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ABUNDANCE AND DISTRIBUTION OF ICHTHYOPLANKTON IN FLORIDA BAY AND ADJACENT WATERS

Allyn B. Powell, Donald E. Hoss, William F. Hettler, David S. Peters, and Stephanie Wagner

ABSTRACT

An ichthyoplankton survey in Florida Bay and adjacent waters focused on the abundance and distribution of larvae of four species—red drum (*Sciaenops ocellata*), snook (*Centropomus undecimalis*), gray snapper (*Lutjanus griseus*) and spotted seatrout (*Cynoscion nebulosus*). Spotted seatrout was the only target species whose larvae were regularly collected. Our data indicated that this species spawned in intermediate to high salinity waters within western Florida Bay and adjacent estuarine waters, but not in brackish waters. We never collected spotted seatrout larvae in the Keys area. From samples taken from March through November, we concluded that spawning was protracted as larvae were collected in all months except November. All snapper larvae were found in the Atlantic Ocean, but juveniles were found both in Florida Bay and the Atlantic Ocean. It appears that gray snapper spawn near offshore reefs, during the summer, in the Atlantic Ocean and at least some enter Florida Bay as advanced larvae or juveniles. Our research provided an insight into the distribution and abundance of the total ichthyoplankton fauna within Florida Bay and adjacent waters. One of the most striking patterns was the dominance and ubiquitous distribution of gobiid larvae.

Previously published ichthyoplankton studies from waters in and adjacent to the Everglades National Park are limited. Houde and Chitty (1976) and Collins and Finucane (1984) conducted extensive ichthyoplankton surveys in coastal waters in the eastern Gulf of Mexico, but only a few of their stations were in the Park or in nearshore waters adjacent to the Park. Previous studies conducted by National Park Service personnel were designed to examine ichthyoplankton distribution and abundance in the Park but the results have been unavailable until this symposium (see Rutherford et al., 1989). Starck (1970) did an extensive study of the gray snapper, *Lutjanus griseus,* that included larval distribution in the vicinity of lower Matecumbe Key. A seasonal study of larval sciaenid fishes in the northwestern portion of the Park (Little Shark River) was conducted by Jannke (1971).

This paper describes the composition of the larval fish community within and adjacent to the Park. We emphasize the abundance and distribution of four recreationally important species: red drum (*Sciaenops ocellata*), snook (*Centropomus undecimalis*), gray snapper and spotted seatrout (*Cynoscion nebulosus*). To our knowledge, the results presented here are the most comprehensive to date on the abundance and distribution of ichthyoplankton in Florida Bay and adjacent waters.

METHODS

Ichthyoplankton Sampling.—Ten larval fish collecting trips were made between March 1984 and September 1985. Twenty stations were selected to document spawning or larval immigration into Florida Bay and to compare the distribution of ichthyoplankton in Florida Bay to that of adjacent waters (Fig. 1). Some stations were sampled only during the day, because of night-time navigational

