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Population Dynamicsand Assessmentof *Carasobarbusluteus* (Heckel, 1843) Inhooral-Azim Wetland (Khuzestanprovinces, Iran)

[1]Afrooz Eydizadeh, [2]Gholamreza Eskandary, [2]Gholamhossein Mohammadi and [3]Seyed Ahmad Reza Hashemi

[1]Khuzestan Science and Research Branch, IslamicAzad University, Ahvaz, Iran
[2]South of Iran Aquaculture Fishery Research Center, Ahvaz, Iran
[3]Department of Fisheries, Gorgan University of Agricultural Sciences and Natural Resources, Iran

Abstract: The Population Dynamics and status of Hemeri (*Carasobarbusluteus*) in Hoor Al-azimwetland (Khuzestan provinces, Iran) were investigated to derive information required for their management. During this study from 2011 to 2012more than 460specimens*C. luteus* were measured. Mean±S Dlength values for this species were 228±15 respectively and maximum and minimum total lengthwere 118 mm and 362 mm respectively. Mean±SDweight values for this species were 190±91g and maximum and minimum weight were86- 416g respectively. The relationship between weight and total length was found to be$Y=0.0018L^{3.18}$ (n=466, R2 =0.96) for total fishes, these results shows isometric growth in studied fish (P>0.05). Growth and mortality parameters were calculated for *C. luteus* as below, L_8: 375 mm and K: 0.67 y^{-1} and t_0: -0.16, M: 1.22, F: 0.46, Z: 1.66, E: 0.28respectively. Relative yield per recruitment (Y'/R) :0.02 relative biomass per recruitment, (B'/R) :0.21 exploitationratio maximum sustainable yield, E_{max}: 0.59precautionary average target for*C. Luteus* stock respectively was calculated. According to exploitation coefficient *C. luteus* stocksis not over fishing.

Key words: *Carasobarbusluteus* · Population Dynamic · Hoor Al-Azim Wetland

INTRODUCTION

For a given level of fishing mortality to be sustainable, there must be a balance between the mortality, which reduces population biomass and reproduction and growth, which increase it [1]. Yet understanding the population biology of fished species is essential to meet one of the main objective of fishery science, that of maximizing yield to fisheries, while safeguarding the long-term viability of populations and ecosystem [1].

Hoor Al-Azim is parts of a single hydrological system and forms one of the largest permanent freshwater wetlands in Lower Mesopotamia, being located between N 30° 58´- 31° 50´ and E 47° 55´- 47° 20´ [2]. This wetland is situated in the North Azadegan Plain, 80 km south-west of Ahvaz city, near the border between Iran and Iraq. The marshes have experienced significant changes during the last two decades and are expected to face further modifications in the next years formerly they extended 85 km from north to south and 40 km from east to west, covering about 254000 ha. The system was fed by two tributaries of the Tigris and by the River Karkheh, which rises on the Zagross Mountains in western Iran. The northern and central parts of the marshes were permanent, while in the south they were largely seasonal [3].

Order Cypriniformes with six families, 321 genera and some 3268 species [4] is one of the most widespread and large (specious) orders of fishes all over the world. Thus cyprinids are, as well, a major element in Iran'sichthyofauna, found in all its major drainage basins. The genus Barbus (Cyprinidae, Barbinae), being a member of this group, is a polyphyletic taxon in southwest Asia where one monophyletic clad comprising of six species is reported from the Levant, the Arabian Peninsula, the Tigris-Euphrates basin and neighboring drainages in western Iran [5].

Corresponding Author: Afrooz Eydizadeh, Department of Fisheries, Khuzestan Science and Research Branch, Islamic Azad University, Ahvaz, Iran.

