Rev. Biol. Trop., Suplemento 41 (1): 53-57, 1993

Gut contents of larval fishes from light trap and plankton net collections at Enmedio Reef near Veracruz, Mexico

Cecilia M. Riley and G. Joan Holt
The University of Texas at Austin Marine Science Institute, Port Aransas, Texas 78373, USA.

Resumen: Se recolectaron larvas de pez en el arrecife Enmedio, México, con arrastres de red y trampas lumínicas, en tres tipos de hábitat: lecho de talaseas, arena y arrecife. Ambos métodos producen cantidades semejantes de ejemplares, pero las especies difieren. La red recolecta individuos más comunes en los arrecifes y las trampas solo funcionaron bien en el lecho de talasea. Los contenidos del tubo digestivo en 153 larvas de dos clases (3.0 y 5mm) mostraron que las larvas pequeñas se alimentan principalmente de tintinidos y dinoflagelados, las más grandes consumieron presas mayores, como crustáceos y huevos de invertebrado.

Key words: tropical reef fishes, larvae, diets, light-trap

Traditionally, it has been assumed that reef fish recruitment is a density dependent process determined by adult population size and resource limitations (Sale 1978). More recent ideas on factors regulating population size include the concept that reef populations are strongly influenced by pre-recruitment limitations (Victor 1986, Richards and Lindeman 1987, Doherty and Williams 1988). Variation in larval survival rates due to starvation can strongly affect year class strength. Finding appropriate planktonic prey within a few days of hatching is critical to larval survival. However, little is known about the diets of early (preflexion) larval reef fishes, thus studies of their feeding ecology would provide insight into survival and subsequent recruitment to reefs. A major limitation to such studies has been the low yield of reef fish larvae in plankton tows (Victor 1986, Leis 1989). Light traps are an attractive alternative since many fish larvae are attracted to light, and traps can be easily deployed in shallow reef sites. We conducted a study to examine the diets of tropical fish larvae collected by light traps and plankton tows at different habitats on a shallow coral reef. Our objective was to collect first feeding preflexion larvae and to identify prey organisms in their guts. This information is needed for our long term goal of culturing coral reef fishes in the laboratory.

Collections were made at Enmedio Reef (19°06'N,95°56'W) located 7 km from the mainland fishing village of Anton Lizardo just south of Veracruz, Mexico (see Tunnel 1988 for details). Enmedio is an emergent platform-type reef (2.25 x 1.15 km) surrounding a 1-3 m deep lagoon that contains both sandy bottom and seagrass beds of *Thalassia testudinum.*

Fish collections were made over three habitats (seagrass, sand and reef with depths of 1-1.5, 2-2.5 and 1.5-2 m respectively) from 12-20 June, 1991. All were evening, surface collections. Light traps (Fig. 1) constructed from 5 gallon plastic buckets had narrow (3 mm) slits to limit entrance of large organisms. These traps floated approximately 2 cm below the surface during the 10 or 15 min sampling periods. Net tows to collect both zooplankton and ichthyoplankton were made using a 0.5 m diameter x 1.5 m long 30 µm or 153 µm nitex net pulled behind a boat. From 5-10 m^3 of water were sampled during tows.

