Ecological larval fish groups in Chabahar Bay in relation to day/night and monsoon variations

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Introduction

Studies on larval fish abundance allow important inferences about the spawning grounds, reproduction season and migration pattern of fishes (Goulding, 1980; Pavlov, 1994). Larval densities can also be used to estimate the abundance index, which in turn can be correlated to the fisheries yield, and provide an alternative approach for measuring the size of the spawning stock (Smith and Richardson, 1977). Previous studies in this ecosystem have focused on the abundance of fish larva without consideration of daily fish larva variations (Thangaraja, 1987, 1989, 1991; Thangaraja and Al-Aisry, 2001; Rabbaniha *et al*., 2014). Sanvicente-Añorve *et al*. (2000) reported that seasonality and day/night variations seem to play an important role on larval fish abundance and composition. In this research we consider the monsoon as an important phenomenon, affecting the daily fish larval distribution.

Material and methods

Day and night samplings of fish larvae were done at 3 stations on the south-eastern coastal areas of Chabahar Bay in the middle of each season during 2013 (Fig. 1) using a plankton- sampler with a mesh size of 300µ (Smith and Richardson, 1977). Fish larvae identification was based on Leis and Rennis (1983), Houde, *et al.* (1986), Leis and Transky (1989), Olivar, *et al*. (1999) and Richards (2006) and the larva were allocated to ecological groups.

Figure 1: The position of sampling stations in Chabahar Bay.

Data analysis

Fish larvae abundance was standardized to the number of larvae per 10 m^2 (Smith and Richardson, 1977). Then the fish larvae were separated into different ecological groups based on their spawning behavior pattern following Leis and Rennis (1983), Leis and Transky (1989).

Shannon–Wiener diversity index (H′), richness index (R) and evenness (j) were measured in night and day samples (Ludwig and Reynolds 1988).

Results and discussion

Totally 1163 fish larvae specimens belonging to 29 families with the average abundance of 647.24±30.87 (mean± standard deviation) larvae per 10 m^2 were collected. Clupeidae, Gobiidae and Blennidae were the dominant families.

Day time samples included a total of 518 fish larvae specimens belonging to 23 fish families, with an average abundance of 282.12±29.38 larvae per 10 m^2. Families of Blenniidae, Scombridae and Clupeidae with a total relative abundance of 65.17% were dominant.

The average Shannon, evenness and richness indices were calculated as 0.88±0.54, 0.66±0.34 and 1.0±0.67 respectively (Table 1). The family names with their relative larval abundance are listed in Table 2. The ratios of ecological groups with consideration of the monsoon period are shown in Fig. 2.

Night samples consisted of 650 fish larvae specimens belonging to 24 fish families, with an average abundance of 365.11±33.23 larvae per 10 m^2 . The family names with their relative larval abundance are listed in table 2. Families of Clupeidae and Gobiidae with a total relative abundance of 65.17% were dominant. Larvae of the families Nomeidae, Paralichthyidae, Platycephalidae and Sphyraneidae were not recorded in night samples. Moreover larvae of the families Blenniidae and Scombridae which were dominant in day time samples,

significantly decreased showing that these families are diurnal or crepuscular. Brebbia and Zubir (2012) reported that new Blenniid larvae feed only on rotifers and other small zooplanktons, while the Scombrid larvae is zooplanktivorous in the early larval stages and starts eating fishes at later stages, whereas others shift early in the larval period. The shift to piscivorous feeding invariably results in an increase in predator growth rate (Juanes *et al.*, 2008). It would be logical to assume that predation in the daytime is more successful. The average Shannon, evenness and richness indices were calculated as 0.94±0.6, 0.56±0.3 and 1.36±0.89, respectively (Table 1). Fig. 3, shows the relative ecological groups in total, pre, and post monsoon at night.

The result of the ratio of day/night fish larvae sampling shows the fish larvae assemblage at night was more than that in the day time. Bonecker *et al*. (2009) found that larval fish densities in Mucuri estuary were significantly higher during the night compared to daylight sampling.

Table 1: The bio- factors of fish larva during sampling periods.

Sampling period	number	abundance	H′	J	R
Day	518	282.12±29.38	0.88±0.54	0.66±0.34	1.0±0.67
Night	650	365.11±33.23	0.94±0.6	0.56±0.3	1.36±0.89

Shannon–Wiener diversity index (H′), richness index (R) and evenness (j)

Table 2: Relative abundance of fish larva and ecological habitats during sampling periods.

family	habitat	spawning	Relative abundance day	Relative abundance night	Relative abundance pre-monsoon	Relative abundance post-monsoon
Apogonidae	coral reef	demersal	0.131	0.292	0.55	0.00
Blenniidae	demersal	demersal	**31.242**	1.777	4.18	**21.60**
Bothidae	demersal	pelagic	0	0.427	0.13	0.32
Callionymidae	demersal	pelagic	0.407	0.655	1.35	0.00
Carangidae	pelagic	pelagic	10.885	4.365	3.65	9.58
Clupeidae	pelagic	pelagic	**14.833**	**27.361**	**47.86**	4.30
Cynoglossidae	demersal	pelagic	0.898	0.998	1.40	0.65
Engraulidae	pelagic	pelagic	5.030	9.486	**14.59**	2.76
Gerridae	demersal	pelagic	0.122	0.889	0.13	0.84
Gobiidae	demersal	demersal	5.360	**26.389**	5.69	**25.01**
Lethrinidae	demersal	pelagic	0	0.407	0.41	0.11
Leiognathidae	demersal	pelagic	0.261	2.706	3.44	0.42
Lutjanidae	demersal	pelagic	0.253	0.817	1.41	0.00
Monacanthidae	demersal	demersal	0.430	0.115	0.00	0.42
Mugilidae	demersal	pelagic	1.383	0.182	1.55	0.13
Myctophidae	mesoplagic	pelagic	1.435	0.439	0.00	1.46
Nemipteridae	demersal	pelagic	0	2.254	2.45	0.47
Nomeidae	pelagic	pelagic	0.388	0	0.42	0.00
Paralichthyidae	demersal	pelagic	0.625	0	0.00	0.46
Platycephalidae	demersal	pelagic	0.131	0	0.14	0.00

