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Feeding ecology of *Centropomus undecimalis* (Bloch, 1792) and *Centropomus parallelus* (Poey, 1860) in two tropical estuaries in Northeastern Brazil

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Abstract: This study provides information on the feeding habitats of *Centropomus undecimalis* and *Centropomus parallelus* in two estuaries of Pernambuco, Northeast Brazil. Specimens were collected every three months from February 2013 to June 2014 in the estuary of Sirinhaém River (south coast) and the Estuarine Complex of Santa Cruz Channel (north coast). To access diet composition we used frequency of occurrence %Fo; numerical frequency %N and weight percentage %W. Multivariate analysis of MDS, ANOSIM and SIMPER were used to evaluate the similarity and differences of the diet between species and regions. A total of 390 individuals were evaluated. The results indicate that the Estuary of Sirinhaém River and the Estuarine Complex of Santa Cruz Channel are used as a feeding ground by the *Centropomus* species. The diet of the *C. undecimalis* and *C.parallelus* in both areas was based primarily on Crustaceans - Decapoda and teleosts. *C. undecimalis* appeared as a predator with piscivorous tendency in the two study regions, whereas *C. parallelus* was classified as zoobentivorous in the south coast and as piscivorous in the north coast.

Key-words: Estuaries, overlap, trophic ecology, snook

Resumo: Ecologia alimentar do *Centropomus undecimalis* (BLOCH, 1792) and *Centropomus parallelus* (POEY, 1860) em dois estuários tropicais no Nordeste do Brasil. **Este** estudo fornece informações sobre a alimentação do *Centropomus undecimalis* e *Centropomus parallelu*s em dois estuários de Pernambuco, Nordeste do Brasil. Os espécimes foram capturados trimestralmente no período de fevereiro de 2013 a maio de 2014 no Estuário do rio Sirinhaém (litoral sul) e Complexo Estuarino do Canal de Santa Cruz (litoral norte). Para composição da dieta foram utilizados os índices de frequência de ocorrência (%Fo), frequência numérica (%N) e peso percentual (%P). Foram utilizadas as análises multivariadas MDS, ANOSIM e SIMPER para avaliar similaridade da dieta entre as espécies e as regiões. Foram avaliados 390 indivíduos. Os resultados indicam que o Estuário do Rio Sirinhaém e do complexo estuarino do Canal de Santa Cruz são utilizados como área de alimentação pelas espécies da família Centropomidae. A dieta do *C. undecimalis* e *C. undecimalis* em ambas regiões foi formada por peixes teleósteos e crustáceos - decápodes. *C. undecimalis* se mostrou como um predador com tendência piscívora para as duas regiões de estudo, enquanto que *C. parallelus* foi classificado como zoobentívoro no litoral sul e, no litoral norte, apresentou uma tendência piscívora.

Palavras-chave: Estuários, sobreposição, ecologia trófica, camurim

Introduction

The coastline of Brazil measures about 8000 km and estuarine areas can be found all through the coastal areas (Coelho Júnior 2000). With 187 km of coastline, the state of Pernambuco, Northeast Brazil, includes estuaries with high productivity, biodiversity (Lacerda *et al.* 2004, Ramos *et al.* 2011, Bezerra *et al.* 2011, Valença & Santos 2013) and great socio-economic importance as fishing is a source of income and food (Barbosa *et al.* 2007, Pinto *et al.* 2015). Artisanal fishing in this state is dominant, accounting for 80% of the total catches between 1988 and 2007. Among the species caught by the fishing activity in Pernambuco, snooks from the genre *Centropomus* are relevant as total catch and economic value (IBAMA 2008) mainly for artisanal fishing communities that operate predominantly in the estuaries (Lira *et al.* 2010a,b).

Centropomus spp. are also considered potential species to aquaculture as they have relatively high growth rates and appreciated meat in the market (Souza *et al.* 2011, Rhody *et al.* 2014). A number of studies concerning the use of this species in aquaculture are available (Alvarez-Lajonchère 2004, Tsuzuki *et al.* 2008, Jimenez-Martinez *et al.* 2012, Carvalho *et al.* 2014). However, there are few studies on population dynamics and stock assessment of the species of this genus. Available literature are particularly from Mexico (Díaz-Jaimes *et al.* 2007, Perera-García *et al.* 2011, 2013), United States (Brennan *et al.* 2008, Adams *et al.* 2009, Boucek & Rehage 2015), Puerto Rico (Aliaume *et al.* 2000) and Guatemala (Andrade *et al.* 2013). In Brazil, Vitule *et al.* (2013) described the feeding habit of *Centropomus* in estuarine complexes in the southeast region and Oliveira *et al.* (2014) studied the genetic structure of the *Centropomus* genus in the north and northeast coast.

