

FISH AND FISHERIES

**AT THE SANTA CATARINA-PARANA
COAST, SOUTHERN BRAZIL**

ABSTRACTS OF 55 SCIENTIFIC PAPERS PUBLISHED 1994-2019

BY THE ESTUARINE ICHTHYOLOGY LABORATORY,

UNIVERSIDADE FEDERAL DO PARANA

Edited by Paulo de Tarso Chaves

FISH AND FISHERIES

AT THE SANTA CATARINA-PARANA COAST, SOUTHERN BRAZIL

ABSTRACTS OF 55 SCIENTIFIC PAPERS PUBLISHED 1994-2019 BY THE
ESTUARINE ICHTHYOLOGY LABORATORY, UNIVERSIDADE FEDERAL DO PARANA

Edited 2014 by Paulo de Tarso Chaves

Dep. Zoologia UFPR – C.P. 19020, 81531-980, Curitiba, Brazil

ptchaves@ufpr.br. Support: CNPq, Brazil

<https://ictiologiaufpr.wordpress.com>

Contents

I. Reproduction

- 1- Eggs and larvae mouthbreeding in *Genidens genidens*
- 2- Reproductive aspects of *Bairdiella ronchus*
- 3- Reproductive evidences in the *Citharichthys* species
- 4- Reproduction of *Stellifer rastrifer*
- 5- Use of mangrove habitat for reproductive activity
- 51- Fecundidade de peixes e tamanhos máximos de captura: (...)
- 54- Biologia reprodutiva do robalo-peva, *Centropomus parallelus* (...)

II. Trophic habits

- 6- Features of the feeding of *Genidens genidens*
- 7- Feeding of *Bairdiella ronchus*
- 8- Diet diversity in the flatfishes assemblage
- 9- Feeding habits of *Stellifer rastrifer*
- 10- Individual size influence on diet in *Genidens genidens*
- 11- Changes in space and time of the feeding activity of fishes
- 12- Changes in the diet composition of transitory fishes in coastal systems
- 13- Trophic organization and functioning of fish populations
- 14- Study on feeding habits comparatively between salt marshes and mangroves
- 15- Diet of *Ctenogobius shufeldti*

III. Inventory, population structure, spatial distribution

- 16- Fish faunal composition of the mangrove area
- 17- Strategy of the occupancy of the Guaratuba mangrove (...) *Isopisthus*
- 18- Ambicoloration in the flatfish species *Symphurus tessellatus*
- 19- Populational structure of *Pomadasys corvinaeformis*
- 20- Biological aspects of *Diapterus rhombeus*
- 21- Biodiversity and dynamics of ichthyic ecommunities
- 22- The mangrove as a temporary habitat for fish: the *Eucinostomus*
- 23- Temporary use of a coastal ecosystem (...) *Pomadasys*
- 24- A complementary note about the habits of *Gerres melanopterus*
- 25- Remarks about the life cycle of the croaker, *Micropogonias furnieri*
- 26- A complementary note about the ichthyofaunistic composition
- 27- Ichthyofauna in the ecological organisation
- 28- Biology of *Chirocentrodon bleekermanus*
- 29- Use of an estuarine environment (...) as nursery by fish
- 30- Biology of *Paralonchurus brasiliensis*
- 31- Environmental and subtidal fish assemblage relationships
- 32- Salinity influence on development (...) of the fat snook

IV. Aquaculture, fisheries

- 33- Selection of candidate fish species for farming
- 34- Reproductive status of *Menticirrhus americanus* in fisheries performed
- 35- Reproductive status of *Trichiurus lepturus* exposed to small-scale fishing
- 36- Biological, technical and socioeconomic aspects of the fishing activity
- 37- Boats, gears and procedures of the artisanal fishing
- 38- Demersal ichthyofauna (...) exposed to shrimp trawl fisheries
- 39- Fisheries of mullets at the Guaratuba Bay
- 40- Loss and abandon of fishing gears (...) and risks of ghost-fishing
- 41- Effects of the shrimp trawling fisheries on the reproductive activity of fish
- 42- The physiography influence on small-scale fisheries strategies
- 43- Recreational fishing and catch-and-release
- 44- Use of the maturation size in fisheries management: a critical review
- 45- Fish composition in the shrimp fisheries at the Southern Coast of Parana
- 46- Elasmobranchs caught by artisanal fishing
- 47- Dynamics of the artisanal fishing activity in two communities
- 48- Reproductive activity of fish and closed season to shrimp trawling
- 49- Artisanal fishing net float loss and a proposal for a float design solution
- 50- Ictiofauna e pesca amadora (...):capturas e potencial impacto

- 52- Investigação sobre fishing down marine food webs no sul do Brasil (...)
 53- Rejeitos da atividade pesqueira no litoral do Paraná (...)
 55- Recursos-alvo que são também bycatch (...) pesca de emalhe (...)

WHERE TO GET IT

SUBJECT, GROUP	ABSTRACTS	GENERA	ABSTRACTS
Ariidae	1, 6, 10, 21, 50	<i>Achirus</i>	8
Boats	37, 42, 47	<i>Anchoa</i>	14, 48
Carangidae	12, 21, 45, 48, 50	<i>Anchoviella</i>	14
Centropomidae	32, 33, 50, 51, 54	<i>Atherinella</i>	14
Chondrichthyes	16, 46	<i>Bairdiella</i>	2, 7
Clupeiformes	14, 26, 28, 38, 41, 45, 48, 50	<i>Centropomus</i>	32, 33, 50, 51, 54
Continental Shelf	12, 18, 28, 30, 34, 35, 37, 38, 40-42, 45-48	<i>Citharichthys</i>	3, 8
Fisheries technology	37, 40, 41, 42, 43, 47, 49	<i>Ctenogobius</i>	15
Gerreidae	20-22, 24, 48, 50	<i>Chirocentrodon</i>	28, 48
Gobiidae	15, 26	<i>Chloroscombrus</i>	12
Haemulidae	19, 21, 23, 38	<i>Cynoscion</i>	12
Mangrove	1-17, 19-27, 29, 31-33, 36, 39	<i>Diapterus</i>	20, 48
Migration	12, 17, 25	<i>Etropus</i>	8
Pimelodidae	26	<i>Eucinostomus</i>	22, 24
Pleuronectiformes	8, 18, 41, 48	<i>Genidens</i>	1, 6, 10
Salt marsh	14, 29, 31	<i>Harengula</i>	14
Sciaenidae	2, 7, 4, 9, 12, 17, 21, 25, 30, 33, 34, 38, 41, 45, 48, 50, 55	<i>Isopisthus</i>	12, 17, 41, 48
Serranidae	21	<i>Larimus</i>	48
Shrimps	38, 41, 45, 48, 50	<i>Menticirrhus</i>	12, 33, 34, 48
Tetraodontiformes	38	<i>Micropogonias</i>	12, 25, 33
Trichiuridae	35, 55	<i>Mugil</i>	39
		<i>Opisthonema</i>	14
		<i>Paralonchurus</i>	30, 41
		<i>Pellona</i>	41
		<i>Pomadasys</i>	19, 21, 23, 48
		<i>Selene</i>	48
		<i>Stellifer</i>	4, 9, 21, 41, 48
		<i>Syacium</i>	48
		<i>Symphurus</i>	8, 18, 41, 48
		<i>Trichiurus</i>	35

1- Eggs and larvae mouthbreeding in *Genidens genidens* (Valenciennes) (Siluriformes, Ariidae) from Guaratuba Bay, Parana, Brazil

Paulo de Tarso CHAVES

***Revista Brasileira de Zoologia* 11(4):641-648 (1994)**

<http://dx.doi.org/10.1590/S0101-81751994000400008>

ABSTRACT. At Guaratuba Bay, the catfish *Genidens genidens* shows incubating behavior during the summer months. Larvae are either less or heavier than eggs, and their stomach analysis confirms the exogenous feeding during incubation. Embryo size can increase to 59 mm in total length and 2.8 g in total weight, including the yolk sac. It was observed that the largest larvae are guarded by the largest adults, and that the embryo size is similar among individuals coming from the same adult.

**2- Reproductive aspects of *Bairdiella ronchus* (Cuvier)
(Pisces, Sciaenidae) at Guaratuba Bay, Parana, Brazil**

Paulo de Tarso CHAVES
***Revista Brasileira de Zoologia* 12(4):759-766 (1995)**
<http://dx.doi.org/10.1590/S0101-81751995000400005>

ABSTRACT. *Bairdiella ronchus* is one of the most common species of demersal ichthyofauna in Guaratuba Bay, south Brazil. However, this study reveals that it does not inhabit permanently the mangrove area. Individuals with more than 94 mm total length leave mangrove area in late summer and early autumn, returning in spring, when they start ovarian vitellogenesis. During late spring and early summer, oocytes undergo hydration and empty follicles can be found in the ovaries, indicating that this is the reproductive time for this species.

3- Reproductive evidences in the *Citharichthys* Bleeker species (Teleostei, Pleuronectiformes) of the Guaratuba Bay, Brazil

Paulo de Tarso CHAVES & Ana Lúcia VENDEL
Revista Brasileira de Zoologia 14(1):73-79 (1997)
<http://dx.doi.org/10.1590/S0101-81751997000100007>

ABSTRACT. The species *Citharichthys arenaceus* and *C. spilopterus* are the most common flatfishes found in Guaratuba Bay, southern of Brazil. Different size categories of these flatfish occur in the mangrove area throughout the year. Gonadosomatic Index and Condition Factor values, as well as morphological analyses of the gonads from samples obtained from 1994 to 1996 reveals a spawning activity during late spring and early summer. This period coincides with the increase in temperature and the decrease in salinity values. Spawning evidence and the presence of all size categories throughout the year indicate that *Citharichthys pp* are permanent inhabitants of the mangrove area in Guaratuba Bay, where individuals accomplish their life cycle.

