NOTE
BRAZILIAN JOURNAL OF OCEANOGRAPHY, 57(4):339-343, 2009

STOMACH CONTENTS OF THE PELAGIC STINGRAY (*Pteroplatytrygon violacea*) (ELASMOBRANCHII: DASYATIDAE) FROM THE TROPICAL ATLANTIC

Dráusio Pinheiro Véras[1,3], Teodoro Vaske Júnior[2], Fábio Hissa Vieira Hazin[3], Rosangela Paula Lessa[2], Paulo Eurico Travassos[4], Mariana Travassos Tolotti[1,4] and Taciana Martins Barbosa[2]

[1]Universidade Federal de Pernambuco – Departamento de Oceanografia
(Cidade Universitária, 50670-901 Recife, PE, Brasil)
E-mail: drausioveras@bol.com.br

[2]Universidade Federal Rural de Pernambuco - DIMAR/DEPAQ
(Av. Dom Manuel de Medeiros s/n, Dois Irmãos, 52171-900 Recife, PE, Brasil)
E-mail: vaske@ig.com.br; rlessa@depaq.ufrpe.br; taciana.martins@hotmail.com

[3]Universidade Federal Rural de Pernambuco - LOP/DEPAq
(Av. Dom Manuel de Medeiros s/n, Dois Irmãos, 52171-900 Recife, PE, Brasil)
E-mail: fhvhazin@terra.com.br

[4]Universidade Federal Rural de Pernambuco - LEMAR/DEPAq
(Av. Dom Manuel de Medeiros s/n, Dois Irmãos, 52171-900 Recife, PE, Brasil)
E-mail: p.travassos@depaq.ufrpe.br; mari.trrr@gmail.com

The pelagic stingray *Pteroplatytrygon violacea* (Bonaparte, 1832) is the only pelagic dasyatid ray occurring in tropical and subtropical waters of the Atlantic, Indian and Pacific Oceans (BIGELOW; SCHROEDER, 1953; MOLLET, 2002; ELLIS, 2007). This poorly known species was originally described from the Mediterranean Sea, and was first reported from the Atlantic by Bigelow & Schroeder (1962). The species has no commercial value, but is fairly abundant off the Southeastern United States representing about 2.5% in number of the catches by pelagic longlines between 1992-2000 (BEERKIRSHER et al., 2004).

The first record in southern Brazilian waters was reported by Sadowski; Amorim (1977) and Mazzoleni; Schwingel (2002) subsequently recorded the pelagic stingray as a bycatch species regularly caught by tuna longliners off southern Brazil. Menni et al. (1995) reported on the presence of the pelagic stingray in northeastern Brazilian waters. Although the pelagic stingray is caught regularly by tuna longliners operating along the Brazilian coast, few biological data are available on the species. In this context, the stomach contents of the pelagic stingray were analyzed to provide more specific information on its feeding habits in the southwestern equatorial Atlantic Ocean.

The sampled area was located between 40º-25ºW and 5ºN-20ºS (Fig. 1). All specimens were caught by the Research Vessel Riobaldo (CEPENE-IBAMA), in the years 1993, 1994 and 1995 through the Ecotuna Project, and by the Brazilian tuna longline fleet, in the years 2005 and 2006 (SEAP, Onboard Observer Program), in waters of 2000 to 5000 m local depth, with hook depth between 50 and 250 m along the longline. The specimens were stored on ice onboard, and at the laboratory, they were sexed and had their disc width measured to the nearest centimeter.

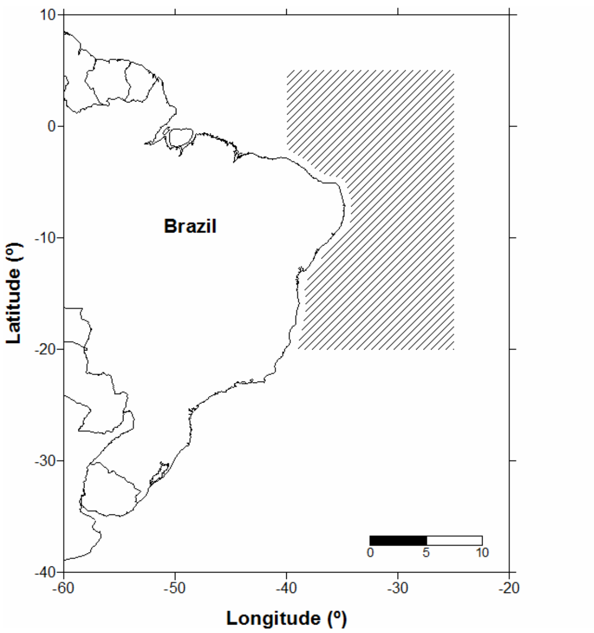

Fig. 1. Sampling area for pelagic stingray in the Southwestern equatorial Atlantic.