Studies on the feeding activity of species economically and ecologically important in their natural environment are extremely relevant because they help the understanding on how these organisms contribute to the functioning (Blaber & Bulman 1987, Winemiller *et al.* 2008), control, monitoring and management of these water resources (Whitfield & Elliott 2002, Mclusky & Elliott 2004), as well as to the potential development of mariculture (Alvarez-Lajonchère & Tsuzuki 2008). In estuarine areas, this knowledge is also essential for the determination of key species and development and maintenance of these biomes (Selleslagh *et al.* 2012, Mouquet *et al.* 2013). This study has the purpose of characterizing and determining the feeding habits of the species *Centropomus undecimalis* and *C. parallelus* in two estuarine regions of Pernambuco, northeast Brazil.

Material and Methods

The study area comprised the Estuary of Sirinhaém River and the Estuarine Complex of Santa Cruz Channel (SCC), located at the southern and northern coast of Pernambuco, respectively (Figure 1). The estuarine complex of SCC has a U-shape, about 22km long and variable width which can reach up to1.5 km. Its depth ranges from 4-8 m with higher values (10-17m) close to the ocean discharges. SCC, composed by different rivers, is considered the largest estuarine ecosystem of the Pernambuco State. The Estuary of Sirinhaém River, with 9.5 km long, 350 m width, and depth varying between 1.2-4.5m, is classified as coastal plain estuary (Silva *et al.* 2011).

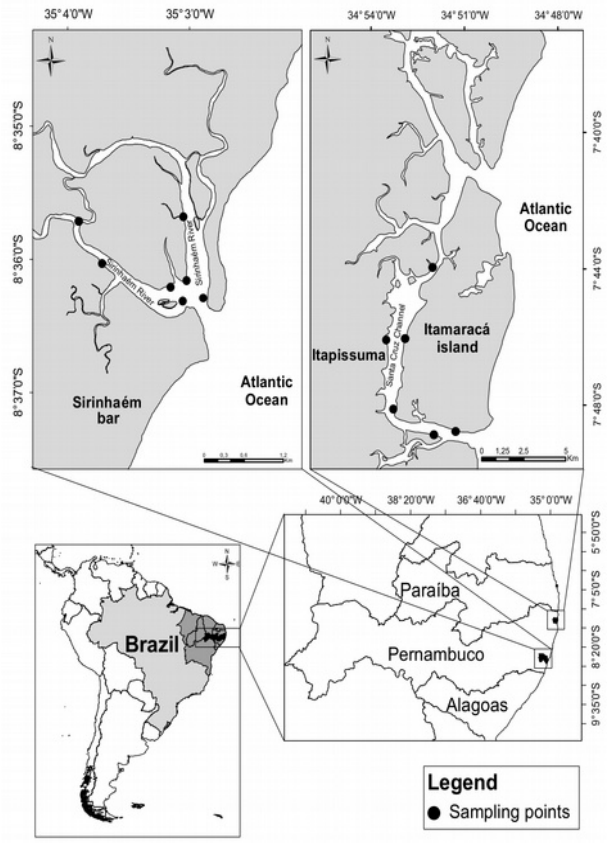

Figure 1– Study area. Estuary of Sirinhaém River and the Estuarine Complex of Santa Cruz Channel (Pernambuco, Northeast Brazil) and sampling points.

Data was collected quarterly, from February 2013 to June 2014. To sample a large range of length for both species, two fishing gears were

used: (a) “camboa”, block nets were set along the mangrove forest and channels and measured in total 600 m long, 3 m high with mesh size varying between 25 - 80 mm. At low tide, the net was anchored to the bottom. At slack high-water, the net was deployed and attached to stakes and pulled taut so that it was above the water, enclosing the mangrove area. Blocking was initiated at the end of the high tide and continued throughout the entire ebb tide cycle. For both Itapissuma and Sirinhaém, the time of data collection was standardized, from around midnight and 6 a.m. (b) Beach seine with 250 m long, 2.5 m high and mesh size of the 25 mm, the operation, operated in the morning for both studied areas, lasted no more than 20 min and was repeated three times.