4- Reproduction of *Stellifer rastrifer* (Jordan) (Teleostei, Sciaenidae) at the Guaratuba Bay, Brazil

Paulo de Tarso CHAVES & Ana Lúcia VENDEL
***Revista Brasileira de Zoologia* 14(1):81-89 (1997)**
<http://dx.doi.org/10.1590/S0101-81751997000100008>

ABSTRACT. A total of 1312 individuals of *Stellifer rastrifer* was sample from March 1994 to September 1996 at the Guaratuba Bay, Southern Brazil. This species is a permanently inhabitant of the mangrove area throughout the year. The total weight (TW) / length (TL) relationship of the species is $TW = -12.35 + 3.22 \ln TL$, and the individuals may reach 172 mm TL. The analysis of gonadal morphology and Gonadosomatic Index indicate that *S. rastrifer* constitutes a multiple spawner species, breeding in the mangrove during a long period of the year. The reproductive activity is more intense during winter and mainly spring, when the values of Condition Factor decline and empty follicles are found in the ovaries.

5- Use of mangrove habitat for reproductive activity by the fish assemblage in the Guaratuba Bay, Brazil

Paulo CHAVES & Jean-Luc BOUCHEREAU
Oceanologica Acta **23**(3):273-280 (2000)
[http://dx.doi.org/10.1016/S0399-1784\(00\)00130-4](http://dx.doi.org/10.1016/S0399-1784(00)00130-4)

ABSTRACT. The role played by a southwestern Atlantic mangrove in the breeding activity of estuarine fishes was evaluated. This fish assemblage represented 85 % of the total catches of the experimental fishery surveyed between 1993 and 1997. To evaluate the maturation and spawning processes, qualitative (macroscopic stages of maturation) and quantitative (gonadosomatic index) attributes were considered which were combined in a reproductive activity index. Four types of occupation were found in the mangrove, according to the reproductive patterns presented by each species. It was estimated that the Guaratuba mangrove is used as a spawning site – either regularly or occasionally – by about 40 % of the species, that make up 41 % to 46 % of the total abundance of this fish assemblage. However, besides the spawning species, the mangrove attracts other species at advanced stages of maturation. The use of mangrove habitat for reproductive activity by the species is 52 to 57 % of the total fish abundance. Spring and summer are the seasons most associated with the maturation and spawning processes. Although most of the assemblage is formed by species that do not permanently inhabit the system, the Guaratuba mangrove is a significant site for the life cycle of estuarine and marine species occupying this coastal region.

**6- Features of the feeding of *Genidens genidens*
(Valenciennes) (Siluriformes, Ariidae) at the Guaratuba Bay,
Brazil**

Paulo de Tarso CHAVES & Ana Lúcia VENDEL
***Revista Brasileira de Zoologia* 13(3):669-675 (1996)**
<http://dx.doi.org/10.1590/S0101-81751996000300016>

ABSTRACT. Seasonal changes in food items of the catfish *Genidens genidens* was studied based on monthly samples between September 1993 and April 1995, at the Guaratuba Bay, coast of Parana, Brazil. The stomach contents of 105 specimens were analyzed by the Occurrence Frequency method and 41 of these have also been analyzed by the Volumetric method. Matching both methods using the Preponderance Index, a larger incidence of decapods was determined, followed by other crustaceans and by mollusks, polychaets, fish, and plant material. The data show the existence of a strong seasonal variation in the diet.

**7- Feeding of *Bairdiella ronchus* (Cuvier, 1830)
(Perciformes, Sciaenidae) at the Guaratuba Bay, Parana,
Brazil**

Ana Lúcia VENDEL & Paulo de Tarso CHAVES
***Revista Brasileira de Zoologia* 15(2):297-305 (1998)**
<http://dx.doi.org/10.1590/S0101-81751998000200003>

ABSTRACT. Seasonal variation of food items of *Bairdiella ronchus* classified by size was analysed based on monthly samples obtained from September 1993 to September 1996 at the Guaratuba Bay, Southern Brazil. The stomach contents of a hundred eighty-two specimens were analyzed by the Occurrence Frequency Method and Point Count for a Lot Method. Individuals were divided in two groups, smaller and longer than 140 mm, and a comparative study of digestive tract and branchial arc was performed for these groups. For specimens smaller than 140 mm the following sequence of items was obtained, matching both methods by using the Preponderance Index: decapods (subdivided in Brachyura, Caridae and Penaeidea), polychaets, isopods, fishes, copepods, amphipods, mollusks and plant material. For specimens longer than or equal to 140 mm the sequence was decapods, polychaets, fishes, copepods, amphipods, isopods, mollusks and plant material, in this order. These results suggest that *Bairdiella ronchus* at the Guaratuba Bay is a carnivorous species using mainly decapod crustaceans as food throughout the year.

8- Diet diversity in the flatfishes assemblage (Teleostei, Pleuronectiformes) in the mangrove of the Guaratuba Bay, Brazil

Paulo de Tarso CHAVES & Adriana SERENATO
Revista Brasileira de Oceanografia 46(1):61-68 (1998)
<http://dx.doi.org/10.1590/S1413-77391998000100005>

ABSTRACT. *Citharichthys arenaceus* and *C. spilopterus* form together almost 70% of the flatfishes abundance in the mangrove of the Guaratuba Bay. Other important Pleuronectiformes species are *Symphurus tessellatus*, *Etropus crossotus* and *Achirus lineatus*. The main food items of this assemblage are composed by Crustacea, fishes, Gastropoda and Polychaeta. None of these species was found to have a highly specialized diet, but they present some particularities: *Citharichthys spp* and *S. tessellatus* have a diet based on Caridea and fish; *E. crossotus*, on Amphipoda Gammaridae; and *A. lineatus*, on Polychaeta. The partially overlapping habits correspond to the most generalized diets, so any interspecific competition would be reduced by the nature of the complementary food items. Additional support for this hypothesis is provided by the results concerning both the species density and the percent occurrence of the prey categories.

9- Feeding habits of *Stellifer rastrifer* (Perciformes, Sciaenidae) at Guaratuba mangrove, Parana, Brazil

Paulo de Tarso CHAVES & Ana Lúcia VENDEL

***Brazilian Archives of Biology and Technology* 41(4):423-428 (1998)**

<http://www.scielo.br/pdf/babt/v41n4/a06v41n4.pdf>

ABSTRACT. The feeding habits of *Stellifer rastrifer* were studied from February 1996 to February 1997. It was observed that its diet is based on invertebrates, mainly Decapoda non-Brachyura and Polychaeta. In a smaller proportion there were plants, Copepoda, Gammaridea and Mollusca. The level of contribution of each food item has changed according to the season and the individual size. Such plasticity in feeding behavior is similar to that described to some fish populations from other estuaries, and may be an indicator of the high level of instability presented by this kind of ecosystem.

10- Individual size influence on diet in *Genidens genidens* (Teleostei, Ariidae) at the Guaratuba Bay (Brazil)

Maria Antônia MICHELS-SOUZA & Paulo de Tarso CHAVES
Acta Biologica Leopoldensia 22(2):249-260 (2000)

ABSTRACT. The feeding habits of the catfish *Genidens genidens*, one of the most common estuarine-resident fish species inhabiting the Guaratuba Bay, Brazil, are investigated in order to know how much its diet can change along the growth of the individuals. It is supposed that a certain plasticity in the feeding habits of the estuarine-resident species is necessary for them to live in a not-stable milieu. Indeed, an aptitude to eat several kinds of animals or plants according their body size could help the individuals to avoid intra specific competition. It was show that many types of crustaceans, mollusks and polychaets have taken part in the diet of *G. genidens*, but some differences were observed according to the body size. In all seasons the presence of decapods increased with the body size, whereas that of Tanaidacea decreased. The smaller individuals use to contain more food categories than the larger ones, but this can be explained by the sample size.

11- Changes in space and time of the feeding activity of fishes in an estuary (Guaratuba Bay, Brazil)

Paulo de Tarso CHAVES & Helen Audrey PICHLER
Acta Biologica Leopoldensia 22(2):277-287 (2000)

ABSTRACT. The intensity of feeding in an estuarine ecosystem has been investigated, aiming to evaluate the influence of fresh and marine waters, as well as seasons of the year, in the food ingestion by fish. The intensity of feeding was inferred by the stomach-fullness index from 2,422 individuals belonging to 60 species, collected along a year in three areas of the Guaratuba Bay, south of Brazil. For the entire assemblage, it was verified that the intensity of feeding is similar in both continental and marine regions. However, at least five species feed mainly in a region than in the other, according to the season of the year. The assemblage showed the highest intensity of feeding in May, a fact that is discussed in view of the largest abundance of fish during the autumn.