A total of 106 specimens were analyzed (69 males, 26 females, and 11 with no sex information). Females were slightly larger, ranging between 40.0 cm and 60.0 cm, with a mean disc width of 49.0 cm. Males varied from 32.0-50.0 cm, with a mean disc width of 43.5 cm (Fig. 2).

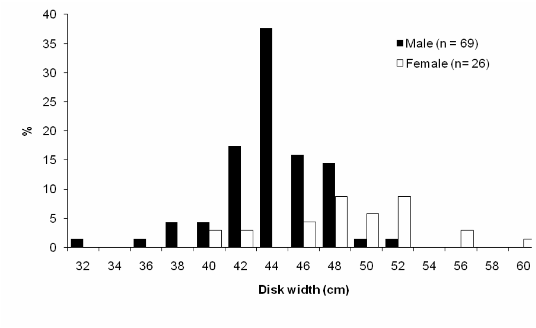

Fig. 2. Size distribution (disc width) for the pelagic stingray.

The stomachs were removed and preserved in 10%formalin, with the food items subsequently identified to the lowest possible taxon. The importance of each food item in the diet was obtained by the Index of Relative Importance (IRI) (PINKAS et al., 1971), utilizing weight data:

$$IRI_i = \%FO_i \times (\%N_i \times \%W_i)$$

Where $\%FO_i$ is the relative frequency of occurrence of each item; $\%N_i$ is the proportion in prey number of each item in the total food; and $\%W_i$ is the proportion in weight of each item in the total food. Longline baits (*Loligo* sp. and *Scomber japonicus*) were not included. Preys in very good condition had their total length measured to investigate preferential prey sizes ingested in the size range of the rays sampled.

Two species of fish were observed (*Diodon hystrix* and *Gempylus serpens*), although most fish remains could not be identified. Various cephalopods were observed, including glass squid (Cranchiidae), ommastrephid squids and the octopod *Japetella diaphana*. Crustaceans were well represented in the diet, especially in terms of hyperiid amphipods (*Phronima sedentaria, Phronimopsis* sp., *Phrosina semilunata* and platyscelids), with shrimps (*Heterocarpus ensifer*), brachyuran megalopae, and squillids also consumed. Other prey included tunicates, pteropods and heteropods (Table 1).

The five most important prey were included among the hyperiid amphipods, teleosts, brachyuran megalopae and pteropods. Although prey size ranged from 1.0 to 140.0 mm length, most prey were between 1.0 and 40.0 mm, being represented by small crustaceans, pteropods and heteropods (Fig. 3). The largest prey species were fish, cephalopods and polychaetes.

References in the literature describe the pelagic stingray as epipelagic (SCOTT; TIBBO, 1968; WILSON; BECKETT, 1970; SADOWSKI; AMORIM, 1977; BRANSTETTER; MCEACHRAN, 1983; PRATT et al, 1990; MENNI et al., 1995), although Nakaya (1982) suggested that they may be a benthopelagic species, utilizing both benthic and pelagic habitats, since captures of pelagic stingray were observed between 330 and 381 m depth, with occasional incursions to superficial waters. However, Bañón et al. (1997) had observed and suggested that the *P. violacea* was probably caught in the top 100 m in the bottom trawl fishery, when the bottom trawl at 800 m was hauled up. Siqueira and Sant'Anna (2007) obtained specimens from the artisanal fishery, caught by handline, operating at depths from 30 to 45 m in the adjacent areas of Father Island and Shallow Island, Rio de Janeiro. Therefore, the distribution of *P. violacea* in the water column is probably related to the geographical location and environmental parameters of the region.