For each specimen, we recorded the total length (TL - cm) and total weight (TW - grams). Subsequently, the fishes underwent a ventral longitudinal incision to remove the stomach. Feeding intensity was defined by observing the degree of fullness, with degree I - empty stomach, II - partially empty, III - partially full and IV - full stomach (Santos 1978 adapted by Viana *et al.* 2010). Contents of individual stomachs were then sorted, counted, weighed (g) and identified to the lowest possible taxonomic level.

As an indicative of the species feeding intensity, we defined a Fullness index (FI) based on Zavala-Camin (1996): %FI = (CW / TW) x 100, with CW - stomach contents weight and TW - total weight of the fish. Two seasons were considered based on the monthly average rainfall: dry (September - March) and rainy season (April - August) (APAC 2015). The FI difference between the species by area of study and season was analyzed through the nonparametric Kruskal-Wallis test after the basic assumptions of normality and homogeneity were not sufficient for a parametric test. Analyses of multiple comparisons tested subsequent comparisons in case of significant differences ($p<0.05$) (Siegel & Castellan Jr 1988).

Three methods described by Hynes (1950) and Hyslop (1980) were used for qualitative composition of the diet: frequency of occurrence %Fo; numerical frequency %N; weight percentage %W. The diets of *Centropomus* were described by estuary. Only identified items were considered for subsequent analyses.

The niche breadth, obtained by species and estuary, was estimated by Levin’s standardized index: $Bi = [1/(n-1)][1/(\Sigma\ jpij^2)-1]$ (Levin 1968), where B*i* = standardized index of niche breadth, *pij* = proportion of prey j in the diet of predator i and n = total number of food resources. Bi breadth from 0 (species consumes only one item) to 1 (species consumes a similar proportion of all evaluated items).

To assess the degree of similarity in the diet of species, a multivariate technique of multidimensional scaling (MDS) based in a Bray-Curtis similarity matrix was applied, with the stomachs considered as the sampling unit for species-area. Preys abundance (as %W) were log10 (x + 1) transformed to reduce the dominance effect of some preys. The differences between species diet and estuaries (within species) were tested through ANOSIM. The items that discriminated the groups were also evaluated using SIMPER routine. The software R software (Corel Team 2015) was used for the multivariate analysis.

Results

We captured 390 specimens of *Centropomus*: 51 *C. undecimalis* caught at the north (20.2 – 39.2 cm TL) and 132 at the south coast (16.9 – 52.5 cm TL); and 88 *C. parallelus* caught at the north (11.2 – 29.8 cm TL) and 119 at the south coast (12 – 32 cm TL). A high proportion of *C. undecimalis* had food contents in their stomachs (degrees II, III and IV), mainly at the north coast (71%), compared to the south coast (60%). The percentage of *C. parallelus* individuals feeding was higher, with the same tendency observed between the areas: 80% were feeding at the south coast and 95% at the north coast. In general, the highest values of fullness index (FI) were observed for *C. parallelus* in both areas and seasons (Figure 2). The FI values between species by season and area (north coast and south coast) were significantly different ($p<0.05$).

The diet of *C. undecimalis* was based on fish, shrimps, crabs, amphipods, gastropods, polychaetes and insects, with a minor representation of plant material. In the southern coast, the most frequent items were unidentified fish and decapod crustacean (%Fo: 49 and 15, respectively), followed by plant material (%Fo: 12), whereas the Peneidae family and *Guavina guavina* species dominated in %N and %W, respectively (Table I). The diet in the north coast was similar to that from the south coast. Unidentified fish and decapod crustacean dominated in occurrence and abundance (%Fo: 46 and 28; %N: 39 and 25 respectively), whereas *Lile piquitinga* and *Gobionellus stomatus* species dominated in biomass (%W: 13 and 11,

respectively) (Table I). In the southern coast, the items *Ctenogobius* spp, *Eucinostomus* spp, *Caranx* spp, shrimps, amphipods, polychaetes were minimally consumed, contributing to the diet breadth. Regarding the north coast, decapod crustacean, *L. piquitinga*, *Mugil* spp and *Farfantepenaeus* spp also contributed to the diet.

