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Secondary Production of *Pisidia* sp. in Salakh Region, Qeshm Island, Iran

[1]Seyed Mohammad Sadeghi Nassaj, [1]Seyed Mohammad Bagher Nabavi, [1]Vahid Yavari, [1]Ahmad Savari and [2]Rahim chinipardaz

[1]Department of Marine Biology, Faculty of Marine Science, University of Marine science and Technology, Khorramshahr, Iran
[2]Department of Statistics, Shahid Chamran University, Ahwaz Iran

Abstract: To estimate the biomass and secondary production of macrobenthos in Salakh region of Qeshm island, a dominant specie (*Pisidia sp.*) identified and chosen. Yaqoob and Miner keys were used for this purpose. Sampling has done in 2008-2009 with collaboration of UNDP-GEF/SGP and Environmental Protection Bureu of Qeshm Free Zone Organization, Qeshm island. Seasonal sampling methodology was adopted. Biomass was estimated by Crisp method (using Dry Weight). A total number of 1552 individuals were grouped into four age classes (cohort) according to Bhattacharya method. The annual biomass (B) and secondary production (P) were 192.4 gDW m^{-2} and 1.4197 gDW m^{-2} y^{-1}, respectively. The majority of biomass and production referred to adult individuals whereas the sex ratio showed the male dominance in abundance. The minimum size for ovigerous female was determined as 3.43mm. The P/B ratio therefore calculated as 1.4197÷192.4=0.029. Considering the ecological efficiency (transfer efficiency) of different trophic levels which is about 10%, the fish production is estimated to be 141 kg km^{-2} y^{-1}.

Key words: Secondary production · Biomass · *Pisidia sp.* · Cohort · Persian gulf

INTRODUCTION

Secondary production is the rate at which energy or organic carbon is incorporate into living mass by heterotrophic organisms per unit area overtime. It is an important measure for demodulating the functioning of any ecosystem, because it quantifies the transmission of energy from one trophic level to the next in food webs [1-4].

There are few studies on marine environments of the Persian Gulf, particularly on the Iranian side [5]. In recently published paper on species diversity of macrobenthic communities in Salakh Region, Qeshm Island, it is reported the dominance of *Pisidia sp.* [6] which belongs to Porcellanidae (Decapods). Qeshm is the largest island in the Persian Gulf situated near the straits of Hormoz south of Bandar Abbas. The Qeshm island with its unique natural characteristic is geographically situated at 55 to 57 degrees longitudinally and 25 to 27 latitudinally. The dominant weather is tropical and the temperature throughout the year always stays a few degrees above zero. The island's climate is characterized by a long warm season, often extraordinary hot, high relative humidity and a short temperate season [7]. Salakh is the southern coast of Qeshm island and has an active port for both fishery and commercial aims (Fig. 1). Because of their dominance, the secondary production of *Pisidia sp.* could account for most of the macrofaunal production which is an indicator for responses of environment to natural and man-induced disturbance. The objective of this study was to estimate the secondary production of this dominant benthic specie and also to investigate its growth parameters.

MATERIALS AND METHODS

Sampling and Laboratory Procedures: During April 2008 to March 2009, specimens were seasonally collected from twelve stations located in Salakh coastal waters (Fig. 1).

Corresponding Author: Seyed Mohammad Sadeghi Nassaj, Department of Marine Biology, Faculty of Marine Science, University of Marine science and Technology, Khorramshahr, P.O. Box: 669, Iran. E-mailL nassaj_aqua@yahoo.com.