Probably due to the hook selectivity of the longline, the smallest individual had 32.0 cm of disc width. The individuals analyzed by Mazzoleni and Schwingel (2002) in Trindade and Martin Vaz islands ranged from 30.0-66.0 cm of disc width, which are, respectively, the smallest and the largest sizes observed for Brazilian waters. Ribeiro-Prado and Amorim (2008) analyzed individuals in São Paulo that ranged from 35.0-65.0cm. Mazzoleni and Schwingel (2002) pointed out that size differences between males and females could be related to reproduction. Although other studies have reported a predominance of females in the sex ratio (MOLLET, 2002), males predominated in this study, corroborating with what was observed by Forselledo et al., (2008), but it is not clear if it is a population characteristic or due to some kind of depth or spatial segregation related to reproduction or feeding habits, or if vertical distribution is in part due to the influence of the sea water temperature. Sexual segregation has been widely observed in sharks by geographical location, intraspecific competition, and requirements of reproductive choices associated with pre- or post-mating strategies (SPRINGER, 1967; MENNI et al., 1979; SIMS et al., 2001; ODDONE et al., 2007). Experiments with captive specimens at the Monterey Bay Aquarium (USA) showed that females reach 20.0 to 30.0 cm more than males at the same age, and that females were more abundant than males (MOLLET et al., 2002).

Table 1. Percentages in number, weight, and frequency of occurrence of food items of *Pteroplatytrygon violacea* in the Southwestern equatorial Atlantic. IRI – Index of Relative Importance, ranging from 1 to 10 in order of importance.

PREY ITEMS	N	%N	W	%W	FO	%FO	IRI
KINGDOM ANIMALIA							
PHYLUM ANNELIDA							
CLASS POLYCHAETE							
ORDER ACICULATA							
FAMILY ALCIOPIDAE	7	1.10	3	0.75	2	3.17	**8**
GENUS *Naiades*							
SPECIES *Naiades* sp.	2	0.31	1	0.25	2	3.17	
PHYLUM ARTHROPODA							
SUBPHYLUM CRUSTACEA							
SUBCLASS EUMALACOSTRACA							
SUPERORDER PERACARIDA							
ORDER AMPHIPODA							
SUBORDER HYPERIIDEA							
SUPERFAMILY PHRONIMOIDEA							
INFRAORDER PHYSOCEPHALATA							
FAMILY PHRONIMIDAE							
GENUS *Phronima*							
SPECIES *Phronima sedentaria* (Forskål, 1775)	364	57.14	66	16.5	40	63.49	**1**
FAMILY PHROSINIDAE							
GENUS *Phrosina*							
SPECIES *Phrosina semilunata* Risso, 1822	74	11.62	19	4.75	8	12.70	**4**
FAMILY LESTRIGONIDAE							
GENUS *Phronimopsis*							
SPECIES *Phronimopsis* sp.	5	0.78	-	-	1	1.59	
SUPERFAMILY PLATYSCELOIDEA							
FAMILY PLATYSCELIDAE	1	0.16	1	0.25	1	1.59	
ORDER STOMATOPODA							
SUPERFAMILY SQUILLOIDEA							
FAMILY SQUILLIDAE	1	0.16	1	0.25	1	1.59	
ORDER DECAPODA	2	0.31	2	0.5	2	3.17	
SUBORDER PLEOCYEMATA							
INFRAORDER BRACHYURA	87	13.66	10	2.5	17	26.98	**3**
FAMILY PANDALIDAE							
GENUS *Heterocarpus*							
SPECIES *Heterocarpus ensifer* Milne-Edwards, 1881	1	0.16	3	0.75	1	1.59	
PHYLUM CHORDATA							
SUBPHYLUM VERTEBRATA							
CLASS OSTEICHTHYES							
INFRACLASS TELEOSTEI							
ORDER PERCIFORMES							
FAMILY GEMPYLIDAE	1	0.16	2	0.5	1	1.59	
GENUS *Gempylus*							
SPECIES *Gempylus serpens* Cuvier, 1829	1	0.16	8	2	1	1.59	**10**
ORDER TETRAODONTIFORMES							
FAMILY DIODONTIDAE							
GENUS *Diodon*							
SPECIES *Diodon hystrix* Linnaeus, 1758	1	0.16	3	0.75	1	1.59	
UNIDENTIFIED TELEOSTEI	24	3.77	262	65.5	19	30.16	**2**
SUBPHYLUM TUNICATE							
FAMILY SALPIDAE	15	2.35	5	1.25	6	9.52	**6**
PHYLUM MOLLUSCA							
CLASS GASTROPODA							
ORDER PTEROPODA							
FAMILY CAVOLINIIDAE							
GENUS *Cavolina*							
SPECIES *Cavolinia gigas*	3	0.47	-	-	2	3.17	
SPECIES *Cavolinia uncinata* (Rang, 1829)	33	5.18	2	0.5	9	14.29	**5**
ORDER HETEROPODA	5	0.78	-	-	4	6.35	**9**
CLASS CEPHALOPODA							
ORDER OCTOPODA							
FAMILY BOLITAENIDAE							
GENUS *Japetella*							
SPECIES *Japetella diaphana* Hoyle, 1885 (beak)	1	0.16	-	0	1	1.59	
FAMILY OMMASTREPHIDAE (beak)	3	0.47	-	0	3	4.76	
ORDER TEUTHIDA							
SUBORDER OEGOPSINA							
FAMILY CRANCHIIDAE	5	0.78	9	2.25	4	6.35	**7**
UNIDENTIFIED CEPHALOPOD	1	0.16	1	0.25	1	1.59	
TOTAL	**637**	**100**	**400**	**100**			

