ICHTHYOPLANKTON IN NERITIC WATERS OF THE NORTHERN GULF OF MEXICO OFF LOUISIANA: COMPOSITION, RELATIVE ABUNDANCE, AND SEASONALITY

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ABSTRACT

Ichthyoplankton samples were collected monthly between November 1981 and October 1982 in neritic continental shelf waters off Louisiana. The survey provided the first quantitative data on the abundance and seasonal occurrence of larval fishes from open coastal waters of this area. At least 48 families of fishes were represented in samples that included 107 taxa, 54 of which were identified to species. Larval densities were lowest during the winter and highest during the summer with a mean monthly density of 208/100 m^3. Five families accounted for about 90% of total larvae: Engraulidae, Sciaenidae, Clupeidae, Carangidae, and Bothidae. The five most abundant taxa overall, in order of decreasing abundance, were anchovies (Engraulidae); Atlantic croaker, *Micropogonias undulatus*; Atlantic thread herring, *Opisthonema oglinum*; gulf menhaden, *Brevoortia patronus*; and Atlantic bumper, *Chloroscombrus chrysurus*. These taxa accounted for 82% of all larvae collected. Comparison of ichthyoplankton surveys throughout the Gulf of Mexico showed that the 10 most abundant families contributed over 90% of total larval abundance in coastal surveys but less than 70% in offshore surveys. Likewise, the five most abundant taxa contributed over 80% of total larval abundance in all but one of the coastal surveys but less than 40% in the offshore surveys. These data suggest that compared with offshore waters, there are relatively fewer dominant taxa among the ichthyoplankton in neritic waters of the Gulf of Mexico.

The northern Gulf has traditionally been one of the most productive fishery areas in North America (Gunter 1967), yet seasonality and abundance of larval fishes from open waters are poorly known. Previous studies of early life history stages in this area have mainly been focused either on select taxa (Turner 1969; Fore 1970, 1971; Christmas and Waller 1975; Fruge 1977; Ditty 1984; Cowan 1985; Shaw et al. 1985) or to surveys limited in temporal and areal coverage (Walker 1978; Ditty and Truesdale 1984). Stuck and Perry (1982) surveyed the ichthyoplankton community adjacent to Mississippi Sound, while Marley (1983) conducted an egg survey and Williams (1983) a larval fish survey of lower Mobile Bay, AL. The most comprehensive studies of the offshore larval ichthyofauna in the Gulf of Mexico and adjacent areas were those of Finucane et al. (1977) from the south Texas outer continental shelf; Houde et al. (1979) from the eastern Gulf of Mexico off Florida; Richards (1984) from the Caribbean Sea; and Powles and Stender (1976) from the South Atlantic Bight area off the east coast of the United States. The objective of this paper is to provide quantitative data on the abundance and seasonal occurrence of larval fishes from open coastal waters of the northern Gulf of Mexico off Louisiana.

MATERIALS AND METHODS

Plankton samples were collected monthly between November 1981 and October 1982 (except March 1982) in neritic continental shelf waters off Louisiana. Samples were collected at six stations in a 3.2 km^2 area located about 12.9 km south-southwest of Caminada Pass, in depths of 10-12 m (Fig. 1). Collections were made with a 60 cm paired-net, opening and closing bongo-type BNF-1 sampler[2], each net was of 0.363 mm Nitex[3] mesh. Nets were lowered to depth, opened, and towed simultaneously, in series, at discrete depths (surface, middepth, and near-bottom) for about 3 min, at a ship speed of approximately 1.5 kn; all samples were collected during the day. A General Oceanics (Model 2030) flowmeter was placed in the mouth of each net to estimate volume filtered. Samples were preserved in seawater with buffered Formalin and returned to the laboratory for sorting. Fish larvae were removed from each net and identified to the lowest

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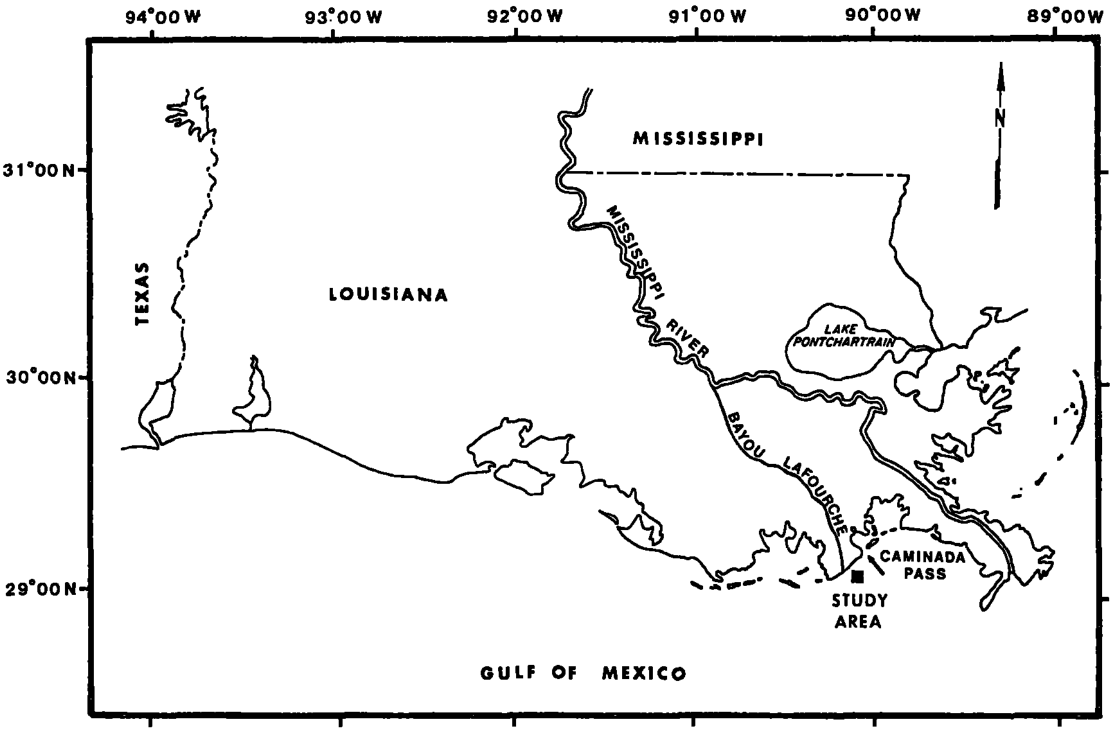

