Gulf and Caribbean Research

Volume 12 | Issue 1

January 2000

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Cesar Flores-Coto
Instituto de Ciencias del Mar y Limnologia, Mexico

Fernando Flores-Hernandez
Instituto de Ciencias del Mar y Limnologia, Mexico

Faustino Zavala-Garcia
Instituto de Ciencias del Mar y Limnologia, Mexico

Virgilio Arenas-Fuentes
Instituto de Ciencias del Mar y Limnologia, Mexico

Maria Adela Monreal-Gomez
Instituto de Ciencias del Mar y Limnologia, Mexico

et al.

DOI: 10.18785/gcr.1201.04

Gulf and Caribbean Research Vol. 12, 31–35, 2000

Manuscript received December 31, 1997; resubmitted August 20, 1998; accepted April 7, 1999

OCEANIC AND NERITIC ICHTHYOPLANKTON AT THE EDGE OF THE CONTINENTAL SHELF IN THE SOUTHERN GULF OF MEXICO

César Flores-Coto, Fernando Flores-Hernández, Faustino Zavala-García, Virgilio Arenas-Fuentes, María Adela Monreal-Gómez and David Alberto Salas-de-León

Instituto de Ciencias del Mar y Limnología. Universidad Nacional Autónoma de México. Cd. Universitaria. Apdo. Postal 70-305. México 04510 D.F.

ABSTRACT Oceanic and neritic ichthyoplankton were examined at a single sampling site at the edge of the continental shelf in the southern Gulf of Mexico. Double oblique tows were made with a 60 cm Bongo net fitted with 505 μm mesh netting. Collections were taken every 2 hours over a 24 h period during spring, summer and fall of 1992. Fish larvae were described as either oceanic or neritic depending upon adult life-stage habitat. The larvae of 59 taxa were collected in spring (50 oceanic, 9 neritic), 53 in summer (26 oceanic, 27 neritic) and 55 in fall (22 oceanic, 33 neritic). Larvae were least abundant during spring and most abundant in fall, for both oceanic and neritic taxa. Highest abundances of larvae were collected at night indicating increased gear avoidance during daylight.

Introduction

Several areas in the Gulf of Mexico (GOM) exhibit great biological diversity, including frontal areas of the Loop current (Richards et al. 1993), and transitional zones between oceanic and neritic water, in a wide area around the continental shelf-break in the southern GOM (Flores-Coto et al. 1988, Sanvicente-Añorve 1990, Flores-Coto et al. 1993). This paper describes the variation in ichthyoplankton composition and abundance, and the possible causes of this variation at a fixed sampling site at the edge of the continental shelf in the southern GOM.

This transitional area, where oceanic and neritic provenance communities meet, is dynamically complex and exhibits large seasonal variation in the location, extent and composition of ichthyoplankton assemblages (Sanvicente-Añorve et al. 1998). The origin of this variation in composition and abundance has not been well studied but is likely due to the mixing of oceanic, neritic and even estuarine water masses.

Materials and Methods

Collections used in this study were obtained at a single site at the edge of the continental shelf (Figure 1) along the 180 m isobath (19⁰33'5"N, 92⁰37'5"W). Sampling was conducted every 2 hours during one 24 h period in spring, summer and fall of 1992. Collections were taken with paired 60 cm Bongo nets fitted with 505 μm mesh and calibrated flowmeters. Double oblique tows were made to a maximum depth of 170 m at a speed of 2 knots (1 m s^{-1}).

All fish larvae were sorted and identified to the lowest taxonomic level possible. Each taxon (genus or species) was classified according to the habitat most commonly frequented by the adult life stage. Four habitats were considered: oceanic (O); neritic-pelagic (NP); neritic-demersal (ND); and reef (R). The abundance was standardized as larvae per 100 m^3 and presented as the mean of the 24 h cycle. Larval engraulids and gobiids were not considered in our analysis because larvae in these 2 families cannot be reliably identified to genus or species level.

Results

Larvae of 103 taxa were identified in these collections; 57 were oceanic, 9 neritic-pelagic, 34 neritic-demersal, and 3 reef (Table 1). The oceanic taxa were comprised mainly by members of the mesopelagic families Myctophidae, Gonostomatidae, Paralepididae and Bregmacerotidae. The neritic-pelagic taxa were represented primarily by the Carangidae and Sphy-raenidae. Neritic-demersal forms were represented by species of pleuronectiforms and several perciforms. Mean total abundance of all larvae varied widely among seasons and highest abundances of larvae were collected at night, indicating increased gear avoidance during daylight (Figure 2).