The barbels, genus *Barbus*, are found in Europe, Southwest Asia and Africa and comprise about 800 species [6]. According to Coad [7], Abdoli [8] more than 17 species of Barbus have been reported from different basins of Iran. Hemeri (*Carasobarbus (=Barbus)luteus*) belong to the order Cypriniformes, the family Cyprinidae and the genus Barbus. This specieswidely distributed in the rivers Tigris and Euphrates and adjacent drainage basins. In Iran, it is found in the Tigris River Basin including the Hoor Al-Azim Marsh, the Persian Gulf Basin including the Helleh, Dalaki, Shapur, Mond and DashtePalangRivers and LakeFamur (Parishan), the Lake Maharlu Basin and the Hormozgan Basin and also Iraq and Syria (Berg, [9]; Marammazi, [10]; Abdoli, [8]). Different aspects of biological work of *C.luteus* have been done by different authors, Szypula *et al*. [11], AL Hazzaa [12], Gokcek and Akyurt [13]. Hashemiand Hashemi *et al*. [14-19], but no work has been done on population dynamics of this species in Hoor Al-Azimwetland. Unfortunately, no references from other studies are available regarding Hemeri species in this local.In this context, the aim of the present study was: (i) to estimate its growth and mortality parameters via length frequency methods (ii) to determine the exploration pattern of the population of *C.luteus*. Results will greatly contribute to elaborating management programs for this economically important fish species of the region under study.

Table 1: Three stations in Hoor al-azim wetland

Station	Longitudes E	Latitudes N
Rofaie	47°,53′	31°,35′
Tabore	47°,51′	31°,29′
Shatali	47°,42′	31°,23′

MATERIALS AND METHODS

Length-frequency data of *C.luteus* were collected monthly from the catches from landing at three station: Rofaie, Tabor and Shatali (Table1): from April 2011to March 2012 (Fig. 1). Fish sampling was carried out by using 12.5m long gill nets, with meshes of 45 mm (stretched). Nets were anchored at each of the sampling stations at sunset and they were removed at sunrise on the following day, remaining 12 h in water. Total length (TL, mm) and total weight (W, g) were measured for each fish.

Parameters of the length weight relationship were obtained by fitting the power function $W= a \times L_F^b$ to length and weight data where:W is the total wet weight, ais a constant determined empirically, L_F is the fork length andbis close to 3.0 for species with isometric growth.

The data were then pooled monthly from different landing sites and subsequently grouped into classes of four centimeter intervals. The data were analysis using FiSAT II (FAO-ICLARM Stock Assessment Tools) as explained in details by Gayanilo *et al*. [20].

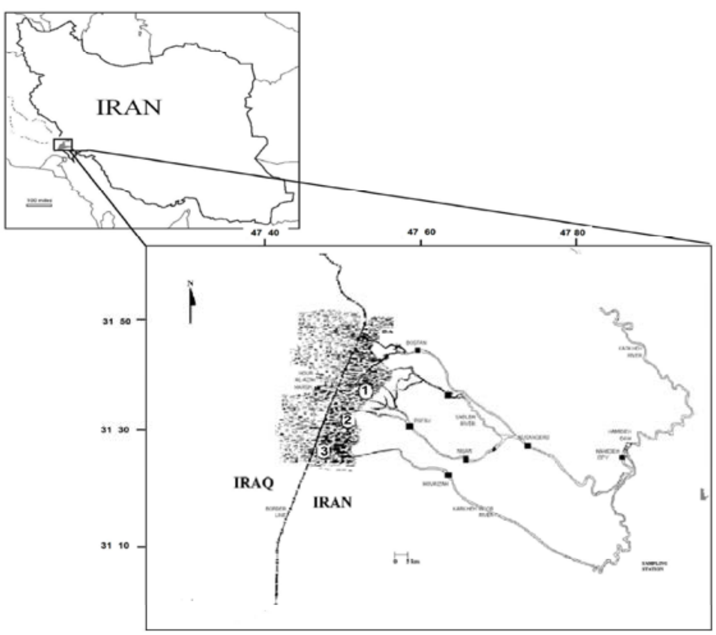

Fig. 1: The map of Situation on HoorAl-Azimwetland(1: Rofaye, 2: Tabar, 3: Shatali) in Khuzestan province (South West of Iran)

Growth was calculated by fitting the von Bertalanffy growth function to length frequency data. The von Bertalanffy growth equation is defined as follows [21]:

$$L_t=L_8\ [(1\text{-exp}\ (\text{-}K\ (t\text{-}t_0))]$$

where L_t is length at time t, L_8 the asymptotic length, K the growth coefficient and t_0 is the hypothetical time at which length is equal to zero.

