Preliminary Assessment of the Association of Larval Fishes with Pelagic *Sargassum* Habitat and Convergence Zones in the Northcentral Gulf of Mexico

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ABSTRACT

Surface plankton samples were taken adjacent to concentrations of pelagic *Sargassum* during May and July 2000 in the northcentral Gulf of Mexico. Sampling was conducted next to *Sargassum* located both along convergence zones (fronts) and in areas not associated with particular hydrographic features. In addition, collections were taken up to 1.5 kilometers away from the sampled *Sargassum* as a control. A total of 1453 larvae/postlarvae comprising 22 families were collected. Collections were dominated by carangids and exocoetids, but also included specimens of tuna (including bluefin in May), dolphin and billfishes. Species composition and abundance were generally similar for collections taken both adjacent to *Sargassum* located along frontal zones and "control" collections taken within a few hundred meters of the sampled front. These preliminary observations indicate the potential influence of both *Sargassum* habitat and the convergence of water masses associated with frontal zones. The supposition that the convergence of water masses affects the diversity and abundance of fish larvae is further strengthened by the relatively low diversity and abundance of larvae found in collections taken adjacent to large patches of *Sargassum* not associated with particular hydrographic features. Larvae may accumulate in frontal zones both with and without *Sargassum*, but the growth and survival of the larvae of many species may be quite different in both areas.

KEY WORDS: *Sargassum*, fronts, habitat

INTRODUCTION

In the western North Atlantic and Gulf of Mexico pelagic brown algae of the genus *Sargassum* (Family Sargassaceae) forms a critical floating habitat for a diverse assemblage of flora and fauna (Butler et al. 1983, Coston-Clements et al. 1991). In the North Atlantic the center of distribution of pelagic *Sargassum* is in the Sargasso Sea located near the center of the North Atlantic gyre southeast of Bermuda (Sieburth and Conover 1965). This *Sargassum* is comprised primarily of *S. natans* and *S. fluitans* (Winge 1923, Parr 1939), although detached algae of five other species occur in low frequency (SAFMC 1998). The floating algae is transported into the Gulf of Mexico by the Yucatan current, which is termed the Loop current as it passes through the Gulf. *Sargassum* is often concentrated in long rows by the convergence of surface waters along fronts, Langmuir circulation, or internal waves (Langmuir 1938, Shanks 1988, Kingsford 1990). When currents and winds are negligible, *Sargassum* is generally found in broad irregular mats or scattered clumps. Aggregations of this algae provide refuge for small fish and invertebrates, represent a source of concentrated prey for many organisms, including such diverse taxa as planktivorous invertebrates and large piscivorous fishes, provide a unique nursery habitat for numerous oceanic organisms, and may serve as a spawning substrate for certain marine species (Dooley 1972, Coston-Clements et al. 1991).

Pelagic *Sargassum* habitat has been the focus of considerable attention in recent years relative to its status as essential fish habitat (EFH). In December 1998, the South Atlantic Fishery Management Council (SAFMC) in the final draft of its Fishery Management Plan (FMP) for pelagic *Sargassum* habitat (SAFMC, 1998) recommended restricting, and then phasing out, the harvest of *Sargassum* in south Atlantic marine waters based upon its importance as EFH. After consideration, the National Marine Fisheries Service (NMFS) voted against such a measure unless it included a provision for limited commercial harvest of the algae. The need for protection of this offshore fish habitat is further emphasized in the current draft of the FMP for the dolphin and wahoo fisheries of the Atlantic, Caribbean, and Gulf of Mexico (SAFMC 2000).

Several studies have examined the diversity of macro-organisms associated with pelagic *Sargassum* habitat (Fine 1970, Dooley 1972, Bortone et al., 1977, Butler et al. 1983, Coston-Clements et al. 1991, Settle 1993, Moser et al. 1998), and only one of these studies (Bortone et al. 1977) was conducted in the Gulf of Mexico. Collectively, these studies found over 145 species of invertebrates, four species of sea turtles and 100 species of fishes associated with *Sargassum*, including various life history stages of several important fishery species such as cobia (*Rachycentron canadum*), greater amberjack (*Seriola dumerili*), common dolphin (*Coryphaena hippurus*), tripletail (*Lobotes surinamensis*), wahoo (*Acanthocybium solandri*), tunas (*Thunnus* sp.), and billfishes (family Istiophoridae) (SAFMC 1998). The extent to which these fishes are dependent upon *Sargassum* as a habitat likely varies among their life history stages, but for many species *Sargassum* may play a more significant role in the survival and growth of larval and juvenile life stages than for adults.

