Jellyfish of Khuzestan coastal waters and their impact on fish larvae populations

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Introduction

One of the most valuable groups in the food chain of aquatic ecosystems is zooplankton. A large portion of them are invertebrate organisms with great variety of forms and structure, size, habitat and food value. The term ‘jellyfish’ is used in reference to medusa of the phylum Cnidaria (hydromedusae, siphonophores and scyphomedusae) and planktonic members of the phylum Ctenophora (Mills, 2001). Jellyfish medusa is a zooplankton which is frequently present in coastal ocean waters and all marine habitats. They are also primary predators of other zooplanktons which have significant impact on abundance and diversity of zooplankton communities that are one of the key parts of the marine food web. Most jellyfish include Hydromedusae, Siphonophora and Scyphomedusae and planktonic Ctenophora, especially in the productive warm months (Brodeur *et al*., 1999). In recent years, the frequency of the jellyfish in many ecosystems has increased (Xian *et al*., 2005; Lynam *et al*., 2006).

Following the increase of jellyfish populations in world waters, scientists have studied medusa due to its high feeding rate of small crustaceans such as copepods (fish larvae food) and being food rivals for some fishes (Pitt *et al*., 2008). For example, increasing *Chrysaora hysoscella* has severely reduced Pilchard fish populations (Lynam *et al*., 2005b). Life cycles of many important economic fish consist of a planktonic stage at which they are highly vulnerable to jellyfish. Therefore, the recruitment of fish stocks is declining severely. Medusa blooms have attracted the world's fishing industry. For instance, the *Crambionell orsini* bloom in eastern Oman in 2003, which lasted for 16 months had adverse effects on fishing gears but due to lack of ecological information, the cause of the bloom was not specified (Daryabandar, 2004). According to studies in the Persian Gulf, 29 species of jellyfish medusa and 4 species of comb jelly comprise less than 0.2% of plankton population (Michel *et al*., 1981). In another study on distribution and abundance of zooplankton in Kuwaiti waters, 26 species were identified that were less than 0.1% of the plankton population (Michel *et al*., 1986a). In ROPME (Regional Organization for the Protection of the Marine Environment) studies after the Iran-Iraq War, jellyfish were 0.3% of total abundance of zooplankton communities (Somer, 2003). Plankton studies in coastal region of Bushehr in 1989, showed that 2% of zooplanktons were Medusa. The presence of *Phialella quadrata* was also mentioned in this report (Ajdari, 1989).

This study was part of a research project conducted at the Iranian Fisheries Science Research Institute on jellyfish to identify the jellyfishes of the northwest coast of the Persian Gulf in Khuzestan province and the east and west part of Khure-Mussa canal.

Material and methods

The study area was the east and west part of Khure-Mussa canal in the northwestern Persian Gulf. Sampling was conducted monthly from February 2007 until January 2008. Locations of sampling stations were selected randomly (Fig. 1). Micro jellyfish samples were collected using 500 microns plankton net. The jellyfish was separated using a stereo microscope and identified to lowest possible taxonomic level (Zheng Zhong, 1989). The number of taxa was expressed in 10s per square meter. In order to collect larger jellyfish, shrimp trawls were hauled. Total stock number per unit area was calculated. In order to identify jellyfish, they were separated from trawl catches, and fixed in formalin and seawater. Then the samples were transported to the laboratory in plastic bins. Among the environmental factors, temperature and salinity were measured (Riley and Chester, 1971).