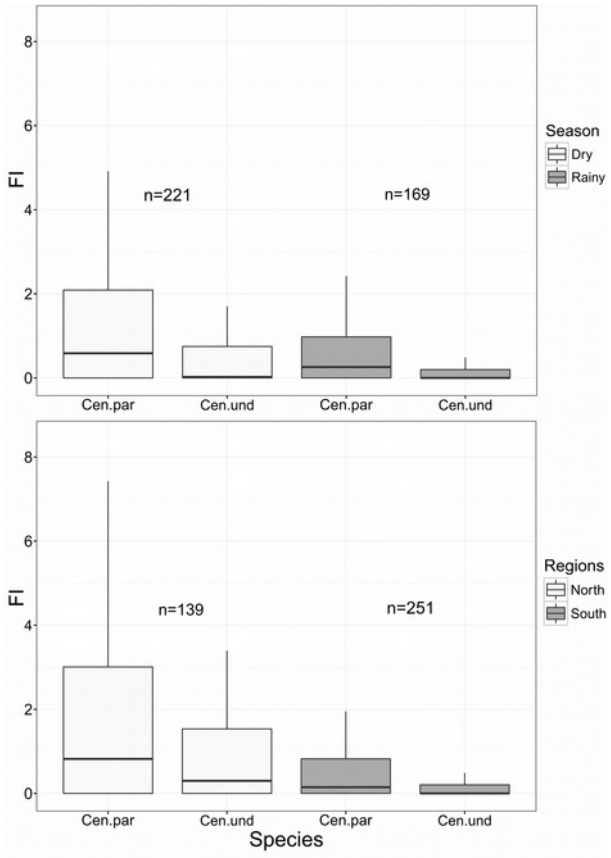

Figure 2 – Boxplot of the fullness index (FI) value for regions and season. Cen.par: Centropomus parallelus; Cen.und: Centropomus undecimalis. The black horizontal line and box represent median value and interquartile range respectively, while the black vertical line is upper limit (25% of the data).

C. parallelus showed different diets for each studied area. In the southern coast, the diet was based on crustaceans with a reduced intake of fish. Decapod crustacean (%Fo: 57;%N: 30;%W: 22), *Callinectes* spp (%Fo: 19;%N: 21) and *Alpheus* spp (%Fo: 17;%N: 8;%W: 18) were the most important prey items for all methods; *Eleotris pisonis* also contributed significantly to the total biomass (%W: 19) (Table II). In the north coast, however, the species presented a diet based on fish with reduced intake of shellfish. The Gobiidae family was the most representative prey in occurrence, abundance and biomass. Among gobies, *Ctenogobius* was the most representative. Crustaceans such as Alpheidae shrimps, swimming crabs (*Callinectes* spp) and Xantidae and Sesarmidae crabs were also dietary items for the species. It was also reported the occurrence of insects in their stomachs (Table II). Items such as amphipods, *Callinectes* spp and *Alpheus* spp were sporadically consumed and considered rare, whereas *E. pisonis*, Anguiliformes, *Litopenaeus schmitti*, *Uca cumulata* and *Aratus pisonii.* Much of the items were rare, showing that the species has no clear specialization on an item.

The largest niche breadth (B*i*) was observed for both species in the north coast. *C. parallelus* showed a greater niche breadth in any case (north coast - B*i*: 0.49; south coast - B*i*: 0.23), compared to *C. undecimalis* (north coast- B*i*: 0.22; south coast - B*i*: 0.10). The arrangement obtained by multidimensional analysis (MDS) demonstrated a partial overlap between diets of the different species, although weak significant differences have been detected (ANOSIM; R=0.156; $p<0.05$) (Figure 3). Significant differences in the feeding habits of *C. parallelus* and *C. undecimalis* between the north and south coast were detected (ANOSIM, R=0.232; $p<0.05$) (Fig. 5). The SIMPER test indicated that especially decapod crustaceans, *Alpheus* spp and Gobiidae family were responsible to distinguish the diet of the species and the area (within species), contributing with more than 50% in the species diet (Table III).

Discussion

Estuaries are susceptible to a number of anthropogenic interference, for example, through industrial activities and fishing (Blaber 2011, Viana *et al.* 2012, Ecoutin *et al.* 2014), which may cause changes in the food chain (Blaber 2013). The *Centropomus* species are key components in estuarine systems, mainly because they are predators at the top of the food chain in these ecosystems (Sosa-López *et al.* 2005, Blewett *et al.* 2006, Moreno-Sánchez *et al.* 2015). They are also considered high-value species in domestic and international markets and target of many fisheries.