FIGURE 1.—Location of study area.

possible taxon, and standard length was measured with an ocular micrometer; all specimens were subsequently archived in 70% ethanol. Hydrographic profiles of the water column were taken at approximately 1-1.5 m intervals with a Martek Mark VI water quality monitor, except during January, February, and September 1982 when the Martek unit was inoperable. During these 3 mo, water temperatures and salinities were measured with a Beckman RS-5 inductive salinometer near surface, middepth, and bottom. Estimates of monthly mean larval densities were calculated by dividing total larvae by total volume filtered at each depth and integrated over depth. Densities are expressed as number/100 m^3. Seasonal designations were based primarily on mean surface water temperatures during the year: <20°C (Winter: December-February); 20°-25°C (Spring: April-May); >25°C (Summer: June-August); and rapidly declining surface water temperatures (Fall: September-November).

Additional data on larval occurrence and seasonality only were compiled from surface-towed meter net (0.363 mm mesh) collections at stations sampled between January 1981 and December 1982. These data consisted of four nearshore stations located adjacent to the bongo stations and were sampled monthly. Two additional groups of stations, one of four and the other of five stations, were located about 24 km south of the nearshore stations in depths of about 30 m. Each group of offshore stations was sampled quarterly but on consecutive months during 1981; thereafter, monthly samples were collected only at the four station group. These seasonality data are not discussed but are included in the Appendix Table.

Ancillary occurrence and seasonality data on larval bothids, scombrids, and sciaenids collected off Louisiana during the spring and early summer of 1982 were compiled from surface-towed 0.5 m ring net (0.505 mm mesh), 60 cm bongo net (0.333 mm mesh), and surface-towed 1 × 2 m neuston net (0.946 mm mesh) samples (SEAMAP 1983). Bongo tows were oblique and from the surface to 200 m or within 5 m of the bottom at shallower depths. Seasonality data for these taxa were compiled only from stations located between long. 88°30′W and 93°30′W and shoreward of lat. 27°00′N and, although not discussed, are also included in the Appendix Table. Additional station and cruise data are provided in Richards et al. (1984).

RESULTS

Taxonomic Problems

Larvae of many fishes in the northern Gulf of Mexico are poorly known and taxonomic problems are common, even in some of the most abundant taxa. No attempt was made to identify blennies, gobies, myctophids, synodontids, or cynoglossids to species because of the paucity of literature on larval development for these taxa. Little is also known about the taxonomy and morphological development of engraulid larvae. At least five species of engraulids are known to occur as adults in the north-central Gulf: *Anchoa mitchilli*, *A. hepsetus*, *A. lyolepis*, *A. cubana*, *Anchoviella perfasciata* (Modde and Ross 1981), and possibly *Engraulis eurystole* (Hastings 1977). *Anchoa mitchilli*, *A. hepsetus*, and *A. lyolepis* probably account for most of the engraulid larvae collected. Larvae of *A. hepsetus* and *A. mitchilli* in the Chesapeake Bay Region can be distinguished from each other primarily on placement of dorsal and anal fins (Manseuti and Hardy 1967), but this character is insufficient to separate reliably the additional species of anchovy that may occur in this area. Separation of menhaden larvae is also difficult. Three species of menhaden are known to occur as adults in this area: *Brevoortia smithi* (Chandeleur Sound, LA, eastward), *B. patronus* (Tampa Bay, FL, westward to Veracruz, Mexico) and *B. gunteri* (Mississippi Sound, MS, westward) (Christmas and Gunter 1960; Springer and Woodburn 1960; Dahlberg 1970; Turner 1971). Published descriptions are available for laboratory-reared larvae of *B. smithi* (Houde and Swanson 1975) and *B. patronus* (Hettler 1984) only. *Brevoortia gunteri* have never been described nor positively identified from the northern Gulf. Although the congeners have spawning seasons that reportedly overlap, the center of spawning of *B. patronus* is apparently off Louisiana between the Mississippi and Atchafalaya River Deltas (Turner 1969; Fore 1970; Christmas and Waller 1975). Since *Brevoortia* larvae collected during this study appear similar to that described as *B. patronus* (Hettler 1984) and because I have recognized in subsequent samples (at sizes >7 mm SL) a second morph that could be *B. gunteri*, all larvae were considered *B. patronus*.

