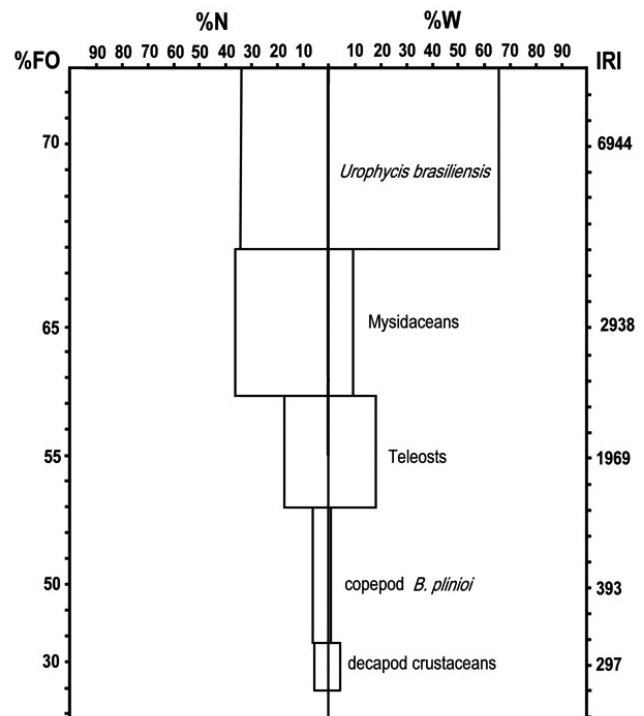


Fig. 2. IRI diagram for the main stomach contents of *Gurgesiella dorsalifera*.

of *U. brasiliensis* (prey size as TL/predator DW x 100) is seen in the Fig. 5 and evidence an apparent tendency of narrowing the range of prey size with growth in order to stabilize under the limit of 20% of the predator DW. This relation ranged from 40.8% (group 1) to 3.3% (group 3) with an average of 15.3%. The largest amplitude of proportional prey size in the same predator size class was 19.7% DW (7.3-27.0% DW) (group 1).

One mature female (207 mm disc width and 365 mm total length) had one partially formed egg case in each 14 mm width horseshoe shaped oviducal gland (Fig. 6). Each uterus had part of the egg case which was opened to the oviducal gland and ready to receive the ova after fertilization. The left egg case was yellowish golden, 45 mm length, 16 mm wide and had two 33 mm anterior tendril-like horns directed to the cloaca. Both ovaries were functional and leaf shaped. The left ovary had a single 3 mm vitellogenic diameter follicle and total weight of 1.2 grams, while the right ovary had a yellow 4 mm diameter follicle, six undeveloped white follicles and total weight of 0.9 grams. The cloaca was slightly extroverted suggesting recent egg deposition activity. The partially formed egg case occupied the whole uterus. Another female with 375

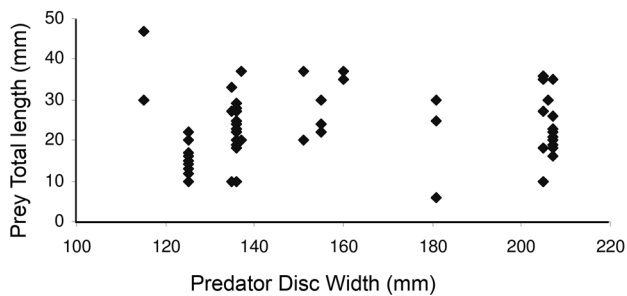


Fig. 3. Distribution of prey size on different size classes of the onefin skate.

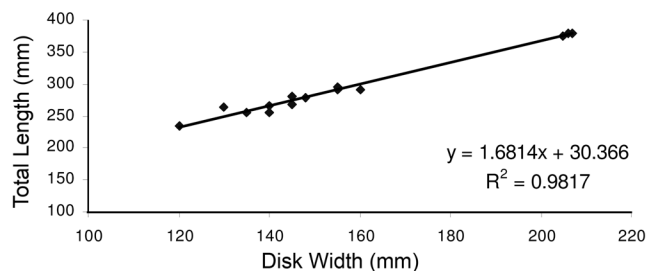


Fig. 4. Linear relationship between disc width (DW) and total length (TL) of the onefin skate.

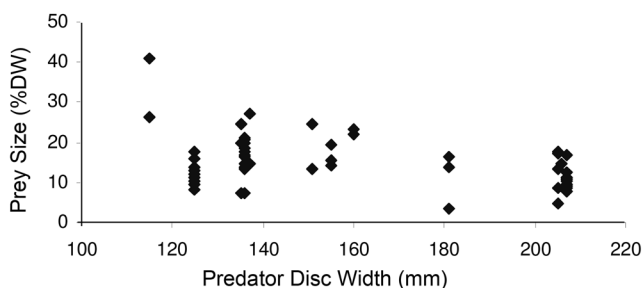


Fig. 5. Proportional prey size in relation to predator disc width (DW).

mm total length (205 mm width) was immature with developing follicles of 1 mm diameter and 7 mm width oviducal glands. Both uteri were creamy and strongly attached to the dorsal cavity wall. All other females were still immature with undifferentiated follicles in their 8-12 mm length ovaries and presented undeveloped 1.5-2 mm width oviducal glands. No mature male was found based on clasper rigidity.

