

Habitat Distribution and Diet Analysis of Two Sympatric Species of *Balistes* in the Western Gulf of Guinea

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ABSTRACT

The study was conducted during R/V Dr. Fridtjof Nansen survey 2005 in the Western Gulf of Guinea. A total of 165 station trawls were taken along the Western Gulf of Guinea from Nigeria-Benin border to Côte d'Ivoire-Liberia border. Of the 165 trawls 23 hauls yielded triggerfish. The study sought to find the distribution, depth range and diet preferences of *Balistes capriscus* and *Balistes punctatus* L. after two decades of their apparent disappearance in the area. The species show habitat overlap in the Western Gulf of Guinea. *B. capriscus* occur at 23 – 60 m depth, whereas *B. punctatus* occur at 22 – 32 m depth range from Benin to Côte d'Ivoire. The gut analysis of *B. capriscus* and *B. punctatus* indicates that both triggerfish species are more planktivorous at juvenile stage (12.0-21.9 cm size class) and more benthivorous at later stage in life. It suggests there could be competition for food resources between the two fish species. However, it appears *B. capriscus* is better adapted in terms of benthic life as the species occurs at deeper depth of coastal waters and therefore, better selected for benthic feeding.

Key words: Habitat distribution; Diet analysis; Planktivorous; Benthivorous; Triggerfish

INTRODUCTION

The grey triggerfish occurs in both eastern and western parts of the Atlantic Ocean (Sazonov and Galaktionova 1987). There had been recordings of the species in the English waters (Dulèia et al. 1997), occurrences along Mediterranean Sea, Azores, Canary Islands (Lobel and Johannes 1980), Islands of Madeira and the coast of West Africa to Angola (Sazonov and Galaktionova 1987). The triggerfish distribution in the western Atlantic is from Nova Scotia to Argentina (Briggs 1958 cited by Moore 1967; Sazonov and Galaktionova 1987). Up to 1978, *Balistes capriscus* had become an important element in the catches from Senegal to Nigeria, an ecosystem which used to be a biotope for the sciaenid community was dominated by the triggerfish in the late 1970s. The species formed about half of the total demersal biomass in the Gulf of Guinea (Longhurst and Pauly 1987; Koranteng et al. 1996). The species, *B. capriscus*, has a very wide bathymetric distribution in Ghanaian coastal waters (Koranteng

1993) and occurs at near the bottom as well as near the surface of the sea (usually 15 to 50 m depth). The stocks of triggerfish had almost disappeared in the Gulf of Guinea (Stromme et al. 1982; Stromme 1983; Ofori-Adu 1994; Mensah and Quatey 2002; Aggrey-Fynn 2008).

It is known that triggerfish is carnivorous as well as omnivorous (Ofori-Adu 1987, 1994). The species is basically a demersal fish which feeds mainly on benthic invertebrates like marine molluscs and crustaceans. Triggerfish also feeds on zooplankton such as amphipoda and copepoda (Ofori-Danson 1981). The study sought to assess the distribution and depth range of triggerfish after two decades of their apparent disappearance in the Western Gulf of Guinea. Diet analysis of triggerfish in this study was done to ascertain the possible food preferences in the two sympatric species of *Balistes* that occur in the Western Gulf of Guinea.

