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Stephen A. Bortone
University of West Florida

Philip A. Hastings
Harbor Branch Foundation, Inc.

Sneed B. Collard
University of West Florida

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THE PELAGIC-*SARGASSUM* ICHTHYOFAUNA OF THE EASTERN GULF OF MEXICO

By

Stephen A. Bortone[1], Philip A. Hastings[2] and Sneed B. Collard[1]
[1]Faculty of Biology
University of West Florida
Pensacola, FL 32504

[2] Harbor Branch Foundation, Inc.
Ft. Pierce, FL 33450

ABSTRACT: A total of 2857 fishes comprising 15 families and 40 species was collected at 62 localities in the eastern Gulf of Mexico between 1971 and 1976. The fauna was dominated by the Carangidae, Balistidae, and Syngnathidae. *Monacanthus hispidus* was the most abundant species and comprised 84.5% of the total fauna. Species diversity (H′) was variable within the Gulf and low in comparison with the western Atlantic *Sargassum* - associated ichthyofauna. "Index of Affinity" was high within the Gulf due to the abundance of *M. hispidus*. Perhaps conditions associated with community dispersal, for which *M. hispidus* is better adapted, permit this species to dominate this community. Additionally, species diversity differences may be due to substrate area or "clumpsize".

Floating pelagic *Sargassum* (or "Gulf weed") and its associated fauna have long held the fascination of biologists and physical oceanographers. Early studies examined the distribution and life history of the weed (see Dooley, 1972 for a review). The faunal communities associated with *Sargassum* have also been examined and two recent treatments of the subject by Fine (1970) and Dooley (1972) have added considerably to our knowledge of this floating community. The relatively short residence time of most species implies that the *Sargassum* associated fauna may not represent an ecological community in the usual sense. Nevertheless, it does represent an important biocenosis and demands the attention of ecologists.

Virtually all of the previously published work deals with *Sargassum* associates of the western Atlantic or western Pacific Oceans. There have, however, been few published works on this fauna from the Gulf of Mexico. Caldwell (1959), Dawson (1962) and Hastings and Bortone (1976) described the range extension of several species to the northern Gulf of Mexico and attributed the distribution to the species' association with floating *Sargassum*. There are other references to fishes associated with *Sargassum* in the Gulf, but these generally apply to systematic-biological studies of specific groups (e.g., Adams, 1960, *Histrio histrio;* Berry and Vogele, 1961, Monacanthidae; Berry, 1959, *Caranx;* Moore, 1967, Balistidae) and are not concerned with the entire ichthyofauna. During a series of teaching-research cruises in the eastern Gulf of Mexico from 1971-1976 floating *Sargassum* was dipneted. While the collection sites and dates were not organized into a systematic sampling pattern, we feel composite examination of the faunal data will add to our knowledge of eastern Gulf of Mexico ichthyofauna.

The purpose of this paper is to describe the *Sargassum* ichthyofaunal associates in the eastern Gulf of Mexico. We examine this community with regard to distribution affinites and relative abundance. Comparisons are made with other *Sargassum* community studies.

MATERIALS AND METHODS

A total of 62 collecting stations (Fig. 1) was occupied at irregular intervals from May 1971 to August 1976. One collection was made in January, the remaining from May through October. Collections were obtained from floating *Sargassum* with a dipnet (6.5 mm stretched mesh), or on a few occasions, with a neuston net towed through clumps of *Sargassum*. Collecting stations were occupied for 30 min. to 2 hours. Only specimens which were actually shaken from the *Sargassum* are considered in this report. Our concern was with fish which used the weed as a substrate. Excluded from this analysis were larval fishes, flying fishes (Exocoetidae) and sardines and herring fishes (Clupeidae). Specimens once removed from the weed were fixed in 10% formalin and stored in 40% isopropyl or 70% ethyl alcohol. Later, specimens were identified, measured to the nearest mm for standard length (SL) and deposited in the University of West Florida fish collection (UWF). Biomass and species composition of the weed were not recorded.

To compare potential faunal regionalization, inshore/offshore zones were designated: depths less than 20 fathoms (37 m) were placed in zone A; 20-100 fathoms (37-183 m) in zone B; and samples from water deeper than 100 fathoms (183 m) in zone C. To examine possible NW to SE changes in community composition along the Florida shelf the northernmost area was designated zone I; the intermediate area zone II; and the southernmost area zone III (Fig. 1).

