Distribution pattern of coral & non coralline fish larvae in Khark & Kharko (Persian Gulf)

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Abstract

Khark and Kharko Islands are located at far northern point of fringing coral reefs in the Iranian coast of the Persian Gulf. These coralline are the habitats of the wildlife refuge with total area of 2400ha and located in the territory of Bushehr province. The present study was carried out from July 2006 to June 2007 over 12 stations. Sampling was conducted obliquely from bottom using Bongo-net plankton sampler with 500µ of mesh size. In total, 1808 specimens, both in pre and post flexion stages were collected and examined. They were belonging to 45 families from different ecological groups (21 coralline and 24 non coralline fish larvae families). 96% of examined fish larvae were in preflexion stage. Some families are new ones from the area. Among identified families, Clupeidae, Blenniidae, Sillaginidae, Atherinidae and Tripterygiidae; were dominant families in studied area and the peaks were estimated in spring. The mean abundance of total fish larvae was 18.71 per 10m² of sea surface. The most abundant families were Clupeidae, Sillaginidae, Blenniidae, Atherinidae and Tripterygiidae in which comprised 65% of fish larvae. Abundance in spring showed significant difference with other seasons. The distribution pattern of fish larvae changed seasonally in both groups, increasing in east coasts of Khark Island and in three coastal stations during summer and autumn and in west coast of Khark in spring. The distribution of fish larvae seemed to be correlated to sea currents.

Keywords: Coralline fish larvae, Abundance, Khark and Kharko Islands, Persian Gulf, Iran

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Introduction

The study on life cycle, spatial and temporal distributions of larval stages of commercial fishes are important in marine biology and fishery management subjects.

Ichthyoplankton survey addition to increase knowledge of early life history inclusive growth, behavior, food requirement and others information help to explore for new resource and locating spawning concentrations of important stocks.

Few studies on ichthyoplankton were carried out in the Persian Gulf. Nellen (1973) sampled larval fishes in the northern and eastern sides of the Persian Gulf as part of Indian Ocean survey. His study provided useful information, however, samples were only taken during a single cruise and the survey was conducted in limited area of the Iranian waters (31 stations). Houde (1986) studied Kuwait waters, and collected 214 ichthyoplankton samples by Bongo-net with 333μ mesh size and 61cm in diameter. In last two decades, surveys on ichthyoplanktons were conducted in the Iranian waters by the Iranian Fisheries Research Organization. These studies were performed in the coastal waters of Khouzestan (Dehghan *et al*., 2000), Bushehr (Owfi & Bakhtiary, 1999; Owfi & Mohamadnejad, 2000), and Hormouzgan (Jokar & Saraji, 2002) provinces. The present study, focused on coralline sites of Bushehr waters, including Khark & Kharko Islands, which being environmentally protected since 1967 (Danekar, 1999). This was designated as a preserved wildlife area in 1975 and is composed of two islands named of Khark & Kharko. The total area of the Islands are 2398ha which located 4km away from each other in the north part of the Persian Gulf territory of Bushehr province. The aims of the present study were to identify different fish larvae, to determine their abundance and temporal and spatial distribution in the studied areas.

Materials and methods

Khark & Kharko coralline Islands are located in the northern part of the Iranian side of the Persian Gulf, in Bushehr province waters. Nine stations around islands and 3 stations toward coastal waters were selected for sampling and the study was conducted during July 2006 to June 2007 (Fig. 1).