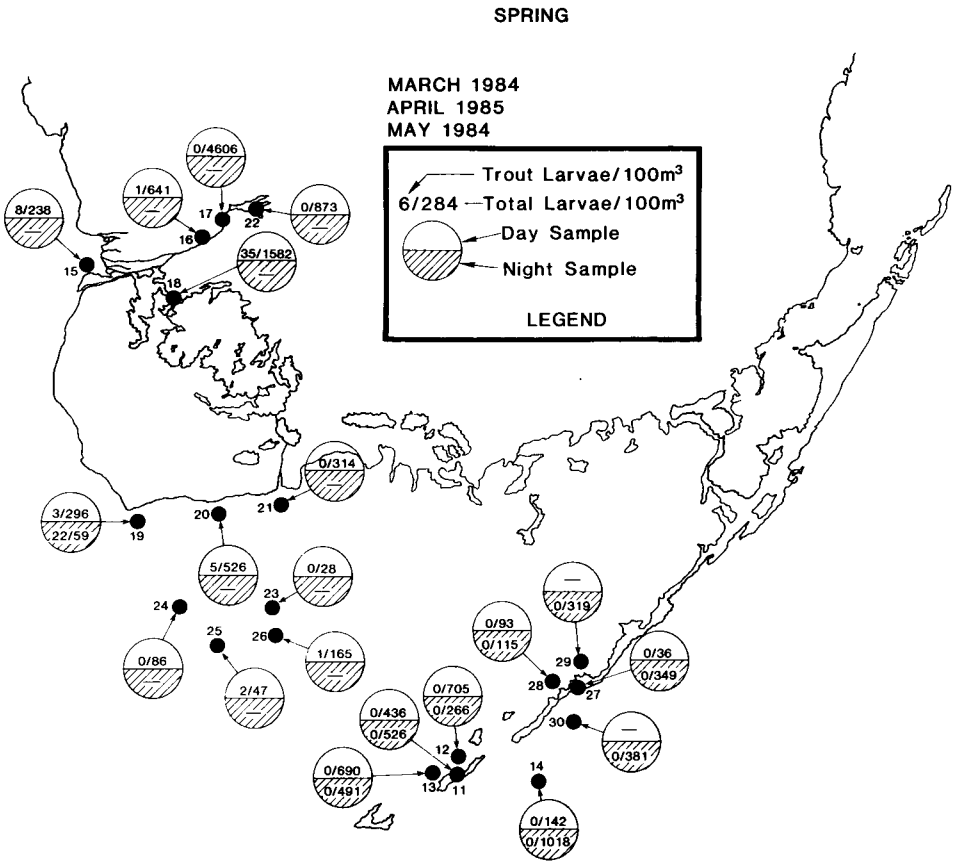

Figure 4. The relative abundance of spotted seatrout and total fish larvae during spring. Dash indicates no sample taken.

Although there was a greater proportion of larger larvae captured at night, still very few postflexion larvae were collected (Fig. 3). We believe that these older nektonic larvae were not accessible to our gear and to study this life history stage would require the development of different sampling gear.

More seatrout larvae were captured in step-oblique tows than neuston tows both during the day (14.3 vs. 0.5 per tow) and night (8.6 vs. 2.4 per tow). Neuston tows filter approximately one-half the volume of water of step-oblique tows and they would be expected to catch half as many larvae if they were distributed uniformly. The relatively low catch in the day neuston-tows may indicate active avoidance of the surface by seatrout larvae during daylight hours, as there was a greater proportion of seatrout larvae in the neuston at night than day. We concluded from our gear assessment analysis that step-oblique tows are preferable to neuston tows, especially during daylight, and that they can provide valuable information for describing seatrout spawning areas both spatially and temporally. Step-oblique tows at night provided limited additional information on spotted seatrout beyond day-tows in describing the life history of postflexion larvae.

Distribution and Abundance. Seatrout larvae were captured throughout the year except during cruises in November and December. They never were the dominant species (Figs. 4–6). We collected the majority of seatrout during late