Published descriptions of sciaenid larvae are inadequate to reliably distinguish between small larvae of the species of *Menticirrhus* (*M. americanus*, *M. littoralis*, and *M. saxatilis*) or between small *Cynoscion arenarius* and *C. nothus*. Two types of *C. arenarius* larvae were recognized primarily on the absence (Type A) or presence (Type B) of pigment in the dorsal midline immediately above the enlarged melanophore located in the ventral midline about midway along the anal fin base. Additional data on the separation of these types are provided in Cowan (1985). Small carangid larvae (<5 mm SL) of certain taxa are also difficult to identify and were referred to a morphological type when a generic or specific epithet could not be assigned. The taxonomy and/or larval development of some of the other monthly dominants (e.g., *Lepophidium* spp., *Ophidion* spp., *Auxis* spp., and *Ariomma* sp.) are poorly understood.

Hydrography

Water temperatures between November 1981 and October 1982 ranged from 16°C in January and February to 31°C in June and were below 20°C from December through February and above 25°C from May through October. There was little thermal stratification except during the summer, with stratification most pronounced in June (Fig. 2A).

Salinity stratification was most pronounced from February through August, with little stratification from September through January. Salinities were lowest near the surface, increased with depth, and ranged from <20‰ near the surface in February to 32‰ in December; salinities near the bottom ranged from 31‰ in September to 36‰ in the spring and early summer. Salinities near the surface steadily decreased from April through July and increased thereafter, whereas those near the bottom were comparatively more stable throughout the study period (Fig. 2B). In February, there was a distinct salinity gradient within the upper 6 m of the water column that ranged from 18‰ at the surface to 30‰ near middepth. In June, two distinct water masses were present with a halocline near middepth. Salinities of these two water masses differed by about 10‰ with the less saline waters above middepth (Fig. 2B). Further information on water temperature and salinity variability and the physical processes that affect the hydrography of the study area are provided in Wiseman et al. (1982).

Seasonal Composition and Abundance

At least 48 families of fishes were represented in bongo net samples that included 107 taxa, 54 of which were identified to species. About 36,500 larvae were collected, with <5% (primarily damaged or yolk-sac larvae) unidentifiable to family. The majority of larvae collected were <5 mm SL except

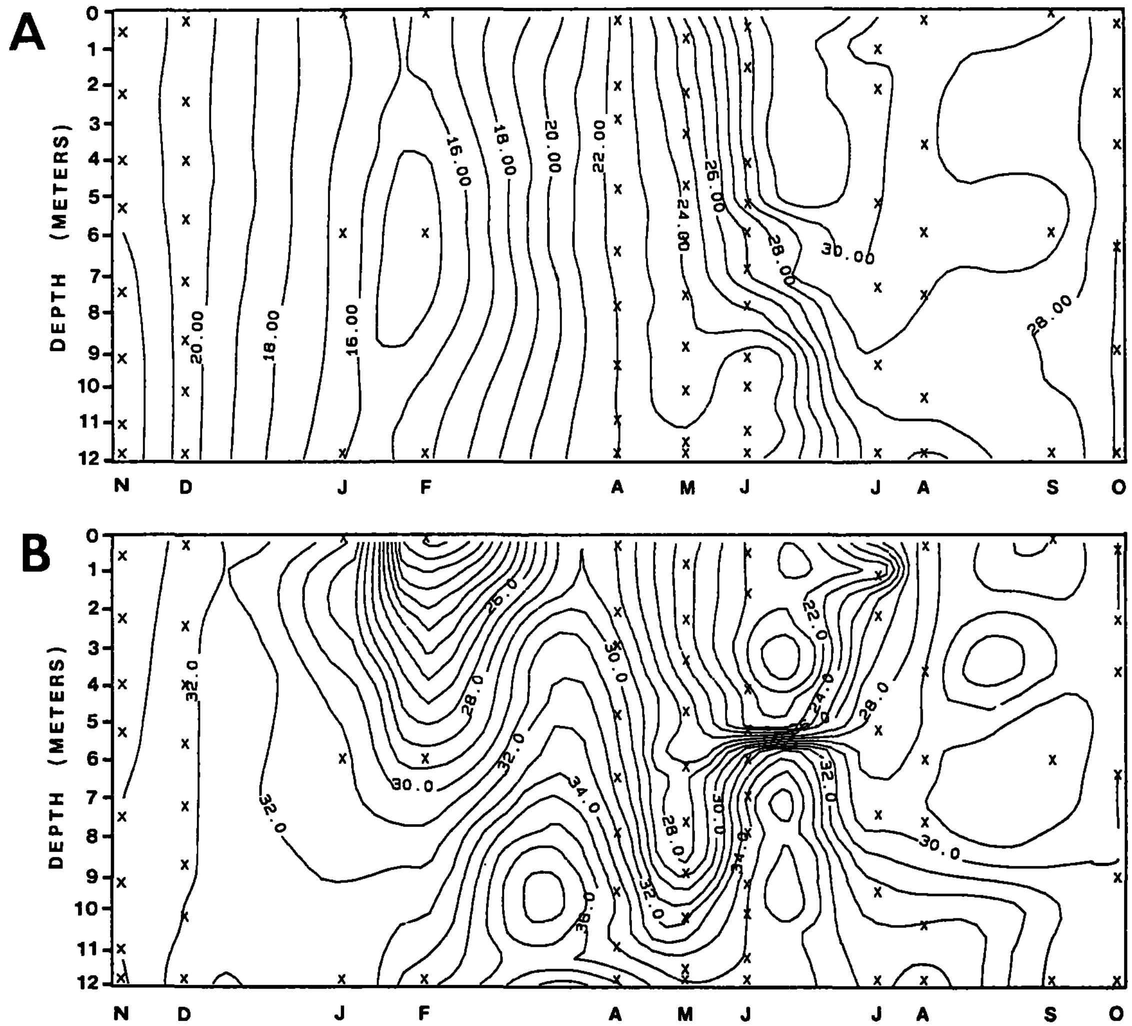

FIGURE 2.—Profiles of water temperature and salinity (November 1981-October 1982) at a representative station from the study area located in neritic waters of the northern Gulf of Mexico off Louisiana. A. Water temperature, B. Salinity. X indicates sampling depths. Collection dates were scaled by Julian calendar.

larvae of clupeiform fishes; these were usually <10 mm SL.

