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Research Article

Feeding habits of the mojarras (Gerreidae) population in the hyperhaline lagoon system of Ría Lagartos, Yucatan, Mexico

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ABSTRACT. The trophic preferences and ontogenic variations were evaluated and compared between five species of mojarras collected bimonthly for two years (2004-2005) in the hyperhaline lagoon system of Ría Lagartos, Yucatan Peninsula. A total of 361 specimens corresponding to *Eucinostomus argenteus*, *Eucinostomus gula*, *Eucinostomus harengulus*, *Eugerres plumieri* and *Diapterus auratus* were collected and used for trophic analysis. The trophic components were analyzed using the Relative Importance Index (RII) and multivariate analysis. The mojarras were defined as second-order consumers, feeding on microcrustaceans (amphipods, copepods, tanaidaceous, ostracods) and significant amounts of detritus with variations in the proportion and frequency of different types of food according to their ontogeny and food availability. Three species shared the same resources. However, differences were observed at the general and ontogenetic level, avoiding inter and intraspecific competition. Results provide evidence of the importance of these coastal habitats for the trophic requirements of marine-euryhaline juvenile fish species.

Keywords: mojarras, stomach content, food preferences, Ria Lagartos, Yucatán.

INTRODUCTION

Coastal lagoons are highly productive systems regarding matter, energy and are an important source of food and resources for their biotic components (Prado *et al*., 2013). One of these components is the fish that participate actively in the processes of transformation, conduction, exchange, storage and regulation of the energy that flows in the system (Abascal-Monroy *et al*., 2016), which to some extent determine the size of the populations, speed of growth and living conditions of the fish (Mouillot *et al*., 2007). Due to these characteristics, several studies have been carried out contributing to the bio-ecological knowledge of representative families in these ecosystems. One of these is the analysis of stomach contents, which help us to understand and predict trophic relationships and energy flow between populations, so that these interrelations tend to define the ecological role of the organisms belonging to the ecosystem (Bondavalli & Bodini, 2014; Salcido-Guevara & Arreguín-Sánchez, 2014). However, these feeding habits may be different even in the same species depending on factors such as food availability, seasonality, age and/or sex (Chi-Espínola & Vega-Cendejas, 2016).

The distribution of food resources among fish that coexist in the same place has been studied extensively (Braga *et al*., 2012; Chi-Espínola & Vega-Cendejas, 2013) but few studies described the ontogenetic changes in the diet, even if it is a very common fish in the area (Ellioth & Hemingway, 2002). This variation in diet can be attributed to external or internal influences of the environment (Clark & Pessanha, 2014) availability of prey (Whitehouse *et al*., 2017), or just because of the increase in energy required for growth and metabolic activities (Specziár & Erős, 2014).

The Gerreidae family has very abundant species in the coastal lagoons, where they form large shoals and feed mainly on benthic organisms. Its commercial importance lies in the use of bait for the sustenance of fishery resources in both local and artisanal fisheries (Araújo & Santos, 1999), without forgetting its biological importance as part of the structure and func-

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tion of coastal ecosystems in tropical regions and subtropics of the world (González-Acosta *et al*., 2007). However, despite its biological, ecological, and economic importance, information on its feeding habits is insufficient in a hyperhaline lagoon system with the status of a Biosphere Reserve.

Based on the above, the present research was carried out under the hypothesis that the trophic structure of five species of the Gerreidae family; *Eucinostomus argenteus* (Bair & Girard, 1855), *Eucinostomus gula* (Quoy & Gaimard, 1824), *Eucinostomus harengulus*, (Goode & Bean, 1879), *Eugerres plumieri* (Cuvier, 1830) and *Diapterus auratus* (Ranzani, 1842), have variations in its diet both intraspecific and interspecific. With this information, it will be possible to contribute to the functional knowledge of this hyperhaline ecosystem in conservation status and to establish management strategies for future protected areas.