12- Changes in the diet composition of transitory fishes in coastal systems, estuary and Continental Shelf

Paulo de Tarso CHAVES & Simone Camargo UMBRIA
***Brazilian Archives of Biology and Technology* 46(1):41-46 (2003)**
<http://www.scielo.br/pdf/babt/v46n1/a07v46n1.pdf>

ABSTRACT. The feeding habits of five species of teleosts in the southern coast of Brazil were analyzed comparatively between estuary and continental shelf. The displacement between the two sites caused expressive qualitative alterations, the proportion of different items varying from 50% in the diet of *Micropogonias furnieri* to 89% in *Isopisthus parvipinnis*. In the group of species, 57% of the items were exclusive to one of the environments and, within the three most common items in the estuary - fish, Polychaeta and plants, only the former was also among the most common items in the shelf. In spite of these differences, the high spectrum of items in both environments and the nature of the item that was most consumed in each one, indicate that there was a certain similarity of patterns between estuary and shelf: *Chloroscombrus chrysurus* had a carnivorous diet, with a predominance of copepods; *M. furnieri* and *Menticirrhus americanus* showed a tendency towards an omnivorous diet; and *Cynoscion leiarchus* and *I. parvipinnis* showed a tendency towards ichthyophagy.

13- Trophic organization and functioning of fish populations in the Bay of Guaratuba, Brazil, on the basis of a trophic contribution factor

Paulo de Tarso CHAVES & Jean-Luc BOUCHEREAU
Acta Adriatica 45(1):83-94 (2004)
http://jadran.izor.hr/acta/pdf/ostalo/45_1.pdf

ABSTRACT. Trophic organization and seasonal development in the Bay of Guaratuba (Brazil) are characterized, based on feeding habits of fish species taken from the literature and on a factor that combines biomass and species richness to determine to what extent detritus and primary production contribute to the trophic network. The Bay of Guaratuba contains all trophic categories of fish: herbivores, plankton-eaters, consumers of invertebrates with occasional supplementation of plants and fish, and fish-eaters. Resident and migrant species occupy different trophic ranges, depending on whether their food sources are available on a permanent or seasonal basis. Residents tend to feed on benthic invertebrate meiofauna and macrofauna, using relatively more detritus than primary production sources. Migrants time their presence in the bay with seasonal productivity, especially of plants. Most occasional visitors consume invertebrates plus fish or primarily fish. The fish-eaters could explain the lower number of fish in this estuary in winter. The Trophic Contribution Factor is a useful tool for characterizing the input of basic elements to the trophic network, monitoring how the occupancy status of species affects their time-space variations, and comparing different localities and ecosystems.

14- Study on feeding habits in estuarine fish (Teleostei) comparatively between salt marshes and mangroves in southern Brazil (Guaratuba Bay)

Paulo de Tarso CHAVES & Ana Lúcia VENDEL
Revista Brasileira de Zoologia 25(1):10-15 (2008)
<http://dx.doi.org/10.1590/S0101-81752008000100002>

ABSTRACT. Diet of fish inhabiting shallow waters close to salt marshes and mangroves was analyzed in order to evaluate how different the influence of these environments on fish feeding habits is. The six studied species, the most abundant in these areas, are mainly planktivores, however they showed particularities in each area. In salt marshes *Atherinella brasiliensis* presented the largest number of food items and the lowest value of similarity regarding other species. In mangroves these attributes were presented by *Anchoa januaria*, the main species to feed on Brachyura and non-Brachyura Decapoda, and the only one in this area that includes Gammaridae in its diet. *Anchoviella lepidentostole* showed a large affinity with *Anchoa lyolepis* in salt marshes but a large one with *Opisthonema oglinum* and *Harengula clupeola* in mangroves. Similar behavior between salt marshes and mangroves has linked *H. clupeola* to *O. oglinum*, whose diet was composed almost integrally by Diatomacea and Copepoda. The ability of fish to change their feeding habits according to the environment is well known worldwide; here it probably results from the availability of preys, which is supposed to be different between salt marshes and mangroves. However, it was also observed that, although food items change from salt marsh to mangrove, the relationships between species remain different in both areas, helping them to be abundant in the shallow estuarine waters.

15- Diet of *Ctenogobius shufeldti* (Jordan and Eigenmann, 1887) (Teleostei, Gobiidae) in Guaratuba Bay, subtropical west Atlantic

Diego ZANLORENZI & Paulo de Tarso CHAVES
Biotemas **24**(1): 37-46 (2011)
www.biotemas.ufsc.br/

ABSTRACT. The diet composition of the American freshwater goby, *Ctenogobius shufeldti*, was investigated in an estuarine area and two of its tributaries. 397 individuals, total length from 21 to 70mm, were sampled over a period of 12 months and their stomach contents were analysed by the Frequency of Occurrence and Number of Points methods. According to the Alimentary Index, diet was constituted mainly by Ostracoda (IA=50.51) and Tanaidacea (IA=40.85), and secondarily by Gastropoda (IA=1.21), Amphipoda (IA=0.10), Isopoda (IA=0.01), Cirripedia (IA=0.01), Decapoda larvae (IA=0.01), Insecta (IA=0.01), Chlorophyta (IA=2.15) and Rodophyta (IA=0.15) filamentous algae, and plants (IA=4.99). Diversity of diet was higher in rivers than in the Bay. Except for Decapoda larvae, items found in the two rivers were the same. In the Bay, Amphipoda and Cirripedia were not found. Previous to this research, the filamentous algae Chlorophyta and Rodophyta had not been noted in the diet of this species in estuaries close to Guaratuba. In view of this, and regarding the possible roles played by cryptobenthic fish species in aquatic communities (Depczynski and Bellwood, 2003), it is concluded that *C. shufeldti* takes part in trophic dynamics feeding on benthic organisms as well as on algae, a behaviour that can result from both marine and continental influences existing in the region.

**16- Fish faunal composition of the mangrove area of the
Guaratuba Bay, Brazil (25°52'S;48°39'W)**

Paulo de Tarso CHAVES & Marco Fábio Maia CORRÊA
Revista Brasileira de Zoologia **15**(1):195-202 (1998)
<http://dx.doi.org/10.1590/S0101-81751998000100017>

ABSTRACT. The Guaratuba Bay is the second largest estuarine system of the State of Parana, Brazil. It is extended inside the continent for about 15 kilometers and is surrounded by mangroves. Water depth can reach up to six meters. The fish faunal composition of this area was evaluated with a bottom trawl and, occasionally, casting and gill nets. A single species of Chondrichthyes and 59 of Actinopterygii (50 genera and 28 families) were reported from the Bay. Results were not significantly different from those of the Paranagua Bay, except by the lower number of species. These differences appear related to distinct collection efforts and the extension of surveyed areas. No species can be considered endemic to the region. Typically freshwater species were not found.

17- Strategy of the occupancy of the Guaratuba mangrove by the predator *Isopisthus parvipinnis* (Teleostei, Pisces)

Paulo de Tarso CHAVES, Adriana RICKLI & Jean-Luc BOUCHEREAU
Cahiers de Biologie Marine 39(1):63-71 (1998)
<http://www.scielo.br/pdf/babt/v42n1/v42n1a09.pdf>

ABSTRACT. From observations done between September 1993 and February 1997 on abundance, biometry, diet and reproduction of *Isopisthus parvipinnis* living in Guaratuba Bay, Brazil, biotic parameters of this population have been described and behavior in occupying the mangrove, identified. During spring and summer individuals transit sporadically to the most opened areas of the Bay and feed on fish and crustaceans. During this period the species reproduces, and spawning occurs either in this sector or in the open sea. During autumn and winter, an important part of the population of *I. parvipinnis* enters into channels and pools and its diet changes to become entirely based on fish. This is associated with the general increase of fish abundance at that time in the mangrove. Growth is allometric and relations between mass (M) and length (L) are: $M = 1.592 \cdot 10^{-7} L^{3.82}$ (males), $M = 5.284 \cdot 10^{-8} L^{4.01}$ (females) and $M = 1.233 \cdot 10^{-7} L^{3.85}$ (sexes altogether). The strategy of occupation of the ecosystem and the ichthyophage behavior characterize *I. parvipinnis* as an opportunist predator species, playing with respect to the mangrove a part in energy export towards other areas of the Bay and the marine adjacent region.

18- Ambicoloration in the flatfish species *Symphurus tessellatus* (Cynoglossidae) from Southern Brazil

Paulo de Tarso CHAVES, Iracema David GOMES, Eveline de Almeida FERREIRA, Kelly Dayane AGUIAR & Priscilla SIRIGATE

Acta Biológica Paranaense31(1,2,3,4):59-63 (2002)

<http://ojs.c3sl.ufpr.br/ojs/index.php/acta/article/viewFile/606/498>

ABSTRACT. The first occurrence of an ambicoloured flatfish specimen of *Symphurus tessellatus* is reported. The specimen was collected by bottom trawling on the south coast of Brazil. On the blind side of its body, only the cephalic region had no pigment.

19- Populational structure of *Pomadasys corvinaeformis* (Steindachner) at Guaratuba Bay, Parana, Brazil

Paulo de Tarso CHAVES

***Revista Brasileira de Zoologia* 15(1):203-209 (1998)**

<http://dx.doi.org/10.1590/S0101-81751998000100018>

ABSTRACT. Reproductive and biometrical analyses were performed on 1629 individuals of *Pomadasys corvinaeformis* collected monthly from October 1993 to September 1996 at Guaratuba Bay, Southern Brazilian coast. Results indicate that the species is more abundant in the mangrove area during winter, when the largest individuals were found, and spring, when the water temperature is lower and the salinity higher than in summer or autumn. The relationship of body weight (TW) to body length (TL), for grouped sexes, is $\ln TW = -12.0456 + 3.1831 \ln TL$. The monthly Condition Factor values are highest in summer and lowest in winter. It is suggested that *P. corvinaeformis* is present in the mangrove area during a transitory phase of its life cycle and does not use this area for maturation and spawning.