Generally, seasonal larval densities followed water temperatures (T) and were lowest during winter ($\bar{X}$ = 51/100 m^3 at T <20°C), increased during the spring ($\bar{X}$ = 207/100 m^3 at T <25°C), peaked during the summer ($\bar{X}$ = 394/100 m^3 at T near 30°C), and declined during the fall ($\bar{X}$ = 179/100 m^3 at rapidly declining T). Approximately 6% of all fish larvae were collected during the winter and 47.5% during the summer. Larval densities were lowest in December and highest in June, with a mean monthly density of 208/100 m^3 (Fig. 3). Overall, December had the fewest taxa (13) and September the most (37). Five families accounted for about 90% of total larvae: Engraulidae, Sciaenidae, Clupeidae, Carangidae, and Bothidae. The five most abundant taxa overall, in order of decreasing abundance, were anchovies (Engraulidae); Atlantic croaker, *Micropogonias undulatus*; Atlantic thread herring, *Opisthonema oglinum*; gulf menhaden, *Brevoortia patronus*; and Atlantic bumper, *Chloroscombrus chrysurus*. These taxa accounted for about 82% of all larvae taken. Thirty-eight taxa occurred in sufficient numbers that they were within the 10 most abundant taxa collected in at least one month. Densities of these taxa are presented in Table 1.

Anchovies accounted for about 49% of all larvae and were collected throughout the year, but were most abundant in June and least abundant in November (Table 1). Anchovies accounted for 65% of all larvae taken during the spring and 69% during the summer, but declined to about 6% of all larvae collected during the fall and winter, respectively; anchovies were the second most abundant taxon collected during the winter and were fourth during the fall. Most anchovy larvae were collected near the surface and middepths; only 11% were collected near the bottom. A few flat anchovy, *Anchoviella perfasciata*, postlarvae were collected in February only.

Atlantic croaker accounted for 66% of all sciaenid larvae and were most abundant in November (Table 1). This species accounted for 58% of all larvae taken during the fall and for 14% of larvae overall. Most Atlantic croaker (65%) were collected near middepth with only 1% collected near the surface. Two types of sand seatrout, *Cynoscion arenarius*, were recognized with Type A collected from April to September and Type B from April to October. Of all sand seatrout larvae taken, 60% were Type A and 40% Type B, with Type A the second and Type B the third most abundant of all sciaenid larvae. Density of Type A exceeded that of Type B until September

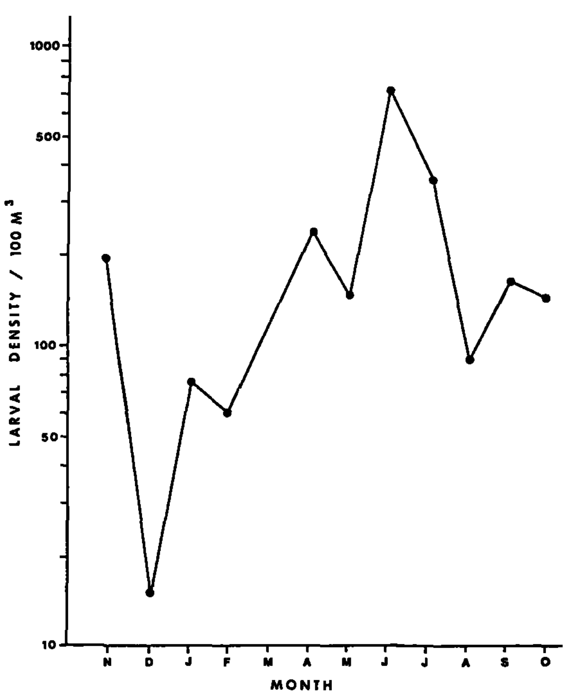

FIGURE 3.—Density of ichthyoplankton (no./100 m^3) by month, from neritic Gulf of Mexico waters off Louisiana, November 1981-October 1982.

and October when Type B were more abundant (Table 1). Most Type A (66%) and Type B (56%) larvae were collected near the bottom with <5% of Type A and of Type B larvae, respectively, collected near the surface. Larvae of red drum, *Sciaenops ocellatus*, were taken during the fall only and were most abundant in September, whereas *Menticirrhus* spp. were collected in all months except December and January and were most abundant in October (Table 1). Larval densities of other less abundant sciaenids that included black drum, *Pogonias cromis*; banded drum, *Larimus fasciatus*; spot, *Leiostomus xanthurus*; silver perch, *Bairdiella chrysoura*; and silver seatrout, *Cynoscion nothus*, never exceeded 1/100 m^3. Densities of star drum, *Stellifer lanceolatus*, and spotted seatrout, *C. nebulosus*, were <2/100 m^3 for any month.