MATERIALS AND METHODS

Study area

The coastal lagoon of the Ría Lagartos Reserve is located in the far east coast of the state of Yucatan between 21°26'-21°38'N and 87°30'-88°15'W, it covers an area about 9,371 ha, a width of 0.25 to 3.5 km; a depth that varies between 0.5 to 3 m and a length of 80 km. Three seasonal climates represent the climate regime: dry (March to June), rainy (July to October) and northern (November to February) (Herrera-Silveira & Ramírez-Ramírez, 1997), the average annual temperature is 22°C. Considering its geomorphology, it has three basins, Ría Lagartos, Las Coloradas, and El Cuyo (INE, 1999). The system presents diverse types of substrates (sand, silt, and clay) and a marked salinity (Valdés-Lozano & Real-De León, 2004), with an internal zone of 4 to 5 times higher than seawater (>100) (Vega-Cendejas & Hernández de Santillana, 2004, Peralta-Meixueiro & Vega-Cendejas, 2011).

Sampling

Six samplings were carried out (October and December 2004, February, April, June and August 2005) that covered the three climatic seasons of the region (dry, rainy and northerly) through 30 sites distributed throughout the system (Fig. 1), the fishing gear used was a 15 m long beach seine with 1.5 m fall and one inch of mesh size. The individuals collected were injected with 10% formaldehyde in the abdominal cavity for the preservation of the stomach contents, and later they were placed in plastic bags labeled for their transfer.

Data analysis

The components of the diet were analyzed by numerical percentage (Nr), gravimetric (Gr), frequency of occurrence (FO) proposed by Chavance *et al*. (1983) and the Relative Importance Index (RII) developed by Pinkas *et al.* (1971) and modified by Yañez-Arancibia *et al.* (1985). The gravimetric corresponds to the weight of each component using an analytical balance, and the frequency of occurrence (FO) to count the times a given prey appears in the stomach content of the group of fish (NE) expressed as a percentage FO = (n×NE-1)×(100)] (Tresierra-Aguilar & Culquichicón-Malpica, 1995). Finally, the RII unifies the percentage values of the area and weight with the frequency of occurrence [RII = (Nr +Gr)×FO]. Food was classified as preferential (FO >50%), secondary (50% > FO > 10%) and accidental (FO <10%) based on FO values (Yañez-Arancibia *et al.*, 1976).

A cluster analysis was developed using the RII matrix of the food components against the species of study, applying the similarity index of Bray & Curtis (1957) using the PAST statistical package (Hammer *et al*., 2001). A cut line was arbitrarily applied to 0.6 to define the size of the groups (Herrera-Moreno, 2000).

A canonical correspondence analysis (CCA) was carried out (TerBraak & Smilauer, 2002) using the matrix of preferential and secondary diets against the presence of the species of fish, however incidental prey and size were included as covariates. The Monte Carlo test was performed to determine if the measured variables have significance in the study (Kupschus & Tremain, 2001). For this analysis, the statistical package CANOCO 4.5 was used.

The ontogenetic analysis of the diet was analyzed by means of the Sturges rule (Sturges, 1926) which divides the categories of the sizes based on the standard length of the specimens collected (Table 1) (Class interval = maximum size - minimum size/number of classes), where number of classes = 1+ (3.3 log n).

RESULTS

Trophic structure

A total of 382 stomach contents of the *Eucinostomus argenteus* species (142 specimens), *Eucinostomus gula* (93), *Eucinostomus harengulus* (36), *Eugerres plumieri* (49) and *Diapterus auratus* (62) were analyzed. The 15% of the total stomachs were full, 52% contained some kind of food, and 33% contained very little food. The species with empty stomachs were *Eucinostomus argenteus* (11), *Eucinostomus gula* (5), *Eucinostomus harengulus* (2), *Eugerres plumieri* (2) and *Diapterus auratus* (1).