The t_0 value estimated using the empirical equation [22].

$$\text{Log}_{10}\ (\text{-}t_0) = -\ 0.3922 - 0.2752\ \text{Log}_{10}L_8 - 1.038\ \text{Log}_{10}K$$

The fitting of the best growth curve was based on the ELEFAN I program [23], which allows the fitted curve throughthe maximum number of peaks of the length-frequency distribution. With the help of the best growth curve, growth constant (K) and asymptotic length (L8) were estimated.

The growth performance index Φ' [24], was calculated in order to provide a basis for the comparison of growth characteristics in terms of length:

$$\Phi' = \Phi - 2/3\ \log_0\ (a),$$

where $\Phi = \log_{10}(k) + 0.67\ \log_{10}(W_8)$ and $W_8 = a\ L_8{}^3$.

The constant, a, was derived from length-weight relationships and k and L_8 were obtained from the von Bertalanffy growth function.

The annual instantaneous rate of total mortality (*Z*) was obtained using length converted catch curves adapted to incorporate seasonal growth patterns [24]. Pooled length frequency samples were converted into relative age frequency distributions using parameters of the von Bertalanffy growth function.

The annual instantaneous rate of natural mortality (M) was estimated using the empirical equation derived by Pauly's empirical relationship [25].

$$\text{Log}_{10}M = 0.0066 - 0.279\ \text{Log}_{10}\ L_8 + 0.6543\ \text{Log}_{10}K + 0.4634\ \text{Log}_{10}\ T$$

where L_8 is expressed in cm and T, the mean annual environmental water temperature in °C. Here it is 25°C. Fishing mortality (F) was obtained by subtracting M from Z and exploitation rate (E) was obtained from F/Z.

Pauly and Soriano [26], was used to predict the effects of increasing the existing mean size at first capture (L_{50}) to that at which yield per recruit would be maximized (L_{max}).

Relative yield per recruit (Y/R) and relative biomass per recruit (B/R) values as a function of E were determined from the estimated growth parameters and probability of capture by length [26]. Evaluations of resource status were made using estimates of exploitation rates associated with: a marginal increase of relative yield per recruit which is maximum sustainable yield (E_{max}).

RESULTS

Length Frequency Distribution: The total lengths of 466 fish in the size range 118 to 362 mm for *C. luteus* using a meter scale (1±mm) were measured. Length frequency percentage groups of *C.luteus* during period from April 2011 to March 2012 are presented in Fig. 2. Mean ±S Dlength valuesfor this species were 228±15 respectively and maximum and minimum total lengthwere 118 mm and 362 mm respectively.

Length–Weight Relationship: Mean±SDweight values for this species were 174±87g and maximum and minimum weight were 154- 202 g respectively. The mean value of length for the male and female were calculated as 216±37 mm, 233±38 mm and mean value of Weight for the male and female was as 170±91g, 211±88 g respectively. The linear regression analysis of the length-weight data allowed the estimation of the constants, a and b of the length–weight relationship represented by the

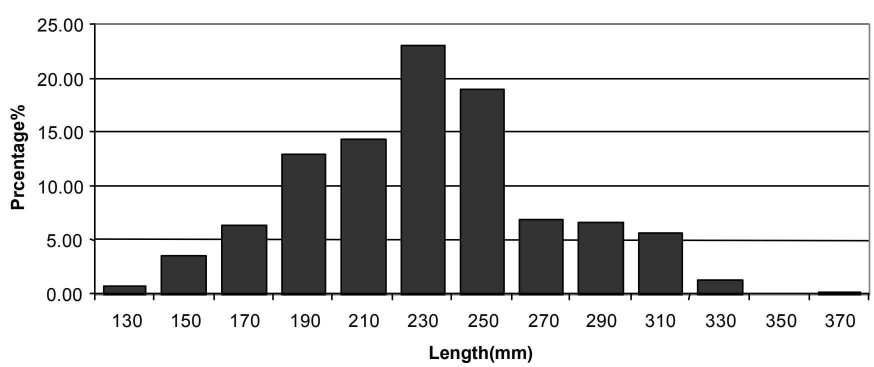

Fig. 2: Percentage frequency of length*C. luteus*onHoorAl-Azimwetland in Khuzestan province during 2011-2012.