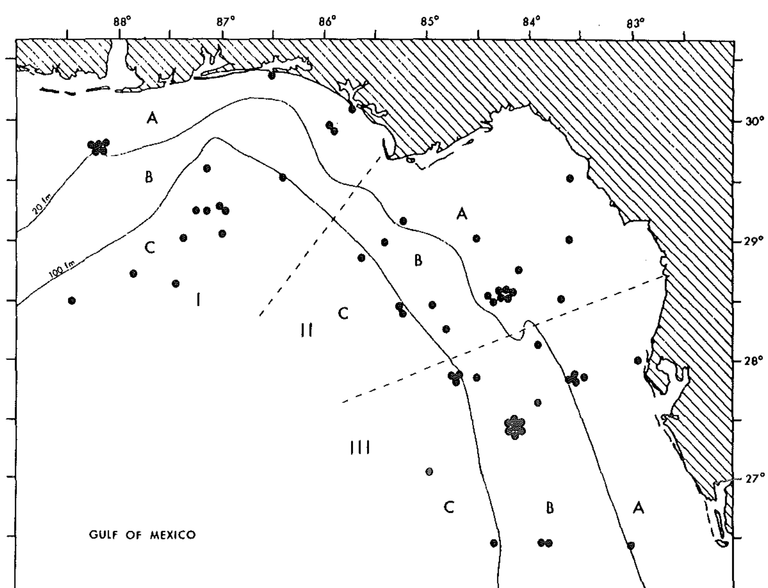

Figure 1. — Dots indicate collection sites for the *Sargassum*-associated ichthyofauna of the eastern Gulf of Mexico. Roman numerals and dashed lines indicate latitude zones. Letters indicate depth zones.

Faunal samples were assigned to the designated zones previously described (summarized in Tables 1 and 2) and were analyzed by several methods. A Shannon-Weaver species diversity index (H′) was calculated: $H' = -\Sigma^{s} P_i \ln P_i$ for each zone and corresponding subzone according to Pool (1974): where s is the number of species, and P_i corresponds to the proportion of the total number of the *i*th species.

To compare faunal homogeneity or similarity an "index of affinity" was calculated according to Sanders (1960). This is computed by calculating the percentage species composition for each geographic subzone and summing the smallest percentage for each species in common to a pair or groupwise comparison (Fig. 2).

OBSERVATIONS

Ichthyofaunal collection data are summarized in Table 1 by species, number, number per sub-zone, and SL mean and range. The family Carangidae dominated the species list with 10 out of the total number of 40 species. The Balistidae and Syngnathidae had the next highest number of species, 9 and 5 respectively. Ten of the 15 families recorded were represented by one species each.

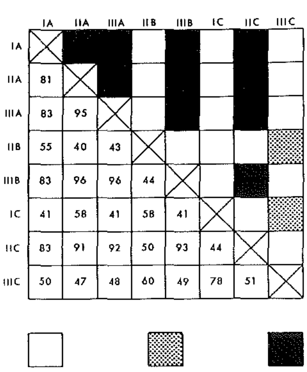

Figure 2. — Trellis diagram with "index of affinity" calculated for sub zones I - III, A-C.

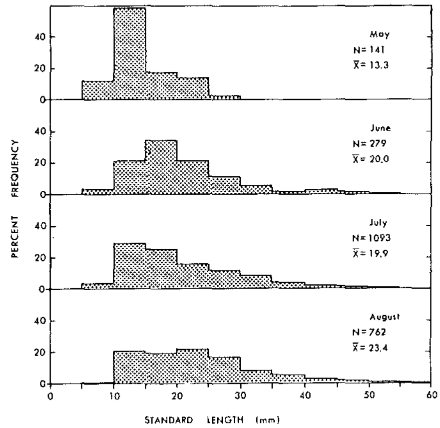

Figure 3. — Length-frequency histogram for *Monacanthus hispidus* collected in association with pelagic-*Sargassum* in the eastern Gulf of Mexico.

The pelagic-*Sargassum* community in the eastern Gulf of Mexico was dominated by *Monacanthus hispidus* as it comprised 84.5% of all fishes (2857) captured in association with the weed. The next most abundant species were: *Balistes capriscus* (6.1%), *Histrio histrio* (1.8%) and *Caranx crysos* (1.4%). Most species are apparently incidental to the *Sargassum* community as 10 of the total number of 40 species collected were each represented by a single individual, and 27 species were represented by 5 or fewer individuals.