**20- Biological aspects of *Diapterus rhombeus* (Cuvier)
(Teleostei, Gerreidae) at Guaratuba Bay, Parana, Brazil**

Paulo de Tarso CHAVES & Gislaine OTTO
***Revista Brasileira de Zoologia* 15(2):289-295 (1998)**
<http://dx.doi.org/10.1590/S0101-81751998000200002>

ABSTRACT. *Diapterus rhombeus* is one of the most common Gerreidae species in the estuarine region of the Guaratuba Bay, Southern Brazil. Based on studies developed between July 1993 and January 1997, it was observed that its presence in the mangrove area is not regular: the smallest individuals are more abundant during late summer and in autumn, and the largest ones during spring and early summer. Its diet comprises plant material and invertebrates, mainly polychaets. The morphological aspects of the gonads, the monthly changes on the Condition Factor, and the monthly distribution of the individual size groups, suggest that this population spawns during the spring, out the estuarine region. The smaller individuals use the mangrove area of Guaratuba Bay to a growth phase, and the adults to make somatic reserves for the spawning period.

21- Biodiversity and dynamics of ichthyic communities in the mangrove of Guaratuba, Brazil

Paulo CHAVES & Jean-Luc BOUCHEREAU

Oceanologica Acta 22(3):353-364 (1999)

<http://www.sciencedirect.com/science/journal/03991784/22/3>

ABSTRACT. The Bay of Guaratuba, whose area is approximately 45 km², is a basin, situated to the south of Brazil (25° 52' S; 48° 39' W) and connected to the Atlantic ocean. This work describes characteristics of the fish populations occupying this mangrove, and temporal and spatial evolution of populations of the main species from available data on their biology. Between September 1993 and August 1996, fish samplings have been undertaken monthly by trawl, according to the same fishing effort, in channels of this ecosystem. Species richness, Shannon-Weaver's diversity index were calculated and abundances were processed by the multivariate analysis. The global species richness is 61 species, distributed in 28 families; the better represented species are Sciaenidae (10), Gerreidae (5), Carangidae (5), Ariidae (4), Haemulidae (3), Serranidae (3), Bothidae (3). Each year, the number of species varies between 41 and 44, and a group of eight species represents between 80 to 90 % of the density and 75 % of the biomass. The most represented species in abundance is *Pomadasys corvinaeformis* in the first two years, then *Stellifer rastriifer*. The group of eight main species is shared by 15 species in total, of which 13 for the density and 14 for the biomass. The most important monthly catches take place in winter season, during which one observes a decrease of water temperature and an increase of salinity. These species, however, being likely to be replaced by others according to the year or the season; one never finds the same composition in the assemblage which preserves always the same structures. Seasonal differences between seasons under marine (winter) and continental (summer) influences play a major role on the dynamics of fish in the Guaratuba mangrove. This ecosystem plays a functional role in the achievement of the life cycle of many permanent or temporary species. Those having succeeded to reach high levels of abundance are not represented in a uniform way in the course of the year, even when they reside permanently in the ecosystem. Periodic displacement strategies for self regulation of stocks abundance, are necessary mechanisms for these populations, which thus succeed to coexist in occupying the mangrove.

22- The mangrove as a temporary habitat for fish: the *Eucinostomus* species at Guaratuba Bay, Brazil (25°52'S; 48°38'W)

Paulo de Tarso CHAVES & Gislaine OTTO
Brazilian Archives of Biology and Technology 42(1):61-68 (1999)

ABSTRACT. Several coastal fish use the estuarine habitat during a part of their life cycle. These sites are considered good for the reproductive activity, as well as for the growth of larvae and juveniles. Concerning the Gerreidae, however, many studies reveal that most species leave the estuaries to reproduce at sea. At Guaratuba Bay, Southern Brazil, this family is represented by three genera and five species, which make up an important fraction of the local assemblage. The present study has investigated the populational structure and breeding habits of *Eucinostomus argenteus*, *E. gula* and *E. melanopterus*, in order to know what relationship exists between and the mangrove. It was found that the Guaratuba mangrove represents a transitory habitat for the life cycle of the *Eucinostomus* species. The sub-adults grow in the mangrove throughout the year and leave this milieu in spring or summer, when they complete the gonadal maturation and presumably spawn. *Eucinostomus argenteus* and *E. gula* do not return to the mangrove after spawning. The three species feed mainly on polychaets, but differences occur with respect to the secondary components of the diet.

23- Temporary use of a coastal ecosystem by the fish
Pomadasys corvinaeformis (Perciformes, Haemulidae) at
Guaratuba Bay, Brazil

Paulo de Tarso CHAVES & Carlos Eduardo CORRÊA
Revista Brasileira de Oceanografia 48(1):1-7 (2000)
<http://www.revistas.usp.br/rbo/article/view/6869/8338>

ABSTRACT. *Pomadasys corvinaeformis* is one of the most abundant species found in Guaratuba Bay, an Atlantic coastal, estuarine ecosystem in Parana, Brazil. We tested whether this species comprises a resident or migratory population. Abundance, size distribution and gonad development of individuals caught during the year show that pre-adults enter the system when salinities are greater (autumn and early winter). During this time, they are mostly associated with mangroves and adjacent areas. When salinities begin to fall (late spring and summer) these now maturing individuals return to the sea where they spawn. Thus, *P. corvinaeformis* is migratory and estuarine-dependent and uses this area prior to sexual maturity. During the period in this bay, the species presents a great plasticity of feeding habits, which include mainly Crustacea, Mollusca and Thaliacea.

24- A complementary note about the habits of *Gerres melanopterus* (Teleostei: Gerreidae) at Guaratuba Bay, Brazil (25°52'S; 48°39'W)

Paulo de Tarso CHAVES & Maurício de Castro ROBERT
Revista Brasileira de Zoologia **18**(1):255-259 (2001)
<http://dx.doi.org/10.1590/S0101-81752001000100028>

ABSTRACT. A survey performed in the Guaratuba Bay supports the hypothesis that the *Gerres* (= *Eucinostomus*) *melanopterus* individuals migrate to reproduce at the sea during summer. In autumn and winter, the adults return to the Bay, a pattern not yet described in the literature for this species. *Gerres melanopterus* explores the most internal areas of the Bay when the continental influence is lower. Differences in feeding habits were registered between individuals occupying the investigate area and those from a nearby mangrove previously studied.

25- Remarks about the life cycle of the croaker,
Micropogonias furnieri (Desmarest) (Teleostei, Sciaenidae),
in the Parana coast, Brazil

Maurício de Castro ROBERT & Paulo de Tarso CHAVES
Revista Brasileira de Zoologia **18**(2):421-428 (2001)
<http://dx.doi.org/10.1590/S0101-81752001000200013>

ABSTRACT. A survey performed in the Guaratuba Bay (25°52'S; 48°39'W) and the adjacent marine area has provided additional data about the habits of the croaker in the southern coast of Brazil. A dynamic pattern of movements along the marine and estuarine waters was observed, but it does not indicate spawning activity in the study area. During autumn and winter, pre-adults and adults use the marine waters. In spring and summer, following gonadal maturation, individuals leave this area and probably move to deeper waters, where they spawn. Until the end of summer, the estuary is then occupied by juveniles coming from the marine spawning area. In autumn and winter, these juveniles and the new pre-adults move to the marine zone adjacent to the Bay and begin gonadal maturation. It is suggested that the Guaratuba Bay and the adjacent marine area constitute an important site for growth and recruitment of the early life stages of *M. furnieri* and initial stages of reproductive activity.

26- A complementary note about the ichthyofaunistic composition of the Guaratuba Bay, Parana, Brazil

Paulo de Tarso CHAVES & Ana Lúcia VENDEL
Revista Brasileira de Zoologia **18**(Supl.1):349-352 (2001)
<http://dx.doi.org/10.1590/S0101-81752001000500032>

ABSTRACT. The utilization of multiple gears and the surveying of other areas than that of mangrove have increased in 27 the number of fish species known in the Guaratuba Bay, an estuarine ecosystem located in the southern of Brazilian coastal region (25°52'S; 48°39'W). The new occurrence of a typically freshwater species (Pimelodidae) and of several Clupeiformes and Gobiidae species reveals the importance of the salt marsh and the innermost zones of this Bay to the distribution of certain fish groups.

27- Ichthyofauna in the ecological organisation of a South-West Atlantic Mangrove Ecosystem: the Bay of Guaratuba, Brazil (25°52'S; 48°39'W)

Jean-Luc BOUCHEREAU & Paulo de Tarso CHAVES
Vie et Milieu 53(2-3):103-110 (2003)
<http://www.obs-banyuls.fr/Viemilieu/>

ABSTRACT. The distribution and behaviour of the fish assemblage in the Bay of Guaratuba, an estuarine ecosystem in the south of Brazil, has been studied in different sectors of the bay according to the variety of continental and marine influences they undergo. There are two separate areas in this bay: one primarily of freshwater influence, the other of marine water. Fish are numerically more abundant in the former but the latter is richer in species. It is suggested that other environmental characteristics besides salinity or pH values are important in understanding the organisation and structure of ichthyofauna. The results are related to the concept of confinement in the paralic domain (Guelorget & Perthuisot 1983). In the most confined area under continental influence, species are mostly sedentary, whereas in the area known as marine where the water is more renewed, migrant and sporadic species are largely dominant.