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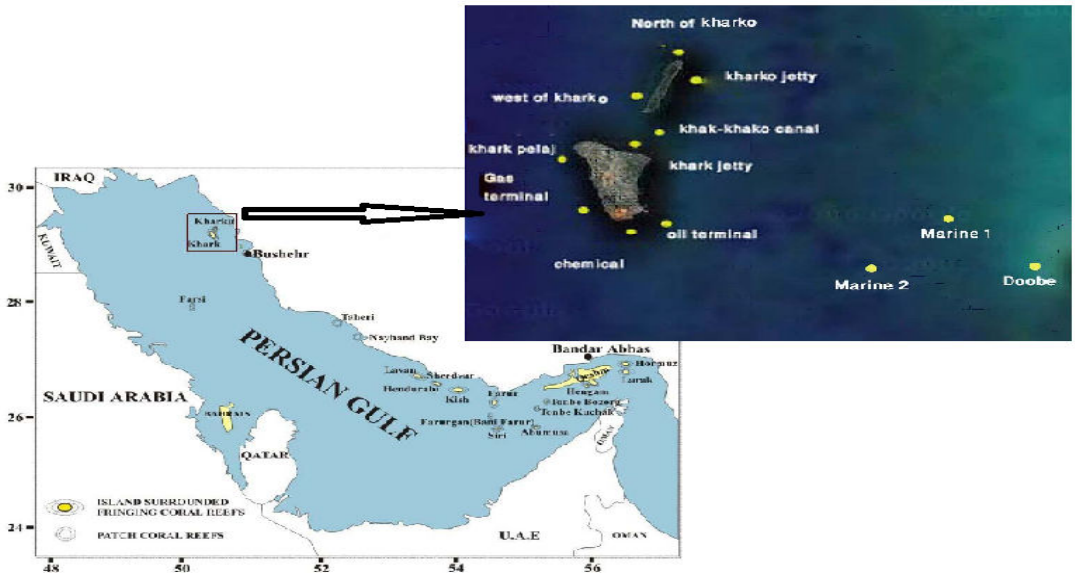

Figure 1: Sampling stations in the peresent study, including Khark & Kharko islands (Ropme, 2004, Google earth).

Fish larvae were collected monthly from July 2006 to June 2007, during daylight hours using a Bongo-net plankton sampler, with 61cm of mouth diameter (Smith & Richardson, 1977) equipped with 500µ-mesh size net and flow meter. Oblique tows were made from near bottom to sea surface. Length of towing wire was calculated based on station depth (Smith & Richardson, 1977). The time of towing for each station was 10 min while the boat speed was approximately 1 knot. Samples fixed in 5% formalin in seawater immediately after towing.

Samples were transferred to the marine biology laboratory of Shrimp Research Center, and the fixative solution was changed from formalin to 10% ethanol. Morphometric and meristic parameters were measured using stereomicroscope equipped with micrometer.

In order to identify, selected specimens were cleared and stained with Alcian blue and Alizarin (Balon, 1985). Fish larvae were identified according to Leis and Rennis (1983); Leis (1983,1989) and Leis and Transky (1989).

The raw data of larvae at each station were converted to numbers per cubic meter of filtered water based on flow meter revolution number. The data were also standardized to numbers in 10m² of sea surface by the method given in Smith & Richardson (1977) and Houde *et al.* (1986). To compare means and average of abundance indices were tested with K independent sample between stations & seasons.

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Results

In total, 1808 fish larvae were collected from 12 stations, including 45 families. The larvae were in different stages and two main ecological groups, including 21 coralline and 24 non coralline were determined (Tables 1 and 2). The coralline fish larvae percent was 39% in the study area and was changed with ecological type of station, for example; in coralline station such as Kharko Jetty, the percent of coralline fish larvae increased up to 66%. Data showed that Clupeidae, Blenniidae, Sillaginidae, Atherinidae and Tripterygiidae were dominant families, which included 65% of total fish larvae abundance.

The relative abundance of preflexion fish larvae was 96%. The mean abundance of total fish larvae; coralline and non coralline fish larvae were 18.7, 6.9 and 11 larvae per 10m² of sea surface, respectively. The maximum abundance was 59.13 larvae per 10m² of sea surface in the Khark Pelaj and the minimum was 4.9 larvae per 10m² in the west of Kharko (Table 3). The fish larvae abundance were differ in the studied area seasonally, the maximum was in spring with significant difference with others seasons ($P<0.05$) (Fig. 3).

