The Ecology of Mojarras (Family: Gerreidae) inhabiting a brackish water estuary in Jamaica, W.I.

La ecología de Mojarras (Familia: Gerreidae) que habita un estuario de agua salobre en Jamaica, W.I.

L'écologie des Mojarras (famille: Gerreidae) habitant un estuaire d'eau saumâtre en Jamaïque, W.I.

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EXTENDED ABSTRACT

Estuaries are often only considered for study in conjunction with mangrove research. Estuarine ecosystems have been purported to outweigh other tropical aquatic habitats in importance, even coral reefs, except in relation to tourism (Blaber 1997). A depiction of a range of fish yields from varying tropical habitats showed that maximum yield from tropical estuaries was 250 tonnes km-1 year-1 while tropical rivers were a distant second with 78 tonnes km-1 year-1 (Yáñez-Arancibia, Linares, and Day 1980). Salt River is a brackish water estuary in Clarendon, located on the southern coastal shelf of Jamaica. The Salt River channel acts as a nursery grounds for the juveniles of the fishes that live offshore and nearby Goat Islands.

Mojarras are a keystone species to tropical and subtropical estuarine ecosystems as they pervade and predominate these habitats (Blaber, 1997). Gerreids are among the most abundant fishes in tropical bays and estuaries distributed along the Western Atlantic from the Caribbean (20°N) to Southern Brazil (30°S) (Costa et al. 2012). Gerreids are euryhaline and form an important part in the trophic web as secondary consumers as they feed on benthic macrofauna and are preyed upon by piscivorous fishes (Costa et al. 2012; Yáñez-Arancibia, Linares, and Day 1980). Their extensible jaw structure enables them to forage through sediment to consume small benthic organisms (Blaber, 1997).

Fifteen families of fishes have established populations along the Salt River channel. In Jamaica, there are nine species of mojarras and five of those species have significant populations at Salt River. These secondary consumers form an important part of the food web of this ecosystem. Mojarras tend to display sympatry as several species usually co-exist in the same geographic area and frequently encounter each other. They are not consumed as preferentially as other more commercial species but they play an important role in artisanal fisheries Gerreids employ a plenitude of methods to decrease both inter- and intra-specific competition such as seasonal and spatial distribution (Franco et al. 2012, Costa et al. 2012, Ramos et al. 2016) as well as developing differential feeding niches (Ramos et al. 2016; Araújo, Dantas, and Pessanha 2016).

Diapterus auratus, Gerres cinereus, Eucinostomus argenteus, Eucinostomus melanopterus and *Diapterus rhombeus* are so morphologically similar that competition for the same resources is inevitable. These five species employ numerous resource partitioning mechanisms to decrease competition.

This study appraises the spatial, temporal, and dietary resource partitioning mechanisms employed by these five species of mojarras.

Thirteen samples were collected from December 2017 to April 2019 (17 months). Two seines, one measuring 10 m long and 1 m tall with a 0.5 cm2 mesh size and one measuring 14.5 m long and 1.9 m tall with a 0.4 cm2 mesh size were used. Samples were taken in replicates of three. All by-catch; crabs, shrimp, crayfish were returned to the river. The samples were all placed into containers of 10% formalin labelled with the corresponding date and site. Mojarras were identified to the level of species using the Fisheries and Agriculture Organization (FAO) Gerreidae key (Gilmore Jr and Beach, n.d.). Subsequently, the alimentary canal was dissected out and weighted to the nearest 0.01g. The liver and gonads were not included in the weight. Contents were flushed with water and a small sample was pipetted onto a haemocytometer and placed under a compound light microscope. All items within and on the right and bottom edges of the grid were recorded in number and plant material was recorded as volume. The specimens were divided into size classes. For each size class the numerical percentage, frequency of occurrence, volumetric percentages and the consequent relative importance index was calculated for each item found in the gut contents of the four most predominant gerreid species captured. Pianka's overlap index was used to determine the extent of dietary overlap among the size classes and species.

The tables of Ranked Index of Relative Importance for Juveniles and Sub-Adults indicate that the four most predominant mojarras consumed mainly five food items in both phases. Six relationships had overlap indices of 80% or higher. Juvenile E. argenteus and juvenile D. auratus had the highest overlap of 96% followed by sub-adult E. argenteus and juvenile E. argenteus (92%) and sub-adult D. rhombeus and juvenile D. rhombeus (89%). This suggests that there is likely competition for resources in this habitat as these species' diet niches overlap considerably. Thus, the assumption made is that these species occupy different spatial and temporal niches to limit competition.

Both the two-way ANOVA and Kruskal-Wallis H tests yielded $p>0.05$. Therefore, we failed to reject the null hypothesis which states that there is no significant difference in how these species are distributed spatially and temporally. This lack