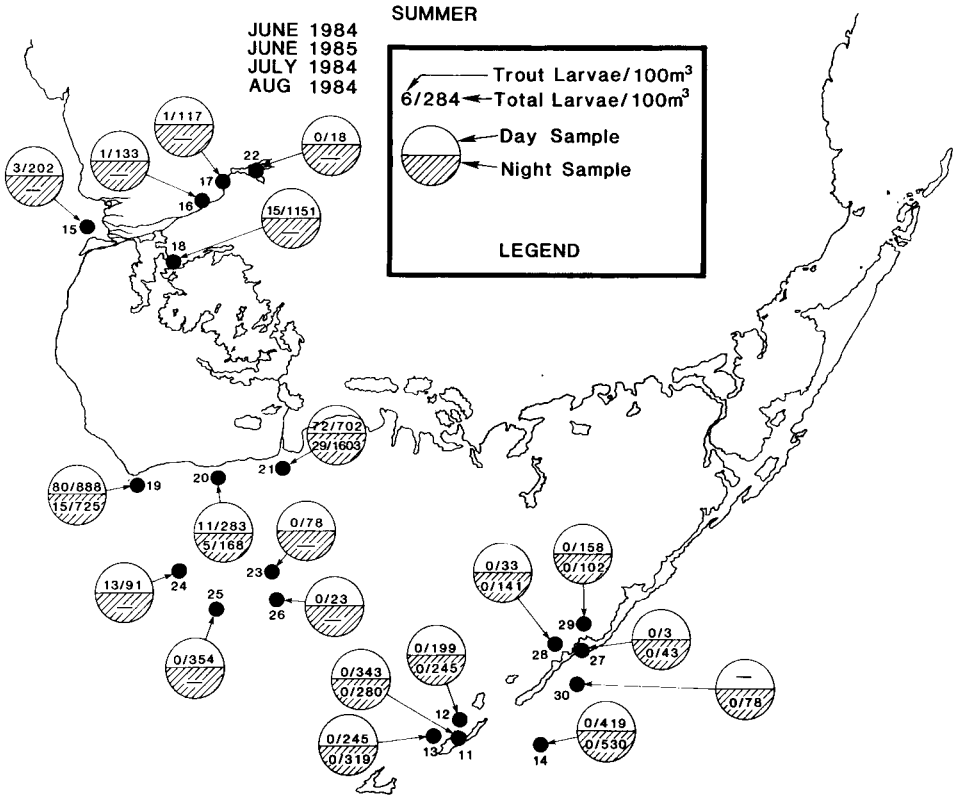

Figure 5. The relative abundance of spotted seatrout and total fish larvae during summer. Dash indicates no sample taken.

spring and throughout the summer. Our seasonal collections along with those of Jannke (1971) demonstrate that spawning is minimal during late fall and throughout the winter months, peaks during mid-to-late spring and continues during the summer at moderate levels, then declines with the onset of winter.

The spatial distribution of seatrout larvae (Figs. 2, 4, 5, and 6) and juveniles (Thayer et al., 1987) suggested that spawning and the early life history of spotted seatrout occurs mainly in the northwestern Florida Bay and adjacent estuarine waters, but studies by Rutherford et al. 1989 indicate that there is some spawning activity in northeastern Florida Bay, an area not sampled by us. To determine the specific areas where spawning occurred within our study area, we used the occurrence of preflexion larvae to indicate recent spawning (Fig. 2). Based on a laboratory study (Fable et al., 1978), preflexion larvae are no older than approximately 7-days. Spawning appeared to be most intense in the Cormorant Pass area (Station 18) and in the northwestern portion of Florida Bay (Stations 19, 20, and 21). Moderate spawning appeared to occur in the western part of Florida Bay (Stations 24, 25, and 26), and in Ponce de Leon Bay (Station 15) in the northwest area of our study. On the western side, we never caught trout in Man-of-War Channel (Station 23) nor Tarpon Bay (Station 22) and preflexion trout were never captured in the upper Shark River (Stations 16 and 17). Studies by Rutherford et al. (1989) also indicate that spotted seatrout spawn mainly in western Florida Bay.

