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Gastropoda and Bivalvia as bycatch of the Atlantic seabob, *Xiphopenaeus kroyeri,* trawl fisheries in Pontal do Paraná, southern Brazil

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Abstract: Bycatch are organisms that are inadvertently caught during fishery. They are usually rejected and/or returned to the sea, and are killed in the process. The aim of this study is to characterize the Gastropoda and Bivalvia caught as bycatch of the trawling fisheries of the Atlantic seabob, *Xiphopenaeus kroyeri,* on the coast of Paraná state, southern Brazil. This work was carried out in the municipality of Pontal do Paraná. A total of 651 living individuals were collected, including four species belonging to three families of gastropods and six species distributed into four families of bivalves. Although the frequency of gastropods (96.5%) was much higher than that of bivalves (3.5%), species diversity was higher in bivalves. Among the Gastropoda, *Olivancillaria urceus* (Gmelin, 1791) was the most abundant species, with 611 individuals. Among the bivalves, *Anadara brasiliana* (Lamarck, 1819) had the most significant occurrence, with eight individuals. It is important to develop further studies to identify the potential impact of trawling on these mollusk populations and the creation and implementation of public policies and the adoption of technological devices to reduce the bycatch in order to preserve them.

Keywords: Bycatch; Environmental impact; Mollusks; Trawl fisheries.

INTRODUCTION

Bycatch are organisms caught unintentionally alongside target species in fishery activities. These animals end up rejected and/or returned to the sea, and most of them are killed during the procedure (Fonseca *et al.* 2005). This rejected fauna may be diverse and usually includes mollusks, crustaceans, cnidarians, fish, and echinoderms. Due to its low selectivity, the bottom trawling method is considered a major source of unintentional mortality (Perez & Wahrlich 2005).

Due to the use of heavy materials to drag the bottoms, added to narrower meshes, shrimp fishing is considered one of the least selective fishing methods. It causes a considerable impact on demersal and pelagic communities by changing the sea floor structure and sediment suspension, which ultimately alters the functioning of ecosystems, and negatively affects biodiversity (King 2007).

In several communities on the southern coast of Brazil (Paraná and Santa Catarina states), artisanal shrimp trawling is considered the basis of family economy. Even though the accompanying fauna presents great nutritional value, it is rarely used as a food source (Pezzuto 2001; Chaves & Robert 2003). Though fishing activities have been developed since the beginning of the Holocene (*ca.* 11,000 years ago) on the coast of Paraná, which is evidenced by vestiges found in prehistoric archaeological sites such as middens (Gernet & Santos 2014), the local fishing techniques continue to be predominantly artisanal, with semi-industrialization occurring punctually on some coastal areas in Santa Catarina (Andriguetto-Filho *et al.* 2009).

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The artisanal fishing of the Atlantic seabob, *Xiphopenaeus kroyeri* (Heller, 1862), is of great economic importance in some coastal municipalities along Paraná state, such as Guaratuba, Matinhos, Pontal do Paraná, and Paranaguá (Andriguetto-Filho 2003). Despite the fact that authors such as Carniel & Krul (2011) and Cattani *et al.* (2011, 2012), in studies in Pontal do Paraná, have identified the ichthyofauna as the most abundant group as bycatch of the bottom trawl fishery, it is important to point out that the malacological fauna is also present in this type of activity (Graça-Lopes *et al.* 2002). Even though it is one of the major animal phyla, presenting great structural variety, wide trophic diversification, and occupying nearly every ecological niche (Geiger 2006), mollusks are still scarcely studied in Brazil, and research related to this group as bycatch in the local fishery is even more incipient. The aim of this work is to characterize the marine gastropod and bivalve mollusks as bycatch of trawling fisheries of Atlantic seabob on the coast of Pontal do Paraná.