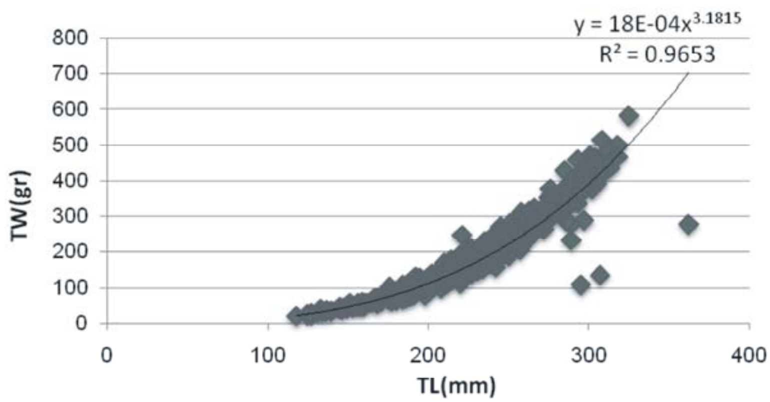

Fig. 3: The length-weight relationship curve for*C. luteus*.

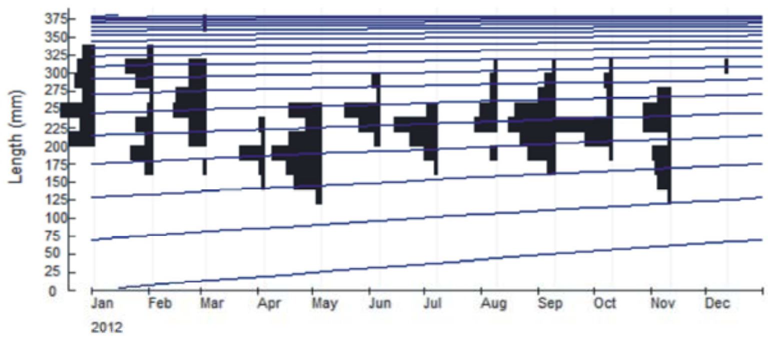

Fig. 4: Growth curve of for*C. luteus* (L8 =375 cm and K = 0.27 yr-1)by ELEFAN I estimated on the restructured length-frequency diagram.

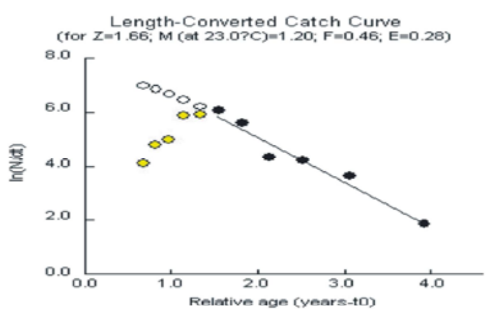

Fig. 5: FISAT graphic output of the catch curve analysis for*C. luteus*

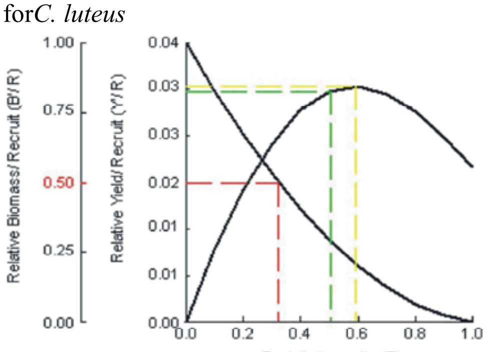

Fig. 6: Relative yield and biomass per recruit curves (descending lines) for*C. luteus* showing the existing exploitation rate (*E*).

equation Y=0.0018L$^{3.18}$ (n=466, R2 =0.96) for total fishes, these results shows isometric growth in studied fish (Fig. 3).