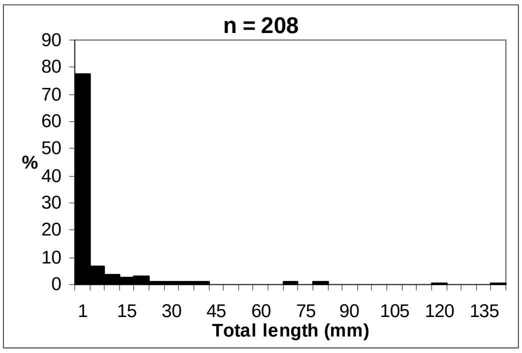

Fig. 3. Prey size distribution of the pelagic stingray.

The pelagic stingray is an epipelagic predator that in the southwestern equatorial Atlantic feeds mainly upon small crustaceans, especially hyperiid amphipods, brachyuran megalopae, and also pteropods, fish and cephalopods. The pelagic feeding habits are further confirmed by the presence of pelagic stingrays in drift gill-net fisheries off southern California (HANAN et al., 1993) and in the Gulf of California (DÁVALOS-DEHULLU; GONZÁLEZ-NAVARRO, 2003).

The stingray catches the bait by wrapping their wings around it and nibbling it until it is gone or until they are hooked (MOLLET, 2002). Bigelow and Schroeder (1962) found two seahorses *Hippocampus* sp., two small shrimps, and fragments of squid in one specimen. SCOTT; TIBBO (1968), found parts of a thalassinoid decapod in a specimen from the northwestern Atlantic, and Wilson and Beckett (1970) found sargassum weed, squid beaks, seahorses, unidentified fish and coelenterates in 16 specimens from the North Atlantic. Two semi-digested skulls of *Scomber japonicus* with a standard length of 235 mm were found in the stomach of a female *P. violacea* in the Gulf of California (DÁVALOS-DEHULLU; GONZÁLEZ-NAVARRO, 2003), although the authors did not comment on the possibility of these *S. japonicus* originating from longline bait. Ribeiro-Prado and Amorim (2008) found mollusca as the most common group, noting also Actinopterygii fishes and Crustaceans in stomachs of *P. violacea*. Siqueira and Sant'Anna (2007) observed only unidentified teleost remains (vertebrae fragments and crystallines).

The dorsal and ventral dark violet color may help to camouflage the pelagic stingrays while they seek pelagic prey in the water column. Besides, the teeth of the pelagic stingray differs from those of most other rays of the Dasyatidae by the presence of cuspidate cutting teeth in both male and female jaws, which contrast with the crushing dentitions of their demersal relatives. These cutting teeth are probably more efficient for grasping small crustaceans. Differences found in the dentition and the swimming behavior of this species, in relation to other *Dasyatis* spp., appear to be autapomorphic (character state that is unique to a particular species or lineage in the group under consideration) functional adaptations to a pelagic lifestyle and a diet of fish and squid (ROSENBERGER, 2001), although prey preferences may vary, as observed in this study, where small crustaceans were more important than fish and squid.