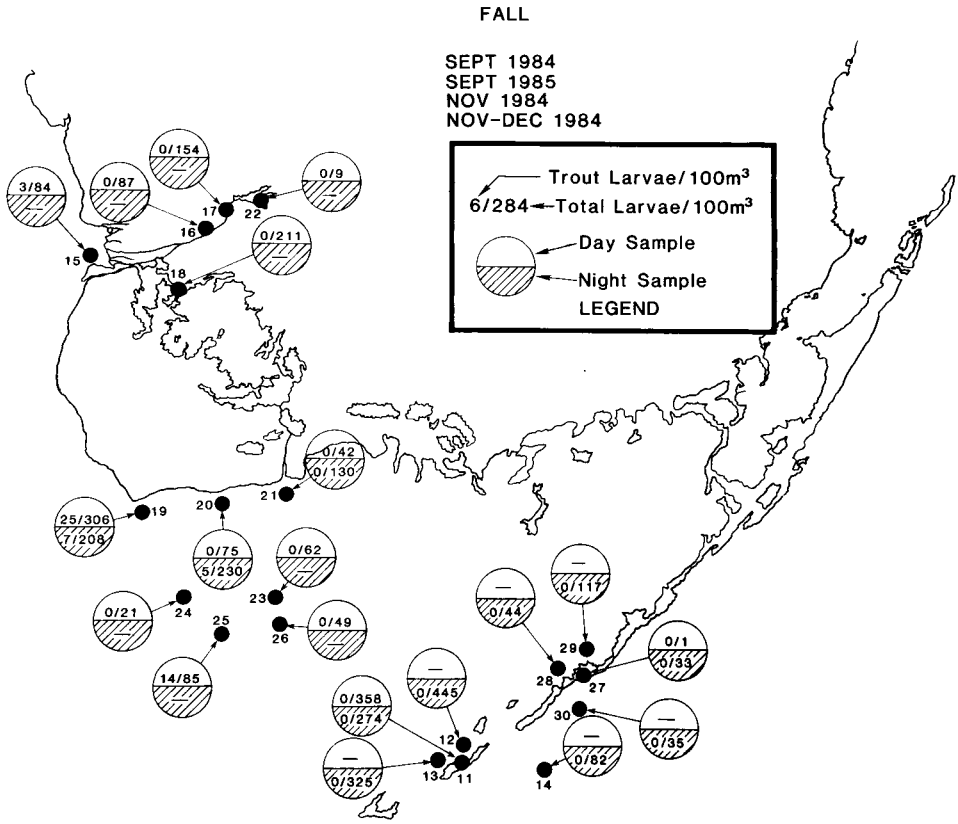

Figure 6. The relative abundance of spotted seatrout and total fish larvae during fall. Dash indicates no sample taken.

We studied the relationship between salinity and presence of preflexion seatrout larvae by plotting seasonal salinities against stations (Fig. 7). There are, in general, three groups of stations with different salinity characteristics. Most of the stations we sampled were in relatively high salinity waters. Two, Cormorant Pass (Station 18) and Ponce de Leon Bay (Station 15), had intermediate salinities while three in the upper Shark River (Stations 16 and 17) and in Tarpon Bay (Station 22) had low and more highly variable salinities. Based on the presence of preflexion seatrout larvae, it appears that spawning occurs in moderate and high salinities, but no spawning occurs at low salinities. Therefore, based on past studies (Collins and Finucane, 1984; Rutherford et al., 1989) and this study, spotted seatrout do not appear to spawn in brackish waters of the western estuaries adjacent to Florida Bay.

Abundance and Distribution of Total Ichthyoplankton.—Although not a primary objective of this study, we have examined the total ichthyoplankton from a large number of samples. This provides an insight into the relative abundance and composition of the total ichthyoplankton in different habitats in Florida Bay and adjacent waters. Because our collections were usually dominated by early stage larvae (i.e., preflexion larvae), we can gain some understanding as to the spawning