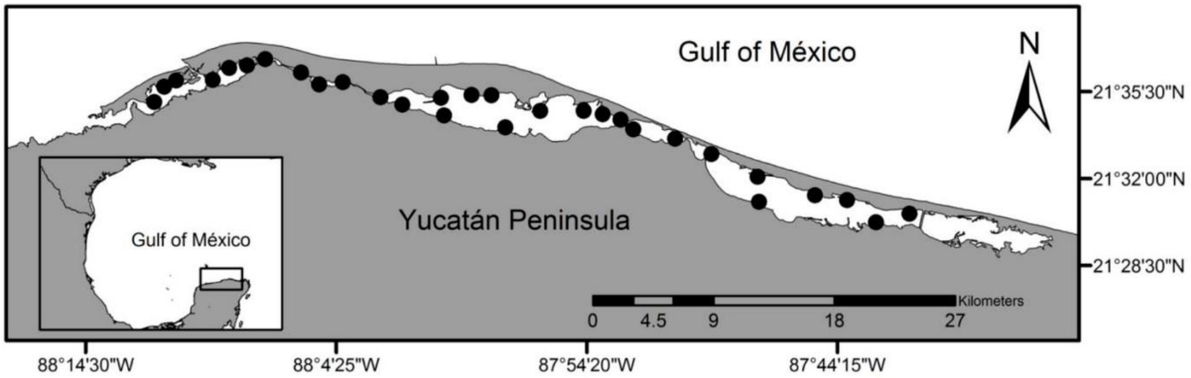

Figure 1. Location of sampling sites in Ría Lagartos coastal lagoon, Yucatan.

Table 1. Class intervals generated by the Sturges' rule for standard length (Ls) (cm) of the fish species, where occurrence frequency is indicated in brackets.

Species/class	A	B	C	D	E	F	G	H
E. argenteus	2,2-3,2 (16)	3,3-4,2 (38)	4,3-5,2 (29)	5,3-6,2 (26)	6,3-7,2 (14)	7,3-8,2 (8)		
E. gula	2,5-3,2 (5)	3,3-3,9 (16)	4,0-4,6 (15)	4,7-5,3 (22)	5,4-6,0 (19)	6,1-6,7 (4)	6,8-7,4 (5)	7,5-8,1 (2)
E. harengulus	2,7-3,3 (3)	3,4-3,9 (6)	4,0-4,5 (2)	4,6-5,1 (4)	5,2-5,7 (4)	5,8-6,3 (6)	6,4-6,9 (5)	7,0-7,5 (3)
E. plumieri	4,1-5,1 (8)	5,2-6,1 (10)	6,2-7,1 (17)	7,2-8,1 (6)	8,2-9,1 (2)	9,2-10,1 (2)	10,2-11,1 (2)	
D. auratus	2,5-3,3 (11)	3,4-4,1 (11)	4,2-4,9 (17)	5,0-5,7 (18)	5,8-6,5 (1)	6,6-7,3 (2)	7,4-8,1 (1)	

We identified 67 food items belonging to 26 trophic categories. The amphipod, copepod, tanaidaceous and polychaete trophic groups being the preferential food (FO >50%) in at least three of the species studied; and the foraminifera, ostracods and UOM (unidentified organic matter) were present preferentially in some of the species analyzed (*E. harengulus, E. plumieri* and *D. auratus*). The highest RII values in most of the species corresponded to amphipods, copepods, tanaidaceous, ostracods, foraminifera, polychaetes and bivalves (Table 2).

Similarity analysis

Regarding the cluster analysis and using the Bray-Curtis similarity index, three groups were obtained by applying a cut line of 60%. The first group corresponded to the species *E. argenteus* and *E. gula*, the second to *E. harengulus* and *E. plumieri*, and finally, the third group conformed solely with *D. auratus* (Fig. 2).

Variation in the trophic structure

The canonical correspondence analysis (CCA), reflects the general food trend of the species in the ecosystem, therefore the three representatives of the genus *Eucinostomus*, had a higher preference for the consumption of tanaidaceous, UOM and detritus, while *D. auratus* was related with the consumption of nematodes and ostracods, and finally *E. plumieri* consumed amphipods preferentially (F = 21.22, *P* = 0.002) (Fig. 3).

Trophic ontogeny

The diet of sizes A and B of *E. argenteus* consist mainly of amphipods. However, with the increase in size (>C) the consumption of amphipods is reduced and replaced by tanaidaceous, annelids and detritus. On the other hand, *E. gula* consumes copepods and annelids, which grow (>D) to include tanaidaceous and detritus. In the diet of *E. harengulus*, amphipods were present in sizes A to E. Annelids, tanaidaceous, and UOM being the main diet of sizes F to H. The main component of the trophic spectrum of *E. plumieri* in the sizes A to D are the amphipods, copepods and tanaidaceous, however in the later sizes (>E), detritus and ostracods were part of their main diet. In sizes A to C of *D. auratus*, ostracods and copepods were the major components of their diet, although subsequently, amphipods form their dominant diet (Fig. 4).