Seasonal Variation

Composition of ichthyoplankton assemblages changed seasonally, but the total taxa number collected remained relatively constant. Of the 17 taxa that occurred in all seasons sampled, 14 were oceanic and 3

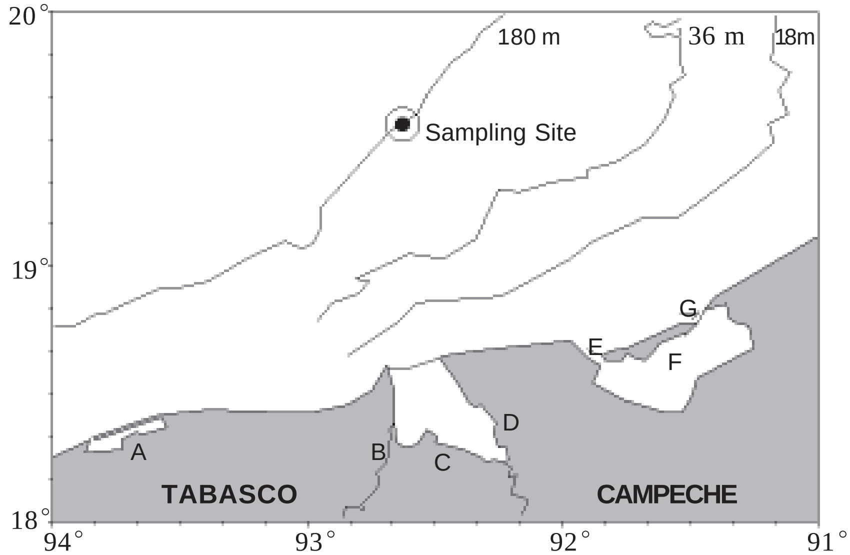

Figure 1. Sampling site location and local bathymetry for ichthyoplankton collections in the southern Gulf of Mexico. A = Carmen and Machona Lagoons; B = Grijalva River; C = Usumacinta River; D = San Pedro y San Pablo River; E = Carmen Inlet; F = Terminos Lagoon; G = Puerto Real Inlet.

were neritic-demersal. In spring, a total of 59 taxa were collected: 50 were oceanic; 9 were neritic-demersal; and 25 taxa occurred only in this season (Table 2). During summer, a total of 53 taxa were collected: 26 were oceanic; 4 were neritic-pelagic; and 23 were neritic-demersal. Fourteen of these taxa occurred only during summer. In fall, a total of 55 taxa were collected: 22 oceanic; 7 neritic-pelagic; 23 neritic-demersal; and 3 reef taxa. Seventeen of these were found only in fall, and most of these latter were neritic forms (Table 2). Of the species collected exclusively in fall only one was oceanic.

Collections from oceanic habitat were most diverse during spring when the number of taxa were about 50% greater than during summer or fall. Taxa occurring exclusively in one of the 3 seasons accounted for 9.7% of the total abundance of fish larvae. These taxa together represented 54% of all taxa identified, and most of them occurred in spring. Mean larvae abundance obtained from each 24 h cycle were 20, 42 and 56 larvae