Because of the obvious importance *M. hispidus* has to the eastern Gulf pelagic-*Sargassum* community and for comparison with other areas an analysis of length-frequency was conducted during the months of May through August. Examination of the length-frequency (Fig. 3) shows that *M. hispidus* is both numerous and of small size during the summer months. The mean size of the species was 20.8 mm SL (range 5-59 mm). *Balistes capriscus* was the next most abundant species associated with pelagic-*Sargassum*. It attained only a slightly larger mean length (27.7 mm SL) and maximum length (78 mm SL) than did *M. hispidus.)*

To examine major differences, similarities, or trends within the *Sargassum*-associated ichthyofauna of the eastern Gulf, the study area was partitioned into zones by depth and latitude. These accumulated data are presented in Table 1 and a summarized data matrix is presented in Table 2. There appears to be a trend for species number to increase from inshore to offshore (zone A to C). A similar increase in species number also occurs from NW to SE along the northeastern Gulf shelf. These apparent trends may not accurately describe the distribution of species because the sampling effort was not controlled and the number of organisms collected was disproportionate in some subzones. To accommodate this problem we used the Shannon-Weaver species diveristy index (H′ in Table 2). This index, which incorporates the number of species present and their relative abundance, is here used merely as a measure of this association. We noted a decrease in species diversity from NW to

Table 1. — List of species collected from floating sargassum in the Gulf of Mexico (mean and range are standard length, SL, in mm). Number of individuals collected per subzone (see Fig. 1) is also presented.

Species	Number	Mean (SL)	Range (SL)	Subzones 1A	1C	11A	11B	11C	111A	111B	111C
Antennariidae											
Histrio histrio	51	31.2	96·6	24	2	5	3	2		4	11
Gadidae											
Urophycis floridanus	1	43				1					
Holocentridae											
Holocentrus vexillarius	1	16								1	
Syngnathidae											
Hippocampus erectus	2	32.5	30-35					1			1
Oostethus lineatus	1	72		1							
Syngnathus louisianae	6	102	37-161	2		1		1	1	1	
S. pelagicus	16	98.9	43-147		1		1	2	1	2	9
S. springeri	9	83.6	69-117			9					
Priacanthidae											
Pristigenys alta	1	19					1				
Carangidae											
Caranx bartholomaei	3	27.3	25-29					1			2
C. crysos	39	19.6	11-40	2	2	9		1	2	10	13
C. hippos	4	11.3	10-14					1	3		
C. latus	9	10.6	8-13		9						
Chloroscombrus chrysurus	1	16			1						
Elagatis bipinnulata	1	31							1		
Seriola dumerili	29	38.9	12-72	2	3	1	1	16	1	3	2
S. fasciata	2	46.0	45-47					2			
S. rivoliana	2	30.5	24-37								2
S. zonata	2	33.5	30-37			2					
Seriola sp.	1	13									1
Coryphaenidae											
Coryphaena hippurus	17	44.4	28-72		1	2	2	5		3	4
Lutjanidae											
Rhomboplites aurorubens	2	32 5	27-38			2					
Lobotidae											
Lobotes surinamensis	5	22.8	11-58								2
Mullidae											
Mullus auratus	3	34.0	23-37			3					
Pseudopeneus maculatus	3	45.0	45							3	
Blenniidae											
unidentified	2	11.5	11-12	2							
Scombridae											
Scomberomorus cavalla	1	41									1
Stromateidae											
Psenes cyanophrys	8	16.8	12-21							6	2
Balistidae											
Aluterus heudeloti	18	51.7	31-75		4		1	6		4	3
A. schoepfi	2	23.5	22-25	2							
Balistes capriscus	73	27.7	9-78		60		2	6	1	12	92
Canthidermis maculatus	5	36.6	20-65		3					1	1
C. sufflamen	4	39.5	30-45							4	
Monacanthus ciliatus	8	16.4	14-19				1	1		6	
M. hispidus	2414	20.8	5-59	150	54	559	9	407	138	973	124
M. setifer	5	39.8	23-54								5
Diodontidae											
Chilomycterus antennatus	1	26			1						
C. schoepfi	1	49				1					
Diodon holocanthus	2	48.0	37-58					1			1

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SE within the shallow depth zone A and a more pronounced decrease in diversity within the southernmost latitude zone (III) from offshore to inshore. In an overall comparison of species diversity with depth one finds an apparent increase in species diversity of the pelagic-*Sargassum* ichthyofauna taken from areas where the water was shallow (i.e., < 20 fms) to deeper offshore areas (> 100 fms). There is no apparent consistent trend with regard to latitude. The data suffer from a lack of comparative material from subzone IB; nevertheless, the highest species diversity (1.9163) was observed at subzone IIB and the lowest (0.2778) was from subzone IIIA. The species diversity for the entire study area was 0.8098.