DISCUSSION

The family Gerreidae was very abundant species in Ría Lagartos coastal lagoon (Vega-Cendejas & Hernández de Santillana, 2004; Peralta-Meixueiro & Vega-Cendejas, 2011). According to the present study, this family consumes a wide variety of food items (67). Therefore, this high density, abundance, and distribution

Table 2. Food items Frequency of Occurrence (FO) and percent of Relative Importance Index (RII) of family Gerreidae species in coastal lagoon in Ría Lagartos coastal lagoon, Yucatan, Mexico. (*) Corresponds to preferential food (FO > 50 %). The number 0,0 corresponds to very low values. UOM: Unidentified organic matter.

Nº Species	*Eucinostomus argenteus*					*Eucinostomus gula*					*Eucinostomus harengulus*					*Eugerres plumieri*					*Diapterus auratus*				
	131					88					33					47					61				
Phytoplankton	(Gr	FO	%Gr	RII	%RII)	(Gr	FO	%Gr	RII	%RII)	(Gr	FO	%Gr	RII	%RII)	(Gr	FO	%Gr	RII	%RII)	(Gr	FO	%Gr	RII	%RII)
1. Bacillariophyceae	0.0	14.5	0.6	12.9	0.1	0.0	31.8	0.6	33.6	0.3						0.0	29.2	0.6	32.0	0.2	0.0	32.8	0.7	49.5	0.4
2. Cyanophyceae	0.0	3.1	0.2	0.7	0.0	0.0	3.4	0.4	2.8	0.0						0.0	2.1	0.0	0.0	0.0					
Macrophytes																									
3. Unident. algae	0.0	4.6	0.3	2.1	0.0	0.0	3.4	0.6	3.8	0.0															
4. Unident. seagrass	0.1	16.8	1.1	29.0	0.3	0.0	20.5	1.1	48.8	0.5	0.1	27.3	0.8	72.7	0.9	0.1	31.3	1.4	94.8	0.7	0.0	6.6	0.2	1.8	0.0
Protozoa																									
5. Dinoflagellida	0.0	1.5	0.1	0.3	0.0	0.0	2.3	0.0	0.1	0.0						0.0	4.2	0.0	0.1	0.0					
6. Foraminifera	0.1	33.6	1.3	89.8	0.9	0.0	21.6	0.3	17.5	0.2	0.0	*72.7	0.2	133.8	1.6	0.2	*72.9	2.6	405.1	3.1	0.1	44.3	1.7	169.7	1.5
Porifera																									
7. Sponge spicules						0.0	3.4	0.1	0.9	0.0	0.0	3.0	0.0	0.1	0.0						0.0	1.6	0.0	0.1	0.0
Nematoda																									
8. Nematoda	0.0	20.6	0.4	23.1	0.2	0.0	14.8	0.5	24.6	0.2	0.0	18.2	0.0	9.1	0.1	0.0	20.8	0.3	11.2	0.1	0.1	23.0	1.8	110.0	0.9
Annelidae																									
9. Polychaeta	1.8	*59.5	27.6	2208.2	22.4	0.8	*69.3	20.1	2784.0	27.2	6.9	36.4	51.8	2686.7	32.0	0.1	18.8	2.2	95.4	0.7	0.1	6.6	2.0	25.3	0.2
10. Oligochaeta	0.0	3.8	0.5	3.0	0.0	0.0	2.3	0.1	0.5	0.0						0.0	2.1	0.4	1.1	0.0	0.0	1.6	0.3	1.1	0.0