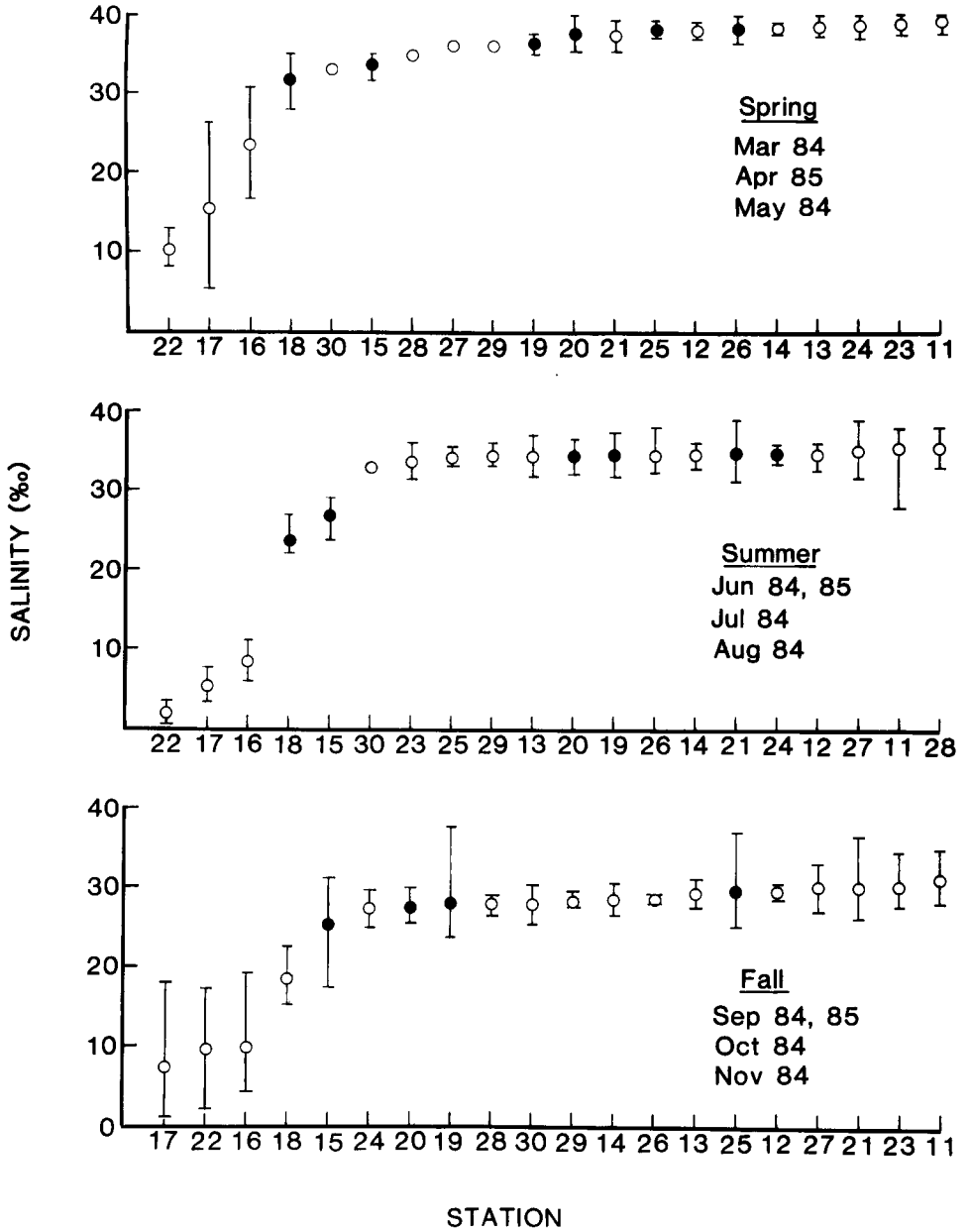

Figure 7. Mean seasonal salinities and ranges at ichthyoplankton stations. Stations are arranged by increasing salinity. Darkened circles denote those stations where preflexion larvae were collected.

time and areas of taxonomic groups, which could provide guidance for more in-depth studies in the future.

Peaks in larval fish abundance occurred during early spring (March 1984, April 1985); moderate abundances during the summer; and relatively low abundances during the late fall (November/December 1984) (Table 3). We are unable to