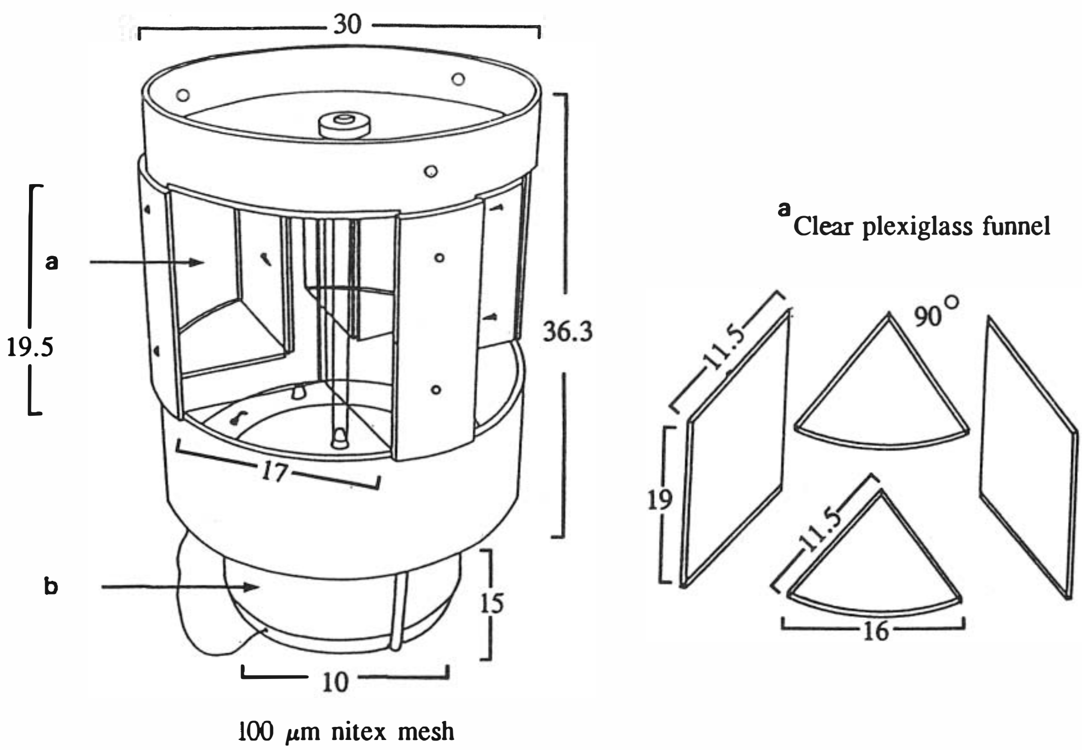

Fig. 1. Light trap with adjustable entrance funnel (a) and removable catch cup (b) was patterned after a design by R. Wallus of the TVA (personal communication), dimensions in centimeters (cm).

Samples were fixed in 10% formalin for two weeks then transferred to 70% ethanol for storage. In the laboratory, larval fish were identified to family, counted and gut contents of selected reef fish families were examined. The entire gastrointestinal tracts of larvae were removed and slit open to expose the contents. With a compound microscope, each food item was identified to the lowest taxonomic group possible, measured at the narrowest width, and counted. A stereomicroscope was used to measure notochord length (NL) and standard length (SL) to the nearest 0.1 mm. Collected larvae naturally fell into two size class distributions (≤3.0 and >5 mm SL). Percent frequency of occurrence (%FO) and percent of total number (%N) of food items found in the guts of larvae in each size class were calculated (Lyczkowski Laroche 1982). Importance values (IPV) of food items were calculated by multiplying %FO by %N.

A total of 895 larvae from at least 27 families were collected in 18 light trap and 12 net tow samples (Table 1). Twenty-eight of the larvae could not be identified. Light trap samples cannot be quantified but light trap and net samples can be compared in terms of number of larvae captured per sample. Although approximately equal numbers of larvae were captured with light traps and net tows (432 and 463 respectively), there were differences in taxonomic composition (Table 1). Individuals from seven families (Clupeidae, Atherinidae, Lutjanidae, Gerreidae, Sciaenidae, Labridae, Microdesmidae) were found only in light trap samples and representatives from 15 different families, including many reef associated families (i.e. Serranidae, Sparidae, Haemulidae, Pomacanthidae, Sphyraenidae, Balistidae) were captured only with net tows.

Total numbers of larvae from seagrass and reef sites were similar (444 vs 439). Larvae from the seagrass habitat were dominated by individuals of Mullidae, Microdesmidae, Scaridae, and Gobiidae. Major families collected over reefs were Blenniidae, Sparidae, Pomacanthidae, and Gobiidae. The sand bottom site was sparse, yielding only 12 larvae from five families, mostly Engraulids.