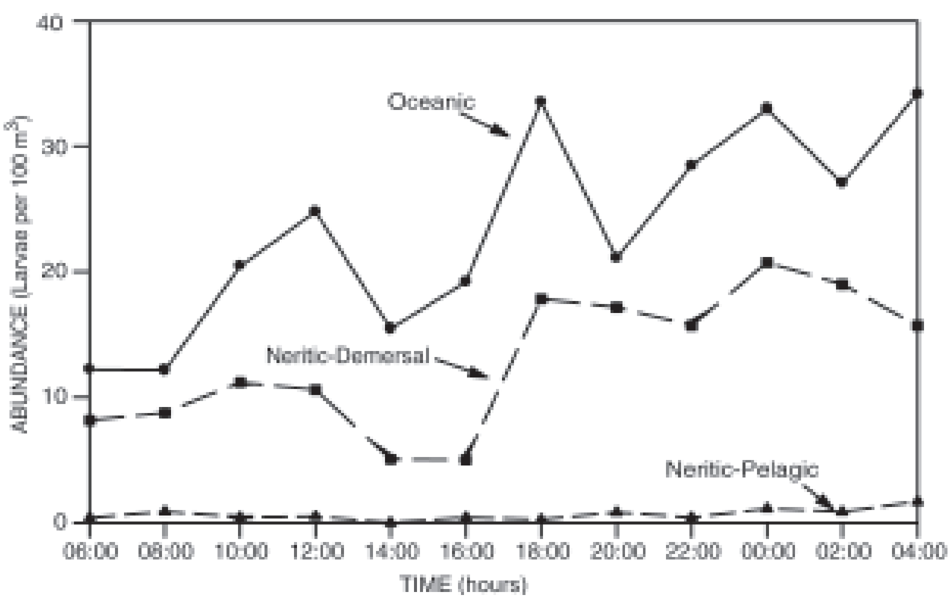

Figure 2. Mean total abundance of fish larvae per 100 m^3 captured every 2 hours over a 24 h cycle during spring, summer, and fall in 1992 in the southern Gulf of Mexico.

TABLE 1

Composition and abundance (larvae per 100 m³) of ichthyoplankton that could be identified to at least genus during spring, summer, and fall in 1992 at a single site in the southern Gulf of Mexico. Adult habitats are coded as: O = oceanic; ND = neritic-demersal; NP = neritic-pelagic; and R = reefs. Larvae of the families Engraulidae and Gobiidae were not included in this summary.

	Adult habitat	Spring	Summer	Fall		Adult habitat	Spring	Summer	Fall
Conger oceanicus	R			1.88	*Bregmaceros maclellandii*	O		0.03	
Neoconger mucronatus	R			1.99	*Bregmaceros* sp.	O		0.03	
Ophichthus spp.	ND	0.23		0.16	*Syngnathus* sp.	ND		0.18	
Pisodonophis sp.	ND		0.15	0.14	*Scorpaena sp.*	ND		0.06	
Pisodonophis cruentifer	ND			1.47	*Scorpaenodes* sp.	ND	0.16	0.04	
Myrophis punctatus	ND			0.83	*Sebastes* sp.	ND			0.03
Etrumeus teres	NP			0.03	*Serranus* spp.	ND		0.45	0.04
Bathylagus spp.	O	0.13	0.07	0.13	*Centropristis* spp.	ND		0.03	0.03
Cyclothone spp.	O	0.04			*Diplectrum* spp.	ND		0.06	0.10
Cyclothone braueri	O	0.83	1.22	4.65	*Gonioplectrus* sp.	ND			0.04
Maurolicus muelleri	O	1.56	1.35	3.85	*Hemanthias* sp.	ND			0.04
Vinciguerria sp.	O	0.04			*Anthias* sp.	ND			0.04
Vinciguerria poweriae	O	0.17			*Caranx* sp.	NP			0.04
Vinciguerria nimbaria	O	0.04			*Chloroscombrus chrysurus*	NP		0.70	0.06
Gonostoma elongatum	O	0.22	0.60		*Decapterus punctatus*	O		0.20	
Pollichthys mauli	O	1.46	0.20	5.59	*Selar crumenophthalmus*	NP		0.24	0.04
Diplophos taenia	O			0.04	*Selene spixii*	NP		0.17	
Argyropelecus sp.	O	0.06			*Selene setapinnis*	NP		0.13	
Synodus foetens	ND		4.89	5.64	*Trachurus lathami*	NP			0.03
Trachinocephalus myops	ND		0.06	0.22	*Gerres* spp.	ND	0.26	0.13	
Paralepis sp.	O	0.06			*Mugil cephalus*	ND		0.12	0.04
Paralepis atlantica	O	1.52			*Mugil curema*	ND			0.06
Lestidiops jayakari	O	0.73			*Sphyraena* sp.	NP			0.04
Lestidiops affinis	O	0.13			*Sphyraena barracuda*	NP			0.03
Lestidium atlanticum	O	0.32		0.17	*Naso* sp.	R			0.04
Lestrolepis intermedia	O	0.54			*Microdesmus* spp	ND	0.24	0.06	
Notolepis rissoi	O	0.30	0.10		*Diplospinus* sp.	ND		0.03	0.32
Macroparalepis breve	O	0.16			*Diplospinus multistriatus*	ND	0.28	0.10	0.19
Scopelarchus analis	O		0.12		*Thunnus* spp.	O	0.19		0.06
Diaphus spp.	O	0.98	0.55	2.22	*Thunnus thynnus*	O	0.10		
Benthosema suborbitale	O	0.28	2.13	0.56	*Thunnus alalunga*	O	0.04		
Notolychnus valdiviae	O	0.52	0.24		*Thunnus albacares*	O	0.30	0.04	
Lampanyctus spp.	O	0.11			*Acanthocybium solanderi*	O	0.03		0.04
Myctophum asperum	O	0.07		0.21	*Auxis* sp.	O	0.03		
Myctophum nitidulum	O	0.27	0.35	0.13	*Scomber japonicus*	O		0.03	
Myctophum obtusirostre	O	0.07	0.03	0.93	*Scomberomorus cavalla*	O		0.27	0.07
Myctophum punctatum	O	0.55	0.22	0.04	*Xiphias* sp.	O	0.04		
Hygophum taaningi	O	0.59	0.06	0.04	*Istiophorus americanus*	O	0.35		
Hygophum macrochir	O	0.20	0.03		*Cubiceps pauciradiatus*	O	0.04		
Hygophum hygomii	O	0.91	2.12		*Bothus ocellatus*	ND		1.30	3.50
Hygophum reinhardtii	O	0.07			*Citharichthys* sp.	ND		0.06	0.04
Hygophum benoiti	O	0.07			*Citharichthys spilopterus*	ND	0.04		0.58
Lobianchia gemellarii	O	0.10			*Citharichthys cornutus*	ND			0.04
Diogenichthys atlanticus	O	0.48	0.24	0.03	*Syacium gunteri*	ND	0.07	3.95	3.78
Lepidophanes gaussi	O	0.07			*Engyophrys* sp.	ND		0.03	
Ceratoscopelus maderensis	O	0.96	1.58	0.58	*Engyophrys senta*	ND	0.04		
Notoscopelus resplendens	O	0.06		0.04	*Etropus* spp.	ND		1.08	
Lampadena spp.	O	0.03		0.26	*Cyclopsetta fimbriata*	ND		0.22	
Lampadena luminosa	O	0.32			*Symphurus* sp.	ND		1.70	
Loweina rara	O	0.07			*Symphurus plagiusa*	ND	0.03	2.83	1.72
Bregmaceros atlanticus	O	1.44	0.41	0.54	*Monacanthus hispidus*	ND		0.03	
Bregmaceros cantori	O	0.75	10.64	12.34	TOTAL		19.75	41.60	55.75