Echiuridae																									
11. Echiuridae						0.1	11.4	2.3	63.3	0.6															
Mollusca																									
12. Bivalvia	0.0	7.6	0.7	8.1	0.1	0.0	3.4	0.2	1.3	0.0	0.3	9.1	2.2	24.1	0.3	0.2	16.7	2.5	83.7	0.6	0.0	3.3	0.1	0.6	0.0
13. Gastropoda	0.0	6.9	0.5	5.4	0.1	0.1	15.9	1.8	64.9	0.6	0.0	3.0	0.0	0.3	0.0	0.2	18.8	2.4	93.4	0.7	0.0	6.6	0.6	10.9	0.1
Crustacea																									
14. Amphipoda	1.3	*66.4	18.9	2047.5	20.8	0.8	*61.3	21.5	2597.8	25.4	0.2	*63.6	1.8	1227.6	14.6	2.6	*97.9	39.3	7848.9	60.7	1.4	*75.4	41.3	6311.7	54.0
15. Copepoda	0.3	48.1	4.2	350.9	3.6	0.4	*63.6	9.3	1014.2	9.9	0.0	33.3	0.3	151.6	1.8	0.4	*89.5	6.3	1219.2	9.4	0.4	*88.5	12.7	2396.5	20.5
16. Ostracoda	0.1	32.8	1.6	96.8	1.0	0.0	20.5	1.2	59.1	0.6	0.0	42.4	0.0	67.8	0.8	0.5	41.7	7.5	590.8	4.6	0.4	*63.9	11.9	1900.4	16.3
17. Cummacea	0.0	3.1	0.3	1.3	0.0	0.0	4.5	0.3	2.5	0.0						0.1	6.3	0.8	8.1	0.1	0.0	1.6	0.1	0.3	0.0
18. Mysidacea	0.0	4.6	0.7	5.5	0.1	0.0	3.4	0.3	4.4	0.0	0.0	3.0	0.0	0.1	0.0	0.1	10.4	2.0	37.6	0.3	0.1	14.8	1.7	50.2	0.4
19. Isopoda	0.0	2.3	0.1	0.5	0.0	0.1	9.1	1.5	26.9	0.3	0.0	9.1	0.1	6.6	0.1										
20. Tanaidacea	0.9	*55.7	14.1	1368.7	13.9	0.6	*59.0	15.0	1770.2	17.3	3.6	*57.5	27.3	2575.6	30.7	0.5	*52.0	7.5	837.2	6.5	0.1	23.0	2.5	133.7	1.1
21. Decapoda	0.1	7.6	0.8	32.6	0.3	0.1	21.6	3.9	151.2	1.5	0.1	12.1	0.8	103.1	1.2	0.0	4.2	0.6	5.1	0.0	0.0	8.2	0.6	12.5	0.1
Insecta																									
22. Insect	0.1	13.7	2.1	68.3	0.7	0.0	1.1	0.2	0.4	0.0	0.0	9.1	0.2	22.6	0.3	0.0	4.2	0.8	6.0	0.0	0.2	19.7	4.5	174.2	1.5
Fish																									
23. Fish	0.0	6.1	0.5	5.0	0.1	0.0	1.1	0.0	0.1	0.0	0.0	6.1	0.0	0.9	0.0	0.0	2.1	0.0	0.1	0.0	0.4	13.1	12.1	165.5	1.4
Detritus																									
24. Detritus	1.1	45.8	17.2	2837.5	28.8	0.4	45.5	11.2	1008.3	9.9	1.7	18.2	12.6	353.4	4.2	1.2	39.6	18.9	1372.3	10.6	0.1	19.7	2.2	78.9	0.7
UOM																									
25. UOM	0.4	48.1	6.5	650.0	6.6	0.2	39.8	6.3	515.5	5.0	0.2	*60.6	1.6	952.5	11.3	0.3	22.9	3.9	178.3	1.4	0.1	18.0	1.9	72.5	0.6
Others																									
26. Others						0.1	8.0	1.4	23.0	0.2	0.0	6.1	0.2	6.7	0.1						0.0	8.2	0.9	18.5	0.2