Growth Studies: As the study has allowed the estimation of several pairs of growth constant values, a mean value was sought by trying the Response Surface Analysis routine. The best fit given by method, L∞=375 mm and K=0.67 for Hemerispecies, is used in all the future analysis involved in this study (Fig. 4). The value of t_0 as –0.16 and Φ' from the growth parameters as 2.76 was estimatedforthis species.

Mortality Estimate and Relatively Yield, Relative Biomass per Recruit: The total mortality (Z), fishingmortality (F), naturalmortality (M) and exploitation rate (E) (Fig. 5), relative yield per recruit (Y'/R), relative biomass per recruit (B'/R) (Table 2), exploitation ratio (*E*) for *C. luteus*were estimate as follows (Figs. 5&6).

Table 2: Estimate mortality and yield of*C. luteus*in HoorAl-Azim wetland

species	Z	F present	M	E present	Y'/R	B'/R
C. luteus	1.66	0.46	1.22	0.28	0.02	0.21

Exploitationratio maximum sustainable yield, E_{max}: 0.59 for *C. luteus* stock was calculated.

The sizes at which yield per recruit would be maximized, 176 mm (LF) for *C. luteus* were considerably greater than the existing mean sizes at first capture (201 mm). The yield per recruit function predicted that an increase in the size at first capture to that which would maximize yield per recruit would be associated with a substantial increase in yield at the current level of exploitation, despite the high level of fishing mortality.

DISCUSSION

Size sexual dimorphism was observed in Hemerispeciessince females dominated in the longer length classes and the males in the shorter. The b parameter values in the weight-length model, W= a L^b are close to 3 for *C. luteus*, indicating isometric growth [27]. The value of b from other studied for *C. luteus* b=2.98 and b=3.00 (male and female) in Orontes River of Turkey [13], b= 3.06 in Shadegan wetland of Iran [14] were estimated. The value of b from other studied for this species b=3.09 in Habbaniya Lake, b= 2.97 in Tharthar Lake were estimated in the Iraq country [11]. The reasons for the variation of b in the different regions are said to be due to seasonal fluctuations in environmental parameters, physiological conditions of the fish at the time of collection, sex, gonad development and nutritive conditions in the environment of fish [28].

Hashemi [14] estimated infinity length and growth coefficient of Hemeri 302mm and 0.24 y^{-1} in Shadegan wetland of Iran. In the present study L_8 and K of *C. Luteus* were 375 and 0.67y^{-1} which indicated lower infinity length and upper growth coefficient. Unfortunately, no references from other studies for L_8 and K are available regarding *C. luteus* in Hoor Al-Azim. Gokcek and Akyurt [13] estimated L_8 and K of Hemeri 403 mm and 0.24 y^{-1} (for male) and 387 mm and 0.30 y^{-1} (for female) in Orontes River of Turkey and AL Hazzaa [12] estimated L_8 and K for this species 547 mm, 0.11 y^{-1} (for male) and 569 mm, 0.1 y^{-1} (for female) in the Intermediate Reaches of the Euphrates River of Syria country. Different L_8 and K might be associated with sampling error or variation in fishing intensity or environmental conditions.L8 and K amounts have reverse correlation and with decrement L8, amount of K increases and vice versa [21].

Age at zero length (t_0) were calculated as -0.16 for *C. luteus* respectively. The value of t_0 for *C. luteus*= -0.37 in Shadegan wetland in the Iran country [14] and t_0= -0.16 (male) t_0= -0. 37 (female) in the Euphrates River in the Syria country [12] were estimated**.** With negative t_0 values, juveniles grew more quickly than the predicted growth curve for adults and with positive t_0 values, juveniles grew more slowly [28].