TABLE 2

Number of taxa whose larvae were captured during spring, summer, and fall in 1992 at a single site in the southern Gulf of Mexico. Numbers in parentheses are larvae per 100 m^3. [1]Total unique taxa found related to each habitat, pooled across all seasons.

		OCEANIC	NERITIC PELAGIC	NERITIC DEMERSAL	REEFS	TOTAL TAXA
SPRING	Total	50 (18.40)		9 (1.35)		59 (19.75)
	Spring only	24		1		25
SUMMER	Total	26 (22.86)	4 (1.24)	23 (17.56)		53 (41.66)
	Summer only	5	2	7		14
FALL	Total	22 (32.52)	7 (0.24)	23 (19.08)	3 (3.91)	55 (55.75)
	Fall Only	1	5	8	3	17
TOTAL[1]		57	9	34	3	103

per 100 m^3 in spring, summer and fall, respectively (Table 1). Larvae were 3 times more abundant in fall than in spring, and the abundance of oceanic fish larvae was always higher than those of neritic habitat regardless of season. Oceanic fish larvae abundance and taxa number varied inversely, while the neritic group varied directly (Figure 3).

DISCUSSION

Most oceanic and neritic species of fishes in the southern GOM reproduce all year long with spawning peaks in spring and summer (Flores-Coto et al. 1988, Flores-Coto and Ordoñez-López 1991, González-Felix 1994). However, at our study site larvae of oceanic and neritic fishes were most abundant in fall and not in spring and summer as expected based on times of reproductive peaks. Larvae of neritic fishes were particularly scarce in spring, and although the abundance of larval oceanic fishes was also relatively low in spring, the highest larval richness of oceanic fishes was found at this time. These results indicate that our study site is not a major spawning area for either group of fishes.