**28- Biology of *Chirocentrodon bleekermanus* (Poey, 1867)
(Clupeiformes: Pristigasteridae) in a Continental Shelf
region of southern Brazil**

Carlos Eduardo CORRÊA, Paulo de Tarso CHAVES & Paulo R. B. GUIMARÃES
Brazilian Archives of Biology and Technology 48(3):419-427 (2005)
<http://dx.doi.org/10.1590/S1516-89132005000300013>

ABSTRACT. This study provides information on the biology of *C. bleekermanus* from Parana State coast, Brazil, assembling data about its abundance, size structure, diet and reproduction. Monthly collections were accomplished in 1999 and 2000 in the internal continental shelf, with trawl net. The catch-per-unit-effort did not vary significantly among the seasons. In the summer, the individuals were larger, followed by autumn, spring and winter. *Chirocentrodon bleekermanus* was predominantly planktivorous and the most frequent items in its diet were copepods followed by diatomaceous algae. Seasonal variation in the frequency values of the gonad maturation stages, Gonadosomatic Index and gonadal condition factor indicated that the reproductive period encompassed spring and summer. The mean total length at first maturity of females was estimated to be 76 mm.

29- Use of an estuarine environment (Barra do Saí lagoon, Brazil) as nursery by fish

Ana Lúcia VENDEL & Paulo de Tarso CHAVES
Revista Brasileira de Zoologia **23**(4):1117–1122 (2006)
<http://dx.doi.org/10.1590/S0101-81752006000400020>

ABSTRACT. Studies were carried out at the Barra do Saí lagoon, on the northern coast of Santa Catarina State, Brazil, to evaluate the function played by this estuary in the life cycle of fish found at the coastal zone. Samplings were performed using beach seine net from December 2000 to November 2001. The continental influence is strong, as showed by the occurrence of freshwater fishes, although most of the 43 species recorded are marine ones. It was verified that around summer, when the temperature of the water is high, the values of salinity decrease and those of turbidity increase. At this time there is also an increase in the abundance of juvenile fish in the lagoon. Because of its average depth of less than 0.7 m, the lagoon is inhabited primarily by juveniles, which may enter either by active movement or passive displacement, originating from the sea or the river to which the lagoon is connected. The lagoon is not used for sheltering spawning individuals. It is showed that a shallow, small estuary with a blind bottom can conceal an importance for the coastal ichthyofauna that is greater than it could be expected from the occurrence – in this case, modest – of large individuals.

30- Biology of *Paralanchurus brasiliensis* (Steindachner) (Teleostei, Sciaenidae) in Paraná coast, Brazil

Maurício de Castro ROBERT, Maria Antônia MICHELS-SOUZA & Paulo de Tarso CHAVES

Revista Brasileira de Zoologia 24(1):191-198 (2007)

<http://dx.doi.org/10.1590/S0101-81752007000100024>

The populational structure, reproduction and feeding features of banded croaker in southern coast of Paraná State are presented. Samplings were performed through bottom trawl from March 1999 to January 2000 at depths 10 and 15 m. *Paralanchurus brasiliensis* is more abundant during spring, when the youngest individuals, smaller than 93 mm, are recruited. The relation weight/length for grouped sexes is $TW(g) = 2.74E^{-6}TL(mm)^{3.22}$ ($n = 659$; $R^2 = 0.99$). Gonadal maturation is recorded since the length class 130-165 mm and the average length of the first maturation (grouped sexes) is estimated in 175 mm. Sand worms (Polychaeta) are the feeding item more usual for the all size classes and seasons, followed by crustacean and fishes. Species reproductive period extends from autumn (start maturation) to summer (end the spawning). After spring, youngs probably leave the area 10 m of depth. The prohibition of the shrimp bottom trawl in this depth during the spring and the summer must be efficient to reduce *P. brasiliensis* bycatch, today composed by recruits or spawning proximity individuals.

31- Environmental and subtidal fish assemblage relationships in two different Brazilian coastal estuaries

Ana Lúcia VENDEL, Jean-Luc BOUCHEREAU & Paulo de Tarso CHAVES
Brazilian Archives of Biology and Technology **53**(6):1393-1406 (2010)
<http://dx.doi.org/10.1590/S1516-89132010000600016>

ABSTRACT. The general structure and organization of the shallow water (<1.5 m) fish assemblages were studied in two southern Brazilian ecosystems, a bay and a lagoon, under different marine or continental influences. The abiotic factors were measured to define the hydrology of the sites and the biotic descriptors were evaluated to characterize the assemblage structures. Transparency, salinity and organic matter were the abiotic factors which best distinguished the sites. A total richness of 69 species was observed. Ecological guilds, density, diversity and evenness indices values were different in each site. Hydrodynamism and geomorphology determined the structure and the organization of the fish assemblages in these shallow waters. It was observed that variations in the hydrological attributes generated by the marine or continental water movements are able to alter the conditions in the lagoon more quickly and at more regular frequencies than those in the bay.

32- Salinity influence on development and weight-length relationship of the fat snook

Paulo de Tarso CHAVES & Amanda Bortolan NOGUEIRA
Boletim do Instituto de Pesca 39(4):423-432 (2013)
ftp://ftp.sp.gov.br/ftppesca/39_4_423-432.pdf

ABSTRACT. It was investigated if the seasonal changes in salinity, temperature, pH and water transparency contribute to *Centropomus parallelus* development in estuaries. The study was performed in 2007 and 2008 at the Guaratuba Bay, Southern Brazil, where individuals 15.0-214.0 mm occupy shallow waters along the year. No relationship between fish abundance and the salinity, temperature, pH or water transparency levels was observed, however salinity was related to the individual size. Because each level of salinity coincides with a particular length of fish, it is concluded that both temporal and spatial environmental changes are favorable to the *C. parallelus* growth in the headwaters of the estuary. Comparing the seasonal distribution of individual sizes with data on the *C. parallelus* growth in aquaculture it is estimated that in Guaratuba the fat snook spawns in late summer/early autumn, when the marine influence is stronger; their eggs hatch in high salinity; and juveniles develop simultaneously to the summer salinity decline, during the rainy season, when the rivers influence increases. Data on juveniles added to those coming from recreational fishing performed around the Bay, males plus females, originated the weight/length relationship $TW = 0.00002.TL^{2.85}$ (n= 1,125); considering males only, $TW = 0.00001.TL^{2.97}$ (n= 185); and considering females only, $TW = 0.000007.TL^{3.04}$ (n = 445). Different coefficients between sexes are due to the gonads weight changes, higher in females than in males.

33- Selection of candidate fish species for farming in the Bay of Guaratuba, Brazil

Jean-Luc BOUCHEREAU, Paulo de Tarso CHAVES & Jean-Jacques ALBARET
Brazilian Archives of Biology and Technology 43(1):15-25 (2000)
<http://www.scielo.br/pdf/babt/v43n1/v43n1a03.pdf>

ABSTRACT. An inventory of the maximum length reached by 57 species of fishes living in the mangrove of Guaratuba, Brazil, was undertaken with an aim to evaluate the relationship between the ecosystem and the size of individuals. For each of these species, the maximum length found in the region was compared with those available in existing literature. The majority of populations presented individuals whose length reached at least 40% than the known maximum length for the species, although only 19.3% were longer than 300 mm in absolute value. Populations of the other species were represented only by individuals either in their initial development phases, or reduced length as compared to the maximum length as compared to the maximum length known elsewhere for the same species. In this mangrove, species having the largest relative size are generally those that had the smallest absolute length. It is proposed the use of an index LR (maximum observed length / maximum available length) as a tool for description and comparison of fish assemblages. Observations of the maximum size make possible the pre-selection of 12 species for breeding tests. In combining the biological, technical and commercial parameters, the pre-selection retains as primordial the following species: *Centropomus parallelus*, *C. undecimalis*, *Menticirrhus americanus* and *Micropogonias furnieri*.

34- Reproductive status of *Menticirrhus americanus*
(Teleostei, Sciaenidae) in fisheries performed on the
Southern coast of Brazil

Elneison da Rosa MUNIZ & Paulo de Tarso da Cunha CHAVES

Acta Scientiarum Biol. Sc., Maringá, **30**(4):339-344 (2008)

<http://eduemojs.uem.br/ojs/index.php/ActaSciBiolSci/article/viewFile/1230/1230>

ABSTRACT. Fisheries rules usually take into account the life cycle of target species. But as these species differ, multi-specific fisheries prove difficult to be managed. In the southern coast of Brazil (26°00'S, 48°36'W), an annual closed fishing season is exclusive to trawling only, which target species such as the shrimp *Xyphopenaeus kroyeri*. In this region, the consequences of trawling and gillnets on the life cycles of fish remain unknown. The present work has surveyed the incidence of small-scale fisheries on the reproductive cycle of the Sciaenidae *Menticirrhus americanus*. Landings were sampled in 2006 and 2007, and sexual ratio, seasonal distribution of gonadal stages, gonadosomatic index and length at first maturity were estimated. Catches of reproductive individuals were analyzed according to the fishing season and fishing gears employed. Results showed that catches of *Menticirrhus americanus* include, at least during two seasons per year, individuals in breeding activity. Trawling does not catch maturing, mature or ripe specimens; gillnets of the caceio type act mainly on young and maturing individuals; and gillnets of the fundeio type act mainly on mature and ripe individuals, in spring and summer.