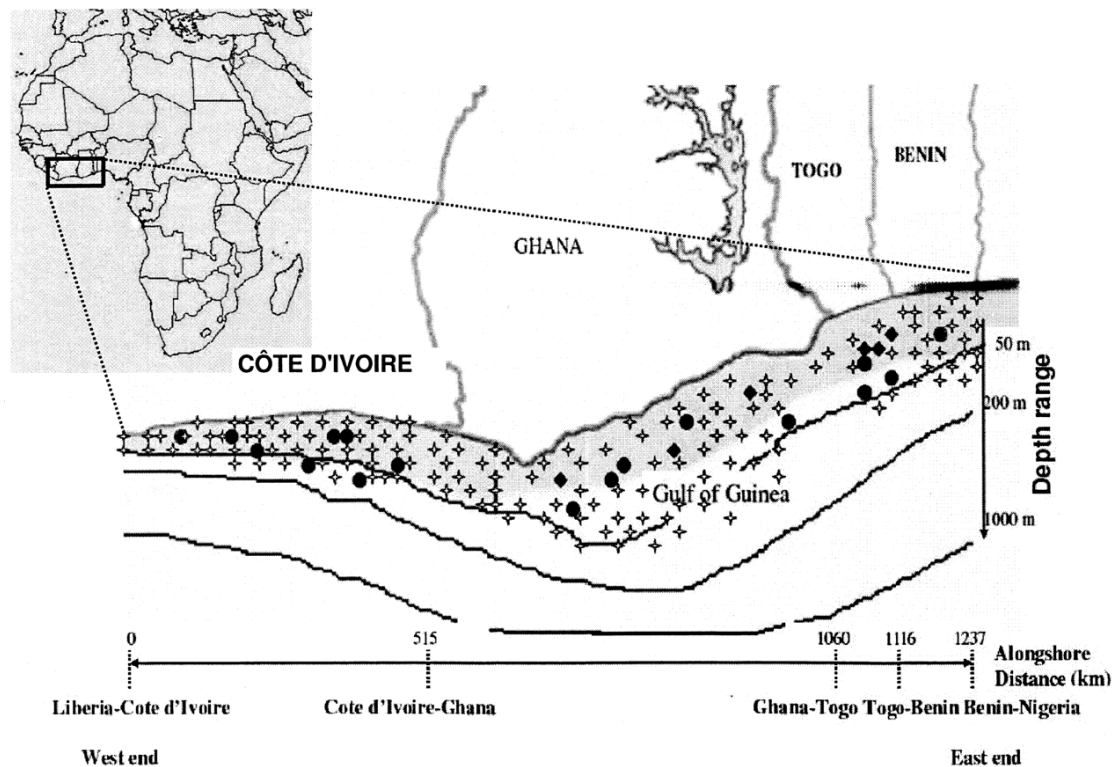


Figure 1: Distribution of triggerfish in Western Gulf of Guinea in May 2005 (●: stations with *Balistes capriscus* catch; ◆: stations with *Balistes punctatus* catch; +: stations with miscellaneous fish catch other than triggerfish). Offshore depths are 50 m, 200 m and 1000 m. Alongshore distance is 1 237 km from west to east ends

MATERIALS AND METHODS

The study was conducted during R/V Dr. Fridtjof Nansen Survey 2005 in the Western Gulf of Guinea ($6^{\circ}28'N$, $2^{\circ}36'E$ and $6^{\circ}51'N$, $5^{\circ}18'W$). In all 165 stations were trawled along the coast from Liberia-Côte d'Ivoire border to Benin-Nigeria border (Figure 1). Of 165 total trawl stations 54 trawls were done between Liberia-Côte d'Ivoire and Côte d'Ivoire-Ghana borders which consisted of 10 pelagic trawls (PT) and 44 bottom trawls (BT); 77 trawls were carried out between Côte d'Ivoire-Ghana and Ghana-Togo borders which comprised of 13 PT and 64 BT; 12 trawls were done between Ghana-Togo and Togo-Benin borders which consisted of 2 PT and 10 BT; 22 trawls were carried out between Togo-Benin and Benin-Nigeria borders which comprised of 2 PT and 20 BT (Mehl et al. 2005). Of the 165 station trawls 23 hauls yielded triggerfish which included 8 stations in Côte d'Ivoire of which one station recorded both *B. capriscus* and *B. punctatus*; 8

stations in Ghana, 6 stations in Togo and 1 station in Benin of which both species occurred.