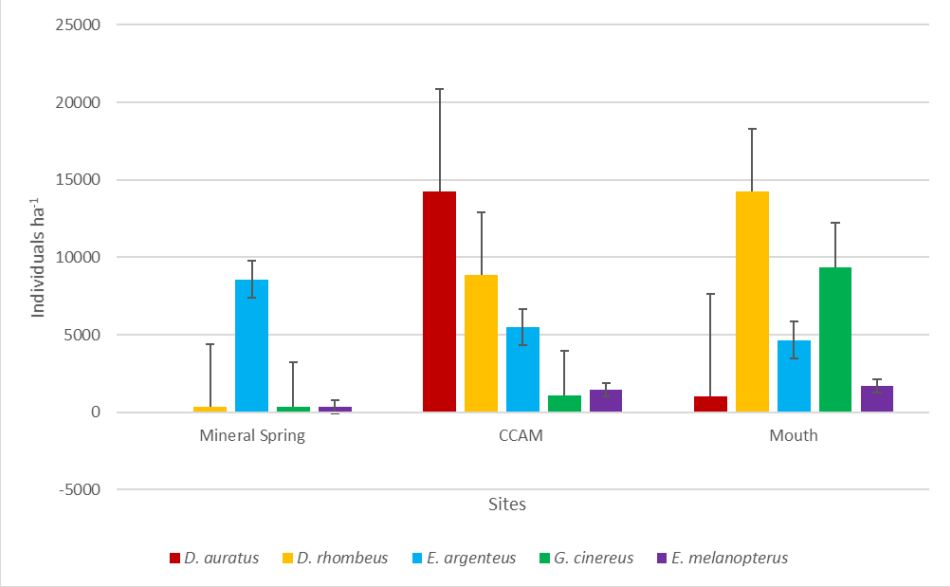

Figure 1. Spatial distribution of the five Gerreid species .

of significance is likely due to the sample size as the catch per unit effort yielded low numbers during some months at the three sites. The bar graphs displaying spatial and temporal distributions of the species hint to differences in how the species distribute themselves over space and time although not necessarily statistically significant.

An analysis of the biology, ecology and habitat dynamics revealed that spatial, temporal, and dietary niches are a few of the measures employed to reduce competition. Stomach content analyses revealed the necessity of these measures as there is significant overlap in the food items consumed by these five species. The spatial distribution of these fishes at different sites along the channel help to limit the feeding competition.

The five morphologically similar species of mojarras have developed different spatial, temporal and feeding niches along the length of the Salt River Channel as a means of partitioning resources to limit competition and both intraspecific ally and interspecifically..

KEYWORDS: Salt River, mojarras, resource partitioning, dietary niches

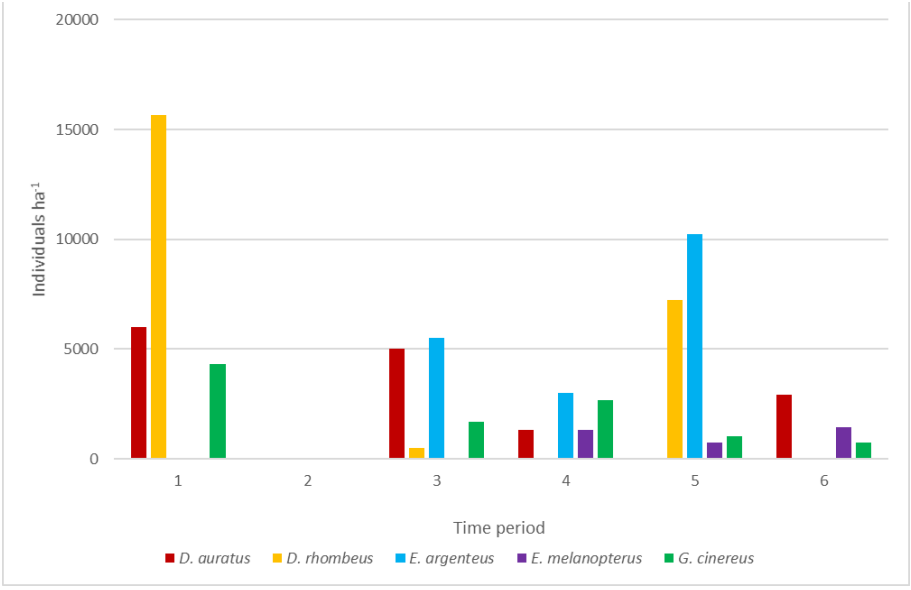

Figure 2. Temporal Distribution of the five Gerreid species.

Table 1. Ranked Index of Relative Importance of four most prevalent species of juvenile mojarras.

Ranked Index of Relative Importance - Juveniles				
Food Item	G.cin	D.aur	D.rho	E.arg
Copepoda	2	1	1	1
Ostracoda A	4	-	-	4
Ostracoda B	5	4	4	5
Eggs	3	2	3	3
Plant Matter	1	3	2	2

Table 2. Ranked Index of Relative Importance of four most prevalent species of sub-adults mojarras .

Ranked Index of Relative Importance - Sub-Adults				
Food Item	G.cin	D.aur	D.rho	E.arg
Copepoda	-	1	2	1
Ostracoda A	2	-	3	3
Ostracoda B	-	2	-	5
Eggs	3	3	4	4
Plant Matter	1	4	1	2

Table 3. Diet Overlap Indices >80%.

Highest Diet Overlap Indices (>80% overlap)		
1.	***E. argenteus* Juvenile + *D. auratus* Juvenile**	**96%**
2.	***E. argenteus* Sub-Adult + *E. argenteus* Juvenile**	**92%**
3.	***D. rhombeus* Sub-Adult + *D. rhombeus* Juvenile**	**89%**
4.	*D. rhombeus* Sub-Adult + ***G. cinereus* Juvenile**	**83%**
4.	***E. argenteus* Sub-Adult + *G. cinereus* Juvenile**	**83%**
5.	***G. cinereus* Sub-Adult + *G. cinereus* Juvenile**	**80%**

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