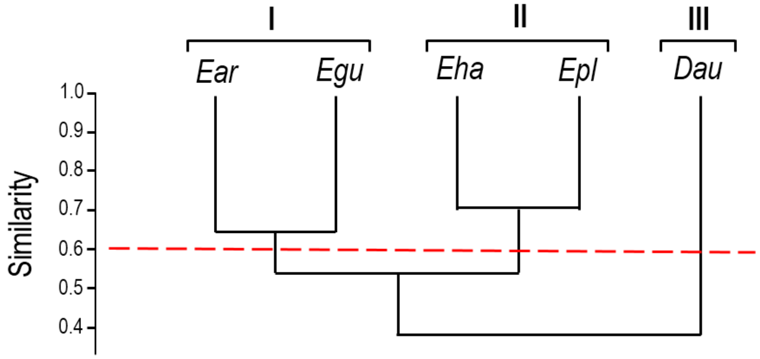

Figure 2. Trophic similarity dendrogram of the Bray-Curtis index (1957) among species of the Gerreidae family registered in Ría Lagartos.

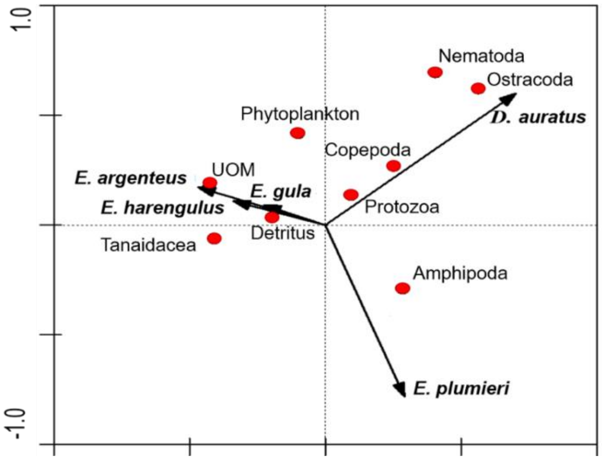

Figure 3. Biplot of CCA sorting of the preferential and secondary food resources registered with the fish species of the Gerreidae family, using sizes and accidental food as covariables.

of prey could favor the coexistence of related species and therefore minimize interspecific competition for food resources (Vinagre *et al*., 2005) among the species captured.

In the analysis of the diet of *E. argenteus*, *E. gula*, *E. harengulus*, *E. plumieri* and *D. auratus*, consumption of the same prey was observed, but with evident variations in the proportion and frequency of the food items. This variation is possibly the result of a series of morphological, physiological and behavioral adaptations. It allowed them to reduce inter and intraspecific competition for food (Arenas-Granados & Acero, 1992), or as mention by Pereira *et al*. (2004) it is a reflection of the availability of resources or a wide range of dietary strategies that allow them to exploit the variety of resources available. Consequently, the species of the Gerreidae family possess a characteristic mandibular morphology, this is a mechanism of pressure suction (Nelson, 2006), which allows them to feed on a great variety of prey on the surface of the substrate (Cyrus & Blaber, 1982). However, in this study the volume of detritus consumed is large, this may be due to the voracity of the fish when capturing the prey. Although the detritus is accidentally consumed, an important amount of benthic invertebrates, bacteria, protozoa and organic matter are obtained from it (Laegdsgaard & Johnson, 2001; Gning *et al*., 2008). On the other hand, the high incidence of UOM in *E. harengulus* could reflect the high degree of digestion of the prey.

The analysis of similarity showed a distribution of food resources according to the genus (*Eucionostomus*, *Diapterus*, and *Eugerres*), behavior that can be closely related to the type of habitat, where they are developed (Pereira *et al*., 2004; Russo *et al*., 2008), the feeding habit (Bacha & Amara, 2009) or the increase in size possibly allowed them to consume larger prey to compensate their metabolic requirements (Wootton, 1990, Hammerschlag *et al*., 2010).

With the ACC it was possible to validate the grouping among the three species of the genus *Eucinostomus* (*E. argenteus, E. gula, and E. harengulus*), which obtained a high correlation with the consumption of tanaidaceous, detritus and UOM; apparently this genus has a broad diet range consisting of benthic invertebrates such as polychaetes, copepods, tanaidaceous, mollusks (Odum & Heald, 1972; Hofling *et al*., 1998; Denadai *et al*., 2012; Almeida *et al*., 2014; Pessanha & Araújo, 2014) and ostracods as the main diet (Santos & Araújo, 1997; Gning *et al*., 2010). It could be an indication that the genus *Eucinostomus* presents an opportunistic trophic behavior since it consumes prey items available and abundant in the environment (Denadai *et al*., 2012).