35- Reproductive status of the swordfish, *Trichiurus lepturus* (Teleostei, Trichiuridae), exposed to small-scale fishing on the north coast of Santa Catarina state, southern Brazil

Soraya Vitória DEL PUENTE & Paulo de Tarso CHAVES
Biotemas 22(2):71-78 (2009)
www.biotemas.ufsc.br/

ABSTRACT. The swordfish, *Trichiurus lepturus*, caught by small-scale fishermen from a community of southern Brazil was investigated based on 398 individuals landed from August 2006 to August 2007, aiming to evaluate in which periods and fishing techniques the reproductive individuals of this species are most exposed to fishing activities. The analysis took into consideration the length of individuals, the morphological attributes of their gonads, the Gonadosomatic Index (GSI), and the kind of gear used in the catches. It was estimated that females mature for the first time at a total length of 75.0cm, and males at 64.0cm. Gillnets and bottom trawling were efficient for the capture of both young and adults, but reproductive individuals were registered only in gillnets. Oocyte hydration and post-spawning in females, the occurrence of mature gonads in males and the values of GSI indicate that “fundeio” and “caceio” (different types of gillnets) are acting on reproductive individuals throughout the entire year, with maximum intensity in spring and summer. Considering that in the studied region fisheries are closed for shrimp bottom trawling in spring, it is suggested that the use of gillnets during spring and mainly summer should be reduced, thus improving the spawning process.

36- Biological, technical and socioeconomic aspects of the fishing activity in a Brazilian estuary (Guaratuba Bay)

Paulo de Tarso CHAVES, Helen Audrey PICHLER & Maurício ROBERT
Journal of Fish Biology **61**(Suppl. A):52–59 (2002)
<http://onlinelibrary.wiley.com/doi/10.1111/j.1095-8649.2002.tb01760.x/pdf>

ABSTRACT. Technical, biological and socioeconomic factors act as obstacles in the development of fishing activity in the Guaratuba Bay, southern Brazil. Amongst the difficulties registered, the following stand out: there was little variety of fishing gear; the purchasing power of the fishermen was low; there was a lack of regularity in the presence of the target species in the estuary; legislation restricted the use of certain gear at particular times; the size of the individual fish was small when compared to those from the continental shelf. Aquaculture could offer an alternative to the revenue of the fishermen, but cultural tradition and the lack of financial resources make it difficult to introduce aquaculture as an activity for the fishermen. The pessimism encountered in the community indicates that the future of artisanal fishing in this estuary is uncertain.

37- Boats, gears and procedures of the artisanal fishing at the southern coast of Paraná state, Brazil

Paulo de Tarso CHAVES & Maurício de Castro ROBERT
Atlântica **25**(1):53-59 (2003)
<http://www.lei.furg.br/atlantica/vol25/ob08.pdf>

ABSTRACT. This work describes boats and gears employed by artisanal fishermen of the Southern Paraná coast, Brazil, and analyses the fishing procedures performed at the shallow continental shelf. Seven types of boats and seven main types of gears were identified. Differences between the fisherman communities were registered concerning the most common type of boat used in fisheries, a fact that can be explained by local conditions of navigability. Shrimps and fishes are exploited by different gears along the year, as a consequence of the governmental fisheries regulations and the types of equipment used. Visual monitoring along 13 months showed that the boats of these communities are not the only ones that exploit the studied area, but also boats coming from other regions of Southern Brazil. At the period when trawl fisheries are forbidden, the number of small boats working in the continental shelf, relative to the number of medium and large ones, increases.

38- Demersal ichthyofauna in a Continental Shelf region on the south coast of Brazil exposed to shrimp trawl fisheries

Paulo de Tarso CHAVES, Gislaine COVA-GRANDO & Cassiano CALLUF
Acta Biológica Paranaense 32(1,2,3,4): 69-82 (2003)
<http://ojs.c3sl.ufpr.br/ojs2/index.php/acta/article/viewFile/618/509>

ABSTRACT. A region of the Continental Shelf of Southern Brazil, isobaths 10 and 15 meters, was studied aiming to compare the attributes of the fish assemblage exposed to the shrimp trawl fisheries, to those of a fish assemblage from a contiguous deeper area that is not exposed to this fishing modality. Individuals were collected with bottom trawl net along 1999 and 2000, and its composition, abundance, size and reproductive activity were analyzed. Of the sixty-two fish species, 30 were common to both areas, while 24 were exclusive to the fishing area and eight were exclusive to the non-fishing area. The shrimp trawl fisheries and the bycatch associated to it occur in a shelf area having very distinctive ichthyofaunistic attributes when compared to those found in the area where this type of fishing does not occur. These attributes include a high number of species exclusive to the fishing area, the formation of larger populational aggregates, a higher intensity of reproductive activity, a larger permanence of species with potential economic value, and a smaller mean individual size. There is evidence that many species do not reside in the study region, but are present because of their migratory behavior. Species whose individuals are valued commercially when adults (mainly Clupeiformes and Sciaenidae) present more uniform abundance values through time in the fishing area than in the contiguous area, where many important groups with no commercial interest (Haemulidae, Tetraodontiformes) were recorded. It is estimated that the ichthyofauna of the area presenting shrimp trawl fisheries is exposed to a disturbance that cannot be counterbalanced by the absence of this fishery activity in its contiguous area.

39- Fisheries of mullets at the Guaratuba Bay, Parana, Brazil

Juliana Ventura de PINA & Paulo de Tarso CHAVES

Acta Biológica Paranaense 34(1,2,3,4):103-113 (2005)

<http://ojs.c3sl.ufpr.br/ojs/index.php/acta/article/view/957/783>

ABSTRACT. In Guaratuba Bay, South of Brazil, fisheries are performed on three mullet species: *Mugil platanus*, *M. curema* and *Mugil* sp., the last of them formerly known as *M. gaimardianus*. Autumn is the period when a higher number of fish gears is used aiming mullet fisheries. Among these gears, beach seine requests more people than others to be performed. Rays and turtles, as well as bony fishes other than mullets, are registered as by-catch in the fisheries. Mature specimens are caught in autumn (*M. platanus* and *M. curema*), and in summer and spring (*M. curema* and *Mugil* sp.). The largest specimens are found in autumn; the smallest ones, in spring. However, at the local market the mean size of the specimens does not change along the year. Even in winter, when mullet catches were not registered at the Guaratuba Bay, mullets are available to be sold.

40- Loss and abandon of fishing gears in Southern Brazil and risks of occurrence of ghost-fishing

Paulo de Tarso CHAVES & Maurício de Castro ROBERT
Boletim do Instituto de Pesca 35(3):513-519 (2009)
ftp://ftp.sp.gov.br/ftppesca/35_3_513-519.pdf

ABSTRACT. It was investigated the presence of lost or abandoned gears by fishing activity in the shallow waters in a region of Southern Brazil, discussing their causal agents and the type of fisheries implicated. Fishers pointed out 25 events in which gillnets were lost, attributing them to the fisheries as bottom trawling, “double” trawling and purse seining. From March to June 2008, five repeated surveys performed along six beaches found 160 netting fragments, their mesh size ranging from <5 cm (trawl net for shrimps) to 18 cm (gillnet for flatfish). All mesh sizes and twines (mono or multifilament) found at the beaches are currently used in the communities of small-scale fisheries inhabiting this region. Most of nets were linked to tree branches and other plant debris. Sometimes nets had formed groups of different mesh sizes. It is proposed that plants can assemble lost gears, helping them to be carried out towards the beach. Registers of intact buoys show that they came from cut cables. In other events, buoys cut in linear sections as thick as a cable indicate that they were lost from operating nets. Technological and operational recommendations are presented in order to reduce both the risks of losing gears and the operational life of the lost gears.

41- Effects of the shrimp trawling fisheries on the reproductive activity of fish: a study case in southern Brazil

Juliana Ventura de PINA & Paulo de Tarso CHAVES
Atlântica, Rio Grande, **31**(1) 99-106 (2009)
<http://www.seer.furg.br/atlantica/article/viewFile/1535/677>

ABSTRACT. The consequences of changing in closed seasons of small scale shrimp in Southern Brazil trawling on the breeding activity of fish bycatch species were investigated from samples collected from October 2005 to March 2007. From the 72 species recognized, 21% were Sciaenidae. Trawling caught mainly immature fish, and individuals of 22 species were found at this condition only. Other 32 species presented mature individuals, nine of them showing also spawned or ripe individuals. Reproductive Activity Index has indicated that in trawling *Pellona harroweri* and *Stellifer sp* are found in a very intense breeding activity, and that *Isopisthus parvipinnis*, *Paralonchurus brasiliensis*, *Stellifer brasiliensis*, *S. stellifer* and *Symphurus tessellatus* are found in intense breeding activity. Spring 2005, Summer 2006 and Summer 2007 were periods with species in a very intense reproductive activity. Summer 2007, having succeeded the closed season of spring 2006, has showed just one more species in breeding activity than summer 2006, a year when trawling was closed in autumn. In view of this, it is proposed that this change in the closed season for trawling did not affected the reproductive activity of the fish assemblage as a whole.