MATERIAL AND METHODS

The present study was carried out on the coast of Paraná state, off the municipality of Pontal do Paraná (25°67’36”S, 48°51’11”W), between Atami and Praia de Leste beaches (Figure 1). Sampling was carried out once a month, from June 2015 to May 2016. The sampling effort involved the work of four fishermen whose fishing equipment included nets with meshes varying from 20 to 40 mm. The trawling technique consisted of winches and doors installed in canoes exclusively made of fiberglass. The trawls were carried out at a distance of up to 5 km from the coast. Live specimens considered bycatch were collected and later transported to the laboratory, where they were sacrificed in boiling water at 100°C. They were properly sanitized in chlorine-diluted distilled water, air dried and then packed in plastic containers containing ethanol 70%. All containers were labeled with standard collection data and registered in the malacological collection of the Laboratório de Ecologia Aplicada e Bioinvasões da Universidade Federal do Paraná (LEBIO 511–542), Pontal do Paraná, Brazil. Taxonomic identification was based on specialized literature (Matthews & Coelho 1972; Diaz & Puyana 1994; Guerón & Narchi 2000; Papp & Duarte 2001; Matthews-Cascon & Rabay 2003; Absalão & Pimenta 2005; Amaral *et al.* 2006; Denadai *et al.* 2006; Rios 2009; Rosenberg 2009; Claremont *et al.* 2011; Teso & Pastorino 2011; Rocha & Matthews-Cascon 2015). The same literature was also used to present herein brief descriptions, bathymetric data, and geographic distribution of the species collected. The taxonomy has been updated according to WoRMS Editorial Board (2017).

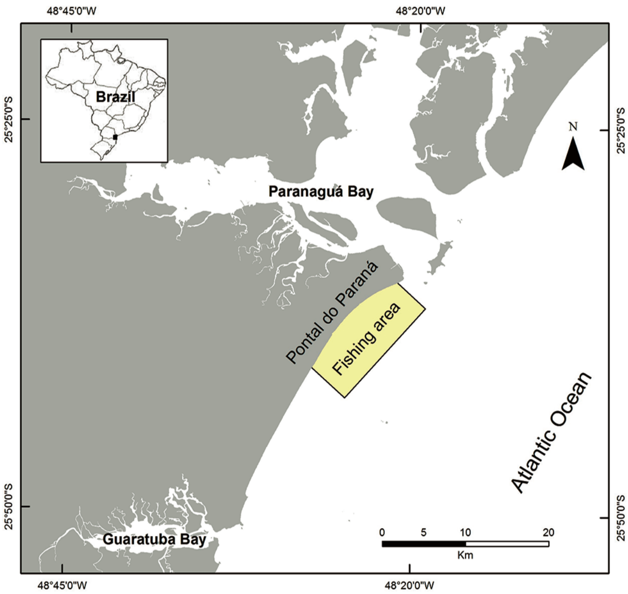

Figure 1: Study site at Pontal do Paraná municipality.

RESULTS

A total of 651 living individuals were collected as bycatch, four species (three families) of gastropods and six species (four families) of bivalves, totaling 10 mollusk species (Table 1; Figures 2–11). The frequency of gastropods (96.47%) was much higher than that of bivalves (3.53%), but species diversity was higher in bivalves (Table 1). For the class Gastropoda, the species *Olivancillaria urceus* (Gmelin, 1791) was the most abundant, with 611 individuals, appearing in all samples throughout the year. The second most collected species of Gastropoda was *Semicassis granulata* (Born, 1778) (eight individuals), though it only occurred in the winter. Among the bivalves, *Anadara brasiliana* (Lamarck, 1819) had a more significant occurrence, with eight individuals, also being present all year long. The bivalves *Pitar rostratus* (Philippi, 1844) and *Tivela dentaria* (Lamarck, 1818) were the least representative, with one