An examination of species diversity and species number and abundance tells us little in the way of faunal affinity or similarity with regard to species between and within zones. To examine the similarities of species as components of the community we employed Sanders' (1960) "index of affinity." The calculated data and corresponding trellis diagram are presented in Fig. 2. Subzones IA, IIA, IIIA, IIIB and IIC showed high faunal affinities (> 80%). In a comparison between subzones within latitude the faunal affinity between zones I and II was 53.6%; between II and III, 69.1%; between I and III, 62.8%; and between all latitude zones was 62.8%. Comparisons by depth zone showed faunal affinities of 63.9% between A and B, 58.6% between B and C, 61.3% between A and C, and 61.2% between all depth zones. The faunal affinity for the entire sample area was 62.0%.

DISCUSSION

Dooley (1972) in his study on fishes associated with pelagic-*Sargassum* in the western Atlantic collected 54 species, but these included several of the families and groups excluded from analysis in the present study. Fine (1970) collected 11 fish species in a *Sargassum* community also in the western Atlantic. Of the 40 fish species collected in the present study, 10 species had not been previously recorded in association with *Sargassum: Urophycis floridanus, Holocentrus vexillarius, Hippocampus erectus, Syngnathus springeri, Chloroscombrus chrysurus, Rhomboplites aurorubens, Mullus auratus, Pseudopeneus maculatus, Scomberomorus cavalla,* and *Chilomycterus antennatus.* To be sure, the above species are all incidental to the community and may be termed "coincidental" according to the classification of Dooley (1972). Of the species reported from the western Atlantic communities by Dooley (1972) *Syngnathus floridae, Kyphosus sectatrix, Selar crumenophthalmus, Abudefduf saxatilus,* and most importantly *Caranx ruber* were conspicuously absent from the eastern Gulf community.

One species which we believe deserves mention as not associated with pelagic-*Sargassum* is *Coryphaena equisetis. C. hippurus* has been collected as a *Sargassum* associate in both the western Atlantic and eastern Gulf. The possibility exists that the specimens are misidentified (our material was cleared-and-stained for verification) or that the samples are inordinately few. *C. hippurus* may, however, have an affinity for *Sargassum* which *C. equisetis* lacks as Dooley (1972) also noted the absence of *C. equisetis* from the *Sargassum* community.

Dooley (1972: Fig. 7) presented a length-frequency histogram for *Monacanthus* (= *Stephanolepis*) *hispidus.* In comparison with our length-frequency data, a notable difference was observed. Between May and August, populations of *M. hispidus* from the western Atlantic increased in mean length from approximately 29mm SL to about

55 mm (net change 26 mm) while in the eastern Gulf the average change in length was only 10 mm for the same months. It seems improbable that the substantial differences in average net change in length reflect real differences in growth rate. We feel several more plausible explanations may be offered. The disparity of size increase may mean that immigration and/or emigration of *M. hispidus* size classes are not equal in both the eastern Gulf and western Atlantic. Possibly smaller *M. hispidus* are recruited into the Gulf *Sargassum* community or perhaps the species remains associated with *Sargassum* at a greater size in the western Atlantic. Another possible explanation may owe to the method of collection. Dooley (1972) used a miniature purse seine which permitted sampling the fauna perhaps as deep as 5.2 m. Our samples were not taken at a depth greater than 1 m from the surface. We have often noted that larger fishes associated with *Sargassum* tend to dive out of the reach of the dipnet.

Dooley (1972) reported that the families Carangidae (14 species), Balistidae (also including Monacanthidae, 14 species) and Antennariidae (1 species) comprised 90% of all fishes collected from the eastern Atlantic. In the present study species from these families comprised 97% of all individuals collected. This difference is apparently due to the complete dominance of the pelagic-*Sargassum* ichthyofauna in the Gulf of Mexico by *M. hispidus*. *M. hispidus* comprised 61% and 69% of the ichthyofauna collected off Miami and Cape Lookout, respectively (Dooley, 1972: Table 5, *Stephanolepis* sp. is combined with *S. hispidus* for this and other faunal comparisons) while *M. hispidus* in the present study comprised 84% of the eastern Gulf fauna. The abundance of *M. hispidus* in the eastern Gulf is also reflected in the species diversity (H′) values. H′ for Miami and Cape Lookout N.C. data (Dooley, 1972: Table 5, excluding flying fish) were 1.5258 and 1.4417 respectively. H′ for all eastern Gulf samples was comparatively low (0.8098). Again, the collecting method might be considered a factor influencing the H′ values. However, comparable H′ values were calculated for Dooley's (1972) samples taken off Miami and Cape Lookout and these were obtained by miniature purse seine and dipnet respectively.