Previous studies have concentrated on the macrofauna associated with *Sargassum* habitat, and little is known about the importance of this habitat for the early life-stages of fishes. The present study is a preliminary effort to assess the diversity and abundance of larval and postlarval fishes found adjacent to *Sargassum* located both along convergence zones and in large isolated mats not associated with particular hydrographic features.

MATERIALS AND METHODS

Sampling Locations and Shipboard Procedure

Sampling was conducted during May and July 2000 in the northcentral Gulf of Mexico (Figure 1). Surface samples were taken with a 1m x 2m neuston frame fitted with 947μm mesh Nitex. Tows were of 10 minutes duration at a ship speed of approximately 2 knots, and the net was approximately 50% submerged, i.e. fished the surface layer to a depth of approximately 0.5 m. In addition, several surface collections of five minutes duration were taken with a 0.73 m diameter ring net fitted with 333μm mesh Nitex and a mechanical flowmeter to measure volume of water filtered. Samples were washed into buckets, concentrated with a sieve, preserved in 95% ethanol and returned to the laboratory for sorting and identification.

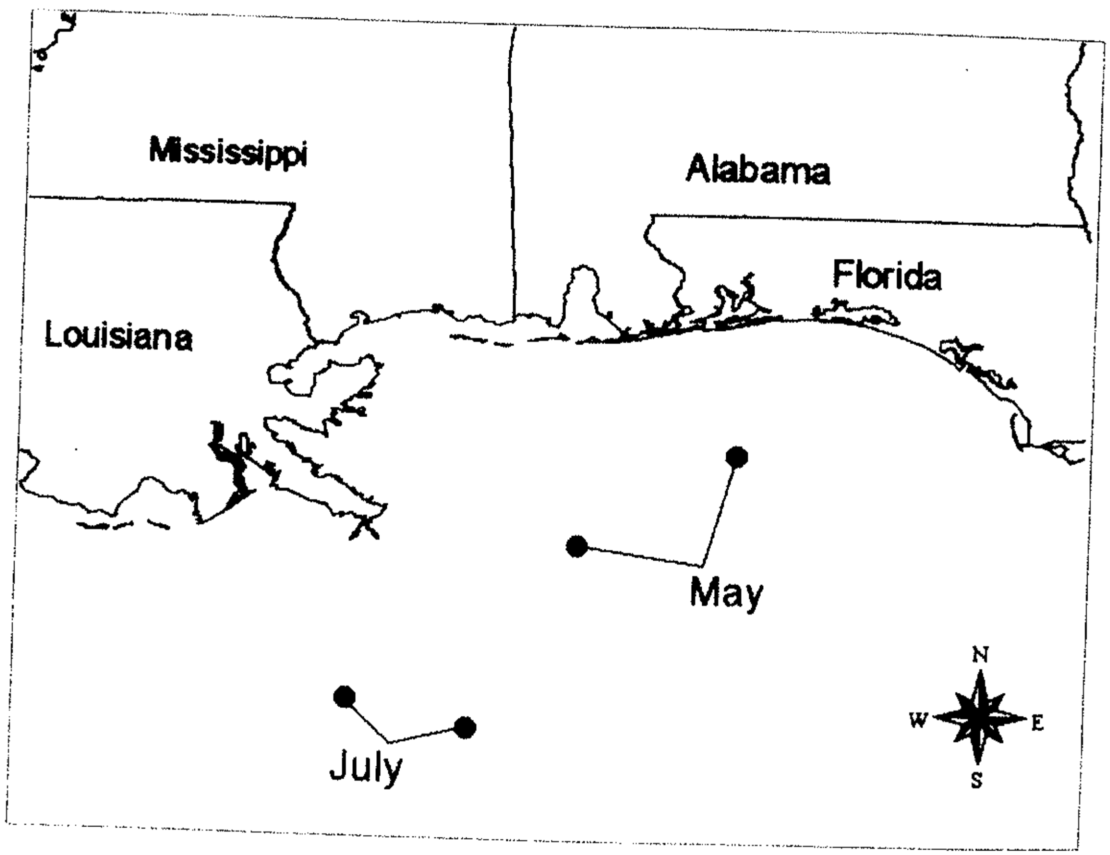

Figure 1. Sampling locations during May, July and 2000 in the northcentral Gulf of Mexico.