The distribution pattern of fish larvae is showed in Figures 3, 4 and 5. The change of fish larvae distribution in two groups; coralline and non coralline were the same. In summer, the most abundance of fish larvae was in east stations of island and stations of coastal area and in spring the most distribution of fish larvae on west stations of island, especially in west of Khark.

Table 1: Number and abundance of coralline fish larval families, in Khark & Kharko Islands (northern part of the Persian Gulf)

Family	Number (per sample)	Mean abundance (N/10 m²)	Family	Number (per sample)	Mean abundance (N/10 m²)
Apogonidae	2	0.0113	Lutjanidae	5	0.0257
Atherinidae	131	1.3329	Mugiloididae	2	0.0205
Blenniidae	152	2.1532	Mullidae	57	0.6183
Bregmacerotidae	3	0.0234	Nemipteridae	9	0.0795
Chaetodontidae	3	0.0245	Platycephalidae	5	0.0689
Creediidae	1	0.0118	Pomacenteridae	26	0.4985
Gerreidae	22	0.2059	Scorpaenidae	2	0.0572
Gobiidae	109	0.7023	Siganidae	1	0.0271
Haemulidae	1	0.0028	Sphyraenidae	30	0.2168
Labridae	2	0.0118	Tetraodontidae	2	0.0294
Lethrinidae	6	0.0545	Tripterygiidae	91	0.8673

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Table 2: Number and abundance of non coralline fish larval families, in Khark & Kharko Islands (northern part of the Persian Gulf)

Family	Number (per sample)	Mean abundance (N /10 m²)	Family	Number (per sample)	Mean abundance (N /10 m²)
Belonidae	1	0.0312	Sciaenidae	1	0.0105
Bothidae	24	0.2821	Scomberidae	35	0.3725
Callionymidae	14	0.1163	Sillaginidae	384	2.2911
Carangidae	49	0.5040	Soleidae	13	0.0788
Cepolidae	23	0.1493	Sparidae	35	0.2814
Clinidae	1	0.0057	Syngnathidae	2	0.0280
Clupeidae	368	5.4801	Synodontidae	1	0.0143
Clupeiform	18	0.2458	Terapontidae	47	0.4878
Cynoglossidae	4	0.0287	Triacanthidae	12	0.0958
Engraulididae	23	0.2672	Triglidae	4	0.0186
Exocoitidae	5	0.0615			

Table 3: The abundance of fish larvae in the study area

Station	Fish Larvae	Coralline	Non Coralline
Oil Terminal	19.9030	14.4063	6.3874
Chemical Terminal	9.1482	2.3406	7.5093
Gas Terminal	11.0874	6.8892	5.3747
Khark Pelaj	59.1295	10.8037	43.6616
Khark Jetty	34.7060	15.8974	16.2382
Khark-Kharko Canal	13.1132	5.1329	8.0422
Kharko Jetty	15.2668	10.3005	3.7458
West of Kharko	4.9208	2.1668	2.5482
North of Kharko	13.7322	1.4469	11.8481
Marine 1	12.9407	4.1378	8.1923
Marine 2	23.3888	8.9229	15.3297
Doobe Creek	7.1632	3.7317	3.3354
Mean	18.7083	7.1814	11.0177

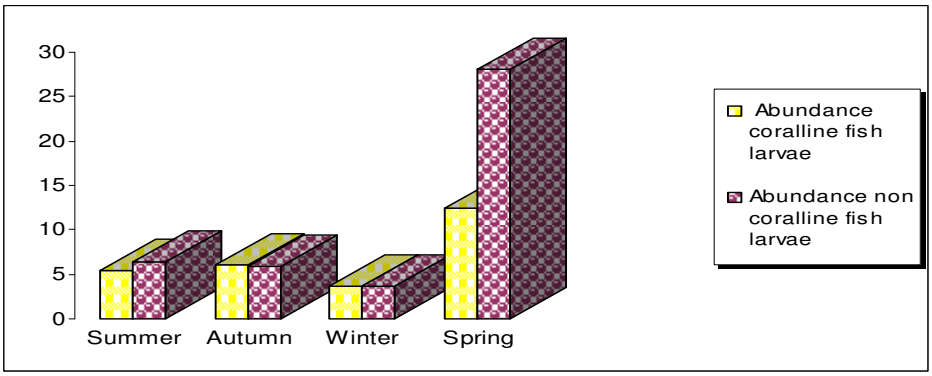

Figure 2: Seasonal variation in coralline & non coralline fish larvae abundance, in Khark and Kharko Islands (northern part of the Persian Gulf)