The data and comments above suggest that the *P. violacea* alter their food items according to their geographical location and also shows how the species, despite belonging to the Dasyatidae family, is adapted to the pelagic environment.

ACKNOWLEDGEMENTS

The authors are grateful to the CEPENE-IBAMA, to the Department of Fisheries and Aquaculture of the Federal Rural University of Pernambuco, Brazil, where the stomachs were examined. The present study was also made possible by funding from the Special Secretariat for Aquaculture and Fisheries of the Presidency of the Republic of Brazil (SEAP) and the Brazilian Onboard Observer Program, also of SEAP.

REFERENCES

BAÑÓN, R.; CASAS, J. M.; PINEIRO, C. G.; COVELO, Y. M. Capturas de peces de afinidades tropicales en aguas Atlánticas de Galicia (noroeste de la península Ibérica). **Boln Inst. esp. Oceanogr.**, v. 13, p. 57–66. 1997.

BEERKIRCHER, L. R.; CORTES, E.; SHIVJI, M. Characteristics of shark bycatch observed on pelagic longlines off the southeastern United States, 1992-2000. **Mar. Fish. Rev**., v. 64, n. 4, p. 40-49, 2004.

BIGELOW, H. B.; SCHROEDER, W. C. Sawfishes, guitarfishes, skates and rays. In: TEE-VAN, J. et al. (Ed). **Fishes of the Western North Atlantic** , Part 2. New Haven: Mem. Sears Fnd . mar. Res**.**., Yale Univ., 1953. p. 1-514.

BIGELOW, H. B.; SCHROEDER, W. C. New and little known batoid fishes from the western Atlantic. **Bull. Mus. comp. Zool. Harv**., v. 128, n. 4. p. 161-244, 1962.

BRANSTETTER, S.; MCEACHRAN, J. C. A first record of the bigeye thresher, *Alopias superciliosus*, the blue shark, *Prionace glauca*, and the pelagic stingray, *Dasyatis violacea*, from the Gulf of Mexico. **NE Gulf Sci.**, v. 6, p. 59-61, 1983.

DÁVALOS-DEHULLU, E.; GONZÁLEZ-NAVARRO, E. Stomach content of one pelagic ray *Dasyatis violacea* (Bonaparte, 1832) (Rajiformes: Dasyatidae) from The Gulf of California, Baja California Sur, Mexico. **Oceánides,** v. 18, n. 1, p. 43-44, 2003.

ELLIS, J. R. Occurrence of pelagic stingray *Pteroplatytrygon violacea* Bonaparte, 1832) in the North Sea. **J. Fish Biol.,** v. 71, p. 933–937, 2007.

FORSELLEDO, R.; PONS, M.; MILLER, P.; DOMINGO, A. Distribution and population structure of the pelagic stingray, *Pteroplatytrygon violacea* (Dasyatidae), in the south-western Atlantic. **Aquat. Living Resour**., v. 21, n. 4, p. 357-363. 2008.

HANAN, D. A.; HOLTS, D. B.; COAN, A. L. JR. The California drift gill net fishery for shark and swordfish 1980–81 through 530 H. F. Mollet http://www.publish.csiro.au/ journals/mfr 1990–91. **Fish Bull. Calif. Fish Game,** v. 175, p. 1–93, 1993.

MAZZOLENI, R. C.; SCHWINGEL, P. R. Aspectos da biologia das espécies capturadas por espinhel pelágico na região sul das ilhas de Trindade e Martin Vaz no verão de 2001. **Notas téc. FACIMAR**, v. 6, p. 51-57, 2002.

MENNI, R. C.; LÓPEZ, H. L.; GOSZTONYI, A. E. Sobre la ecología y biología de *Halaelurus bivius* (Chondrichthyes, Scyliorhinidae). **Revta Mus. argent. Cienc.nat. Bernardino Rivadavia Inst. nac. Invest. Cienc. nat.**, (Ecol.), v. 2, n. 3, p. 71-88, 1979.