TABLE 1

Mean number of larval fish (by family) collected per sample at three sites with two gear types, two mesh sizes were used in reef tows

	Light Trap			Net Tow				
Family	Seagrass	Reef	Sand	Seagrass	Reef	Reef(lg)	Sand	[a] Total
[b] N	7	3	8	2	5	3	2	
Clupeidae	1.00	-	-	-	-	-	-	7
Engraulidae	-	-	-	0.50	5.60	0.66	3.00	37
Syndontidae	-	-	-	-	-	1.00	-	3
Ophidiidae	-	-	-	-	-	0.33	-	1
Exocoetidae	-	-	-	-	0.20	-	-	1
Atherinidae	0.14	-	-	-	-	-	-	1
Scorpaenidae	-	-	-	-	-	0.33	-	1
Serranidae	-	-	-	-	-	0.66	-	2
Carangidae	-	-	-	-	0.40	1.33	-	6
Lutjanidae	0.14	-	-	-	-	-	-	1
Gerreidae	0.29	-	-	-	-	-	-	2
Haemulidae	-	-	-	-	-	2.00	-	6
Sparidae	-	-	-	0.50	5.80	29.66	0.50	120
Sciaenidae	0.29	-	-	-	-	-	-	2
Mullidae	7.29	-	-	-	1.40	-	-	58
Pomacanthidae	-	-	-	-	-	10.33	-	1
Pomacentridae	0.29	-	-	-	-	4.00	-	14
Sphyraenidae	-	-	-	-	-	0.66	-	2
Labridae	2.29	-	0.20	-	-	-	-	17
Scaridae	13.43	-	-	-	-	1.33	-	98
Blenniidae	-	-	-	5.50	17.40	23.33	-	168
Gobiidae	9.29	-	-	-	6.80	4.33	0.50	113
Microdesmidae	26.86	-	-	-	-	-	-	188
Bothidae	-	-	-	-	1.00	0.66	-	7
Soleidae	-	-	-	-	-	-	1.00	2
Balistidae	-	-	-	-	0.20	1.33	-	5
Tetraodontidae	0.14	-	-	-	0.20	0.66	-	4
Unknown	-	-	-	-	4.20	2.00	0.50	28
Totals	61.45	0.00	0.20	6.50	43.20	84.60	5.50	

[a] Total number of larval fish collected per family
[b] N=number of samples at each site

Preflexion larvae from 1.1-3.0 mm NL ($\overline{x}$=1.52, SD=0.35) dominated the collections (84%) whereas larger larvae 5.4-14.3 mm SL ($\overline{x}$=6.25, SD=1.01) were only caught in light traps over seagrass beds. Light traps usually catch more later stage larvae than do towed nets (Doherty 1987). The lack of intermediate size larvae in net samples could be due to gear selectivity however their absence in light traps is perplexing. They were either not attracted to light during this stage or were distributed away from the reef.

The guts of 153 common or reef associated larvae (Table 2) were dissected, of which 35 (23%) were empty. The kinds of prey consumed by both size classes were similar (Table 3), however, the dominant food types differed. Dominant food (IPV) items for small larvae were tintinnids and dinoflagellates, and less importantly protozoans (primarily ciliates). In

TABLE 2

The number of guts examined in each larval size class by family

	Size Class	
Family	≤ 3 mm	> 5 mm SL
Serranidae	2	-
Carangidae	6	-
Lutjanidae	-	1
Gerreidae	-	3
Haemulidae	6	-
Sparidae	8	-
Sciaenidae	2	-
Mullidae	27	-
Pomacanthidae	1	-
Pomacentridae	11	2
Sphyraenidae	1	1
Labridae	-	17
Scaridae	4	19
Blenniidae	16	-
Gobiidae	7	4
Bothidae	6	-
Balistidae	5	-
Teteraodontidae	4	-
Total	106	47

TABLE 3

Summary of gut content examination of 153 larval fish collected in June, 1991 at Enmedio Reef, Mexico