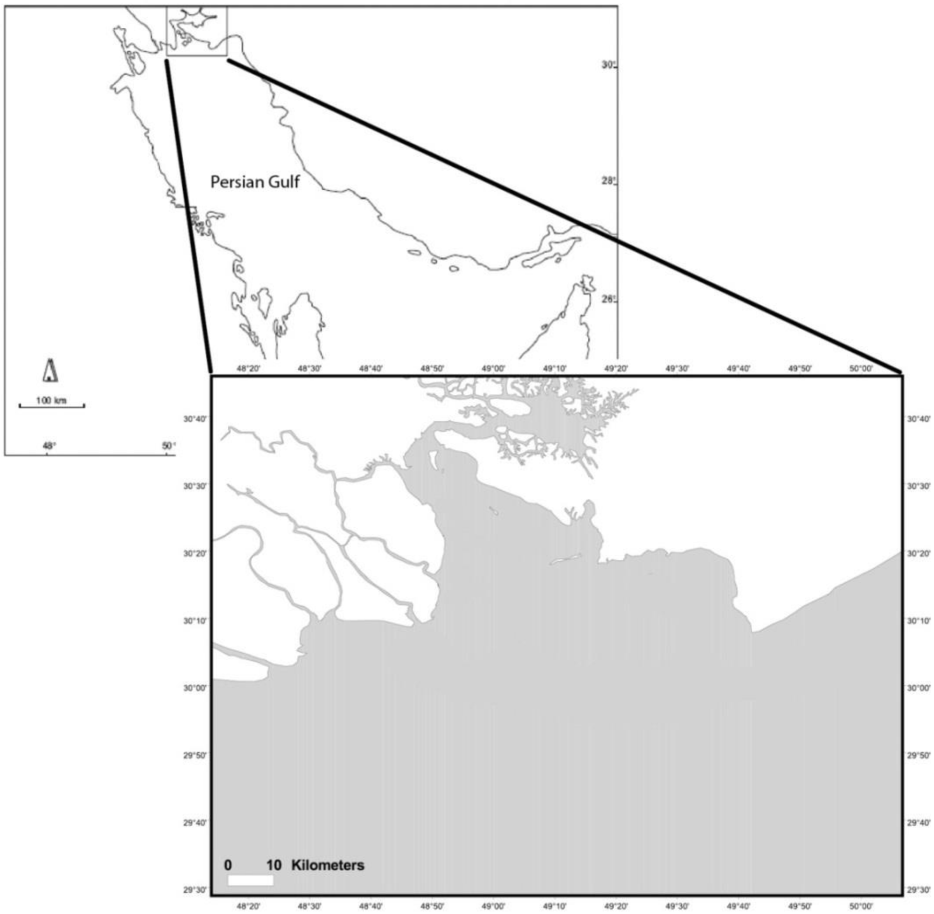

Figure 1: Study area.

Tows and abundance standardization for micro jellyfish samplings followed the methods described by Smith and Richardson (1979):

$C=10(a^{-1}b^{-1}cd)$

C = the number of collected medusa samples

a = cross section of net (m^2)

b(f*r) = towing distance (m) d = maximum depth

f = flowmeter calibration coefficient

r = rotation number of flowmeter

The stock number of large medusa caught using trawl nets in the study was calculated by (King 2007):

$N= (A/a) \times \sum x/n$

N = total stock number

A= study area (square kilometers)

a =trawled area (square kilometers)

$\Sigma x/n$= the average number of catch number in trawl**…**

Ichthyoplankton data, which compared with jellyfish abundance were used from a parallel study in studied area (Koochaknejad, 2011)

Results and discussion

During the study year in Khuzestan (2007-2008) a total of 18 species of Jellyfish were identified including Hydromedusa (9 species), Siphonophora (3species), Scyphomedusa (2 species) comb jellies (2 species) and two unknown species in very low densities.

From the 5357 isolated microscopic jellyfish, 56.6 percent of microscopic jellyfish were from the east coast stations, and 43.4 percent of them were from the west coast stations. In addition to plankton net sampling, shrimp trawls were used to study larger jellyfish. Totally 5343 large jellyfish were caught using trawl nets during the study.

The percentage of frequency of Jellyfish species are presented in Table 1. The highest percentage frequencies belonged to Pleurobranchia at 31 percent and *Eiren hexanemalis* at 22 percent. In the western part, Pleurobranchia with more than 60 percent of frequency was the most abundant taxa of jellyfish. Other species were present at less than 10 percent. *Eiren hexanemalis* was the most frequent species in the east coast of the canal. Monthly changes of jellyfish are presented in Fig. 2. The most frequent jellyfish was observed in the western part in July at a frequency of 1080 number/10m^2. The density of jellyfish declined sharply in summer and autumn and reached zero in October. The highest frequency in the eastern part was observed in September at 655 number/10m^2. There were two clear peaks of frequency in May–June and in late summer in the eastern part. The identified species of microscopic jellyfish in this study have high similarity to those reported by Mosavi Deh Mordi (2006) in a study in Ghazale and Doragh creeks in which all coastal water species were observed in creeks. Most of the creek species were young individuals and two dominant species were *Eirene kambara* and *Diphyes chamissonis*. In this study *Eiren hexanemalis* and Pluerobranchia (Ctenophora) were the most frequent species. Common dominant species in Khuzestan coastal waters were *Catostylus tagi* and *Chrysoara hysocella*. The highest frequency of *Catostylus tagi* was observed in June in the eastern part but *Chrysoara hysocella* was observed at lower frequencies during the summer months, especially in August. Despite being present throughout the year, they were mostly observed on the east coast in July at a frequency of 2811 no/km^{2}where the temperature was 24°C and salinity was 38.6 ppt.