MENNI, R.C.; HAZIN, F. H.; LESSA, R. P. T. Occurrence of the night shark *Carcharhinus signatus* and the pelagic stingray *Dasyatis violacea* off northeastern Brazil. **Neotropica,** v. 41, n. 1056-106, p. 105-110, 1995.

MOLLET, H. F. Distribution of the pelagic stingray, *Dasyatis violacea* Bonaparte, 1832), off California, Central America, and worldwide. **Bull. mar. Freshwater Res**, v. 53, p. 525–530, 2002.

MOLLET, H. F.; EZCURRA J. M.; O'SULLIVAN J. B. Captive biology of the pelagic stingray, *Dasyatis violacea* (Bonaparte, 1832) **Bull. mar. Freshwater Res.**, v. 53, p. 531–541, 2002.

NAKAYA, K. *Dasyatis violacea*. In: OKAMURA, O. et al. (Ed.). **Fishes of the Kyushu-Palau Ridge and Tosa Bay**. Tokyo: JAMARC, Tosho Printing Co., 1982. p. 54-55, 315.

ODDONE, M. C.; PAESCH, L.; NORBIS, W.; VALESCO, G. Population structure, distribution and abundance patterns of the patagonian smoothhound *Mustelus schmitti* Springer, 1939 (Chondrichthyes, Elasmobranchii, Triakidae) in the rio de La Plata and inner continental shelf, sw Atlantic ocean (34º30'-39º30'S). **Braz. J. Oceanogr.**, v. 55, n. 3, p. 167-177, 2007.

PINKAS, L.; OLIPHANT, M. S.; IVERSON, I. L. K. Food habits of albacore, bluefin tuna, and bonito in Californian waters. **Calif. Dep. Fish Game, Fish. Bull**., v. 152, 105 p, 1971.

PRATT, H. L. JR.; S. H. GRUBER; T. TANIUCHI, T. (Ed.). Elasmobranchs as living resources: advances in the biology, ecology, systematics, and the status of the fisheries. U.S. Dep. Commer., **NOAA tech. Rep**., **NMFS,** n. 90, 519 p, 1990.

RIBEIRO-PRADO, C. C. ; AMORIM, A. F. Fishery biology on pelagic stingray *Pteroplatytrygon violacea* caught off southern Brazil by longliners settled in São Paulo State (2006-07). **International Commission for the Conservation of Atlantic Tunas**, v. 62, n.6, p. 1883-1891, 2008. Collective Volume of Scientific Papers**.**

ROSENBERGER, L. J. Phylogenetic Relationships within the Stingray Genus *Dasyatis* (Chondrichthyes: Dasyatidae) **Copeia**, v. 2001, n. 3, p. 615–627, 2001.

SADOWSKI, V.; AMORIM, A. F. Primeiro registro de ocorrência da arraia pelágica *Dasyatis violacea* (Bonnaparte, 1832) nas águas do Atlântico sul ocidental. **Ciênc. Cult.**, São Paulo, v. 29, n. 7, p. 792, 1977.

SCOTT, W. B.; TIBBO, S. N. An occurrence of the pelagic stingray, *Dasyatis violacea*, in the Northwest Atlantic. **J. Fish. Res. Bd. Canada**, v. 25, p. 1075-1076, 1968.

SIMS, D. W., NASH, J. P.; MORRITT, D. Movements and activity of male and female dogfish in a tidal sea lough: alternative behavioural strategies and apparent sexual segregation. **Mar. Biol., v.** 139, p. 1165–1175. 2001.

SIQUEIRA, A. E. ; SANT´ANNA, V. B. Data on the Pelagic Stingray, *Pterolatytrygon violacea* (Bonaparte, 1823) (Myliobatiformes: Dasyatidae) caught in the Rio de Janeiro coast. **Braz. J. Oceanogr.**, v. 55, p. 323-325, 2007.

SPRINGER, S. Social organization of shark populations. In: GILBERT, P. W.; MATHEWSON, R. F.; RALL, D. P. (Ed.). **Sharks, Skates and Rays.** Baltimore, MD: John Hopkins Press, 1967. p. 149-174.

WILSON, P. C.; BECKETT, J. S. Atlantic ocean distribution of the pelagic stingray, *Dasyatis violacea*. **Copeia**, v. 4, p. 696-707, 1970.

(Manuscript received 31 July 2008; revised 26 February 2009; accepted 07 July 2009)