	Larval fish size class									
	≤ 3 mm					> 5 mm				
Food item	N[a]	FO	%N	%FO	IPV	N	FO	%N	%FO	IPV
Diatom	55	22	8.4	26.5	222.6	3	2	0.9	5.7	5.1
Dinoflagellate	172	48	26.3	57.8	1520.1	24	3	7.6	8.6	65.4
Tintinnid	235	44	36.0	53.0	1980.0	15	6	4.7	1.7	8.0
Protozoan[b]	122	23	19.0	27.7	526.3	6	3	1.9	8.6	16.3
Coelenterate	3	2	0.5	2.4	1.2					
Invertebrate egg	40	16	6.1	19.3	117.7	154	14	49.0	40.0	1948.0
Crustacean[c]	26	15	4.0	18.1	72.4	110	21	35.0	60.0	2088.0
Larval fish						4	1	1.3	2.9	3.8
Total # food items	653					316				
No. of larvae	106					47				
No. empty larvae	23					12				

a N = number of food items in guts of larvae of each size class, FO = number of fish with this food item, %N = percent of total number, %FO = percent frequency of occurrence among larvae containing food. IPV = importance value = %FO x %N.

b Other protozoans including ciliates, flagellates, radiolarians, and foraminiferans

c Includes whole and parts of organisms

TABLE 4

Size ranges of food items (measured at smallest width in μm) found in guts of two size classes of larval fish collected at Enmedio Reef, Mexico, June, 1991

	Larval fish size class	
	≤ 3 mm	> 5 mm
Diatom	3-40	10-108
Dinoflagellate	5-100	15-60
Tintinnid	8-78	23-70
Protozoan[a]	5-40	40-51
Coelenterate	50-75	-
Invertebrate egg	5-100	25-256
Crustacean[b]	10-200	35-500
Larval fish	-	1000-1500

a Other protozoans including ciliates, flagellates, radiolarians, and foraminiferans

b Includes whole and parts of organisms

contrast, major dietary components for >5 mm larvae were crustaceans and invertebrate (mostly copepod) eggs. Coelenterates (medusa stage) were consumed only by the small larvae, and larval fish were among the gut contents of a single large Sphyraenidae larva. There were also differences in the size of food consumed. Sightly larger food items were found in the guts of the >5mm size class larvae (Table 4).

In summary, we found that small mesh plankton nets were as effective as light traps in capturing preflexion larvae at shallow coral reefs. The findings of this study emphasize the importance of microzooplankton in the diets of tropical fish larvae. Dinoflagellates and tintinnids are also preferred food for the young of several temperate species and although protozoans are probably important, they are quickly digested and difficult to quantify (Spittler *et al.* 1990). It is hoped that this information will be useful for culture of coral reef fish larvae in the laboratory.

ACKNOWLEDGEMENTS

Jim Ditty (LSU) provided invaluable assistance with larval fish identifications. Patti Pickering assisted with manuscript preparation and with gut examinations. Beau Hardegree and Paul Chocair were my boat captains and friends in Mexico. Thanks also to Wes Tunnell who graciously invited me along on his graduate student field course.

REFERENCES

Doherty, P.J. 1987. Light-traps: selective but useful devices for quantifying the distributions and abundances of larval fishes. Bull. Mar. Sci. 41:423-431.

Doherty, P.J. & D.M. Williams. 1988. The replenishment of coral reef fish populations. Oceanogr. Mar. Biol. Annu. Rev. 26:487-551.

Leis, J.M. 1989. Larval biology of butterflyfishes (Pisces, Chaetodontidae): what do we really know? Environ. Biol. Fishes 25:87-100.

Lyczkowski Laroche, J. 1982. Trophic patterns among larvae of five species of Sculpins (Family: Cottidae) in a Maine estuary. Fish. Bull. 80:827-840.

Richards, W.J. & K.C. Lindeman. 1987. Recruitment dynamics of reef fishes: Planktonic processes, settlement and demersal ecologies, and fishery analysis. Bull. Mar. Sci. 41:392-410.

Sale, P.F. 1978. Coexistence of coral reef fishes-a lottery for living space. Environ. Biol. Fishes 3:85-102.

Spittler, P., U. Brenning & G. Arlt. 1990. Protozoans-the first food of larval herring (*Clupea harengus* L.)? Int. Revue ges. Hydrobiol. 75:597-603.

Tunnell, J.W. 1988. Regional comparison of southwestern Gulf of Mexico to Caribbean Sea coral reefs. Proc. 6th International Coral Reef Symposium, Australia 3:303-308.

Victor, B.C. 1986. Larval settlement and juvenile mortality in a recruitment-limited coral reef fish population. Ecol. Monogr. 56:145-160.