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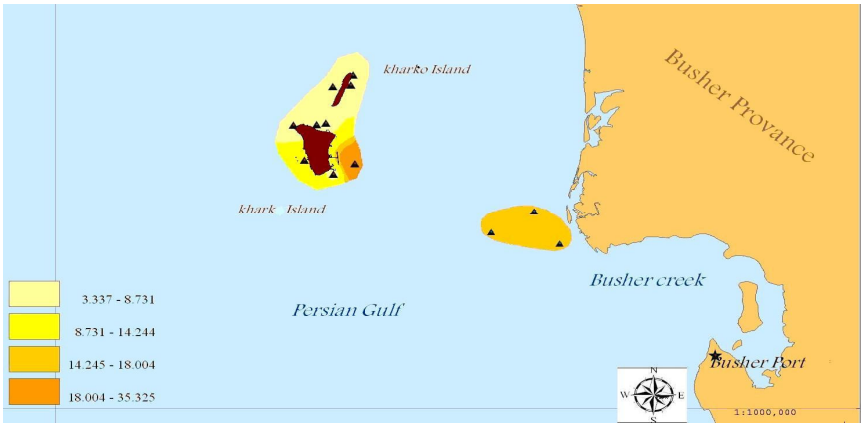
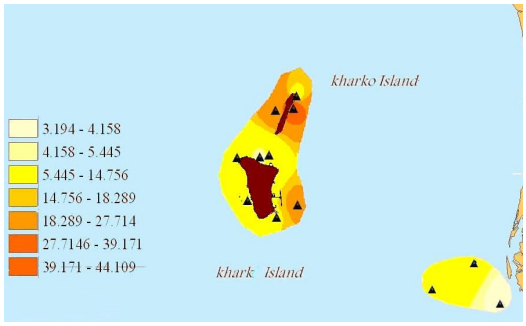
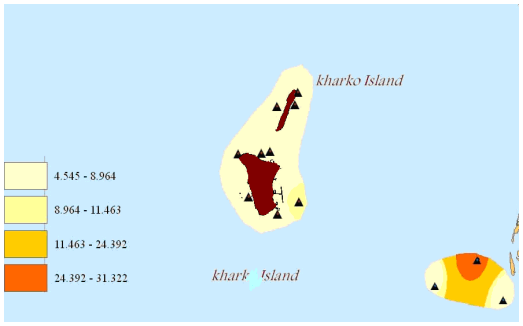


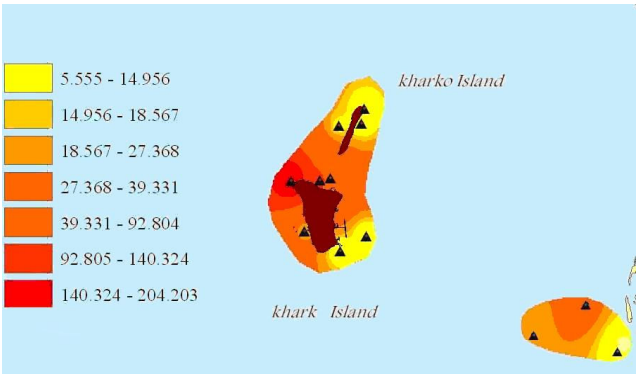
a) Summer



b) Autumn



c) Winter



d) Spring

Figure 3: Seasonal distribution pattern of fish larvae (no. per 10m²) in Khark And Kharko area (northern part of the Persian Gulf),▲(station),*(port), a) summer, b) autumn, c) winter, d) spring.