All the trawl hauls during the survey were plotted along the coast of Benin, Togo, Ghana and Côte d'Ivoire. The hauls that resulted in *Balistes* catch were shown as well as those of miscellaneous fish catches (Figure 1). The numbers obtained for the two species of *Balistes* (*B. capriscus* and *B. punctatus*) were plotted against the actual capture depth and area the species were caught in a 3-dimensional space plot to assess the depth range of the two species of triggerfish (Figure 2). The stomach contents of 115 triggerfish were studied using frequency of occurrence and gravimetric methods after Hyslop (1980). The guts of individual triggerfish specimens obtained during the survey were removed and preserved in 10 % formalin for analysis. The food items were identified as far as possible (at least to the family level) using identification manuals such as Newell and Newell (1977), Gibbons (2000), Ruppert and Barnes (1994), Boltovskoy (1999). Stomach contents were weighed to the nearest 0.001 g. Few

drops of water were added to stomach contents when they were clumped together for easy separation of food items in a petri dish for further analysis. The *B. capriscus* specimens were grouped into size (TL cm) class interval of 9.9 cm as follows: 12.0-21.9, 22.0-31.9, 32.0-41.9 and 42.0-52.0 cm. The number of fish gut specimens in each size class was at least 10, except size class 42.0-52.0 cm which was eight in number. The size groupings of *B. punctatus* were the same as those of *B. capriscus* except the size class 42.0-52.0 cm which did not occur in *B. punctatus*. The number of *B. punctatus* gut specimens in size class 12.0-21.9 cm was five, that of 22.0-31.9 cm was 35 and that of 32.0-41.9 cm was only four. The relatively small sample size of triggerfish used, was due to the fact that the stocks had drastically declined in the Western Gulf of Guinea for nearly two decades. The numerical method was not considered in the data analysis due to the difficulty in counting the fragments of food items that occurred in the diet.

RESULTS

Figure 1 shows the distribution of triggerfish that were caught in the Western Gulf of Guinea during the survey. Of the 165 station trawls 23 hauls yielded triggerfish which included 8 stations in Côte d'Ivoire of which one station recorded both *B. capriscus* and *B. punctatus*; 8 stations in Ghana, 6 stations in Togo and 1 station in Benin of which both triggerfish species occurred. The round plots indicate the stations where the hauls resulted in *B. capriscus*, the diamond plots indicate the locations where *B. punctatus* were caught, and the cross plots represents other stations for which miscellaneous fish species were caught other than triggerfish (Figure 1). The main pelagics obtained in the miscellaneous trawl stations included: clupeids, carangids, scombrids, hairtails and barracudas. The miscellaneous trawl stations recorded valuable demersals such as seabreams, snappers, groupers, grunts and croakers. Alongshore distance from west-end (Liberia-Côte d'Ivoire border) to the east-end (Benin-Nigeria border) which covers the stretch of 1,237 km is indicated. The figure also shows the depth ranges of 50 m, 200 m and 1000 m offshore. The triggerfish capture depth ranged from 22-60 m depth during the survey period.

Figure 2 shows the capture depth range of *Balistes* caught during the survey. It also indicates the area where the fish occurred (represented by the distance, km) and the number of *Balistes* obtained in each area.

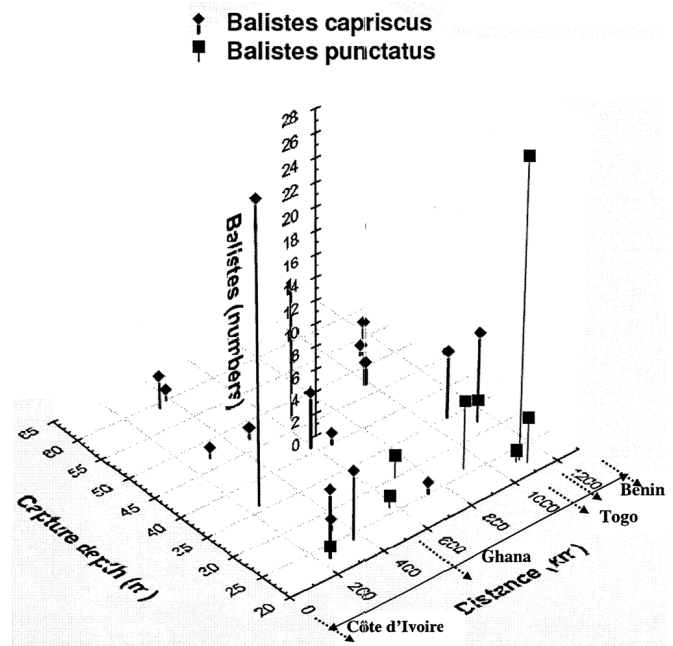


Figure 2: Distribution, capture depth and *Balistes* caught in Western Gulf of Guinea in May 2005. Countries bordering Western Gulf of Guinea are shown