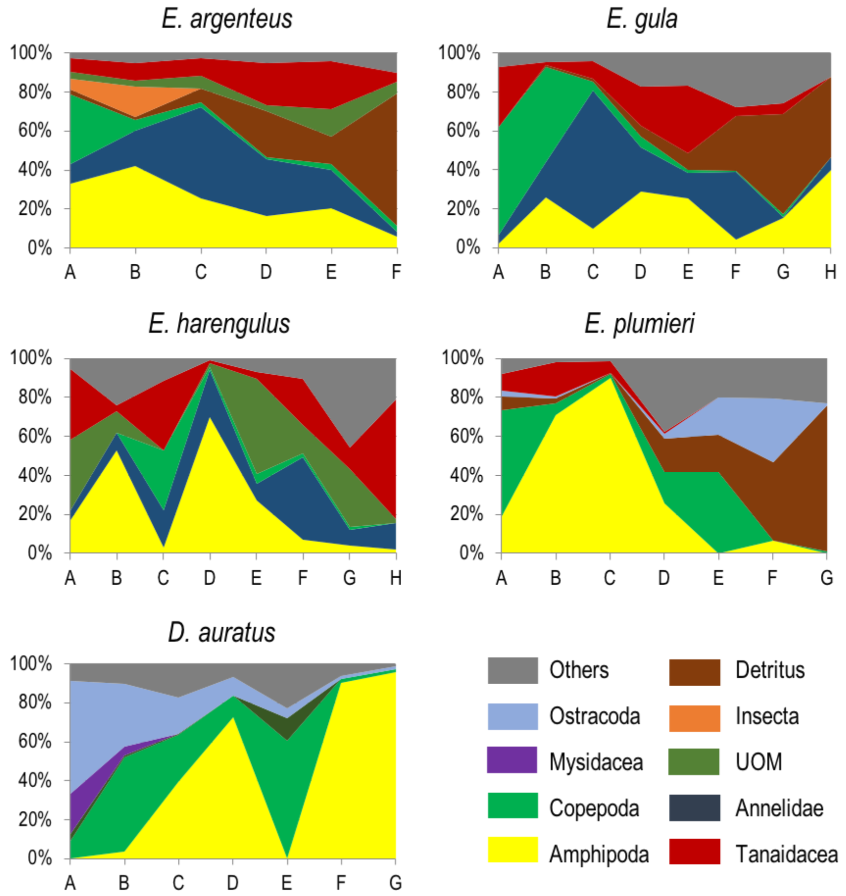

Figure 4. Percent Relative Importance Index (%RII) of the stomach contents of the Gerreidae family species, where the x-axis corresponds to the size category generated by the Sturges' rule.

On the other hand, the ACC in *Eugerres plumieri* indicated a high correlation with the consumption of amphipods. This diet has also been reported by Aguirre-León & Díaz-Ruiz (2000) in Términos Lagoon. However, in other studies (Aguirre-León & Yáñez-Arancibia, 1986; López-López *et al.*, 1991; Arenas-Granados & Acero, 1992) the use of different food categories such as ostracods, foraminifera, tanaidaceous, and copepods has been documented, which were part of the secondary food in the present study. Possibly the high incidence of amphipods in the diet of *E. plumieri*, as well as in the other species of gerrids in the present study the studies, is a reflection of the high abundance of this resource in the lagoon of Ría Lagartos and adjacent areas (Pech *et al.*, 2007; Kuk-Dzul *et al.*, 2012).

The ACC on *Diapterus auratus* showed a very strong correlation with ostracods and nematodes, although, the trophic information on this species is null, the diet of the genus *Diapterus* has been widely studied in the estuaries of Brazil where a high incidence of polychaetes is reported, amphipods, ostracods, copepods, mollusks (Denadai *et al.*, 2012; Ramos *et al.*, 2014), nematodes and algae (Pessanha & Araújo, 2014; Almeida-Silva *et al.*, 2015). Also, in the Pom-Atasta system in Mexico, *Diapterus* sp. feeds on foraminifera, ostracods, and tanaidaceous (Aguirre-León & Díaz-Ruiz, 2000). The occurrence of undigested nematodes in the stomach contents were considered as parasites (Denadai *et al.*, 2012), so their registration and correlation with *D. auratus* are not considered as part of their trophic spectrum. However, this data can be a starting point for the study of the parasitic incidence in the species.