Values of Φ' = 2.3 has been obtained for this species in Shadegan wetland in the Iran country [14]. The estimate obtained in our study (2.76) compares with the upper of other studies.

A method of validating growth parameters involves the comparison of growth performance indices (Φ') in terms of growth in length with other estimates obtained for the same or a similar species [24].

Reliable estimate of M can only be obtained for an unexploited stock [29]. Errors in estimates of the natural mortality rates (*M*) from the empirically derived formula of Pauly [25], may have occurred as the relationship has tended to overestimate *M*, especially for slow growing species [30].

Gulland [31], suggested that in an optimally exploited stock, fishing mortality should be about equal to natural mortality, resulting in an exploitation rate over of 0.5/yr.

The length converted catch curve method used for estimating the annual instantaneous rate of total mortality (*Z*) is based on the assumption that all of the relative age groups used in the analyses were equally vulnerable to the fishing gear and equally abundant at recruitment[24].

This result indicates not over fishing for this species and in combination with the results of the yield-per-recruit analyses. However, the existing exploitation rate for Hemeri species (0.27) were shorter than that which would maximize yield per recruit, the results indicate not over fishing is also occurring for this species. The relative biomass per recruit of *C. luteus* at the estimated fishing mortality rates was particularly at less than 35% of unexploited levels. Critical spawning stock biomass is between 20% and 50% of the unexploited levels, as suggested by suggested by King [27].