Both species of triggerfish were caught from Côte d'Ivoire to Benin waters. In Côte d'Ivoire waters, 46 triggerfish were caught at eight stations with depth range of 23 to 60 m. In Ghana, 30 triggerfish were caught at eight stations between 25 and 47 m depth. In Togo, 41 triggerfish were caught at six stations with depth range of 22 to 52 m; whereas 10 triggerfish were caught in Benin waters at 32 m depth in one station. *B. punctatus* were found in coastal waters between 22 to 32 m depth in the Western Gulf of Guinea, while *B. capriscus* were caught in waters between 23 to 60 m depth from Côte d'Ivoire to Benin. The highest number of *B. punctatus* (26) was caught off the coast of Togo at the depth of 23 m; and the highest number of *B. capriscus* (26) was caught off the coast of Côte d'Ivoire at the depth of 36 m (Figure 2).

The gut analyses of the species is presented in Tables 1 and 2. Seventy four gut specimens of *B. capriscus* (including nine empty guts) and 41 gut specimens of *B. punctatus* (all with food contents) were analysed. Food items were grouped into four categories, namely zooplankton, benthic macroinvertebrates, vertebrates and miscellaneous. Table 1 shows the percent frequency of occurrence of diet of both species of triggerfish. In the case of *B. capriscus*, Mysidae and

Table 1: Percent gravimetric composition of *Balistes capriscus* (Bc) and *Balistes punctatus* (Bp) gut specimens collected during R/V Dr. Fridtjof Nansen survey in May, 2005 in the Western Gulf of Guinea

Food items	Size class (TL, cm)							
	12.0-21.9		22.0-31.9		32.0-41.9		42.0-52.0	
	Bc	Bp	Bc	Bp	Bc	Bp	Bc	
No. of Fish	12	5	26	32	28	4	8	
No. of empty guts	1	0	7	0	1	0	0	
No. of non-empty guts	11	5	19	32	27	4	8	
(A) Zooplankton								
Amphipoda: Hyperiids	-	4.5	9.1	1.8	1.4	-	-	
Copepoda	-	-	1.8	-	1.4	-	-	
Eupausiidae	-	-	1.8	-	-	-	-	
Mysidae	3.0	-	-	1.8	-	5.3	-	
Anthomedusa	3.0	-	-	-	-	-	-	
Jellyfish	-	-	-	1.4	-	-	-	
Cumacea	-	4.5	-	0.9	-	-	-	
Lamellibranch larvae	-	-	-	1.8	-	5.3	-	
Gastropod larvae	-	-	-	0.9	-	-	-	
Bivalve larvae	-	-	-	0.9	-	-	-	
Fish larvae (Batoid)	-	-	-	-	1.4	-	-	
(B) Benthic macroinvertebrates								
Bivalvia	3.0	13.6	5.5	3.6	4.1	10.5	-	
Decapoda:								
Brachyura (Crabs)		12.2	9.1	1.8	10.7	6.8	5.3	4.0
Nephropidae (Crayfish/Lobsters)		9.1	13.6	16.4	6.3	12.3	10.5	8.0
Penaeidae (shrimps)		6.1	9.1	3.6	19.7	5.5	10.5	12.0
Sepiida:								
Sepia/Flesh of Sepia		-	-	3.6	3.6	5.5	-	24.0
Nematoda		3.0	-	7.3	-	8.2	-	8.0
Polychaeta		3.0	-	1.8	-	-	-	-
Volutacea: (Cybium)		-	-	-	-	1.4	-	-
Shell of siphonidae		3.0	-	-	-	-	-	-
Echinodea (pieces)		-	4.5	-	11.6	-	10.5	-
(C) Vertebrates								
Fish bones/scales/fins		3.0	-	3.6	1.8	9.6	15.8	4.0
(D) Miscellaneous								
Mollusc shells		18.2	9.1	10.9	4.5	11.0	5.3	16.0
Marine debris		3.0	4.5	-	7.1	4.1	-	-
Sand grains/stones		-	-	-	0.9	-	5.3	-
Unidentified		-	9.1	-	-	-	-	-
Digested materials		30.4	18.2	32.7	22.3	26.0	15.8	24.0