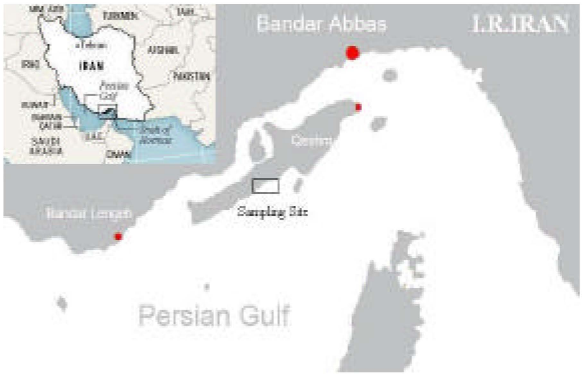

Fig. 1: Map of sampling area

A total number of 1552 individuals was collected by Van-Veen grab (285 cm^2 surface area) and fixed in ethanol for further investigations [8]. Yaqoob and Miner keys were used for specie identification [9, 10]. All crabs caught were counted, measured (carapace width, CW) and sexed by observing the presence or absence of the copulatory pleopods [11]. Sex ratio was obtained for *Pisidia sp.* and X^2 test used to compare it with expected ratio (1:1) [12]. Crisp method was used for determination of biomass value of macrobenthos in order of their dry weight (DW, 70°C for 48 h) [13].

Data Analysis: The secondary production can be estimated by several methods. Most of the classical methodologies, based on the recognition of cohorts or on size frequency and mass specific growth rate, are expensive and time consuming [14, 15]. Although less accurate, a number of empirical models based on equations relating production to biomass and lifespan [16], maximum individual body weight [17] and environmental variables like temperature [18, 19] and depth [20, 21] have been proposed. In our study, secondary production was estimated by the Bhattacharya's method in FiSAT II software (FAO-ICLARM Stock Assessment Tools) version 1.2.0 [22]. It identifies cohorts by decomposing the polymodal size distribution into their normal distribution components [23]. Cohorts were assumed to be single with a separation index greater than 2. The annual production (P) was calculated for *Pisidia sp.* by the mass specific growth rate method [24] from the size-frequency distribution obtained from pooled samples:

$$P=\sum N_i M_i G_i$$

$$G_i=(M_2-M_1)\Delta t$$

Whereas P is the production (gDW m^{-2} yr^{-1}), N_i is the average number of individuals in length class i (ind m^{-2}), M_i is the mean individual dry weight in length class i (gDW), G_i is the mass-specific growth rate (yr^{-1}) and Δt is the duration of time between two sampling procedures.

RESULTS AND DISCUSSION

Collected individuals were divided into male and female in 14 length groups. The minimum, maximum and group sizes were determined as 0.93, 7.93 and 0.5 mm, respectively. Sex ratio for all caught crabs was 63% for males against 37% for females, which means that male population is 1.70 orders of females. In large size groups the males are the only observed sex (Fig. 2). This can relate to faster rate of growth in males [25]. Another fact is that adult female typically place themselves at active burrows [26].

X^2 test conducted for each length group and the results showed a significant difference ($P<0.05$) for larger groups (Table 1).

In decapods three types of allometry (geometric growth) exist: (i) positive allometry or progressive geometric growth, in which the dependent variable grows fast with respect to body size, (ii) isometric or arithmetic growth and (iii) negative allometry or retrogressive geometric growth, in which the dependent variable grows slower than body size [27]. Here we take the dry weight (DW) as dependent variable and studied its relation to carapace width (CW). The relation between DW and CW is:

$$DW=a\times(CW)^b$$

Whereas a is the specific constant and b is the equation power which expected to be 3, so there must be an positive allometry. Although the obtained values for

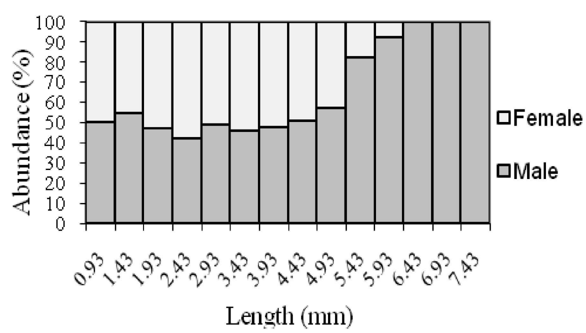

Fig. 2: Abundance of male and female individuals in length groups.