Figures 2–11: Species of mollusks as bycatch of Atlantic seabob fishery. **2.** *Semicassis granulata,* LEBIO 512, H: 42.6 mm; **3.** *Olivancillaria vesica,* LEBIO 514, H: 31.2 mm; **4.** *Olivancillaria urceus,* LEBIO 511, H: 14.8 mm; **5.** *Stramonita brasiliensis,* LEBIO 525, H: 17.1 mm; **6.** *Anadara brasiliana,* LEBIO 513, L: 41.0 mm; **7.** *Lunarca ovalis,* LEBIO 538, L: 15.8 mm; **8.** *Pitar rostratus,* LEBIO 541, L: 28.8 mm; **9.** *Tivela dentaria,* LEBIO 535, L: 35.3 mm; **10.** *Temnoconcha galathaea,* LEBIO 522, L: 32.8 mm; **11.** *Psammotella cruenta,* LEBIO 536, L: 62.0 mm. H: shell height for gastropods, L: shell length for bivalves.

specimen each. On a seasonal scale, the highest diversity of species (five) was observed during autumn, and the highest number of individuals was captured during autumn and winter (Table 1).

Brief description of collected species

Semicassis granulata (Figure 2) has a robust shell with a smooth and glazed protoconch, with up to 90 mm in height, there are numerous pustules and small folds on the columellar wall. The shell aperture is oval, with the outer lip reflected and thick presenting delicate folds that resemble small teeth. The tentacle and ommatophore from the left side are larger than those from the right side. The posterior and anterior siphonal channels are well defined. Straight and wide monopectinate gills at the superior central part of the pallial chamber. In the anterior extremity of the proboscis is the buccal mass, anchored by thin radial muscles, including the odontophore and the radula. Distal margin pleated by the stretching of the lateral-center nucleus elevations. The corneus operculum is light yellow, fan shape, axially stretched with radial elevations cut by a number of fine concentric grooves. This species prey on echinoderms like starfish, sea urchins and sand dollars. It inhabits shallow water (up to 95 m in depth) and its specimens are occasionally found in the intertidal strip, partially buried in the sand. This species occurs in the USA (North Carolina to Florida, Texas), Bermuda, eastern coast of Colombia, Venezuela, Brazil (including Trindade and Martin Vaz Archipelago), Uruguay, South Atlantic Seamounts, Cape Verde, Canary Islands and Madeira.

Table 1: Species of mollusks as bycatch in Atlantic seabob fishery and number of individuals collected per season.

Class/Family	Species	Number of specimens				Total	Percentage (%)
		Winter	Spring	Summer	Autumm		
GASTROPODA							
Cassidae	*Semicassis granulata* (Born, 1778)	8	0	0	0	8	1.23
Olividae	*Olivancillaria vesica* (Gmelin, 1791)	5	1	1	0	7	1.07
	Olivancillaria urceus (Röding, 1798)	172	125	22	292	611	93.85
Muricidae	*Stramonita brasiliensis* Claremont & Reid, 2011	0	1	0	1	2	0.31
BIVALVIA							
Arcidae	*Lunarca ovalis* (Bruguière, 1789)	0	0	0	6	6	0.92
	Anadara brasiliana (Lamarck, 1819)	1	2	3	2	8	1.23
Veneridae	*Pitar rostratus* (Philippi, 1844)	0	0	0	1	1	0.15
	Tivela dentaria (Lamarck, 1818)	0	0	1	0	1	0.15
Tellinidae	*Temnoconcha galathaea* (Lamarck, 1818)	0	1	0	2	3	0.46
Psammobiidae	*Psammotella cruenta* (Lightfoot, 1786)	0	0	4	0	4	0.62
Total		186	130	31	304	651	—
Percentage (%)		28.57	19.87	4.76	46.70	—	100

Olivancillaria vesica (Figure 3) has a polished shell that can reach up to 60 mm in height, with a short spire, covered by a thick callosity and deep suture on the dorsal side. The shell has a smooth shiny surface with little visible growth lines. The protoconch is not covered by the columellar callus. The siphon is short with a small amount of same-sized papillae. The external lip is curved, with the elongated aperture representing 4/5 of the shell size. Smooth columella with broad thickening that extends to the spire and with 4 or 5 oblique folds. Operculum absent. This species is carnivorous and has already been observed feeding on the bivalve *Donax hanleyanus* Philippi, 1847, and on the crustacean *Emerita brasiliensis* (Schimitt, 1935). It inhabits the sandy bottoms of the infralittoral zone about 20 m deep and is found from Iguape Bay, Bahia state, to Florianópolis, Santa Catarina state, Brazil.