The difference in species diversity between western Atlantic and eastern Gulf pelagic-*Sargassum* ichthyofauna

Table 2. — Data summary of ichthyofauna collected from floating *Sargassum* in the eastern Gulf of Mexico. Data presented per subzone (from top to bottom): number of species, number of individuals, number of stations (i.e., collections), species diversity (H′). Subzone locations correspond to Fig. 1.

		Latitude Zones I	Latitude Zones II	Latitude Zones III	Total Respective Depth Zones
Depth Zones	A	9	12	7	18
		185	595	145	925
		9	13	7	29
		0.7079	0.3526	0.2778	0.4705
	B	—	10	15	17
		—	22	1033	1055
		0	3	11	14
		—	1.9163	0.3605	0.4236
	C	13	15	19	26
		144	455	278	877
		11	3	5	19
		1.0542	0.5666	1.6045	1.2820
Total Respective Latitude Zones	No. species	17	22	25	40
	No. specimens	329	1072	1456	2857
	No. stations	20	19	23	62
	H′	1.3434	0.5432	0.7437	0.8098

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warrants attention. The numerical values reflect the dominance of *M. hispidus*. This species is more numerous in the Gulf perhaps at the exclusion or (more appropriately) the reduction of other species. Postulated hypotheses which seek to explain differences in diversity such as stability, spatial heterogeneity, competition, and predation (Emlen, 1973) all may be excluded from consideration. Exclusion is based on the qualitatively similar faunas and comparable physical parameters of the areas (i.e., latitude, salinity, temperature). However, two postulates may need further examination: ecological time and productivity (Pianka, 1974).

Patterns of diversity may be affected by ecological time (i.e., dispersal time, Pianka, 1974). Pelagic-*Sargassum* associated fishes of the Gulf presumably have similar ecological requirements of Atlantic conspecifics in order to exist in such a community. Gulf species, however, also must accommodate to another important factor. *Sargassum* distribution in the western Atlantic depends on the rather constant, and generally geographically stable, Gulf Stream. The western Atlantic studies (Fine, 1970; Dooley, 1972) were made in or near the immediate vicinity of the Gulf Stream, insuring a rather constant and proximate input of the drifting weed and its associated fauna. The *Sargassum* community in the Gulf of Mexico, however, may depend on receiving its associated fauna and substrate from the Sargasso Sea area by way of the Caribbean current and variable Gulf Loop current (see Jones, 1973 for a review of the Gulf Loop current). Because *Sargassum* and its associated fauna may originate from outside the Gulf and depend on the Loop current for dispersal into the Gulf, species such as *M. hispidus* may be better adapted to the long dispersal into the Gulf than are other species. The dominance of *M. hispidus* is, therefore, potentially possible by way of a density independent controlling factor such as the ability to withstand extended pelagic dispersal. Differences in productivity may explain the disparity in H′ between the Atlantic and the Gulf. More productive areas may be able to support more species and numbers of those species by allowing dietary specialization (Pianka, 1974). Geographically, net productivity and respiration by the *Sargassum* community is apparently lower in the Gulf than the Atlantic, but this may be due to the methods or season of measurement (Blake and Johnson, 1976). Another potentially important but as yet unmeasured parameter affecting species diversity may be substrate area (i.e., clumpsize) available for colonization. Our observations during sampling indicate that clumps of *Sargassum* in the Gulf are relatively small in comparison to clumps sampled and observed in the western Atlantic. This feature as well as species composition of the *Sargassum* need further investigation.

Faunal affinity studies within the eastern Gulf may tell us little because of the complete dominance of the community by *M. hispidus*. Sanders (1960) indicated that there is a lack of discrimination against ubiquitous and abundant species in the "index of affinity." Therefore, the domination of the fauna by *M. hispidus* may render this analysis useless, particularly on a comparative basis within the Gulf.

We believe few or no important qualitative differences exist between the *Sargassum* associated ichthyofaunas of the western Atlantic and eastern Gulf of Mexico but some quantitative differences may exist. The "index of affinity" data indicate a rather homogenous ichthyofauna associated with the pelagic *Sargassum* in the eastern Gulf.

Additional studies of a quantified nature may permit more explicit dissection of the study area to determine subtle but important differences in latitude or distance from shore parameters. This information may be useful in explaining current patterns along the eastern Gulf shelf. There may also be important day/night and seasonal differences in the fauna which we could not detect because of our irregular sampling effort and frequency.

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