Table 1: Results for X^2 test for male and female abundance

Male/Female	X2	Female Abundance (%)	Male Abundance (%)	Legth (mm)
1.00	0	50	50	0.93
1.22	0.1	45	55	1.43
0.89	0.03	53	47	1.93
0.72	0.2	58	42	2.43
0.96	3.32	51	49	2.93
0.85	7.12	54	46	3.43
0.92	12.46	52	48	3.93
1.04	9.23	49	51	4.43
1.33	16.82	43	57	4.93
4.56	10.19	18	82	5.43
11.50	6.16	8	92	5.93
-	5.72	0	100	6.43
-	3.9	0	100	6.93
-	2	0	100	7.43

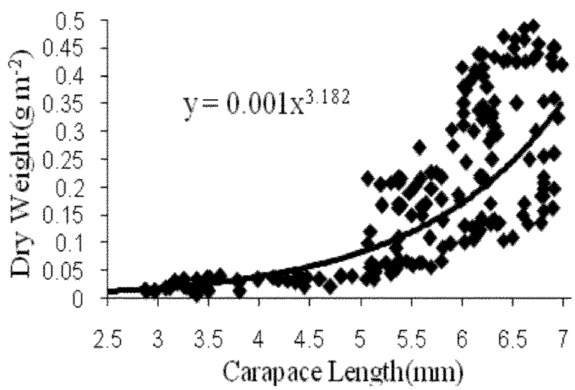

Fig. 3: Relation of carapace width with dry weight in male

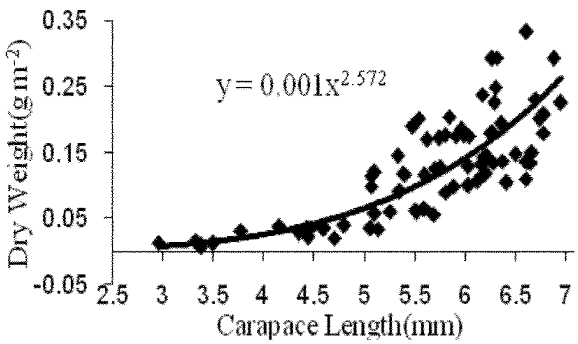

Fig. 4: Relation of carapace width with dry weight in female

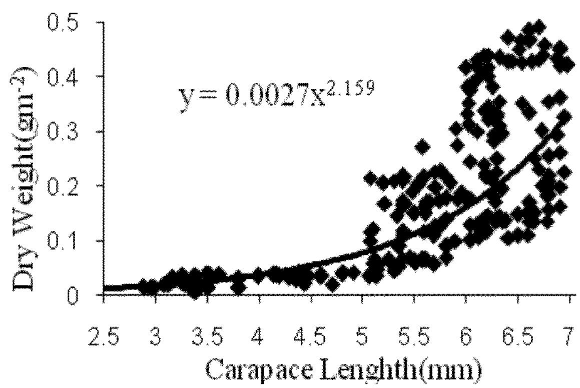

Fig. 5: Relation of carapace width with dry weight in both sexes Abundance distribution of individuals for each season is shown for males and females separately (Figs. 6 to 9).

b have a meaningful difference with expected one (Fig. 3 to 5), but the growth is still progressive.

Overall production for both sexes varied by season (highest in summer, 0.836 gDW m^{-2} y^{-1} and lowest in autumn, 0.0178 gDW m^{-2} y^{-1}) and the production by males (1.2671 gDW m^{-2} y^{-1}) was higher than females (0.5517 gDW m^{-2} y^{-1}) (Table 2). Since the majority of production is made by adult members of the community [28], it was predictable that male production should be more than for female members (2.2 times). Adult age of females is estimated by the smallest ovigerous female [29]. Hence, the minimum size for an adult female calculated to be 3.43 mm. By dividing the size range into four age groups, (0+, 1+, 2+ and 3+) an adult female should has at least 1 year old.

The highest amount of total biomass is measured in spring (80.44 gDW m^{-2}) and the lowest in autumn (19.50 gDW m^{-2}). The highest value for male biomass was 34.18 gDW m^{-2} in summer and for females was 48.73 gDW m^{-2} in spring. The production to biomass ratio (P/B) was 0.029. This might due to low rate of growth beside of relatively long term of life cycle.