Olivancillaria urceus (Figure 4) has a solid sub-quadrangular shell (up to 63.5 mm in height) with a strong parietal callus and pleats on the fasciolar band. The protoconch is always visible and it is never covered by the callus. The transition to the teleoconch is undistinguishable. Operculum absent. The rachiglossate radula possesses tricuspid rachidian teeth. The back of the body is slightly conical. The outer lip is smooth, but the columellar wall contains oblique folds and a strong callosity. It has a smooth surface covered with a shiny enamel cover and with scarcely visible growth lines. This species is carnivorous and feeds mainly on the bivalve *Donax hanleyanus.* It inhabits sandy bottoms up to a depth of 50 m and it is distributed from Subaúma, Bahia state, Brazil, to Puerto Lobos, San Martin Gulf, Chubut province, Argentina.

Stramonita brasiliensis (Figure 5) has a medium-sized shell, around 70 mm in height, with nodular sculpture and a crenulated outer lip. The shell aperture is sub-oval and the siphonal channel is short. There spire angle is variable and the columellar is smooth with broad thickening and slightly orange color. It has a corneus operculum with a lateral nucleus. It is carnivorous and feeds mainly on marine bivalves such as oysters and mussels. It presents great capacity of locomotion when searching for food and it also forms reproduction aggregates. The females lay prismatic and purple egg capsules. This species inhabits all extracts of the rocky shores in the Lesser Antilles and from Venezuela to Uruguay.

Lunarca ovalis (Figure 6) has inequilateral valves, an oval to subtrapezoidal shape, reaching 40 to 60 mm in length; it is sculptured by smooth axial ribs and has slightly crenulated ventral margins; its periostracum is thick and sometimes hairy; the hinge presents several taxodont denticles. The umbo is joined and located in the anterior chamber of the shell, with a narrow ligament and taxodont hinge. The cardinal area is reduced. It filter-feeds on small planktonic organisms using its gills. It inhabits the infralittoral region up to 11 m in depth, burying close to the surface, with its posterior margin just above the substrate. The species is found in the USA (North Carolina to Florida and Texas), the West Indies, Venezuela, Brazil and Uruguay.

Anadara brasiliana (Figure 7) has inflated trigonal valves (left valve is larger than the right one) ranging 41 mm in length, with a white color and a fine brown periostracum. Its surface presents prominent nodular axial ribs and crenulated ventral margins. It has inflated umbos, well separated, and a taxodont hinge. The siphon and pallial sinus are absent and the scars of adductor muscles are discrete. It is a filter feeder, inhabiting depths from 5 to 75 m in sandy bottoms with gravel. It is found in the USA (from North Carolina to Florida and Texas), the West Indies, Venezuela and Brazil (from Amapá to Santa Catarina states).

Pitar rostratus (Figure 8) has symmetrical subtrigonal valves with rounded margins, reaching up to 65 mm in length and presenting a weakly-marked cordiform-elongated lunule. The posterior region is longer than the anterior; the outer surface is smooth, with subtle growth lines and cream-white coloration region and a fine yellowish periostracum; the external ligament is strong and the umbo is anteriorly displaced. The scar of the posterior adductor muscle is rounded and that of the anterior adductor muscle is oval and elongated. The pallial sinus is moderately deep and angulated. It is a filter feeder, inhabiting depths of 10 to 100 m. It is distributed from Rio de Janeiro, Brazil, to Patagonia, Argentina.

Tivela dentaria (Figure 9) has thick oval to subtrigonal shells with rounded margins, which reach up to 60 mm in length; the outer surface is smooth, with subtle growth lines; the periostracum is pink to purple, varying in intensity. The internal region of the shell is white, with a large and angular pallial sinus. The scar of the posterior adductor muscle is rounded and that of the anterior adductor muscle is oval and elongated. The long ligament is attached to a thick nymph. The lunule is cordiform-elongated and weakly delimited. There are delicate stems located on the anterior third of the shell. This species lives in sandy bottoms up to 8 m in depth; it is a filter feeder. It can be found from Espírito Santo state, Brazil, to Golfo San Matias, Argentina.