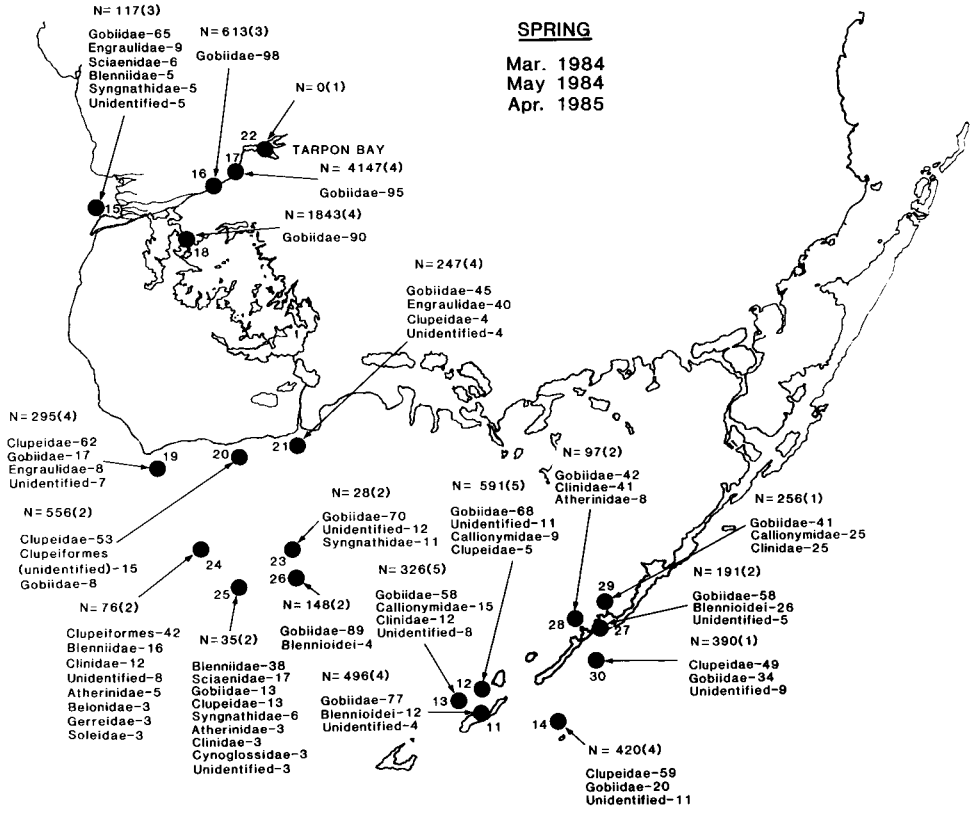

Figure 8. The dominant ichthyoplankton (≃90% of the total) of Florida Bay and adjacent waters during spring. N represents the mean number of larvae 100 m^{-3}, values in parentheses the number of samples, and values following the taxonomic groups the percentage of the total ichthyoplankton.

Table 3. Total fish larvae abundance (number per 100 m^3) at each cruise. When replicate and day-night tows were taken, data were averaged (geometric mean). Dash indicates no sample was taken

Date	Station 11	12	13	14	15	16	17	18	19
Mar 84	1,095	826	1,067	157	194	1,212	5,368	1,824	569
May 84	82	24	17	445	66	14	21	173	62
Jun 84	444	289	433	1,061	217	328	82	2,782	103
Jul 84	146	239	275	77	398	108	38	1,337	155
Aug 84	82	222	83	185	208	45	283	339	129
Sep 84	397	772	589	—	80	244	392	469	88
Nov 84	98	118	204	48	40	10	29	103	163
Nov/Dec 84	53	36	115	118	23	0	10	14	20
Apr 85	676	377	866	122	239	605	22	327	90
Jun 85	463	83	227	225	32	50	44	386	2,631
Geometric mean	223	178	234	176	103	68	80	357	148
Geometric mean (excluding Mar 84)	187	150	197	179	96	49	50	298	127