In the vast majority of studies, polychaetes have been the main prey in Gerridae species (Cyrus & Blaber, 1982; Arenas-Granados & Acero, 1992; Branco *et al.*, 1997; Hofling *et al.*, 1998; Denadai *et al.*, 2012; Pessanha & Araújo, 2014). However, in the present work, it was only an accidental element. Although the absence of this group could be related given its low tolerance to salinity (Nicolaidou *et al.*, 2006; Pech *et al.*, 2007), granulometric characteristics of the sediment, or the presence of organic matter in it

(Beukema & Flach, 1995; Pech *et al.*, 2007), conditions that restrict its abundance in this hyperhaline coastal lagoon.

Although, *E. argenteus* and *E. gula* exhibited a similar diet, both general and by sizes, competition for food is limited due to its distribution in the lagoon according to the salt gradient, where *E. argenteus* is distributed to the inner zone of the lagoon (hyperhaline condition), contrary to *E. gula* that is limited to the inlet and intermediate (Vega-Cendejas & Hernández de Santillana, 2004; Peralta-Meixueiro & Vega-Cendejas, 2011). Their diets have been reported in the region of Celestun, Yucatan, where microcrustaceans such as copepods and amphipods were significant items (Arceo-Carranza *et al.*, 2013), in Términos Lagoon they consume algae and detritus (Pineda-Peralta *et al.*, 2016) or in other regions (Branco *et al.*, 1997; Bouchereau & Chantrel, 2009), which report microcrustaceans as the main diet. Ontogenetically, a change was observed in the food consumed, where small fish feed on microcrustaceans present in the water column and as the size increases, the diet changes on benthic organisms (Pereira *et al.*, 2004; Vega-Cendejas *et al.*, 2012).

The ontogenetic analysis of *E. plumieri* recorded a wide trophic range with a marked consumption of amphipods through sizes A to C. Possibly reflecting the high abundance of these invertebrates, rather than a dietary preference (Kuk-Dzul *et al.*, 2012). Later, in sizes E to G, higher consumption of detritus and ostracods was observed, elements that have been reported in other coastal systems (López-López *et al.*, 1991; Aguirre-León & Díaz-Ruiz, 2000). It has been observed that the ontogenetic variation of *E. plumieri* depends on the environmental conditions during its development (Aguirre-León & Díaz-Ruiz, 2000) since it uses transparent waters, low salinity and availability of organic matter (Aguirre-León & Yáñez-Arancibia, 1986; Rueda, 2001), which was observed in the present study.

Like the other species, the diet of *D. auratus* was based mainly on microcrustaceans; however, it presented a higher consumption of copepods and ostracods in sizes A to C, and amphipods in sizes D to G. These elements have been reported previously forming an important part of the diet of these mojarras (López-López *et al.*, 1991; Arenas-Granados & Acero, 1992; Franco-López *et al.*, 2011; Almeida-Silva *et al.*, 2015). It has been observed that the organisms of the genus *Diapterus* use different environments adjacent to the coastal lagoons to complete their life cycle (Aguirre-León & Díaz-Ruiz, 2006; Ramos *et al.*, 2014). In this regard, Pessanha & Araújo (2012), establishes that this selection of habitats is related to the abundance of the prey and the obtaining of the food in a minimum time (optimal foraging theory) (Griffits, 1975), since there is a higher preference on sedentary organisms like ostracods, or of easy capture as zooplankton or benthic organisms such as copepods and amphipods.

It is important to mention that in this work no individuals were analyzed in the adult stage, and the diet could not be compared with larger individuals. On the other hand, there are reports of *Eucinostomus melanopterus, Gerres cinereus*, and *Diapterus rhombeus* in this lagoon (Vega-Cendejas & Hernández de Santillana, 2004; Peralta-Meixueiro & Vega-Cendejas, 2011), they were not included in the analyzes by its low capture frequency.

With these results, it can be inferred that mojarras species use the same food resources. However, it is a fact that these resources are exploited in different situations, reducing the overlap or competition between them, being a reflection of the feeding strategies as well as the availability of food (Xie *et al.*, 2000). On the other hand, these fish in their first sizes are omnivorous and generalist, but as they increase in size, they become more selective and specialized, as observed in the works of Aguirre-León & Díaz-Ruiz (2000); Franco-López *et al.* (2011) or Pineda-Peralta *et al.* (2016). For this reason, these ontogenetic changes in juvenile fish are essential for understanding the ecology of fish (Schreck & Moyle, 1990).

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