The feeding intensity, described as the fullness index (FI), may be largely influenced by the availability and type of preys, length range of the predators and reproductive season (Mondal & Mitra 2016; Pereira *et al.* 2016; Perelman *et al.* 2017). A high proportion of individuals with food contents in the stomachs of both *Centropomus undecimalis* and *C. parallelus* indicates that the Estuary of Sirinhaém River and the Estuarine

Table I. Contribution by frequency of occurrence (%Fo), number (%N) and weight (%W) of each prey item of the overall diet of *C. undecimalis* in the Estuary of Sirinhaém River (south coast) and the Estuarine Complex of Santa Cruz Channel (north coast), Pernambuco (Northeast Brazil).

	south coast (n=65)			north coast (n=28)		
Prey items	**%Fo**	**%N**	**%W**	**%Fo**	**%N**	**%W**
TELEOSTEI	-	**51.85**	**94.52**	-	**60.71**	**85.52**
CLUPEIDAE	-	-	-	3.57	3.57	10.68
Lile piquitinga	-	-	-	3.57	3.57	13.56
ELETROTIDAE						
Guavina guavina	1.54	1.85	60.57	-	-	-
Eleotris pisonis	1.54	1.85	2.97	-	-	-
GOBIIDAE						
***Ctenogobius* spp**	1.54	3.70	0.52	3.57	3.57	3.27
Gobionellus stomatus	-	-	-	7.14	7.14	11.28
GERREIDAE						
***Eucinostomus* spp**	1.54	1.85	2.87	-	-	-
CARANGIDAE						
***Caranx* spp**	1.54	1.85	1.36	-	-	-
ARIIDAE						
***Catfish* spp**	1.54	1.85	1.21	-	-	-
MUGILIDAE	-	-	-			
***Mugil* spp**	-	-	-	3.57	3.57	1.32
Fish larvae	1.54		0.02	-	-	-
Fish not identified (Fish ni)	49.23	38.89	25.02	46.43	39.29	45.42
CRUSTACEA	-	**37.03**	**2.98**	-	**39.28**	**12.34**
Decapoda	15.38	9.26	1.73	28.57	25.00	6.12
PENAEIDAE	1.54	14.81	0.33	7.14	3.57	1.24
***Farfantepenaeus* spp**	-	-	-	3.57	3.57	3.28
ALPHEIDAE						
***Alpheus* spp**	4.62	7.41	0.68	10.71	7.14	1.52
Branchyura	6.15	5.56	0.17	-	-	-
Crab parts	1.54	-	0.02	3.57	-	0.18
Amphipod	1.54	-	0.04	-	-	-
Crustacea rest	1.54	-	>0.01	-	-	-
GASTROPOD						
NERITIDAE	1.54	1.85	0.02	-	-	-
Neritina virginea						
POLYCHAETA	1.54	1.85	0.01	-	-	-
Polychaeta spp	-	**7.40**	**2.46**	-	-	**2.13**
OTHERS	3.08	3.70	>0.01	-	-	-
INSECT	12.31	3.70	0.82	21.43		0.29
VEGETABLE MATERIAL	20.00		1.63	14.29		1.84
UOM						

Complex of Santa Cruz Channel (SCC) in Pernambuco coast (Northeast Brazil) are used as a feeding ground by the *Centropomus* species. However, the higher proportion was reported, for both species, in the Estuarine Complex of Santa Cruz Channel. This may be related to the geomorphology (Silva *et al.* 2011), high primary productivity (Passavante 1981, Murolo *et al.* 2006) of this estuary. These factors influence the existence of a more complex chain associated with estuarine environments (Meire *et al.* 2005, Loebmann *et al.* 2008). Also, the feeding intensity was higher in the dry season for both species. This scenario is probably related with a greater diversity of preys over the dry season, mainly because a higher number of marine dependent species that migrate to estuarine regions in this period, increasing the contribution of marine resources. (Schwamborn *et al.* 2001, Silva *et al.* 2003, Paiva *et al.* 2005). Gonzalez (2017), studying the resource partioning of *C.undecimalis* and *C. parallelus* in Pernambuco through isotopic analysis, identified a larger isotopic niche in the dry season for both the species.