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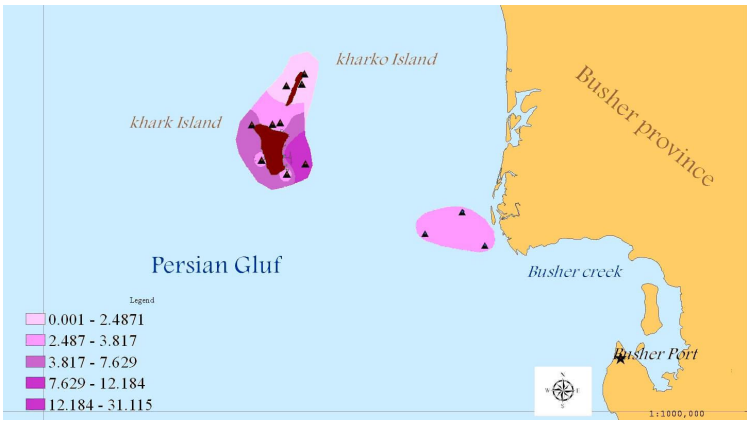
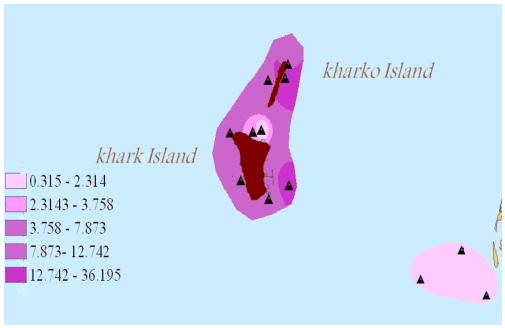


a) Summer



b) Autumn

c) Winter

d) Spring

Figure 4: Seasonal distribution pattern of coralline fish larvae(n per 10 m²) in khark and kharko larvae (no. per 10m²) in Khark And Kharko area (northern part of the Persian Gulf),▲(station), *(port), a) summer, b) autumn, c) winter, d) spring.

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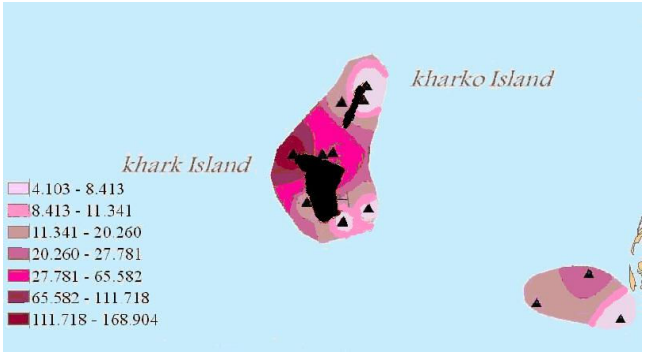
a) Summer

b) Autumn c) Winter



d) Spring

Figure 6: Seasonal distribution pattern of non coralline fish larvae larvae (no. per 10m²) in Khark And Kharko area (northern part of the Persian Gulf),▲(station),*(port), a) summer, b) autumn, c) winter, d) spring.

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Discussion

Among 45 families identified in the present study, families Clupeidae, Sillaginidae, Blenniidae, Atherinidae and Tripterygiidae were dominant with 65% of total abundance. Previous studies, reported families Clupeidae, Gobidae and Sillaginidae comprise 90% of total identified specimens in Bushehr creek (Owfi & Bakhtiary, 1999) and 80% of fish larvae in Frakeh–Genaveh Region were belong to families Clupeidae, Gobidae, Sillaginidae and Engraulidae (Rabbaniha, 2002).