RESULTS

A total of 1453 larvae/postlarvae comprising 22 families were found in surface plankton collections taken during May and July 2000. The relative abundance and diversity of young fishes varied both spatially and temporally. Collections were generally dominated by carangids and exocoetids, but also included specimens of tuna (including bluefin in May), dolphin and billfishes.

May

During May two fronts with associated *Sargassum* were sampled. At the first location surface collections were taken immediately adjacent to a continuous row of *Sargassum* patches with both the ring and neuston nets, and for comparison a neuston "control" collection was taken approximately 100 m from the front (Table 1). Sphyraenid larvae were the most abundant family collected at the front adjacent to the patches of *Sargassum* with both the neuston and ring nets, but no sphyraenid larvae were found in the neuston "control" collection. Carangids and exocoetids were the next most abundant taxa in all three collections, with exocoetids being the most abundant larvae in the neuston "control" collection. All five scombrids (tuna) and the single istiophorid (billfish) and coryphaenid (dolphin) were collected adjacent to the *Sargassum* habitat (Table 1).

Table 1. Larval and post-larval fishes collected in the northcentral Gulf of Mexico with both a neuston and ring net adjacent to Sargassum located along a frontal zone and with a neuston "control" collection taken 100 m from the front. Neuston abundances are numbers of larvae per 10 minute collection, and ring net abundances are numbers of larvae per 100 m^3.

Family	Neuston "Control"	Neuston	Ring Net
Sphyraenidae	0	65	13
Carangidae	17	31	9
Exocoetidae	132	20	7
Mugilidae	0	10	0
Echeneidae	0	6	0
Scombridae	0	3	2
Monocanthidae	2	2	1
Serranidae	0	2	0
Istiophoridae	0	1	0
Coryphaenidae	0	1	0
Myctophidae	1	0	0
Ostraciidae	1	0	0
Scorpaenidae	1	0	0

		100 m			S⟷N
	A' ⟵⟶	A	B	B'	
		26.9°C	27.2°C		
		36.3‰	35.5 ‰		
Family	**A'**	**A**	**B**	**B'**	
Carangidae	36	3	43	103	
Exocoetidae	4	3	14	6	
Myctophidae	8	0	3	0	
Scombridae	2	0	1	3	
Argentinidae	5	0	0	0	

Figure 2. Larval and post-larval fishes from surface ring-net collections taken in the northcentral Gulf of Mexico during May 2000. Collections were taken both adjacent to Sargassum located along a frontal zone, and approximately 100 m from the front on both sides. Abundances are numbers of larvae per 100 m^3.

At the second location sampled in May, surface ring-net samples were taken on both sides of a front containing *Sargassum* and approximately 100 m from the front on each side (Figure 2). Surface salinity and temperature on either side of the front differed by 0.8 ‰ and 0.3°C. Carangids were the most abundant taxa collected; 186 specimens were found in the four collections and a density as high as 103 larvae per 100 m^3 was found in a surface collection approximately 100 m from the front (Figure 2). Densities of carangid larvae were lower on the north side of the front, but larvae were again more abundant approximately 100 m from the front than adjacent to *Sargassum* along the frontal zone. Exocoetid larvae were also relatively abundant and were found in all four collections; the highest abundance was found on the south side of the front adjacent to the line of *Sargassum*. Six scombrids were collected and all specimens were larger than 6 mm and could be positively identified as bluefin tuna. It is coincidence that the reported density of these larvae (Figure 2), i.e., number of larvae per 100 m^3, is the same as the actual number collected. Scombrids from the previously sampled front were smaller and could only be identified as *Thunnus* sp.