Temnoconcha galathaea (Figure 10) has a fairly fragile shell of homogeneous white coloration with up to 40 mm in length. The anterior extremity is slightly larger than the posterior and lightly rounded. The outer surface is smooth, with subtle growth lines. It has a deep palial sinus, with long and separate siphons at the base, which are located behind the central region. There are no lateral teeth on the hinge. It has a discrete ligament with narrower nymph. This filter feeder inhabits depths of up to 25 m in the West Indies, Venezuela, Suriname and Brazil.

Psammotella cruenta (Figure 11) can reach up to 75 mm in length, displaying elliptic-elongated valves, with a rounded anterior region and marked difference in valve morphology: the right valve is strongly convex while the left one is flattened. The shell surface is smooth, with very subtle growth lines. The umbonal region is dark pink. The scars of the adductor muscles are markedly different from one another; the palial line is well marked and the species presents long siphons. This filter feeder inhabits depths of up to 55 m from the Caribbean Sea to Brazil (from Maranhão to Santa Catarina states).

DISCUSSION

A large quantity of organisms was captured as bycatch, a fact that is quite common in shrimp trawls due to the small size of the meshes and, consequently, their low selectivity (Dayton 1995; Kelleher 2005). All mollusk species collected are typical of sandy bottoms, with the exception of *Stramonita brasiliensis,* which is characteristic of rocky shores, and whose presence can be explained by animals fixed on a moving substrate. The abundance of *Olivancillaria urceus* was also observed in other studies, such as Santos *et al.* (1999), Branco & Verani (2006) and Branco *et al.* (2015), and can be explained by the behavior of the species, which lives in large and dense groupings (Boffi 1979), facilitating capture. The large representativeness of this species points to an economic potential, as has already been commented by Santos *et al.* (1999).

Although all fishermen who contributed to this work claim that they discard the fauna of no commercial value in the sea, studies suggest that the survival of most of these individuals is low (Kelleher 2005; Branco & Verani 2006; Cattani *et al.* 2011). The discarding is done because none of the mollusk species collected is widely consumed in Brazil, having no commercial value compared to species that are cultivated or extracted from the natural environment for this purpose, such as *Crassostrea* sp., *Mytella* sp., *Perna perna* (Linnaeus, 1758), *Anomalocardia flexuosa* (Linnaeus, 1767), among others (Baldan & Bendhack 2009; Freitas *et al.* 2012; Castilho-Westphal *et al.* 2014). Martins & Oetterer (2010) argue that nutritional value of seafood is not always directly proportional to its market value and, therefore, the price is more often related to marketing. The development of new food products would be an excellent alternative to give a fitting destination for the underutilized species accidentally caught (Osako *et al.* 2005).

The molluscan bycatch of Atlantic seabob fishery presents a great diversity; however, the impact caused by the mortality of this fauna on the fishing areas is unknown. It is presently not possible to say if there are any changes in the life cycle of these species. The creation and implementation of public policies and the use of new technologies to reduce bycatch are thus necessary. To this end, it is extremely important to research and test bycatch reduction devices (BRD), observing that a simple import of technologies used in other regions is not always adequate to local environmental, economic, and social aspects (Berkes 2003; Fonseca *et al.* 2005; Cattani *et al.* 2012; Medeiros *et al.* 2013).

Further studies focused on the life cycle of bycatch mollusks should also be carried out in order to understand the real impacts of shrimp fisheries. Research on these mollusks in the region is still incipient, but trawling is a very old fishing practice along the coast of Paraná.

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REFERENCES

Absalão R.S. & Pimenta A.D. (2005) *Moluscos Marinhos da APA do Arquipélago de Santana, Macaé, RJ – Chave para Identificação das Espécies do Substrato Inconsolidado.* Editora Ciência Moderna, Rio de Janeiro.