Table 2: Biomass and production values for *Pisidia sp.*

Season		Spring	Summer	Autumn	Winter	Mean	Total
Male	Production	0.082	0.504	0.0091	0.672	0.272	1.2671
	Biomass	26.71	34.18	12.58	15.85	22.33	89.32
Female	Production	0.102	0.332	0.0087	0.109	0.137	0.5517
	Biomass	42.73	34.18	12.58	15.85	26.33	105.34
Both sexes	Production	0.184	0.836	0.0178	0.3819	0.526	1.4197
	Biomass	80.44	55.31	19.5	37.19	48.11	192.4

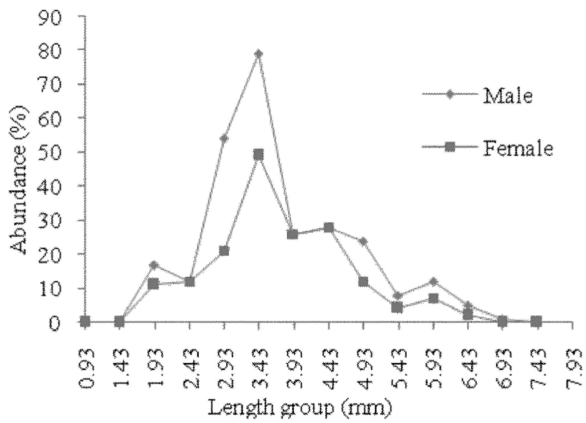

Fig. 6: Length distribution pattern in spring

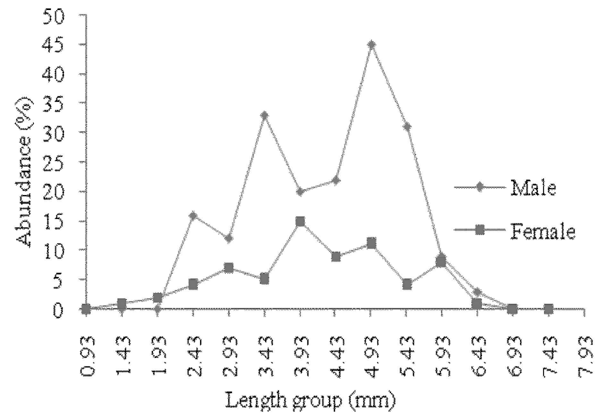

Fig. 8: Length distribution pattern in autumn

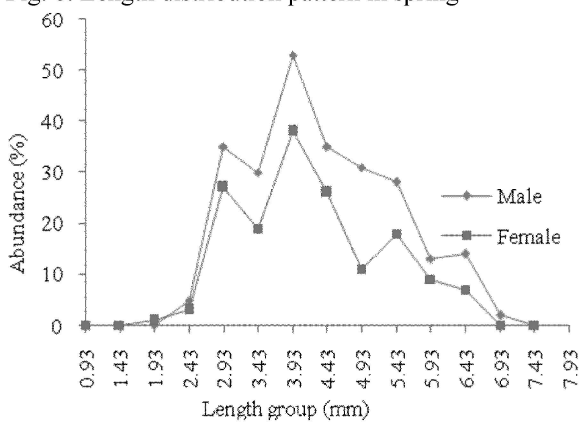

Fig. 7: Length distribution pattern in summer

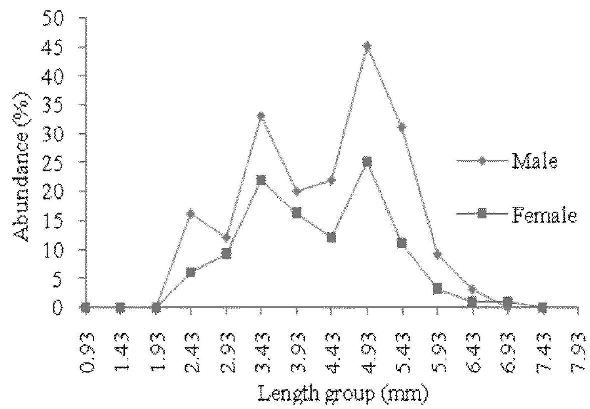

Fig. 9: Length distribution pattern in winter

If the ecological potential transmission between third and forth levels of food pyramid is 10 percent [30], so the annual transferred potential (fish production) by *Pisidia sp.* is 141 kg km^{-2} y^{-1}.

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