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REFERENCES

1. Jenning, S., M. Kasier and J. Reynold, 2000. Marine Fisheries Ecology. Blackwell Science, pp: 391.

2. Ghadiri, H. and M. Ghadiri, 2005. Marsh lands of Mesopotamia and the rivers that feed them. 8th International River Symposium 2005, 5-9 September, Brisbane, Australia.
3. UNEP, 2001. The Mesopotamian Marsh-lands: Demise of an Ecosystem, Early Warning and Assessment Technical Report. United Nations Environment Program. UNEP/ DEWA/TR.01-3.
4. Nelson, J.S., 2006. Fishes of the World.3rd Edition. John Wiley & Sons, New York. xix+601.
5. Krupp, F., 1985. Systematik und Zoogeographie der Süßwasserfische des levantinischen Grabenbruchsystems und der Ostküste des Mittelmeeres. Dissertation zur Erlangung des Grades "Doktor der Naturwissenschaften" am Fachbereich Biologie der Johannes Gutenberg Universität in Mainz. pp: 215, Anhang: Abbildungen, Karten, Tabellen, pp: 169.
6. Coad, B.W., 1995. Freshwater Fishes of Iran.Acta Sci. Nat. Acad. Sci. Bohemicae, 29: 1-164.
7. Coad, B.W., 2006. Endemicity in the freshwater fishes of Iran. Iranian Journal of Animal Biosystematics, 1(1): 1-13.
8. Abdoli, A., 2000. The Inland Water Fishes of Iran.Iranian Museum of Nature and Wildlife, Tehran. pp: 378. In Farsi.
9. Berg, L.S., 1949. Presnovodnyery by Irana i sopredel'nykhstran [Freshwater fishes of Iran and adjacent countries]. Trudy Zoologicheskogo Instituta Akademii Nauk SSSR, 8: 783-858.
10. Maramazi, Gh., 1994. Ichthyology report of marsh Shadegan, South of Iran aquaculture fishery research center, Ahwaz. Iran, pp: 63. In Farsi.
11. Szypula, J., P. Epler, R. Bartel and J. Szczerbowksi, 2001. Age and growth of fish in Lakes Tharthar, Razzazah and Habbaniya. Arch. Pol. Fish., 9(Suppl. 1): 185-197.
12. AL Hazzaa, R., 2005. Some Biological Aspects of the HimriBarbel, *Barbusluteus*, in the Intermediate Reaches of the Euphrates River. Turk. J. Zool., 29: 311-315.
13. Gökçek, C.K. and I. Akyurt, 2008. Age and growth characteristics of himribarbel (*Barbusluteus*Heckel, 1843) in Orontes River, Turkey. Turkish Journal of Zoology, 32(4): 461-467.
14. Hashemi, S.A.R., 2010a. Survey growth parameters of fish species in the Shadegan wetland. National Wildlife Conference, Azad University, Ahvaz, pp: 14 . In Farsi.
15. Hashemi, S.A.R., 2010b. Study of some biology characteristics of fish main species in the Shadegan wetland. National Wildlife Conference, Azad University, Ahvaz, pp: 13. In Farsi.
16. Hashemi, S., Gh. Eskandary, H. Ansary and M. Yooneszadeh, 2011. Stock assessment and production of fish species in the Shadegan Wetland, Iran. World Journal of Fish and Marine Sciences, 3(6): 502-508.
17. Hashemi, S. and H. Ansary, 2012a. Biomass and Production of Fish Species in the Shadegan Wetland, Iran. Global Veterinaria, 9(2): 123-128.
18. Hashemi, S., Gh Eskandary, H. Ansary and M. Yooneszadeh, 2012b. Stock Assessment and Production of Fish Species in the Shadegan Wetland (Iran). American-Eurasian J. Agric. & Environ. Sci., 12(6): 713-718.
19. Hashemi, S.A.R., Gh. Eskandary and H. Ansary, 2012c. Biomass of fish species in the Shadgean Wetland, Iran. Research Journal of Recent Sciences, 1(1): 66-68.
20. Gayanilo, Jr. F.C., P. Soriano and D. Pauly, 1996. The FAO-ICLARM Stock Assessment Tools (FiSAT) Users guide. FAO Computerised In format ion Series (Fisheries), No. 8. Rome, FAO, pp: 266.
21. Sparre, P. and S.C. Venema, 1998. Introduction to tropical fish stock assessment, FAO Fisheries technical paper, Roma, pp: 450.
22. Pauly, D., 1979. Gill size and temperature as governing factors in fish growth: a generalization of von Bertalanffys growth formula.Berichteausdem institute fuer Meereskunde, 63, Kiel University, Kiel.
23. Pauly, D. and N. David, 1981. ELEFAN-I a basic program for the objective extraction of growth parameters from Length frequency data. Meeresforschung/ Rep. Mar. Res., 28(4): 205-211.
24. Gayanilo Jr., F.C. and D. Pauly, 1997. FAO-ICLARM stock assessment tools. Reference manual. ICLARM International Centre for Living Aquatic Resources Management. Food and Agricultural Organization of the United Nations. Rome, pp: 262.
25. Pauly, D., 1980. On the inter-relationships between natural mortality, growth performance and mean environmental temperature in 175 fish stock. Journal du Conseil, 39(3): 175-192.
26. Pauly, D. and M.L. Soriano, 1986. Some practical extensions to Beverton and Holt's relative-yield-per-recruit model. In The First Asian Fisheries Forum, pp: 491e496.Ed. by J.L. Maclean, L.B. Dizon and L.V. Hosillo. Asian Fisheries Society, Manila, pp: 727.

27. King, M., 2007. Fisheries biology & assessment and management.Fishing News Book, London, pp: 342.
28. Biswas, S.P., 1993. Manuel of methods in fish biology, fish biology & Ecology laboratory, Dibruyarh University, Dibrugarh, pp: 157.
29. Al-Hosni, A.H. and S.M. Siddeek, 1999. Growth and mortality of the narrow barred Spanish Mackerel, *Scomberomoruscommerson*(Lacepede), in Omani waters. Fish. Man. Ecol., 6: 145-160.
30. Russ, G.R., D.C. Lou, J.B. Higgs and B.P. Ferreira, 1998. Mortality rate of a cohort of the coral trout, *Plectropomusleopardus*, in zones of the Great Barrier Reef Marine Park closed to fishing. J. Mar. Freshwat. Res., 49: 505-511.
31. Gulland, J.A., 1970. The fish resources of the ocean.FAO Fisheries Technical Paper 97: 425. FAO, Rome.