42- The physiography influence on small-scale fishery strategies and attributes in Southern Brazil

Amanda Bortolan NOGUEIRA, Paulo de Tarso CHAVES, Maurício de Castro ROBERT & Kelly Dayane AGUIAR

Boletim do Instituto de Pesca 37(1):13-30 (2011)

ftp://ftp.sp.gov.br/ftppesca/37_p1_13-30.pdf

ABSTRACT. It was investigated the hypothesis that small scale fisheries attributes, including types of boats, gears and fish caught, depend on the degree of difficulty that fishermen find for accessing marinas and save their boats. Data were obtained from 2001 to 2006 by direct observations, interviews with fishermen, and landing surveys. Seven communities were placed in two groups: “protected”, like estuaries and coves, where physical elements reduce the energy of waves; and “exposed”, normally open beaches without a physical barrier. Both groups were compared between them according to the fleets and gears used in the fishing activities. Boats were classified in five categories, and each one of them was analyzed with regard to the community group and type of gears. Thirteen types of fishing gears were identified and 87 types of taxonomic categories (“fish”) were linked to them. Such occurrence “fish” per gear and season pointed out six groups “gears, seasons”. It was concluded that in the studied region physiography actually acts on the type of boats used in fishing activities, however it does not act on fish gears and, consequently, exploited resources. Boat size is not the only attribute determining fisheries performed by a community, because communities presenting different physiography can, in spite of their different fleets, share the same target species.

43- Recreational fishing and catch-and-release: recent studies and recommendations for studies carried out in Brazil

Paulo de Tarso CHAVES & Kátia Meirelles Felizola FREIRE

Bioikos 26(1):29-34 (2012)

periodicos.puc-campinas.edu.br/seer/index.php/bioikos/article/viewFile/763/743

Abstract. This paper presents a brief review of catch-and-release. Its objective is to provide information about the main problems and solutions associated with this practice that have been discussed in recent years, and placing Brazil within this context. Releasing fish is considered to be a noble gesture, a conservationist approach. Based on this assumption, many have even proposed that some areas should be closed to commercial fishing and open exclusively to recreational fishers. However, many of the effects of this practice remain unknown, mainly if we consider that most studies on post-release mortality have been carried out in fresh water. Current research has focused on the assessment of the well-being of the released fish, the prevention of stress or mortality and, more recently, on the ethical aspects of catch-and-release. Some very well-established practices have been shown to be inefficient; others should be used according to habitat and species. In Brazil, technological and scientific knowledge on this subject is in its infancy and, moreover, it is focused on studies carried out in freshwater habitats. The use of catch-and-release as a management tool should not be seen as a panacea for all situations. We recommend an analysis of preventive measures applied to similar conditions observed in developing countries or economies in transition.

44- Use of the maturation size in fisheries management: a critical review

Paulo de Tarso CHAVES

Acta Biológica Paranaense **41**(3-4): 131-138 (2012)

<http://ojs.c3sl.ufpr.br/ojs2/index.php/acta/article/view/31440/20071>

ABSTRACT. The size of individuals at maturation is currently used as a tool in fisheries management in order to indicate the minimum allowed lengths to caught, a measure aiming to protect young fish and increase the number of the spawner ones in stock. However, an opposite strategy was implemented by a new Brazilian law for recreational fishing, which limits catches to a maximum length, protecting from fisheries the largest individuals. In view of the potential application of this strategy in professional fishing also, this review highlights the biological and methodological attributes of a fisheries management based on the maturation individual size or the maximum one, and offers recommendations about fisheries management.

45- Fish composition in the shrimp fisheries at the Southern Coast of Parana, Brazil

Iracema David GOMES & Paulo de Tarso CHAVES

Bioikos 20(1):9-13 (2006)

periodicos.puc-campinas.edu.br/seer/index.php/bioikos/article/viewFile/852/831

ABSTRACT. At the ocean inner-shelf of the Southern coast of Parana, the fish fauna found as by-catch in the shrimp fisheries was studied to assess its composition and economical value. Sampling was performed between April 2001 and March 2002. The fishing effort was standardized to 50 minutes/month at five sites, all located between Guaratuba Bay and the estuary of river Sai-Guaçu, at 10-meter depth. Distance between sites was approximately 2 kilometers. A total of 7,839 individuals was caught, comprising 61 species and 21 families. Among these species, 35% are marketed in the studied region; however, the sizes of such marketed individuals are larger than those of the samples by-caught at the shrimp fisheries. Sciaenidae, Engraulidae and Carangidae were the most diverse families, indicating the estuarine influence (Guaratuba Bay) over the shrimp catching conducted at the inner-shelf area. The facts point out to economical and environmental effects linked to the fish species composing the by-catch at the shrimp fisheries at the Southern coast of Parana.

46- Elasmobranchs caught by artisanal fishing in the south coast of Parana State and north coast of Santa Catarina State, Brazil

Luciano COSTA & Paulo de Tarso CHAVES

Biota Neotropica 6(3) (2006)

www.biotaneotropica.org.br/v6n3/pt/abstract?article+bn02706032006

ABSTRACT. This study was done in the South coast of Parana State and North coast of Santa Catarina State, Brazil, in two artisanal fishermen communities. Between July, 2001 and March, 2003 the fishing activities were observed aiming to: report the elasmobranchs caught; report which species are commercialized; observe the seasonal occurrence of the species in the landings; estimate the frequency of capture by different fishing gears; and infer about the reproductive biology of the species. During the studied period were captured: *Carcharhinus falciformis*, *Galeocerdo cuvier*, *Rhizoprionodon lalandii*, *R. porosus*, *Sphyrna lewini*, *S. zygaena*, *Squatina guggenheim*, *Narcine brasiliensis*, *Rhinobatos percellens*, *Zapteryx brevirostris*, *Rioraja agassizii*, *Dasyatis americana*, *D. guttata*, *D. hipostigma*, *Gymnura altavela*, *Myliobatis goodei*, *Rhinoptera bonasus* and *R. brasiliensis*. It was observed that all sharks and only two ray species (*R. percellens* and *Z. brevirostris*) are commercialized. In the landings, elasmobranchs were more frequent during winter and spring. Most catches were done by gillnets, while just a few captures were done by shrimp trawls. The data indicated that the studied area is used by *G. cuvier*, *R. lalandii*, *R. porosus*, *S. lewini*, *N. brasiliensis* and *R. agassizii* to give birth; by all species for growing; and during the gestation of *R. percellens* and *Z. brevirostris*. It is suggested that actions aiming to protect the species must be taken, without harming and conflicts for the fishermen communities.

47- Dynamics of the artisanal fishing activity in two communities on the South Coast of Brazil

Maurício de Castro ROBERT & Paulo de Tarso da Cunha CHAVES
Boletim do Instituto de Pesca 32(1):15-23 (2006)
ftp://ftp.sp.gov.br/ftppesca/32_1_15-23.pdf

ABSTRACT. The seasonality in the occurrence of fishing resources can originate a surprising diversity of procedures and gears used by communities of artisanal fishermen. This work describes the routine of two communities in the bordering littoral region of the Santa Catarina and Parana States. The work was performed from April 2002 to June 2003 in two communities of the municipal districts of Itapoá (Santa Catarina state) and Guaratuba (Parana state), and it consisted by interviews, direct observations about the fleet and monthly accompaniments of the landings. The fleet of both communities composes predominantly by wooden canoes. The departure to the sea for daily activities of fishing usually occurs at dawn, and the return, around five hours later. Four main modalities of fishing are used along the year, all performed at open sea. The anchored gillnet is the most frequent, just overcome – in the summer – by the bottom trawl. In the anchored gillnet, the mesh sizes 7, 11, and 16 cm (stretched mesh) are the most representative. Both communities have own annual cyclic characteristics regarding the practiced modality, resulting in an scenery of heterogeneous temporal exploration of the environment. Differences in the exploration form of the environment during the same period can be mostly explained by cultural and logistic differences between Barra do Sai and Brejatuba, fact that leads to the idea of resources spontaneous division by the fishermen communities.

48- Reproductive activity of fish (Teleostei) and closed season to shrimp trawling off the Northern coast of Santa Catarina, Brazil

Leda Maria de SOUZA & Paulo de Tarso CHAVES
Revista Brasileira de Zoologia 24(4):1113-1121 (2007)
[dx.doi.org/10.1590/S0101-81752007000400031](https://doi.org/10.1590/S0101-81752007000400031)

ABSTRACT. Shrimp trawling was monitored in southern Brazil in order to study the reproductive status of teleosts occurring as by-catch. From 2005 to 2007 seventy-six fish species were found in this kind of fisheries. Gonad stages were evaluated and the Reproductive Activity Index was calculated. Mature individuals were 50% of the total caught as by-catch. Breeding activity in *Isopisthus parvipinnis* was “very high” in spring 2005 and summer 2007, and in a particular season (depending on the species) in *Menticirrhus americanus*, *Stellifer sp*, *Pomadasys corvinaeformis*, *Stellifer brasiliensis*, *Syacium papillosum*, *Larimus breviceps*, *Diapterus rhombeus*, *Symphurus tessellatus*, *Chirocentrodon bleekermanus*, *Pellona harroweri*, *Anchoa tricolor*, and *Selene setapinnis*. In the summer of 2007, followed by the spring of 2005, trawling caught more species in “high” or “very high” breeding activity. In the summer of 2007 a larger number of species was in reproductive activity than the same season of 2006, due to a closed season in October-December 2006. Aiming to improve the fish breeding activity in this region, it is recommended to close this area for shrimp trawling during the spring. This measure could be positive for both species that spawn in spring and those preparing to spawn in the summer.

49- Artisanal fishing net float loss and a proposal for a float design solution

Paulo de Tarso CHAVES & Beatriz Ern da SILVEIRA
Brazilian Journal of Oceanography 64: 89-94 (2016)

Abstract. Plastic floats for fishing nets are commonly found washed up on beaches in southern Brazil. They are usually broken and show sign of having been repaired. Characteristics of floats and interviews with fishermen suggest two main causes of float loss. First, collisions between active gear, bottom trawl nets for shrimp, and passive gear, drift nets for fish, destroy nets and releases parts of nets, including floats. Second, the difficulty with which floats are inserted on the float rope of the nets when they are used near the surface. Floats are inserted to replace damaged or lost floats, or they may be removed if it is desired that the nets are used in deeper waters. Thus, floats may be poorly fixed to the cables and lost. Here it is described and tested a float design that offers greater safety in use and replacement of floats.