Larvae of both the scaled sardine, *Harengula jaguana*, and Atlantic thread herring were collected from April to October, whereas gulf menhaden were collected from October to February and round herring, *Etrumeus teres*, only in January and February. No larvae of Spanish sardine, *Sardinella* sp., were identified. Densities of Atlantic thread herring were greatest in June, scaled sardine in July, and gulf menhaden in January. Densities of Atlantic thread herring accounted for about 58% of all clupeid larvae and for 9% of larvae overall; gulf menhaden accounted for 34% of all clupeids and for 5% of larvae overall. Scaled sardine accounted for 8% of all clupeid larvae. Atlantic thread herring was the second most abundant taxon collected in each season except winter, and accounted for 88% of all clupeid larvae collected between April and October; gulf menhaden accounted for 73% of all winter larvae. Over 99% of Atlantic thread herring and 80% of scaled sardine were collected when surface water temperatures were above 25°C; 90% of gulf menhaden were taken at water temperatures below 20°C. Most scaled sardine (79%) larvae were taken near the surface and only 2% near the bottom. Menhaden larvae were abundant at all depths with 37% collected near the surface and 24% near the bottom. Atlantic thread herring were most abundant near middepth (62%) and least abundant near the surface (6%).

Larvae of Atlantic bumper were collected from June to October but were most abundant in July. This species accounted for about 5% of all larvae and was the third most abundant taxon collected during both the summer and fall months. Atlantic bumper accounted for about 94% of all carangid larvae with most bumper (94%) collected when surface water temperatures averaged 30°C. Atlantic

TABLE 1.—Densities (no./100 m^3) of abundant taxa from neritic waters of the northern Gulf of Mexico off Louisiana, November 1981-October 1982[1].

Taxa	Nov.	Dec.	Jan.	Feb.	Apr.	May	June	July	Aug.	Sept.	Oct.
Engraulidae	0.8	4.0	1.6	2.9	193.8	74.3	598.1	213.4	3.0	27.6	3.3
Brevoortia patronus	7.3	2.7	67.1	41.0	—	—	—	—	—	0.8	1.4
Etrumeus teres	—	—	0.4	0.2	—	—	—	—	—	—	—
Opisthonema oglinum	—	—	—	—	0.3	52.1	71.9	2.3	16.6	62.5	([2])
Harengula jaguana	—	—	—	—	5.7	0.2	—	11.9	9.5	0.2	([2])
Synodontidae	([2])	—	([2])	0.6	—	0.3	—	—	—	—	—
Myctophidae	([2])	—	1.0	7.2	0.4	—	—	—	—	—	—
Bregmaceros cantori	0.4	([2])	—	0.1	0.3	0.5	—	—	—	—	0.1
Lepophidium spp.	0.9	—	—	—	—	—	—	—	—	—	—
Ophidion spp.	0.6	—	—	—	—	—	—	—	—	—	—
Membras martinica	—	—	—	([2])	1.0	([2])	—	—	—	—	—
Carangidae Type A	—	—	—	—	—	1.5	—	—	—	—	—
Chloroscombrus chrysurus	—	—	—	—	—	—	7.8	48.3	13.5	39.2	6.7
Oligoplites saurus	—	—	—	—	—	—	1.3	2.8	—	—	—
Trachurus lathami	—	—	—	0.4	—	—	—	—	—	—	—
Orthopristis chrysoptera	—	—	—	([2])	1.0	—	—	—	—	—	—
Archosargus probatocephalus	—	—	—	—	2.9	—	—	—	—	—	—
Lagodon rhomboides	([2])	—	0.3	0.4	—	—	—	—	—	—	—
Cynoscion arenarius (Type A)	—	—	—	—	22.5	6.3	7.2	17.2	10.3	1.9	—
Cynoscion arenarius (Type B)	—	—	—	—	10.6	0.8	6.7	11.1	10.2	5.7	1.5
Leiostomus xanthurus	0.8	0.5	0.1	0.2	—	—	—	—	—	—	—
Menticirrhus spp.	([2])	—	—	([2])	1.2	0.4	1.4	2.5	0.1	2.0	5.2
Micropogonias undulatus	182.8	2.8	—	2.2	—	—	—	—	—	—	126.4
Sciaenops ocellatus	—	—	—	—	—	—	—	—	—	12.8	6.3
Stellifer lanceolatus	—	—	—	—	1.4	0.1	1.6	0.3	0.3	0.3	0.2
Chaetodipterus faber	—	—	—	—	—	([2])	0.6	5.5	0.1	1.3	—
Mugil cephalus	—	—	0.4	([2])	—	—	—	—	—	—	—
Blennidae	0.3	1.6	0.6	([2])	2.8	9.0	1.2	2.0	0.2	0.9	0.1
Gobiidae	0.4	1.0	—	0.4	0.6	0.8	0.2	0.2	—	0.2	0.4
Auxis spp.	—	—	—	—	0.2	1.0	—	—	—	0.5	0.1
Scomberomorus maculatus	—	—	—	—	0.5	0.1	1.7	5.5	4.8	1.5	—
Ariomma sp.	—	—	0.7	—	—	—	—	—	—	—	—
Peprilus burti	1.4	0.1	0.5	0.9	0.1	0.2	0.1	—	—	—	0.5
Peprilus paru	—	—	—	—	—	0.4	0.6	0.5	0.6	4.4	([2])
Etropus crossotus	0.4	—	—	—	—	9.0	9.4	1.9	([2])	0.7	0.5
Citharichthys spilopterus	0.4	([2])	0.4	0.6	0.1	—	—	([2])	—	—	—
Symphurus spp.	0.5	0.1	—	—	0.1	1.5	2.8	1.4	0.1	0.5	0.2
Myrophis punctatus	([2])	0.1	0.1	0.2	—	—	—	—	—	—	—

[1]No data for March 1982.
[2]Density <0.1/100 m^3.

bumper were most abundant near middepth (60%) and least abundant near the bottom (9%). Other abundant carangids included leatherjacket, *Oligoplites saurus*; rough scad, *Trachurus lathami*; and carangid Type A larvae. All carangid Type A larvae were <4 mm SL and appear similar to that described as the round scad, *Decapterus punctatus*, by Aprieto (1974).