Table 2: Percent Frequency of Occurrence of *Balistes capriscus* (Bc) and *Balistes punctatus* (Bp). Gut specimens collected during R/V Dr. Fridtjof Nansen survey in May, 2005 in the Western Gulf of Guinea

Food items	Size class (TL, cm)							
	12.0-21.9		22.0-31.9		32.0-41.9		42.0-52.0	
	Bc	Bp	Bc	Bp	Bc	Bp	Bc	
No. of Fish	12							
No. of empty guts	1	0	7	0	1	0	0	
No. of non-empty guts	11	5	19	32	27	4	8	
(A) Zooplankton								
Amphipoda: Hyperiids	-	0.5	-	-	-	-	-	
Copepoda	-	-	-	-	-	-	-	
Eupausiidae	-	-	-	-	-	-	-	
Mysidae	0.1	-	0.1	-	0.3	-	-	
Anthomedusa	-	-	-	-	-	-	-	
Jellyfish	-	-	-	0.1	-	-	-	
Cumacea	-	0.3	0.1	-	-	-	-	
Lamellibranch larvae	-	-	-	-	-	0.1	-	
Gastropod larvae	-	-	-	-	-	-	-	
Bivalve larvae	-	-	-	-	-	-	-	
Fish larvae (Batoid)	-	-	-	-	-	-	-	
(B) Benthic macroinvertebrates								
Bivalvia	-	7.9	0.5	0.8	0.4	10.4	-	
Decapoda:								
Brachyura (Crabs)		7.3	0.5	1.5	6.2	9.3	1.4	1.4
Nephropidae (Crayfish/Lobsters)		6.2	5.5	32.0	1.3	11.6	15.2	17.1
Penaeidae (shrimps)		-	37.6	0.5	38.2	4.7	0.4	2.2
Sepiida:								
Sepia/Flesh of Sepia		-	-	1.7	3.9	9.8	-	58.0
Nematoda	0.2	-	0.2	-	-	-	-	
Polychaeta	1.0	-	0.1	-	-	-	-	
Volutacea: (Cybium)	-	-	-	-	0.2	-	-	
Shell of siphonidae	-	-	-	-	-	-	-	
Echinodea (pieces)	-	4.6	-	16.0	-	9.9	-	
(C) Vertebrates								
Fish bones/scales/fins		7.7	-	1.5	-	2.3	25.2	1.6
(D) Miscellaneous								
Mollusc shells	9.4	-	4.4	1.7	18.2	-	19.7	
Marine debris	0.9	2.6	-	7.4	4.2	-	-	
Sand grains/stones	-	-	-	-	-	0.4	-	
Unidentified	-	0.5	-	-	-	-	-	
Digested materials		67.1	39.9	57.5	24.2	39.2	36.6	-

Anthomedusa occurred in size class 12.0-21.9 cm whereas Amphipoda (hyperiid) dominated in size class 22.0-31.9 cm. Zooplankton were least represented in size class 32.0-41.9 cm and no zooplankton recorded in the higher size class (42.0-52.0 cm) of *B. caprisus*. Decapoda such as crabs, lobsters and shrimps; and Sepiidae such as *Sepia* sp. dominated in all the size classes in benthic macroinvertebrates group. Vertebrate parts which were mainly fish bones, scales and fins were dominant in size class 32.0-41.9 cm. Miscellaneous group of food items was dominated by mollusc shells which were mostly in fragments (Table 1). The percent frequency of occurrence of *B. punctatus* indicated that zooplankton group was dominated by Amphipoda (hyperiid) in 12.0-21.9 cm, and Mysidae in 32.0-41.9 cm size classes. Gastropod larvae and bivalve larvae were least represented in 22.0-31.9 cm group. Benthic macroinvertebrates dominated by Bivalvia and Nephropidae (crayfish/lobsters) in 12.0-21.9 cm; and Brachyura (crabs), Penaeidae (shrimps) and fragments of Echinodea in 22.0-31.9 cm size class were encountered. Decapoda such as lobsters and shrimps, and Echinodea dominated in 32.0-41.9 cm size class. Vertebrate (fish fragments) were high in percentage in 32.0-41.9 cm. Miscellaneous gut contents which consisted of mollusc shells, marine debris, sand grains and unidentified food items were recorded in almost all the size groups of *B. punctatus*