Amaral A.C.Z., Rizzo A.E., Arruda E.P. (2006) *Manual de Identificação dos Invertebrados Marinhos da Região Sudeste-sul do Brasil. Volume I.* Editora Universidade de São Paulo, São Paulo.

Andriguetto-Filho J.M. (2003) A mudança técnica e o processo de diferenciação dos sistemas de produção pesqueira do Litoral do Paraná, Brasil. *Desenvolvimento e Meio Ambiente* 8: 134–151.

Andriguetto-Filho J.M., Krul R., Feitosa S. (2009) Analysis of natural and social dynamics of fishery production systems in Paraná, Brazil: implications for management and sustainability. *Journal of Applied Ichthyology* 25(3): 277–286.

Baldan A.P. & Bendhack F. (2009) Maricultura sustentável no litoral do Paraná, Brasil: atualidades e perspectivas. *Revista Acadêmica Ciências Agrárias e Ambientais* 7(4): 491–497.

Berkes F. (2003) Alternatives to conventional management: lessons from small-scale fisheries. *Environments* 31(1): 5–20.

Boffi A.V. (1979) *Moluscos Brasileiros de Interesse Médico e Econômico.* Editora Hucitec, São Paulo.

Born I. (1778) *Index Rerum Naturalium Musei Caesarei Vindobonensis. Pars I. Testacea.* Offficina Krausiana, Wien.

Branco J.O. & Verani J.R. (2006) Pesca do camarão sete-barbas e sua fauna acompanhante, na Armação do Itapocoroy, Penha, SC. *In:* Branco J.O. & Marenzi A.W.C. (Eds.) *Bases Ecológicas para um Desenvolvimento Sustentável: Estudos de Caso em Penha, SC.* Editora da UNIVALI, Itajaí. Pp. 153–170.

Branco J.O., Freitas Júnior F., Christoffersen M.L. (2015) Bycatch fauna of seabob shrimp trawl fisheries from Santa Catarina State, southern Brazil. *Biota Neotropica* 15(2): e20140143.

Bruguière J.G. (1789) *Encycloppédie Méthodique. Histoire Naturelle des vers. Tomus I.* Chez Panckoucke, Paris.

Castilho-Westphal G.G., Dal Pont G., Horodesky A., Ostrensky A. (2014) Comunidades ribeirinhas extrativistas e a exploração de bancos de ostras do mangue *Crassostrea* sp., na Baía de Guaratuba - Paraná, litoral sul do Brasil. *Bioscience Journal* 30(suppl. 2): 912–923.

Carniel V.L. & Krul R. (2011) Kleptoparasitism in seabirds during interactions with artisanal fisheries on the coast of Paraná, south Brazil. *Revista Brasileira de Ornitologia* 19(4): 461–468.

Cattani A.P., Santos L.O., Spach H.L., Budel B.R., Guanais J.H.D.G. (2011) Avaliação da ictiofauna da fauna acompanhante da pesca do camarão sete-barbas do município de Pontal do Paraná, litoral do Paraná, Brasil. *Boletim do Instituto de Pesca* 37(2): 247–260.

Cattani A.P., Bernardo C., Medeiros R.P., Santos L.O., Spach H.L. (2012) Avaliação de dispositivos para redução da ictiofauna acompanhante na pesca de arrasto dirigida ao camarão sete-barbas. *Boletim do Instituto de Pesca* 38(4): 333–348.

Chaves P.T. & Robert M.C. (2003) Embarcações, artes e procedimentos da pesca artesanal no litoral sul do estado do Paraná, Brasil. *Atlântica* 25(1): 53–59.

Claremont M., Williams S.T., Barraclough T.G., Reid D.G. (2011) The geographic scale of speciation in a marine snail with high dispersal potential. *Journal of Biogeography* 38: 1016–1032.

Dayton P.K., Thrush M.T, Agardy M.T., Hofman R.J. (1995) Environmental effects of marine fishing. *Aquatic Conservation: Marine and Freshwater Ecosystems* 5(3): 205–232.