Larvae of gulf butterfish, *Peprilus burti*, occurred from October to June and harvestfish, *P. paru*, from May to October (Table 1). Most gulf butterfish (85%) larvae were collected when surface water temperatures were <25°C whereas all harvestfish were collected when surface water temperatures were above 25°C. Spanish mackerel, *Scomberomorus maculatus*, larvae occurred from April to September but were most abundant in July; most (96%) were collected when surface water temperatures exceeded 25°C. Most Spanish mackerel (74%) larvae were collected near middepth; only 5% were collected near the bottom. King mackerel, *S. cavalla*, larvae were collected only in September and at a density <0.5/100 m^3.

Many taxa occurred in relatively low abundance, and although not included in Table 1, provided additional data on seasonality. These data are presented in the Appendix Table. Only taxa with larvae <10 mm SL for a given month (except anguilliform leptocephali or sygnathids) were included in the Appendix Table, except where noted.

DISCUSSION

Data on peak seasonal occurrence of many of the abundant taxa from the present study agree with those of other coastal surveys from the north-central Gulf of Mexico off Mississippi (Stuck and Perry 1982) and off Alabama (Williams 1983). During 1982, greatest densities of larval menhaden off central Louisiana (the present study) occurred in

January-February and off western Louisiana (Shaw et al. 1985) in February-March. Stuck and Perry (1982) found larval menhaden most abundant between January and March adjacent to Mississippi Sound. These data agree with past studies (Fore 1970; Christmas and Waller 1981) from this area that reported high densities of menhaden eggs between December and February. All three of the north-central Gulf studies (Stuck and Perry 1982; Williams 1983; and the present study) reported greatest densities of Atlantic croaker during October and November; densities of sand seatrout were greatest in April, with a second smaller peak in density during either July or August. Both Atlantic bumper and Spanish mackerel were most abundant from July to September in each of these three studies. Stuck and Perry and the present study also found the greatest density of red drum in September; Williams did not sample in September. In the present study, Atlantic thread herring were most abundant in June, with a second peak in September; scaled sardine were most abundant during July and August. Few scaled sardine and Atlantic thread herring larvae were collected by Williams; no Atlantic thread herring and few scaled sardine were collected by Stuck and Perry. All three of these north-central Gulf studies also reported a bimodal peak in abundance of engraulids but differed slightly in month of peak density. Stuck and Perry, and Williams found greatest densities in April, with a second smaller peak in August. The smaller of the two peaks in abundance of engraulids occurred in April, with the greatest density in June in the present study (Table 1).

Comparison of dominant families and taxa collected overall in the present study with those of other ichthyoplankton surveys throughout the Gulf of Mexico are presented in Tables 2 and 3. Lower bay/coastal surveys were those conducted primarily inside the 10 m depth contour, except for Hoese (1965), who had a single transect of six stations out to 50 m. Offshore surveys were those conducted mainly in waters deeper than 10 m but shoreward of the edge of the continental shelf. Although not all the data listed in Tables 2 and 3 are directly comparable because of differences in gear type, mesh size, or tow, these studies provide general information on larval composition and abundance.

Most of the surveys from coastal waters (Hoese 1965; Blanchet 1979; Williams 1983; Collins and Finucane 1984; and the present study) found that engraulids dominated the summer ichthyoplankton, whereas Stuck and Perry (1982) reported engraulids second to Atlantic bumper in abundance. However, Stuck and Perry may have undersampled small engraulid and clupeid larvae because of the large mesh (1.050 mm) of their nets. Menhaden dominated the winter ichthyoplankton in all of the aforementioned coastal surveys, except Collins and Finucane (1984). These authors found that pigfish, *Orthopristis chrysoptera*, larvae were the most abundant taxa during the winter in waters off the Everglades of south Florida. All of these surveys also consistently placed engraulids and sciaenids at or near the top in total larval abundance. Overall, clupeids were relatively more abundant off south Florida (Collins and Finucane 1984) than in the other coastal surveys, except Hoese (1965), who sampled only the

TABLE 2.—Comparison of the five most abundant families collected overall from neritic waters off Louisiana with other ichthyoplankton surveys throughout the Gulf of Mexico.

Study	Engraulidae		Sciaenidae		Clupeidae		Carangidae		Bothidae		Location	Gear type, mesh size, depth of tow, and region[1]
	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%		
Present study	1	49.0	2	19.0	3	16.0	4	5.5	5	1.5	Coastal	1,6,9,10,11,15
Hoese 1965	2	42.0	3	7.0	1	45.0	—	0.5	—	0.5	Coastal	2,4,9,14
Stuck and Perry 1982	2	19.7	3	18.2	6	3.4	1	38.8	4	5.6	Coastal	3,8,9,11,15
Williams 1983	1	69.3	2	14.5	3	4.5	4	2.8	—	0.5	Lower Mobile Bay/Coastal	3,7,9,11,15
Blanchet 1979	1	75.8	2	4.9	8	1.9	7	2.2	—	<0.1	Lower Apalachicola Bay/Coastal	2,6,7,9,16
Collins and Finucane 1984[2]	2	22.5	4	6.9	1	24.1	5	6.1	—	<0.1	Coastal	2,7,9,12,18
Finucane et al. 1979[3]	5	6.2	—	<0.1	3	8.1	8	3.7	6	6.1	Offshore	1,7,13,14
Houde et al. 1979	12	2.0	30	0.3	1	20.5	6	3.9	3	6.4	Offshore	1,2,7,12,17

[1]1 60 cm bongo
2 1 m
3 1 × 0.5 m rectangular
4 0.086 mm
5 0.333 mm
6 0.363 mm
7 0.505 mm
8 1.050 mm
9 surface
10 middepth
11 bottom
12 oblique
13 double-oblique
14 west-central
15 north-central
16 north-east
17 east-central
18 south-east

[2]Inshore data only
[3]1977 bongo net data only

TABLE 3.—Comparison of five most abundant taxa from neritic waters off Louisiana with ichthyoplankton surveys throughout the Gulf of Mexico.