All reported species in this study have been reported in the Persian Gulf (Michel *et al*., 1982; Al-Yamani *et al.*, 1998; Al-Yamani *et al*., 2004). *Eiren hexanemalis* was present most of the year and it also was the dominant species in Kuwaiti waters. *Eiren hexanemalis* was present most of the year and it also was the dominant species in Kuwaiti waters.

Table 1: Species, frequency of occurrence, and mean (±SE) density of jellyfish.

Species	Total No. Species	Frequency of occurrence (%)	Mean density (N/10m^2)± SE
Liriope tetraphylla	310	5.79	12.92±6.12
Aequorea parva	144	2.69	6±3.35
Eiren hexanemalis	1178	22.01	51.22±25.51
Eutima sp	17	0.32	0.71±0.34
Octophialucium sp	156	2.91	6.5±3.44
Phialucium sp	12	0.22	0.5±0.37
Phialella sp	392	7.32	16.33±7.96
Helgicirraha schulzei	506	9.45	21.08±10.31
Eiren kambera	335	6.26	13.96±7.14
Lensia subtiloides	12	0.22	0.5±0.5
Diphyes sp	398	7.44	16.58±11.63
Pleurobranchia sp	1661	31.03	69.21±27.27
Beroea sp	17	0.32	0.71±0.46
Unknown(1)	125	2.34	5.21±3.56
Unknown(2)	90	1.68	3.75±2.89

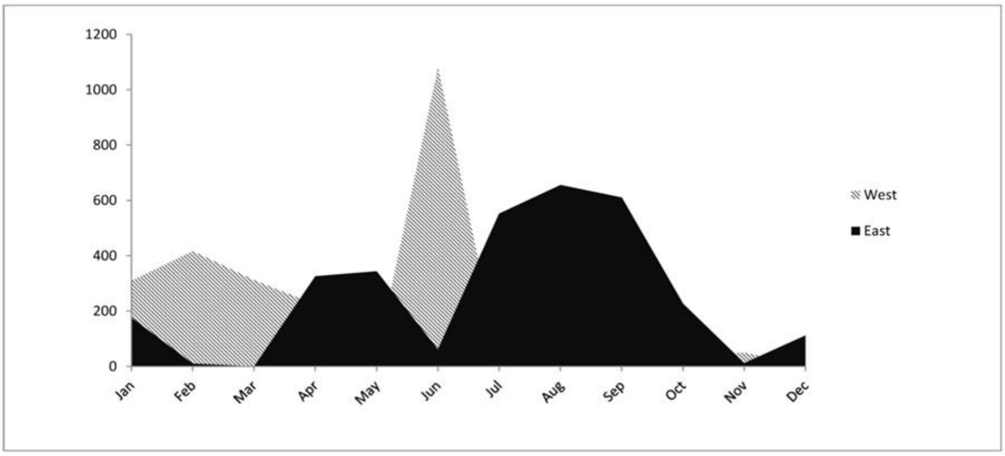

Figure 2: Total abundance (Numbers in 10 square meter) of jellyfish in west and east of Khure-Mussa.

In prior studies in the Persian Gulf, *Eiren kambara* and Eirenidae family had the highest frequencies in the medusa population (Michel *et al*., 1986a and Al-Yamani *et al*., 2004). Michel (1982) reported *Phialucium carolinae* as a dominant species, but in the present study it was only observed in July and August at a low abundance. Two dominant species of macroscopic jellyfish in creeks and coastal waters were from Catostylus genus. Microscopic samples were the aim of the study in the creeks. The species of Catostylus genus are epipelagic and live in tropical waters. Michel (1986a) reported that species of Catostylus are endemic to Iranian waters. The large scyphozoan jellyfish *Catostylus mosaicus* regularly forms blooms in the estuaries and coastal lagoons of eastern and northern Australia. Average abundances during blooms may exceed 2 medusae per cubic meter (Pitt and Kingsford, 2000 and 2003).

Jellyfish are known as higher-order carnivores in plankton communities (Mills, 2001). Although Cnidaria and Ctenophora are low on the phylogenetic tree, they generally feed high in marine food chains, directly competing in many cases with fishes for food. Massive removals of fishes from ecosystems might be expected to open up food resources for gelatinous predators, which seems in some cases to be what has happened. Therefore jellyfishes are important to local fisheries as a competitor and predator of commercial fishes. However, in this study it was observed that with increasing jellyfish abundance in July, population of fish larvae decreased. In Fig. 3, variations of jellyfish abundances are presented in comparison to fish larvae abundances.