The highest abundance of Clupeidae larvae was observed in spring, however in Nayband it was in late summer (Rabbaniha, 1998), in Bushehr Creeks, it was during autumn (Owfi & Bakhtiary, 1999), and in Frakeh Bay-Genaveh Region it was during spring to summer (Rabbaniha, 2002) and in Khouzestan Creeks was in spring . In costal waters of Kuwait, Clupeid larvae have two increasing periods, including April to Jun and then August to October (Houde *et al*., 1986).
The highest abundance of Sillaginidae larva was assessed in Jun, July and November. In Bushehr Creeks, it was in April and December (Owfi & Bakhtiary, 1999), in Frakeh Bay- Genaveh Region, it was in Agust (Rabbaniha, 2002), and in Khouzestan Creeks, it was during July to September.

Occurrence of Blenniidae depends on the coral rocks and tides. The tiny fish lives in the bed of sea with more density around the island (Leis & Rennis, 1983). The highest abundance of Blenniidae larvae was collected in August in the present study, and previously in Nayband Bay, in May and August (Rabbaniha, 1998). In Bushehr Creeks (Owfi & Bakhtiary, 1999) and Frakeh bay- Genaveh Region no larvae of Blenniid was caught, however, in costal waters of Kuwait the most abundance of Blenniid larvae were reported during spring and summer.

The family Atherinidae belongs to shallow waters and lives close to the coral rocks (Leis & Rennis, 1983). Among larval studied, Atherinidae larvae have been recorded from Nayband Bay (Rabbaniha, 1998) and Khark and Kharko in the Persian Gulf with high abundance in the spring. Tripterygiide was demersal and lived near the coral and tide area that was first record from the Iranian waters of the Persian Gulf.

Some families, including Labridae, Apogonidae, Chaetodontidae and Mullidae, were only reported from Khark and Kharko islands and Clinidae, Creediidae and Tripterygiidae were the benthic fish of coralline habitat and were first report from the Persian Gulf. The increased ichthyoplankton types in this area must be largely a consequence of increased habitat divert in the study area; coralline, marine and shore waters.

The mean abundance in Nayband Bay, a very diverse habitat was 28.47 larvae under 10m² of sea surface and the dominated families were Clupeidae, Sphyraenidae, Lutjanidae. This area includes several habitats, such as creek, estuary, and mangrove forest (Rabbaniha, 1998). The mean abundance of fish larvae from Ziarat to Asalouyeh (southern creek of Bushehr City) was 43.67 larvae under 10m² of sea surface and the dominated families were Gobiidae, Engraulididae and Clupeidae (Owfi & Mohamadnejad, 2000). The mean abundance of central Bushehr creek fish larvae was 30.23 larvae under 10m² of sea surface and the dominated families were Gobiidae, Sillaginidae and Clupeidae (Owfi & Bakhtiary,

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1999) which were main ecosystems of this area is creek and estuary. The mean abundance of fish larvae from the creek-estuary Bushehr to Genave (northern part of Bushehr coastal waters) was 7.87 larvae under 10m² of sea surface and the dominated families were Gobiidae, Clupeidae ،Sillaginidae ،Sparidae (Rabbaniha, 2002). Comparing to the mean abundance between these areas showed that the highest abundance is in Central Bushehr creek, because the creeks of this area are sheltered creeks (pond shape and deep canal creeks). Also, the abundance of fish larvae in Khark and Kharko Islands is more than northern creeks of Bushehr, because the most of stations in northern creeks of Bushehr were located in open sea and they do not have shelter area. Therefore, it seems that the fish larvae distributed with currents.

The habitat diversity of Khark and Kharko, is one of the main reasons for species diversity of fish larvae and Clupeidae dominancy is related to the main habitat, the coralline fish larvae as same as Sphyraenidae, Lutjanidae, Blenniidae, Atherinidae, Tripterygiidae are presents.

The mean abundance of Khouzestan coastal waters province (northern part of the Persian Gulf) were 59.11 larvae under 10m² of sea surface and Gobiidae, Clupeidae, Engraulididae dominated fish larval family and so Leiognathidae and Sciaenidae reported in limited area. Creek is main habitat of Khouzestan province.