Table 2 continued:

Polynemidae	demersal	pelagic	0	2.337	3.27	0.00
Pomacentheridae	coral reef	pelagic	0	0.790	0.63	0.32
Scomberidae	pelagic	pelagic	**19.327**	0.257	0.00	14.32
Scorpanidae	demersal	pelagic	0	0.105	0.00	0.10
Serranidae	demersal	pelagic	0.697	4.526	1.38	3.85
Solenostomidae	demersal	brooding eggs	0.208	0	0.00	0.15
Sparidae	demersal	pelagic	3.236	11.921	1.69	12.49
Sphyraneidae	pelagic	pelagic	1.220	0	1.31	0.00
Triacanthidae	demersal	pelagic	1.500	0.507	2.18	0.10

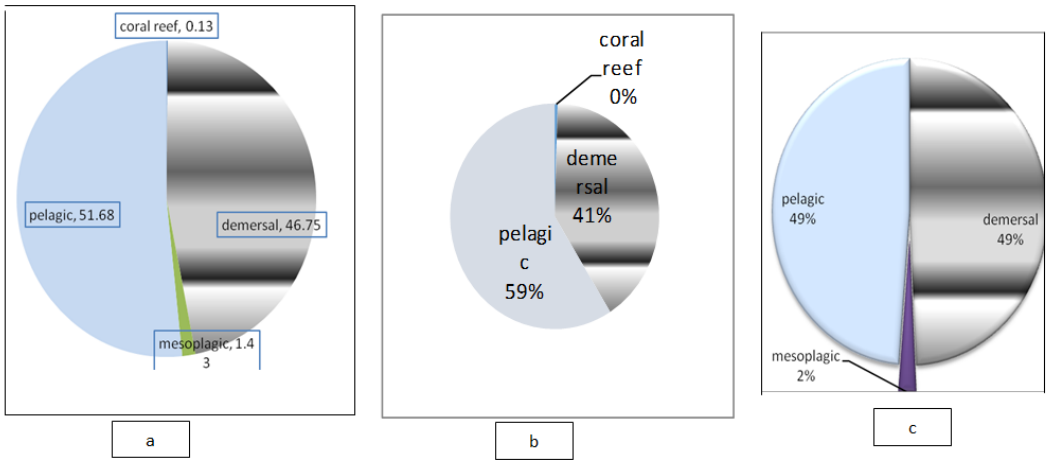

Figure 2: The percent of ecological groups in the day time (a: total; b: pre-monsoon; c: post-monsoon).

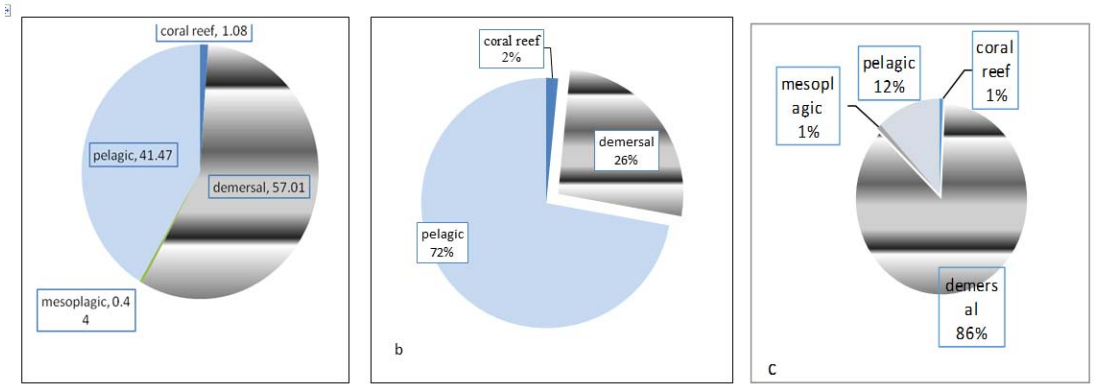

Figure 3: The percent of ecological groups in the night time (a: total; b: pre-monsoon; c: post-monsoon).

In this research we found that during pre-monsoon, the fish larvae assemblage was mainly dominated by the larvae emerging from pelagic eggs (89.4%). During post-monsoon, this pattern changed to fish larvae with demersal eggs (47%) and reduction of pelagic eggs (52%). Malzahn and Boersma (2007) obtained the same results in the North Sea. By comparing Figs. 2 and 3, we notice that during post monsoon, the abundance of the demersal fish group increased, whereas that of the pelagic group decreased considerably. In a study on the fish larvae composition of the coastal waters of Bushehr in Persian Gulf, Rabbaniha *et al.* (2015) reported that the pelagic fish larvae were dominated during the warm period, but during the cold period the demersal groups were dominant, which was in agreement with our results. Our study indicated that Clupeid larvae were dominant in Chabahar Bay during pre-monsoon. This family is pelagic and a high abundance of its larvae was also reported from the Iranian coastal line of the Persian Gulf during the warm season (Vosoghi *et al.,* 2010) which is equivalent to pre-monsoon in our research. During post-monsoon, especially in the night time samples, clupeid abundance decreased to 1/10 of its pre-monsoon period, showing a sharp increase in the ratio of demersal to pelagic groups (Fig. 3c). This result corresponds with the clupeid reproduction cycle which occurs during the pre-monsoon period.

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