July

During July, plankton sampling was conducted at both a well-defined front with associated *Sargassum* (Figure 3), and adjacent to a large patch of *Sargassum* that was not associated with a particular hydrographic feature. Sampling at the front was conducted with both the ring and surface nets, and collections were taken adjacent to *Sargassum* on both sides of the front and approximately 1.5 km south of the front (Figure 3). Of the fourteen families of fishes collected, carangids were again the most abundant larvae, and highest abundances were found in collections taken adjacent to *Sargassum* habitat. The distribution of carangids was patchy, however,

DISCUSSION

The aggregation of fish larvae at fronts may be caused by the spawning behavior of adults and/or the passive accumulation of larvae due to the convergence of surface waters in frontal zones (Kirobe et al. 1988, Sabatés and Masó 1990, Grimes and Finucane 1991, Govoni and Grimes 1992, Brandt, 1993). It is not known how *Sargassum*, which frequently accumulates along fronts, influences the distribution and abundance of fish larvae, but *Sargassum* habitat has certainly been shown to support many species of juvenile fishes (Dooley 1972, Bortone et al. 1977, Conston-Clements et al. 1991, Settle 1993). Only one dated study (Bortone et al. 1977) has examined the abundance and diversity of young fishes associated with *Sargassum* in the Gulf of Mexico, and no studies have examined the ichthyoplankton assemblages found adjacent to *Sargassum* habitat along frontal zones.

Previous studies have shown that juvenile fishes associated with *Sargassum* are usually dominated by the families Balistidae, Monacanthidae and Carangidae (Dooley 1972, Bortone et al. 1977, Settle 1993). This species composition was not reflected in plankton collections. Although present in plankton collections from the present study, balistids and monacanthids were not abundant. Carangids were abundant in plankton collections, but they were dominated by the Atlantic bumper (*Chloroscombrus chrysurus*), a carangid that is not commonly found in *Sargassum*. Exocoetid larvae were also quite abundant, which is expected because the eggs of many species develop in *Sargassum*.

The diversity in plankton collections was generally quite high, and 22 families of larvae/postlarvae were found in this limited study. Several commercially and recreationally important species were collected, including billfishes, dolphin and tuna. The diversity and abundance of fishes was higher in neuston collections than ring net collections because of the larger mouth-opening and longer tow-time for the neuston net. Collections taken as "controls" in May, i.e. collections taken away from a front with its associated *Sargassum*, were removed from a front by approximately 100 m. Results from these "control" collections were inconclusive: carangid and exocoetid larvae were abundant both adjacent to *Sargassum* and at the "control" locations. In addition, all five tuna larvae found at the first station sampled in May were collected adjacent to *Sargassum* at the front, and no tuna larvae were found in the "control" collection. However, at the second front sampled, five of the six tuna larvae were collected at a "control" site

A total of eleven scombrid larvae were collected in the seven May collections, and all specimens larger than approximately 6 mm (n = 6) were identified as bluefin tuna based in part on the presence of one or more melanophores on the dorsal surface of the body (Richards et al. 1990). This species of tuna is expected to occur in these waters during this time based on reported spring spawning (McGowan and Richards 1989). The five smaller scombrids were too small to have developed this pigment and could only be identified as tuna larvae, although it is likely that some of these specimens were also bluefin tuna. The distribution of tuna larvae also brings into question the usefulness of our "control" sites; at the first station sampled in May all five tuna collected were found adjacent to *Sargassum* located along a front, but at the second front five of the six tuna larvae collected were found at the two "control" sites approximately 100 m from the front.

In July a single front with associated *Sargassum* was sampled and the "control" site was moved further away (1.5 km) from the front. The abundance and diversity of fishes was greater for both ring and neuston net surface collections taken along the front than at the "control" location; fishes collected along the front represented 14 families, whereas fishes from only seven families were found at the "control" location. It is likely that the increased abundance and diversity of larvae and young juveniles along the front is due to both the convergence of surface waters in this region, and the presence of *Sargassum* habitat. The supposition that the convergence of water masses affects the diversity and abundance of fish larvae is further strengthened by the relatively low diversity and abundance of fishes found in both the ring and neuston net collections taken in July adjacent to large a large patch of *Sargassum* not associated with a front. In addition to the passive accumulation of larvae in frontal zones, several species may spawn in the vicinity of *Sargassum* located along fonts. Results from this ongoing study are limited because of the relatively few collections. Future planned research will not only increase the sample size but will include collections taken along fronts with no associated *Sargassum*. Larvae may accumulate in frontal zones both with and without *Sargassum*, but the growth and survival of larvae may be quite different in both areas.

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