Denadai M.R., Arruda E.P., Domaneschi O., Amaral A.C.Z. (2006) Veneridae (Mollusca, Bivalvia) da costa norte do Estado de São Paulo, Brasil. *Biota Neotropica* 6(3): 1–34.

Diaz J.M.M. & Puyana M.H. (1994) *Moluscos del Caribe Colombiano: Un catalogo ilustrado.* Colciencias y Fundación Natura, Santafé de Bogotá.

Fonseca P., Campos A., Larsen R.B., Borges T.C., Erzini K. (2005) Using a modified Nordmøre grid for bycatch reduction in the Portuguese crustacean-trawl fishery. *Fisheries Research* 71: 223–239.

Freitas S.T., Pamplin P.A.Z., Legat J., Fogaça F.H.S., Barros R.F.M. (2012) Conhecimento tradicional das marisqueiras de Barra Grande, Área de Proteção Ambiental do Delta do Rio Paraíba, Piauí, Brasil. *Ambiente & Sociedade* 15(2): 91–112.

Geiger D.L. (2006) Marine Gastropoda. *In:* Sturm C.F., Pearce T.A. & Valdés A. (Eds.) *The Mollusks: A Guide to Their Study, Collection and Preservation.* American Malacological Society, Universal Publishers, Florida. Pp. 295–312.

Gernet M.V. & Santos E.V. (2014) A arte e a história da produção de pesos de rede de barro, "Pandulhos", no litoral do Paraná, Brasil. *Divers@!* 7(1): 1–13.

Gmelin J.F. (1791) *Caroli a Linné, Systema Naturae per Regna Tria Naturae, Secundum Classes, ordines, Genera, Species, cum characteribus, differenttis, synonymis, locis. Editio decima tertia, aucta, reformata (Tomus I, Pars VI, Vermes).* Impensis Georg. Emanuel. Beer, Leipzig.

Graça-Lopes R., Tomás A.R.G., Tutui S.L.S., Severino-Rodrigues E., Puzzi A. (2002) Fauna acompanhante da pesca camaroeira no Litoral do Estado de São Paulo, Brasil. *Boletim do Instituto de Pesca* 28(2): 173–188.

Guerón C.O & Narchi W. (2000) Anatomia funcional de *Protothaca (Leukoma) pectorina* (Lamarck) (Bivalvia: Veneridae). *Revista Brasileira de Zoologia* 17(4): 1007–1039.

Kelleher K. (2005) *Discards in the World's Marine Fisheries: An Update.* Food and Agriculture Organization of the United Nations, Rome.

King M. (2007) *Fisheries Biology, Assessment and Management, 2nd edition.* Blackwell Publishing, New Jersey.

Lamarck J.-B.P.A.M. (1818) *Histoire naturelle des animaux sans vertèbres … précédée d'une introduction offrant la détermination des caractères essentiels de l'animal, sa distinction du végétal et des autres corps naturels, enfin, l'exposition des principes fondamentaux de la zoologie. Tomus V.* Verdière, Paris.

Lamarck J.-B.P.A.M. (1819) *Histoire naturelle des animaux sans vertèbres … précédée d'une introduction offrant la détermination des caractères essentiels de l'animal, sa distinction du végétal et des autres corps naturels, enfin, l'exposition des principes fondamentaux de la zoologie. Tomus VI, Pars I.* Verdière, Paris.

Lighfoot J. (1786) *A catalogue of the Portland Museum: lately the property of the Duchess Dowager of Portland deceased which will be sold by auction, by Mr. Skinner and Co. on Monday the 24th of April, 1786, and the thirty-seven following days … Sundays, and the 5th of June … excepted* … Skinner and Company, London.

Martins W.S. & Oetterer M. (2010) Correlação entre o valor nutricional e o preço de oito espécies de pescado comercializadas no estado de São Paulo. *Boletim do Instituto de Pesca* 36(4): 277–282.