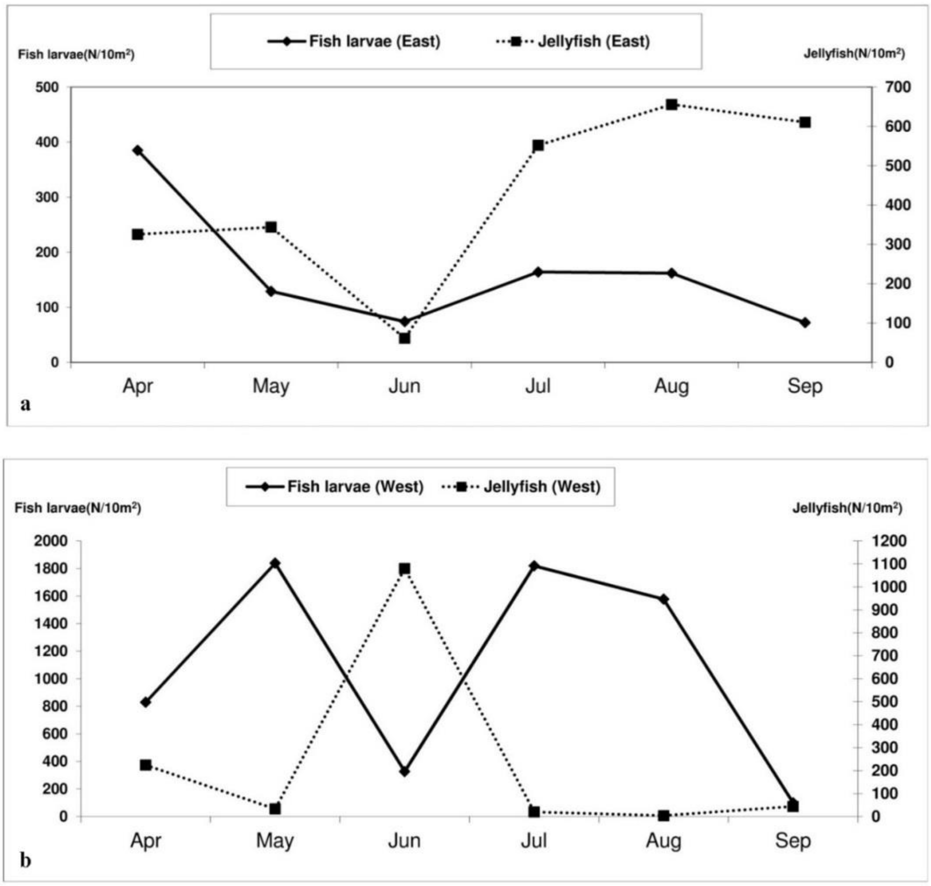

Figure 3: Comparison of jellyfish and fish larvae abundance in East (a) and West (b) of Khure-Mussa canal.

On the west coast in July, with a sharp increase in population abundance of jellyfish, larval fish abundance decreased in the region. And during the summer months of the east coast, population increase of jellyfish reduces fish larvae abundance in the east coast of the canal. Different studies have been carried out on effects of jellyfish on lower levels of food chain (Purcell, 1992, 1997; Schneider and Behrends, 1994; Omori *et al*., 1996; Pages *et al*., 1996).There is high competition among filter feeder fishes, fish larvae and jellyfishes for consuming zooplanktons (Arai, 1988; Purcell and Arai, 2001).In addition, there is a possibility of direct predation of larvae by jellyfish (Hansson *et al*. 2005). So we can say that population growth of jellyfish could have a direct impact on fish larvae populations.

Population dynamics of jellyfishes are different from commercial fishes. Jellyfishes have a complex life history including sexual and asexual stages, high growth rate and a short life span (Arai, 1988). Therefore abundance and biomass of medusa stock undergo numerous short term (weekly and monthly) and long term (yearly) fluctuations (Pitt and Kingsford, 2000). These temporal variations should be considered for stock assessment of jellyfish. Recent droughts followed by decreased volume of freshwater input as well as increasing of industrial, agricultural-residential waste water discharge and high pressure of fishing on large fish can enhance jellyfish blooms in Khuzestan coastal waters.

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