C. undecimalis had a lower number of preys in stomachs for both regions studied, which may directly relate to their diet, since they are fish-eating. Rabelo *et al.* (2009) and Blewett *et al.* (2013) obtained different results in Florida - United States and Bahia – Brazil, respectively. This difference can be associated to the availability of prey or the difficulty for identification of the preys. The difficulty of the identification of the preys of piscivorous species is common, mainly because of the fast digestion of the preys (Nikolsky 1963; Beukers-Stewart & Jones, 2004). The high

Table II. Contribution by frequency of occurrence (%Fo), number (%N) and weight (%W) of each prey item of the overall diet of *C. parallelus* in the Estuary of Sirinhaém River (south coast) and the Estuarine Complex of Santa Cruz Channel (north coast), Pernambuco (Northeast Brazil).

	south coast (n=82)			north coast (n=58)		
Prey items	**%Fo**	**%N**	**%W**	**%Fo**	**%N**	**%W**
TELEOSTEI	-	**12.38**	**31.07**	-	**64.65**	**77.09**
ANGUILIFORMES	2.44	0.44	0.14	-	-	-
ELEOTRIDAE						
Eleotris pisonis	2.44	0.88	19.32	-	-	-
MUGILIDAE						
***Mugil* spp**	1.22	0.44	0.42	-	-	-
GOBIIDAE	-	-	-	36.2	26.72	21.06
Ctenogobius smaragdus	-	-	-	8.62	6.89	16.31
Gobionellus stomatus	-	-	-	6.89	6.89	17.29
***Ctenogobius* spp**	-	-	-	15.51	14.65	12.05
Fish not identified (Fish ni)	15.85	2.65	10.20	20.68	9.48	10.36
Fish larvae	14.63	-	0.92	-	-	-
Fish scale	1.22	7.96	0.07	-	-	-
CRUSTACEA	-	**75.66**	**63.32**	-	**33.62**	**22.47**
Decapoda	57.32	30.09	22.51	15.51	8.62	4.27
CARIDEA	-	-	-	6.89	5.17	3.18
ALPHEIDAE	-	-	-	1.72	-	0.25
Alpheus viridari	2.44	0.88	1.93	-	-	-
Alpheus estuarienses	1.22	0.44	1.00	-	-	-
***Alpheus* spp**	17.07	8.41	18.63	3.44	2.58	2.31
Alpheus chancei	1.22	1.33	3.07	13.79	9.48	8.14
PENAEIDAE						
Litopenaeus schmitti	1.22	0.44	4.4	-	-	-
Brachyura	13.41	3.98	2.86	5.17	1.72	1.06
OCYPODIDAE	1.22	0.44	0.11	-	-	-
Uca cumulate	1.22	0.44	0.17	-	-	-
PORTUNIDAE						
***Callinectes* spp**	19.51	21.01	3.62	1.72	3.44	0.93
GRAPSIDAE	2.44	0.44	0.9	-	-	-
Aratus pisonii	1.22	0.44	2.05	-	-	-
SESARMIDAE						
***Armases* spp**	-	-	-	1.72	0.86	1.32
XANTIDAE	-	-	-	1.72	0.86	0.87
Megalopa	4.88	3.98	0.01	-	-	-
Isopod	3.66	1.77	0.03	1.72	0.86	0.09
Amphipod	6.1	-	0.16	-	-	-
Crustacea rest	14.63	-	1.88	-	-	-
MOLLUSC						
Bivalvia	9.76	6.64	0.03	-	-	-
OTHERS	-	**4.87**	**5.58**	-	**1.72**	**0.43**
UOM	19.51	-	5.00	3.44	-	0.42
VEGETABLE MATERIAL	9.76	-	0.53	-	-	-
INSECT	4.88	4.87	0.04	1.72	1.72	>0.01
DETRITUS	1.22	-	>0.01	-	-	-

proportion of unidentified fish, in diet of the *Centropomus* genus also was observed in others studies with *Centropomus* (Blewett *et al.* 2006, Adams *et al.* 2009). Diet based on fish has a high nutritional coefficient and reduces constant food intake (Nikolsky 1963). Fish-based diet is more efficient than one that is based on crustaceans, because the crustaceans possess exoskeletons, or hard scales, that may be more difficult to digest and are therefore retained longer in the stomachs (Stevens *et al.* 2010). The piscivorous tendency for this specie is also reported by other authors (Aliaume *et al.* 1997, Blewett *et al.* 2006, Nora *et al.* 2012). The importance of fish in diet of the *Centropomus undecimalis* is reported independently of the size of the specimen (Rock 2009).