The presence of immature males, females and one mature female in the analysis indicates that teleosts may be an important food item throughout the life of *G. dorsalifera* and that the area is used by the whole population for feeding purposes. We have also observed occasional massive landings of mature (males and females) and immature specimens of the onefin skate captured as bycatch by the deep-water trawl squid fishery off southern Brazil (July-September/2000) with stomachs full of squid chunks (*Illex argentinus*). These specimens were not included in this study since no precise catch locality information was available, but they were probably feeding on aggregations of spawned dead squids left on the sea floor (Santos & Haimovici, 1997).

Adults of *U. brasiliensis* are not common in deep waters of 400 to 600 meters (Haimovici *et al.*, 1994), but the high importance of these juveniles in the stomachs is strong evidence that it could be a nursery area for *U. brasiliensis*. Comyns & Grant (1992) have observed indications of a shoreward migration for recruitment of *U. tenuis* in the U.S Middle Atlantic Bight and larger concentrations of *U. brasiliensis* larvae have also been observed on offshore to oceanic waters of Southern Brazil (José Muelbert pers. com.). Haimovici *et al.* (1996) report that juveniles with total lengths of 15 cm or less are common on coastal waters of Southern Brazil in spring and summer. If juveniles of *U. brasiliensis* with total lengths of about 20-30 millimeters are using deep waters as nursery ground and migrating to the coast as they grow, they probably suffer the predation of *G. dorsalifera*. However, the high importance of juveniles of *U. brasiliensis* (*i.e.* IRI values) must be carefully considered, even if this importance has been confirmed in three

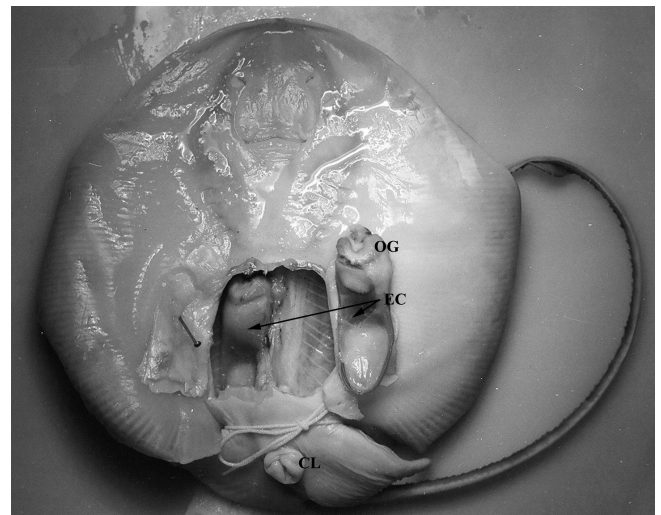


Fig. 6. Ventral view of visceral cavity of *G. dorsalifera*. OG = horseshoe shaped oviducal gland; EC = egg capsules inside the uteri; CL = extroverted cloaca.

different sampling periods (August, September and October). This apparent selectivity may be an artifact resulted from a recent reproductive activity of *U. brasiliensis* and consequently increased the number of juveniles in the area. The high values of %FO reported for all non single occurrences of feeding groups (30 to 70%), the homogeneous size of all *U. brasiliensis* found in the analyzed stomachs and the lack of predator/prey size relationship, may suggest that only juveniles of a given size were available in the area for any onefin skate size and are evidences of the predator's opportunistic behavior.

McEachran & Compagno (1980) have observed immature males with total lengths of 384 mm and 319 mm but the holotype was already mature at 424 mm TL. The largest analyzed male had 340 mm total length and uncalcified claspers. Based on the present analyzed specimen, females of *G. dorsalis* probably mature at total lengths of up to 365 mm. Thus, males seem to reach their maturity at larger sizes than females. The only mature female was already in oviposition phase and the observed ovarian fecundity probably did not correspond to the initial ovarian fecundity at the beginning of reproductive cycle. These results added to the information on the capture of mature and immature specimens by the deep-water trawl squid fishery suggest that the area probably is a nesting and nursery ground for the species.

Oddone & Vooren (2002) and Jañez & Sueiro (2007) provided newborns' DW and egg case widths for *Sympterygia acuta* and *S. bonapartii*, respectively. Based on these values, the average DW of newborns ranged from 1.4 (*S. acuta*) to 1.9 (*S. bonapartii*) times the egg case width. Therefore, if the same proportions are also applied to the onefin skate, embryos hatch from their egg cases (16 mm width) at sizes between 22 to 31 mm DW, probably one of the smallest known newborn skates.

The restricted known distribution of the onefin skate, which is endemic to deep-waters off south-southeastern Brazilian coast and its possible vulnerability to any deep-water otter trawl activity within its area of distribution, has been used as arguments to categorize *G. dorsalis* as a vulnerable species under IUCN's red list criteria (Rincon, 2004). The development of a deep-water fishery such as the monkfish and squid fisheries currently in action at the same known geographic range of the onefin skate (Perez *et al.*, 2003) and the severe lack of information on almost every aspect of this species bring concern to its future conservation.

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