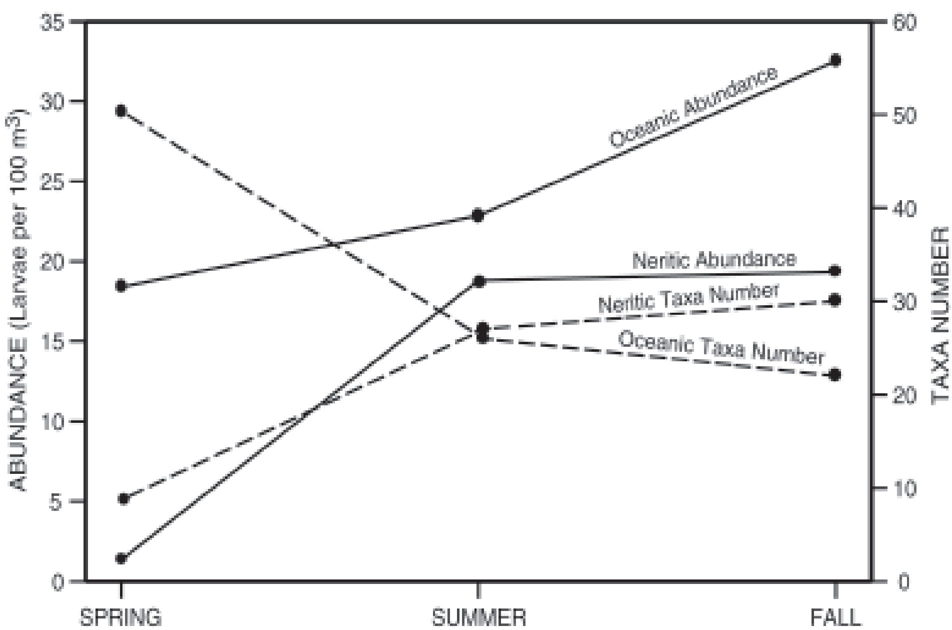

Figure 3. Total taxa number (dashed line) and mean abundance pooled by time (solid line, per 100 m^3) of oceanic and neritic fish larvae during spring, summer, and fall in 1992 at one site in the southern Gulf of Mexico.

Seasonal variations in larval abundance and taxa richness may be caused in part by seasonal currents. The Campeche Bay is dominated by the presence of a large cyclonic eddy, which varies in size and duration (Salas de León and Monreal-Gómez 1986, Velasco-Mendoza 1989, Monreal-Gómez and Salas de León 1990, Vázquez de la Cerda 1993). The effects of this cyclonic eddy, in conjuntion with cold winter winds (northerns) and the discharge from several rivers, combine to play an important role in the hydrodynamics of this area. These undoubtedly influence the variation of the ichthyoplankton composition and abundance at our study site. Salas de León et al. (1998) found that the cyclonic eddy modified the position of the principal axis of the Grijalva-Usumacinta front moving it westward in spring, and eastward in winter. These authors showed that strong westward mesoscale currents in spring displace the haline front to the west of the Grijalva-Usumacinta embrouchure, allowing the penetration of oceanic taxa. In summer, the eddy currents are less intense and the coastal front shows its maximum penetration in the GOM establishing a balance between the oceanic and neritic taxa. During fall, the front moves to the east of the Grijalva-Usumacinta axis and the resulting currents move northeastward (Monreal-Gómez and Salas de León 1990), explaining, in part, the higher abundance of the neritic taxa during fall at our study site.

Neritic taxa spawn mainly in mid-shelf areas, shallower than 110 m (González-Felix 1994). Spawning of some of these taxa, including the sciaenids, is limited to the inner-shelf and these larvae are apparently unable to reach our study site. Larvae of oceanic species were more abundant than larvae of neritic species during each of the 3 seasons examined, indicating a greater influence of oceanic waters in our study area. Highest abundances of larvae were also collected at night, indicating increased gear avoidance during daylight.

In conclusion, our study area is a dynamic region of the GOM as evidenced by the large number of taxa (103) identified. Larvae were least abundant during spring and most abundant in fall for both oceanic and neritic taxa, although the richness of oceanic taxa was greatest in spring. Larvae of reef fishes were rarely found and only 3 taxa were identified.

ACKNOWLEDGMENTS

We express our thanks to the Dirección General de Personal Académico of the Universidad Nacional Autónoma de México for support of this study through program IN202292. We also thank the crew of the R/V *Justo Sierra*. Special thanks to Drs. B.H. Comyns and M.S. Peterson whose hard work and criticisms substantially improved this paper.

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