Matthews H.R. & Coelho A.C.S. (1972) Superfamília Tonnacea do Brasil. IV – Família Cassidae (Mollusca, Gastropoda). *Arquivos de Ciências do Mar* 12(1): 1–16.

Matthews-Cascon H. & Rabay S.G. (2003) Morfologia de *Phalium (semicassis) granulatum* (Born, 1778) (Mollusca, Gastropoda, Cassidae). *Arquivos de Ciências do Mar* 36(32): 57–61.

Medeiros R.P, Guanais J.H.D.G., Santos L.O., Spach H.L., Silva C.N.S., Foppa C.C., Cattani A.P., Rainho A.P. (2013) Estratégias para a redução da fauna acompanhante na frota artesanal de arrasto do camarão sete-barbas: Perspectivas para a gestão pesqueira. *Boletim do Instituto de Pesca* 39(3): 339–358.

Osako K., Hossain M.A., Kuwahara K., Okamoto A., Yamaguchi A., Nozaki Y. (2005) Quality aspect of fish sauce prepared from underutilized fatty Japanese anchovy and rabbit fish. *Fisheries Science* 71(6): 1347–1355.

Papp M.G. & Duarte L.F.L. (2001) Locomotion of *Stramonita haemastoma* (Linnaeus) (Gastropoda, Muricidae) on a mixed shore of rocks and sand. *Revista Brasileira de Zoologia* 18(1): 187–195.

Perez J.A.A. & Wahrlich R. (2005) A bycatch assessment of the gillnet monkfish *Lophius gastrophysus* fishery of southern Brazil. *Fisheries Research* 72: 81–95.

Pezzuto P.R. (2001) Projeto de "análise e diagnóstico da pesca artesanal e costeira de camarões na região sul do Brasil: subsídios para um ordenamento". *Brazilian Journal of Aquatic Science and Technology* 5(1): 35–38.

Philippi R.A. (1844) *Abbildungen und Beschreibungen neuer oder wenig gekannter Conchylien, unter Mithülfe mehrer Deutscher Conchyliologen. Bd. 1.* Drud und Berlag von Theodor Fischer, Cassel.

Rios E.C. (2009) *Compendium of Brazilian Sea Shells.* Evangraf, Rio Grande.

Röding P.F. (1798) *Museum Boltenianum sive catalogus cimeliorum e tribus naturae quae olim collegerat. Joa. Fried Bolten, M.D. pd Pars Secunda continens conchylia sive testacea univalvia, bivalvia & multivalvia.* Johan Christi, Hamburg.

Rosenberg G. (2009) *Malacolog 4.1.1: A Database of Western Atlantic Marine Mollusca.* Available from: www.malacolog.org (Date of access: 22/ix/2017).

Rocha V.P. & Matthews-Cascon H. (2015) Variação morfométrica de arcídeos (Mollusca: Bivalvia) da costa Norte-Nordeste do Brasil. *Brazilian Journal Aquatic Science and Technology* 19(1): 66–75.

Severino-Rodrigues E., Hebling N.J. & Graça-Lopes R. (2007) Biodiversidade no produto da pesca de arrasto-de-fundo dirigida ao lagostim, *Metanephrops rubellus* (Moreira, 1903), desembarcado no litoral do Estado de São Paulo, Brasil. *Boletim do Instituto de Pesca* 33(2): 171–182.

Santos S.R.R., Amaral M.L.F.M. & Tomás A.R.G. (1999) Lista comentada da malacofauna associada à pesca do camarão sete-barbas, *Xiphopenaeus kroiery* (Crustacea: Penaeidae), em Guarujá, São Paulo, Brasil. *Arquivos de Ciências do Mar* 32: 55–58.

Teso V. & Pastorino G. (2011) A revision of the genus *Olivancillaria* (Mollusca: Olividae) from the southwestern Atlantic. *Zootaxa* 2889: 1–34.

WoRMS Editorial Board (2017) World Register of Marine Species. Available from: www.marinespecies.org (Date of access: 14/vi/2017).