50- Ictiofauna e pesca amadora no litoral sul do Paraná: estudo de caso sobre capturas e potencial impacto

Julia Lopes HENKE & Paulo de Tarso CHAVES

Brazilian Journal of Aquatic Science and Technology 21: 37-44 (2017)

Abstract. This work presents data on recreational fisheries at Parana State, Southern Brazil, including catch data, fishing gears, the practice of catch-and-release, and the bait composition and their acquisition. Impacts generate by recreational fisheries are discussed. Data were collected by observing 115 anglers in activity on land, during 10 days in March and April 2017, as well as in championship in 2016. Part of fishers have indicated that the most frequently caught fish are kingcroaker, catfish, whitemouth croaker, mojarras, largehead hairtail, black drum, pompano, snooks and black margate; the most appreciated fish are snooks, kingcroaker, black drum, largehead hairtail, pompano and sardines; the fisheries yield ranges from zero to 30 units; release after catching depends mainly on the fish variety and its size, as well as on the catch size; and natural baits are the most used ones, mainly Penaeid shrimp, 'tatuira' (a mole crab), sardines, 'corrupto' (Crustacea Thalasinidea) and squids. In competitive tournaments played inside the Guaratuba Bay snooks were the most fish variety registered in number, while flatfish and black drum reached the highest individual weight. Impacts associated to recreational fisheries include loss of fishing gears – mainly in rocky zones, where until 12 fishing gears are lost by period of activity – and the crustacean extraction in sand beaches for using as bait.

51- Fecundidade de peixes e tamanhos máximos de captura: instrumento auxiliar à gestão de pesca

Paulo de Tarso CHAVES, Francieli AZEREDO & Emanuelle PINHEIRO
Boletim do Instituto de Pesca, São Paulo 43: 542-556 (2017)

Abstract. The relationships between fecundity (F) and body size, and between the relative fecundity to the gonad weight (Frg) and F, are described for 17 teleost species of the families Clupeidae, Ariidae, Mugilidae, Stromateidae, Centropomidae, Carangidae, Sciaenidae and Paralichthyidae. Adult females were obtained from artisanal fisheries in Parana coast, Southern Brazil. From each specimen data on total length and ovary weight were taken, and on stereoscopic microscopic vitellogenic oocytes were counted. Results have showed that F increases with the individual size in 15 from 17 species. Differences between F maximum and F minimum have varied from 56.9% to 98.2% of F maximum, depending on species, being represented by $F(\text{máx}-\text{mín})= 8405 + 0.7587.F_{\text{máx}}$ (n= 17; r= 0.96). Frg was commonly proportional to F: $F_{\text{rg}}= 1.15.F_{0.7603}$ (r= 0.74; n= 228). Species with larger F values have usually presented oocytes smaller than those with small F values. Strategic sizes for conservation are recommended for the 17 species studied, corresponding to the total lengths in which the F maximum was found. Efficacy of using the maximum size in management rules requires studies on gillnets selectivity, addressed to professional fishing, and educative actions, to recreational one.

52- Investigação sobre fishing down marine food webs no sul do Brasil: implicações financeiras e para a sustentabilidade

Thiago LECHETA, Maíra G. AFONSO & Paulo de Tarso CHAVES
Arquivos de Ciências do Mar 50: 30-44 (2017)

Abstract. Increasing catches of low trophic level, non-piscivorous fish throughout the world indicates an effect *fishing down food webs*. We investigate the occurrence of *fishing down* in Southern Coast of Brazil along the 1990' and 2000' and implications for fisheries yield and sustainability. It was assumed as belonging to a 'high' trophic level piscivorous species (P), and as to a 'low' trophic level those non-piscivorous (NP). Data from fish landings and first commerce price were obtained. Results have shown that, opposing to *fishing down*, the P landings have proportionally increased. In the 1990' landings of P were larger than NP in Rio Grande do Sul state only. Otherwise, in the 2000' the larger landings of P were extended to São Paulo and Santa Catarina states. Despite the higher commercial price of P, the commercial value of landings (VDF) fell more than 50%, because of reduction in NP landings in São Paulo, and in P landings in Rio Grande do Sul. In Santa Catarina VFD has increased due to P resources, as skipjack. However, this fisheries lead to an indirect *fishing down*, because of an impressive contingent of juveniles of Brazilian sardine is used as live-bait.

53- Rejeitos da atividade pesqueira no litoral do Paraná: gestão atual e potencial para destinação alternativa

Paulo de Tarso CHAVES & Juliane Maria VINK
Biodiversidade e Conservação Marinha 6: e2017004 (2017)

Abstract. A regular survey performed along the Parana littoral on fishery landings and the immediate preparing of fish for sale pointed out the provenance, composition and destination of discarded fishery products. Fish and shrimp parts are rejected, either dead or alive, for three reasons: they are undersized, they are damaged, or they do not correspond to the market requirements. Residues of fillets correspond to approximately 60% of the net fish mass; portions cut, to 33%; and simple evisceration, to 23%. Also shrimp shells and whole invertebrates are rejected, besides small fish coming from shrimp trawling, as well as larger fish coming from gillnet fisheries when they are not appropriate for human consumption. The majority of rejects is composed of fish carcasses (with/without head, fins, vertebrae, and other bones), followed by shrimp shells. It is estimated that two markets, Matinhos and Shangrilá, reject each one more than 100kg/day of fish rejects, and the Paraná littoral as a whole more than 360t/year. Rejects normally are transferred to regular garbage depots, using non-adapted vehicles, or are buried in dune areas. Fish preparing is influenced by consumer tradition, and the occurrence of resources changes seasonally, then the wasteful of fish matter also changes along the year. This fact, associated to deficiencies in physical infrastructure and in workers qualification, lead to put in priority three ways of fishery reject exploitation: ensilage, composting and leather production.

54- Biologia reprodutiva do robalo-peva, *Centropomus parallelus* (Teleostei), na Baía de Guaratuba (Brasil)

Paulo de Tarso CHAVES & Amanda Bortolan NOGUEIRA
Acta Biologica Paranaense 47: 69-84 (2018)

Abstract. It was investigated if *Centropomus parallelus*, a snook species with common occurrence in Southern Brazil, spawn in Guaratuba Bay, and in which period of the year; if this species is hermaphroditic as known in other Centropomidae; and the length of first maturation and strategic lengths for its conservation in this estuary. Specimens were obtained from August 2007 to August 2008 by accompanying recreational fishing in Guaratuba Bay. Indicators used to reach the goals of study were found on analysis of gonadal maturation, gonad and body weights, and fecundity values according to fish size. Results indicate that *C. parallelus* spawn in Guaratuba Bay in Spring and Summer, from September to March, with spawning peak in end Spring and middle Summer. They are multiple spawners. Hermaphroditic individuals were not found in the 636 analyzed specimens, total length 170-630 mm. The mean length at first maturation was estimated to be 195 mm in males and 200 mm in females, and the asymptotic length in 371 mm and 327 mm, respectively. Mean fecundity was estimated in 334,219 oocytes and was directly correlated with female length, varying from 9,727 in the smallest specimens to 1144,738 in the largest ones. It is estimated that big females can produce up to 120 more oocytes than the small ones. Aiming to protect the fat snook population, it is recommended for fishing activities in Guaratuba Bay the releasing of all individuals larger than 50 cm, and retention only of those in the interval's length 35-50 cm. The first length agrees with the Brazilian law IBAMA number 8/2003. This procedure, restricting to 15 cm the legal reference for retention, simultaneously agrees with the first maturation size of *C. parallelus* and the resilience in environment of more fecund individuals.

55- Recursos-alvo que são também bycatch, e recomendação para a gestão da pesca de emalhe no litoral do Paraná, Brasil

Paulo de Tarso CHAVES & Amanda Ventura F. da SILVA
Biodiversidade e Conservação Marinha 8: 1-11 (2019)

Abstract. Incidental catches of gillnet fisheries were studied in the small-scale fisheries performed at Parana coast, Southern Brazil. From March to October 2017 twenty-eight landings were observed, giving data on fishery techniques, gillnet dimensions, target resource and bycatch, and catches use. Thirty-three resource types were recognized. Serra Spanish mackerel (Scombridae) was the most common target resource, and largehead hairtail (Trichiuridae) and whitemouth croaker (Sciaenidae) were the most common bycatch. All target resources, mainly the whitemouth croaker, have occurred also as bycatch. Incidental catches were more diversified in the *fundeio* technique, that aims demersal resources, than in the *caceio* one, that aims pelagic resources. *Caceio* and *fundeio* have presented, both of them, demersal and pelagic bycatches. Part of bycatch is commercialized or donated, and part is discarded aboard. Fishery rules for gillnet fishery should consider that the fauna diversity in tropical zones increases catches of non target species. Considering that every target species can also be a bycatch, fisheries rules based on gillnet specifications are not effective for conservation of resources at the studied area, and temporary closing of areas for exploitation would be considered as a better management parameter.



FISH AND FISHERIES

AT THE SANTA CATARINA-PARANA COAST, SOUTHERN BRAZIL

Abstracts of 55 scientific papers 1994-2019

Support:

CNPq – Brazilian Council for Scientific and Technological Development

Curitiba, Brazil, March 2019