C. parallelus had the highest dietary spectrum with a great number of food items and preference for crustaceans in the southern region and fish in the north coast. These differences demonstrate the ability of the species to vary their diet according to the availability of resources present in the local where they inhabit. Hahn *et al.* (1999) indicates that flexibility in the diet is considered an adaptive aspect, particularly in fish from tropical regions, where the diet may reflect the availability of food in the environment. According to Gerking (1994), the trophic plasticity is the ability of a species to take advantage of a

more useful food source at any given time. Tonini *et al.* (2004) verified that *C. parallelus* prefer fish in their diet in southern Bahia, whereas Dutka-Gianelli (2014), in Florida, observed mainly crustaceans (shrimp and crabs) as the main preys in their diet.

The diets of *C. undecimalis* and *C. parallelus* were significantly different between species and regions (north and south coast). However, the statistical test resulted in low values of explanation, indicating a partial overlap of the diets, related to the high availability of prey such as gobies in the north and shrimp in the south coast. Lucena *et al.* (2000) indicates that diet overlap in the presence of abundant prey is not configured as a competition, but sharing of the prey. This is our study case. The wider breadth niche for north and spatial differences in diet of the species can be explained by the diversity preys. Estuarine Complex of Santa Cruz Channel showed the highest functional diversity and species