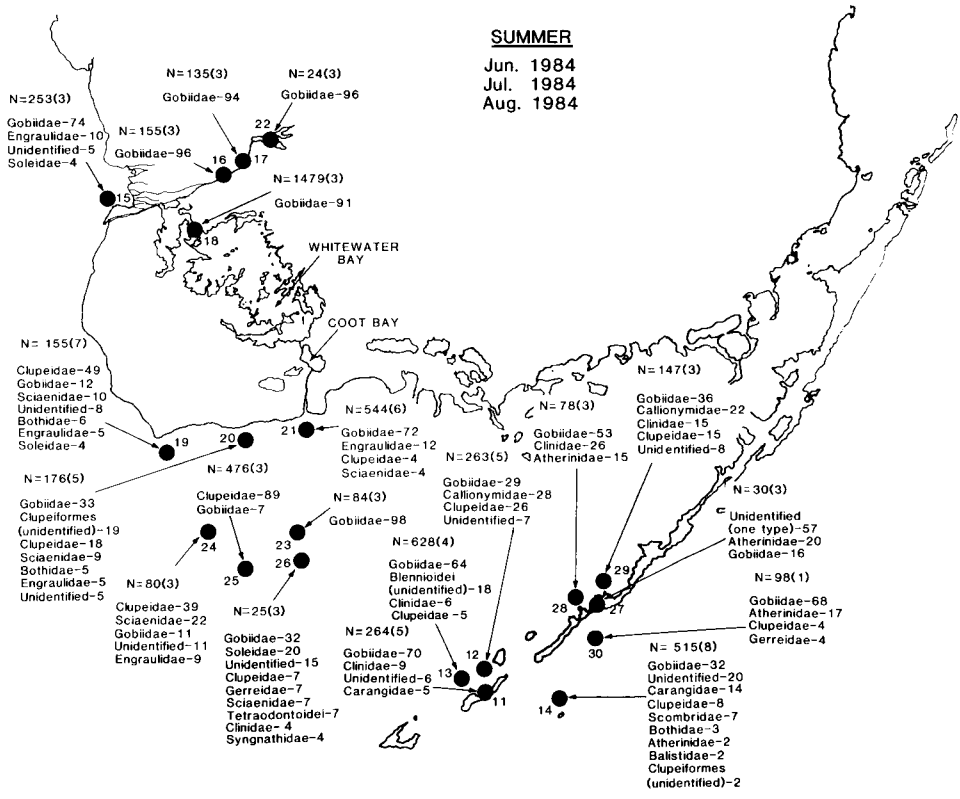

Figure 9. The dominant ichthyoplankton of Florida Bay and adjacent waters during the summer. See Figure 8 for explanation.

Table 3. Extended

Station											
20	21	22	23	24	25	26	27	28	29	30	Mean
1,089	3,558	—	—	—	—	—	—	—	—	—	976.4
17	107	0	20	35	12	0	36	92	—	—	28.5
124	452	11	154	27	1,389	44	5	40	261	—	160.5
246	823	30	94	194	11	22	2	23	73	—	92.5
12	260	29	11	22	45	10	47	183	112	123	75.7
329	27	15	166	35	7	124	36	60	263	—	118.7
222	103	0	5	20	76	3	18	7	84	37	34.1
4	54	0	5	8	12	53	5	54	6	34	15.3
325	347	31	40	128	68	290	349	115	316	381	236.9
398	2,612	9	70	151	48	14	37	61	90	41	110.8
110	295	12	32	42	38	22	21	51	97	75	
85	224										