Table 2 provides data on the gravimetric composition of food of the two species of triggerfish. *B. caprisus* indicated low values of zooplankton food items; and benthic macroinvertebrates were dominated by lobsters in size classes 22.0-31.9 cm and 42.0-52.0 cm. Sepiidae dominated in size class 42.0-52.0 cm whereas Nematoda, Polychaeta and Volutacea (*Cybiium*) were least represented in the food items. Vertebrate group was dominated by fragments of fish which were mostly recorded in 12.0-21.9 cm size class. Again, miscellaneous group comprised of mollusc shells and marine debris, while fragments of mollusc shells dominated in almost all the size classes. The percent gravimetric composition of *B. punctatus* indicated low values of zooplankton food items which consisted of Amphipoda (hyperiid), Mysiidae, Cumacea and Lamellibranch larvae. Gastropod and bivalve larvae did occur but their percent gravimetric composition were negligible. Benthic macroinvertebrates group was dominated by Bivalvia and Penaeidae (shrimps) in size class 12.0-21.9 cm; Brachyuran (crabs), fragments of Echinodea and Penaeidae dominated in 22.0-31.9cm; and Bivalvia, Nephropidae (crayfish/lobsters) and fragments of

Echinodea dominated in 32.0-41.9 cm. Vertebrates (fish fragments) were represented in higher size class, 32.0-41.9 cm. Miscellaneous items which consisted of mollusc shells, marine debris, sand grains and unidentified gut contents were least represented in almost all the size classes of *B. punctatus*

DISCUSSION

Eventhough, only 23 out of 165 stations trawls yielded triggerfish during the R/V Dr. Fridjtof Nansen Survey 2005 in Western Gulf of Guinea the distribution of 127 triggerfish (*B. caprisus* and *B. punctatus*) obtained showed a suggestive habitat overlap (Figure 2) between the two species in the study area. No immediate explanation could be attributed to the observed pattern of distribution in the two sympatric species of *Balistes* in the Western Gulf of Guinea. However, there is indication of high growth rate in *B. punctatus* (Aggrey-Fynn 2008) for which it could be the result of its occurrence in shallow coastal waters. It is likely that the warm shallow coastal waters increase *B. punctatus* metabolic rate and the demand for oxygen, and therefore, growth rate of the fish species increased. The triggerfish species *B. caprisus* was found to be occupying wide range of depth (23-60 m) whereas *B. punctatus* occurred at 22-32 m depth in the area (Figure 2). With the observed distribution of triggerfish in Western Gulf of Guinea *B. caprisus* and *B. punctatus* are segregated by depth in their habitat.

Eventhough there were not much differences in the diet of *B. caprisus* and *B. punctatus* (Tables 1-4) the slight difference could be attributed to the effect of warmer sea conditions that might prevail at the shallow waters (22-32 m depth) for *B. punctatus*, and colder deep coastal waters (up to 60 m depth) for *B. caprisus*. Both triggerfish species were more planktivorous at juvenile stage (12.0-21.9 cm size class) and benthivorous at later stage in life. There could be competition for food resources between the two fish species. However, it appears *B. caprisus* is better adapted in terms of benthic life as the species occur at deeper depth of coastal waters (Figure 2) and therefore, better selected for benthic feeding. For this reason, *B. caprisus* might have a competitive advantage over *B. punctatus* at benthivorous stage. In that sense, *B. punctatus* growth at later stage might be affected negatively and hence stunting could result in *B. punctatus* as suggested by Aggrey-Fynn (2008). The major food items identified in the gut of *B. caprisus* and

B. punctatus were comparable to the results of earlier studies on main food items of *B. capriscus* in Ghanaian coastal waters which were marine crustaceans and molluscs (Ofori-Danson 1981).

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