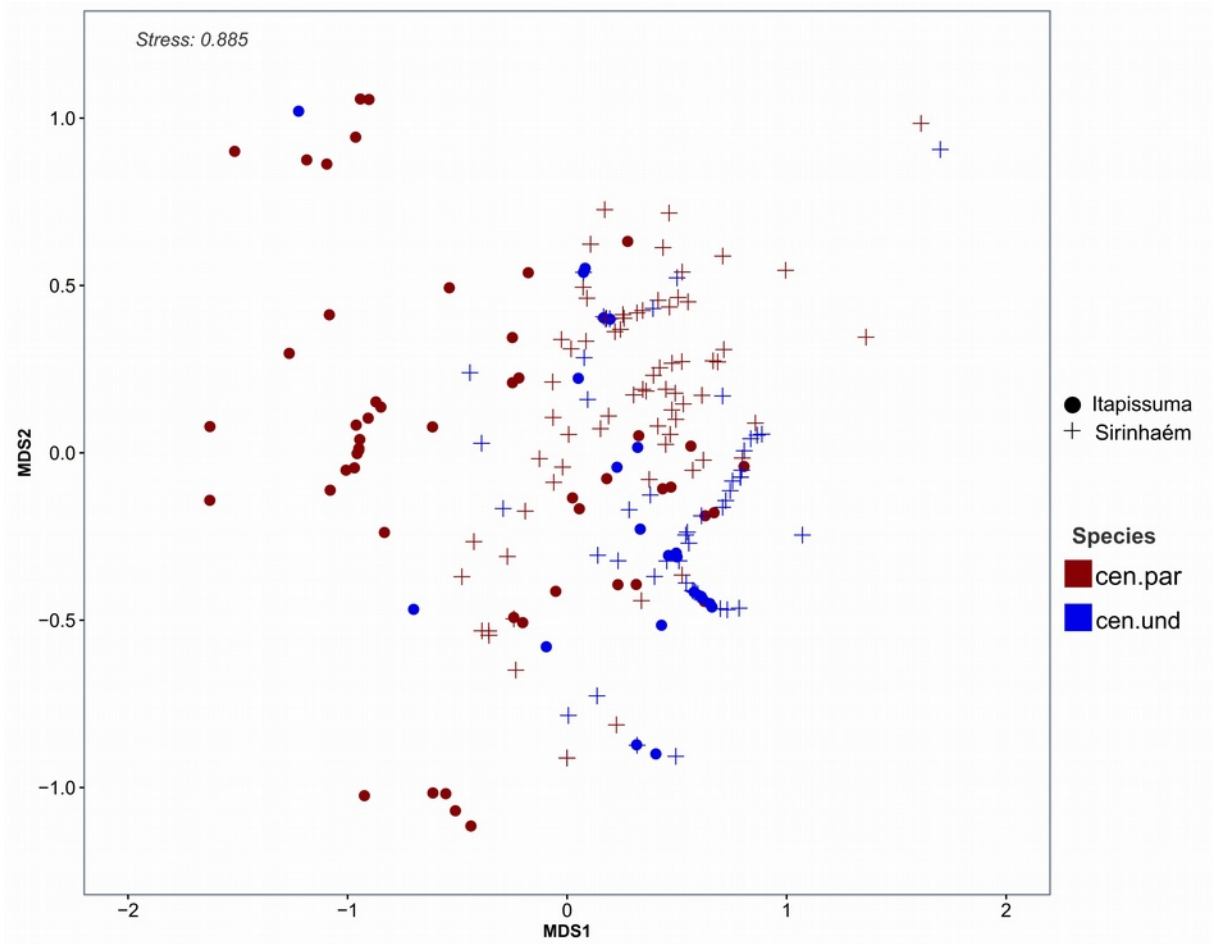

Figure 3- MDS plot of the feed composition of *Centropomus undecimalis* and *Centropomus parallelus* in the Estuary of Sirinhaém River (south coast) and the Estuarine Complex of Santa Cruz Channel (north coast), Pernambuco (Northeast Brazil), where Cen.und (blue): *Centropomus undecimalis*; cen.par (red): *Centropomus parallelus*; • (Solid circles): Itapissuma and + (cross): Sirinhaém

Table III. SIMPER analysis. Breakdown of average dissimilarity and contribution cumulative between species (CPA – *Centropomus parallelus*; CUN – *Centropomus undecimalis*) and regions (north coast - Estuarine Complex of Santa Cruz Channel; south coast - Estuary of Sirinhaém River). * Indicate preys with significant contributions.

Area (north - south coast)			Species (CPA - CUN)		
Prey	Average%	Cumulative Contribution %	Prey	Average%	Contribution cumulative%
Gobiidae*	34.74	34.74	Decapoda*	22.08	23.99
Decapoda	17.18	51.91	Gobiidae	21.43	45.42
Alpheus spp*	16.48	68.39	*Alpheus* spp	13.68	59.10
Brachyura	3.19	71.58	Brachyura	3.77	62.87

Area (north - south coast)			Species (CPA - CUN)		
Prey	Average%	Cumulative Contribution %	Prey	Average%	Contribution cumulative%
Callinectes spp	2.90	74.48	*Eleotris pisonis*	3.18	66.05
Eleotris pisonis	2.34	76.82	*Callinectes* spp	2.85	68.91
Caridea*	1.76	78.58	*Guavina guavina*	2.18	71.08
Fish Larvae	1.29	79.87	*Lile piquitinga*	1.97	73.05
*Lile piquitinga**	1.26	81.13	Penaeidae*	1.96	75.02
Clupeidae*	1.24	82.37	Clupeidae	1.94	76.96
Mugil spp	1.13	83.49	*Eucinostomus* spp	1.93	78.88
Others	16.51	100.00	*Caranx* spp	1.79	80.67
			Catfish spp	1.76	82.43
			Farfantepenaeus spp	1.70	84.13
			Others	15.87	100.00

Table III: continued from previous page

richness when compared to others estuarine zones of Pernambuco, Northeast Brazil, which could be associated to the local environmental geomorphology (Silva-Júnior *et al.* 2016). The fish fauna community of Santa Cruz Channel, according to Vasconcelos Filho & Oliveira (1999), consists of species of various families (Ekau *et al.* 2001).

Species belonging to the same genus are very similar in their morphological, physiological and behavioral characteristics, using spatial strategies to coexist (Krebs 1998). However, the increased feeding overlap between fish species can be minimized by spatial and/or temporal secession (Goldschmidt *et al.* 1990, Jachner 1991, Glova & Sagar 1991). Also in this context, when there is sharing of food resources, the coexistence of fish species is related to the different usage of resources over time (Amarasekare 2003, Sandlund *et al.* 2010). However, this scenario may change depending on the region, given that feeding patterns are often related to prey availability, habitat use, morphological features, energy demand and feeding strategy (Schafer *et al.* 2002, Pasquaud *et al.* 2010).

The snooks can be classified as opportunistic predators, as they feed whether prey are available in the environment (Blewett *et al.* 2006). This feeding strategy is adopted by many estuarine fish, thus leading to the ingestion of a large variety of food items (Moore & Moore 1976, Elliott *et al.* 2002). *C. undecimalis* appeared as a predator with piscivorous tendency for the two study regions. *C. parallelus* showed the shrimp as the main component of their diet in the south coast, being classified as zoobentivorous. However, in the north coast, the diet's most important item was fish, showing a piscivorous tendency.

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