Taxa	Present study %	Hoese 1965 %	Stuck and Perry 1982 %	Williams 1983 %	Blanchet 1979 %	Collins and Finucane 1984[1] %	Finucane et al. 1979[2] %	Houde et al. 1979 %
Engraulidae	49.0		19.7	69.0	75.8	22.5	7.1	
Micropogonias undulatus	14.0			5.8				
Opisthonema oglinum	9.0					4.5		7.9
Brevoortia patronus	5.0	15.6		4.3				
Chloroscombrus chrysurus	5.0		38.4	2.8	1.8	4.8		
Harengula jaguana		29.1						
Anchoa hepsetus		24.0						
Anchoa mitchilli		17.7						
Menticirrhus spp.		2.6						
Cynoscion arenarius			12.0	8.2				
Citharichthys-Etropus complex			5.6					
Symphurus spp.			3.8					
Atherinidae					3.9			
Gobiesox strumosus					3.2			
Gobiosoma spp.					2.7			
Microgobius spp.						9.1		
Orthopristis chrysoptera						4.8		
Gobiidae							15.8	15.1
Bregmaceros atlanticus							7.1	
Saurida spp.							6.1	
Syacium spp.							4.1	
Sardinella anchovia								8.6
Decapterus punctatus								3.1
Diplectrum formosum								2.8

[1]Inshore data only.
[2]1977 bongo net data only.

surface waters of his offshore transect (Table 2).

Offshore, Houde et al. (1979) found that clupeids (Spanish sardine and Atlantic thread herring), gobiids, and bothids (mostly dusky flounder, *Syacium papillosum*) dominated summer ichthyoplankton in the eastern Gulf of Mexico off Florida, whereas clupeids (round herring and Spanish sardine), bothids (mostly gray flounder, *Etropus rimosus*), and bregmacerotids dominated the winter. In the western Gulf of Mexico off the south Texas coast, Finucane et al. (1979) reported that, during 1977, clupeids (mostly scaled sardine) and bothids (mostly *Syacium* spp.) dominated the summer and bregmacerotids and clupeids (menhaden) the winter ichthyoplankton. In the northern Gulf of Mexico off Louisiana, Ditty and Truesdale (1984) found that engraulids and carangids (mostly Atlantic bumper) dominated the summer (July 1976), whereas larvae of clupeids (mostly gulf menhaden) and gobiids dominated the winter (January-February 1976). The most abundant families collected overall off Florida were clupeids and gobiids (35.6% of all larvae), and off south Texas were gobiids and synodontids (26.7% of all larvae). The kinds of larvae (gobiids, bothids, clupeids, and bregmacerotids) that dominated these two offshore surveys were similar, but with clupeids and bothids relatively more abundant off Florida than Texas; engraulids were relatively more abundant off south Texas than off Florida (Table 2). Ditty and Truesdale (1984) found clupeids and engraulids most abundant overall (67.7% of all larvae), but their surveys were too limited temporally and in areal coverage for adequate comparison to the other two offshore surveys.

The 10 most abundant families accounted for 66.6% of all larvae collected off Florida (Houde et al. 1979) and for 68.6% off south Texas (Finucane et al. 1979). In contrast, the top 10 families in each of the coastal surveys contributed over 90% of all larvae collected. Likewise, the five most abundant taxa contributed over 80% of all larvae collected in all but one (Collins and Finucane 1984) of the coastal surveys but <40% in the two offshore surveys (Table 3).

In conclusion, there was general agreement among all three coastal surveys from the north-central Gulf of Mexico on peak seasonal occurrence of many of the abundant taxa and on the dominant families in overall larval abundance. Comparison of other coastal and offshore ichthyoplankton surveys throughout the Gulf of Mexico with the present study suggests that, when compared with offshore waters, there are relatively fewer dominant taxa among the ichthyoplankton in neritic waters of the Gulf of Mexico.

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APPENDIX TABLE.—Seasonality of larval fishes in the northern Gulf of Mexico off Louisiana, January 1981-December 1982.