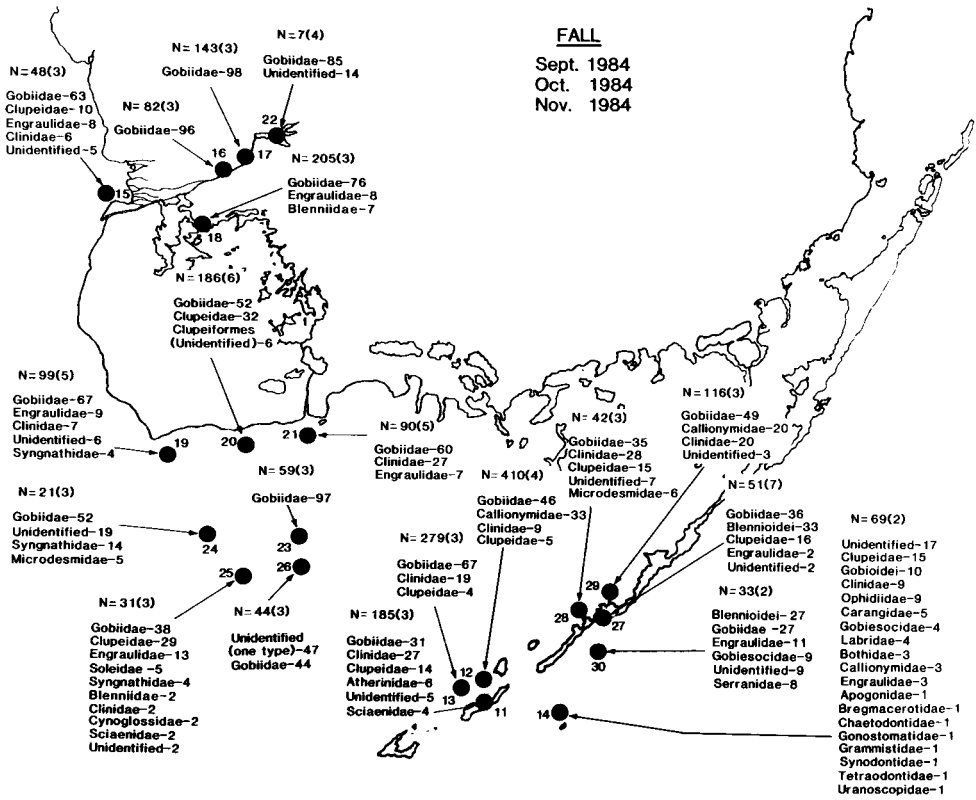

Figure 10. The dominant ichthyoplankton of Florida Bay and adjacent waters during the fall. See Figure 8 for explanation.

explain the relatively low abundances in May, but it appeared that the early spring peak was the outcome of intensive gobiid spawning in the Shark River area (Stations 15–18) (Fig. 8 and see discussion below on specific taxa).

Larval abundances were consistently high in the Lower Matecumbe Key area (Stations 11–13), Alligator Reef (Station 14), Cormorant Pass (Station 18) and the area near Flamingo Channel (Station 21) (Table 3). The habitats in these areas differ (Thayer and Chester, 1989) as do the dominant ichthyoplankton groups (Figs. 8–10). For example, gobiid larvae dominate at Cormorant Pass (Station 18). At Flamingo Channel (Station 21), gobiid larvae dominate, but there is a slightly more diverse group of ichthyoplankton. At Alligator Reef (Station 14) there was, in general, a high diversity of taxonomic groups (Figs. 8–10). For example, during the fall, approximately 17 families made up 90% of the ichthyoplankton (Fig. 10). This was at a time when abundances were relatively low. Relatively low abundances of ichthyoplankton were collected at Tarpon Bay (Station 22), Blue Bank (Station 26) and Snake Creek (Station 27)—three diverse areas. A greater diversity of ichthyoplankton was collected at Blue Bank and Snake Creek than at Tarpon Bay. The latter was dominated by gobiids.

One of the most striking patterns we have been able to discern is the dominance and ubiquitous distribution of gobiid larvae (Figs. 8-10). Gobiid larvae ranked first in abundance at 13-, 16-, and 18- out of 20 stations during the spring, summer and fall, respectively (Figs. 8–10). They dominated our collections in diverse

habitats. For example, during the summer they were first in abundance at low salinity stations at Shark River (16, 17 and 22), at many northwestern Florida Bay stations (20, 21, 23 and 26), at most Florida Bay stations adjacent to the Keys (11–13, 28, 29), at Alligator Reef (14) and Whale Harbor Channel (30). At every cruise, they ranked first in abundance at eight stations, two in eastern Florida Bay (Stations 13 and 30), two in western Florida Bay (Stations 21 and 23), and four in Shark River and adjacent waters (Stations 16, 17, 18 and 22).

The dominant ichthyoplankton we found was similar to that reported in a previous ichthyoplankton survey in the Everglades (Collins and Finucane, 1984) and adjacent areas (Biscayne Bay, Houde and Lovdal, 1984). In Biscayne Bay, a relatively shallow subtropical lagoon, the most abundant family was Clupeidae, followed by Engraulidae, then by Callionymidae and Gobiidae. In our collections clupeoids were not as dominant as in Biscayne Bay, but Callionymidae larvae were among the dominant ichthyoplankton at certain Florida Bay stations adjacent to the Keys (12, 13, and 29) (Figs. 8–10). Like Houde and Lovdal (1984), Collins and Finucane (1984) reported that clupeids and engraulids dominated their collections, but clupeids were rarely caught at estuarine stations. They reported a paucity of ichthyoplankton, both in terms of abundance and diversity, in the estuarine zone compared to the coastal marine zone. They concluded that low and variable salinity was one of the several environmental factors that limited the abundance of larvae in the estuarine zone. At our estuarine stations (15, 16, 17, 18 and 22), diversity was also low, but, with the exception of Tarpon Bay, abundances were not unusually low. Tarpon Bay (Station 22) had variable and lowest salinities (Fig. 7) and the overall abundance was the lowest we observed (Table 3).

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