Nellen (1973) collected larval fishes in 71 net tows at 65 stations off the Iranian side of the Persian Gulf in two week period (31 March to 14 April 1965) using 500µm mesh. In this study, the predominant fish larvae were Pomadasyidae (Haemulidae), Clupeidae, Gobiidae and Apogonidae.

Houde *et al*. (1986) sampled fish larvae from September 1979 to August 1980 from Kuwait waters and two cruises from Saudi Arabia (southern part of the Persian Gulf). The mean abundance was 71m⁻² and dominant families were Engraulididae, Gobiidae and Clupeidae.

Although a lots of researcher such as Laevastu and Hela (1970) believed that climate and oceanographic changes are linked to fish larvae abundance and distribution, but in this study coefficient correlation assessment revealed no distinct relationship between fish larva abundance and a biotic factors of water temperature, salinity and depth. The result showed that fish larvae abundance was highest in spring to early summer.

The mean abundance of fish larvae in Pelaj station was higher than in other stations due to a deeper coralline habitat, which can be as a stable and safe area for fish larvae.

The distribution pattern of fish larvae changed seasonally in two groups in summer and autumn the abundance of all families increased in east coasts of Khark Island and in three coastal stations (Figs. 5 and 6) in case, it was changed in spring and the most abundance was in west coast of Khark. It seems that the distribution of fish larvae was correlated to sea currents, the main current of the Persian Gulf (anti clockwise current) cause the water moved from south-east to north-west, therefore, fish larvae had high abundance in east of Khark and in winter and spring with increased of northwest wind (especially in coast of Bushehr province), the sea current was changed and produce clockwise current, that cause high abundance of fish larvae in east coast.

Sea current distribution and type/ location of stations (path coral habitats) are the main

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causes for the richness increase and abundance of the fish larvae decrease in this area. Also, their spatial distribution pattern will be changed under effect of mentioned phenomenon.

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الگوی پراکنش لارو ماهیان مرجانی و غیر مرجانی در ناحیه جزایر خارک و خارکو (خلیج فارس)

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چکیده

جزایر مرجانی خارک و خارکو در منتهی الیه منطقه مرجانی می باشد که در سال ۱۳۵۴ از نظر رده‌بندی حفاظتی در لیست پناهگاه حیات وحش قرار گرفت. این تحقیق از تیر ماه ۱۳۸۵ لغایت خرداد ۱۳۸۶ صورت گرفت که طی آن علاوه بر ۹ ایستگاه در اطراف جزایر، ۳ ایستگاه ساحلی و دریایی نیز در نظر گرفته شد. جمع‌آوری نمونه‌ها در هر بار توسط تور نمونه‌گیر Bongo با چشمه ۵۰۰ میکرون بصورت کشش مورب از کف به سطح انجام گردید. طی این بررسی ۱۸۰۸عدد لارو جمع‌آوری که در مقاطع لاروی پیش مرحله تشکیل صفحه دمی (Preflexion)، پس مرحله تشکیل صفحه دمی (flexion Post) و در ۴۵ خانواده شناسایی گردید که دو گروه مرجانی (۲۱ خانواده) و غیرمرجانی (۲۴ خانواده) را شامل می‌شدند. ۹۶ درصد لارو ماهیان جمع‌آوری شده در مرحله Preflexion قرار داشتند. میانگین فراوانی لارو در منطقه ۱۸/۷۱ عدد در ۱۰ مترمربع بود که خانواده‌های Clupeidae، Sillaginidae، Blenniidae، Atherinidae و Tripterygiidae بترتیب بیشترین فراوانی را داشته و جمعاً ۶۵ درصد کل فراوانی لاروی را شامل می‌شدند. لاروها در تمامی طول سال در منطقه وجود داشتند و اوج فراوانی آنها در فصل بهار با اختلاف معنی‌دار ($P<0/05$) بود بطوری‌که با افزایش دما، فراوانی آنها کاهش می‌یافت.

کلمات کلیدی: لارو ماهیان مرجانی، فراوانی لاروی، جزایر خارک و خارکو، خلیج فارس

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