Taxa	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Neoconger mucronatus										----		
Muraenidae				----	----							
Gymnothorax sp.				----	----							
Hoplunnis sp.	----	----										
Congridae							----					
Ophichthidae				----					----		----	
Bascanichthys bascanium								----	----			
Myrophis punctatus	----	----									----	----
Ophichthus gomesii							----		----			
Pseudomyrophis 'D'											----	
Brevoortia patronus	----	----	----	----					----	----	----	----
Etrumeus teres	----	----										
Harengula jaguana				----	----	----	----	----	----	----		
Opisthonema oglinum				----	----	----	----	----	----	----		
Sardinella sp.										----		
Engraulidae	----	----	----	----	----	----	----	----	----	----	----	----
Anchoviella perfasciata[1]	----	----							----			----
Gonostomatidae		----	----	----								----
Cyclothone sp.	----	----	----	----	----						----	
Vinciguerria nimbaria	----	----		----								
Synodontidae	----	----	----	----	----		----				----	
Paralepidae		----			----							
Lestidiops affinis		----										
Myctophidae	----	----	----	----	----					----	----	----
Centrobranchus nigroocellatus												----
Diaphus sp.											----	
Diogenichthys atlanticus		----										
Hygophum sp.		----										
Lampanyctus sp.		----										
Gobiesox strumosus		----	----	----	----							
Ceratiodei					----							----
Antennariidae				----						----		
Gigantactinidae					----							
Bregmaceros cantori	----	----	----	----	----				----	----	----	----
Bregmaceros atlanticus										----	----	
Urophycis spp.	----	----									----	----
Ophidiidae					----				----		----	----
Brotula barbata	----											
Lepophidium spp.										----	----	
Ophidion spp.				----						----	----	
Ophidion welshi/grayi			----							----		
Ophidion selenops			----							----		
Exocoetidae						----			----			----
Hyporhamphus unifasciatus									----			
Atherinidae		----			----				----			
Membras martinica				----	----							
Holocentrus sp.					----							
Macrorhamphosus scolopax	----											
Syngnathus spp.		----		----	----	----	----		----			
Serranidae	----	----	----	----	----					----	----	
Anthinae	----										----	
Hemanthias leptus	----											
Grammistinae											----	
Rypticus maculatus							----					
Serraninae		----	----		----					----		
Serraniculus pumilio										----		
Pomatomus saltatrix				----						----	----	
Carangidae Type A[2]					----			----	----		----	
Carangidae Type B[2]			----				----			----		
Carangidae Type C[2]				----	----	----	----	----	----	----		
Carangidae Type D[2]			----				----	----				
Chloroscombrus chrysurus					----	----	----	----	----	----		
Oligoplites saurus					----	----	----	----				
Selene sp.							----	----	----	----		
Trachurus lathami	----	----										
Coryphaena equiselis					----				----			
Lutjanus sp.							----	----	----	----		
Gerreidae						----			----	----		
Orthopristis chrysoptera		----		----								
Archosargus probatocephalus		----	----	----								

APPENDIX TABLE.—*Continued.*

Taxa	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Lagodon rhomboides	----	----									----	----
Bairdiella chrysoura				----	----	----	----	----	----			
Cynoscion arenarius Type A				----	----	----	----	----	----			
C. arenarius Type B				----	----	----	----	----	----	----		
C. nebulosus				----	----	----	----	----	----			
C. nothus						----	----		----	----	----	
Larimus fasciatus									----	----	----	
Leiostomus xanthurus	----	----								----	----	----
Menticirrhus spp.		----	----	----	----	----	----	----	----	----	----	
Micropogonias undulatus	----	----							----	----	----	----
Pogonias cromis	----	----	----	----								----
Sciaenops ocellatus								----	----	----		
Stellifer lanceolatus				----	----	----	----	----	----	----		
Mullidae	----			----			----					
Chaetodipterus faber					----	----	----	----	----			
Labridae				----	----					----	----	
Scaridae												----
Mugil cephalus	----	----	----	----							----	----
Mugil curema					----	----		----				
Sphyraena spp.					----	----	----	----	----	----		
Blenniidae	----	----	----	----	----	----	----	----	----	----	----	----
Callionymus pauciradiatus									----	----	----	
Gobiidae	----	----	----	----	----	----	----	----	----	----	----	----
Gobionellus hastatus	----								----	----		
Microdesmus spp.				----	----		----	----		----		
Diplospinus multistriatus		----										
Trichiurus lepturus				----	----				----	----	----	
Auxis sp.				----	----	----		----	----	----		
Euthynnus alletteratus					----	----	----	----	----	----		
E. pelamis				----	----	----			----			
Scomber japonicus										----	----	
Scomberomorus cavalla						----	----	----	----			
S. maculatus				----	----	----	----	----	----			
Thunnus albacares				----					----			
T. atlanticus				----	----	----			----			
T. thynnus				----	----	----			----			
Ariomma sp.	----		----	----	----							
Cubiceps pauciradiatus				----	----				----	----		
Nomeus gronovii	----											
Peprilus burti	----	----	----	----	----	----				----	----	----
P. paru					----	----	----	----	----	----		
Scorpaena spp.					----	----					----	
Prionotus spp.					----		----			----	----	
Dactylopterus volitans					----							
Bothus sp.				----	----							
Citharichthys sp.	----	----	----	----	----	----				----	----	----
Citharichthys sp. Type A					----							
Citharichthys sp. Type B					----	----	----					
Citharichthys sp. Type C						----						
C. cornutus				----	----	----						
C. gymnorhinus												----
C. spilopterus	----	----	----	----							----	----
Cyclopsetta sp.					----	----	----					
Engyophrys senta					----	----	----					
Etropus crossotus				----	----	----	----	----	----	----	----	
Monolene sessilicauda					----							
Paralichthys sp.	----										----	
Syacium sp.					----	----	----			----	----	
S. gunteri						----	----		----			
S. papillosum						----	----					
Trichopsetta ventralis					----	----	----					
Achirus lineatus					----	----	----					
Trinectes maculatus							----					
Symphurus spp.			----	----	----	----	----	----	----	----	----	----
Monacanthus setifer											----	
Sphoeroides spp.				----	----	----			----	----	----	

[1]Juveniles.
[2]Morph Type A may represent *Decapterus/Elagatis*; Type B - *Selar crumenopthalamus*; Type C - *Seriola* spp.; Type D - *Caranx* spp.